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Original Article

National Trauma Registry of Iran: A Pilot Phase at a Major Trauma Center in Tehran

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Abstract

Background: The main objective was to describe the results of the pilot phase of the national trauma registry of Iran (NTRI) at a referral university trauma center in Tehran.

Methods: The study was performed at Sina Hospital in Tehran, Iran from August 1 to September 30, 2016. Patients who had the NTRI criteria were included. 109 data variables were analyzed including demographics, medical care information, injury characteristics, and outcomes.

Results: Over 2 months, 171 patients, predominantly males (87.1%) with an average age of 37.2 (±19.5) years were registered. The most common mechanism of injury was road traffic crash (RTC) (53.2%), followed by fall (21.1%) and penetrating injuries (18.7%). RTC represented a remarkable proportion of the injuries with higher injury severity score (ISS) (P = 0.046). The mean hospital length of stay (LOS) was 9.8 (±12.2) days. There were significant relationships between Glasgow Coma Scale (GCS) (P = 0.03), drug abuse (P = 0.05), and ISS (P = 0.008) as independent variables and LOS. 21.6% of the patients were admitted to ICU, with a larger proportion of fall injuries (44.4%) (P = 0.002). Eight patients (4.7%) died during hospitalization, of which 7 cases were male. There was significant association between increasing age and ISS with death outcome.

Conclusion: After successful implementation of NTRI at a major trauma center in Tehran, RTC was identified as the main cause of admission. Most patients were young men. The mean time interval between injury occurrence and hospital admission was too long. These findings could be used to improve quality of trauma care and formulate targeted preventive strategies.

Keywords: Data systems, Medical records, Registries, Wounds and injuries

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Introduction

Trauma registry is a dedicated database system for evaluating care delivered to injured patients with specific inclusion criteria.[1] This system can be used to assess and develop quality of care, clinical guidelines, and injury prevention policies.[2,3] Burden of injuries has been significantly decreased in many developed countries in recent years by the establishment of a trauma system in which trauma registry had been its vital component.[4] Moreover, since one of the main objectives of trauma registries is to promote care of injured patients, they provide data for medical researchers that could not be addressed with administrative data.[1]

Trauma is a prominent cause of morbidity and mortality in Iran.[5-7] In 2010, injuries were the main causes of death among 15 to 49-year olds in both sexes (23.6%).[5] On the other hand, amongst developing countries, most trauma registry publications have originated from Iran.[4] Moreover, all hospitalizations are routinely documented via the hospital's health information system (HIS), but there are major discrepancies in content and resources of registries.[8] The administrative database of HIS could not address the above-mentioned aims as well. Accordingly, a nationwide trauma registry can be used to reduce the burden of injury, improve the efficiency of trauma care, and monitor the performance of the trauma system. The Ministry of Health and Medical Education (MOHME) of Iran made investments to reinforce the establishment of the national trauma registry in 2015. The national trauma registry of Iran (NTRI) has been implemented with the cooperation of the Sina Trauma and Surgery Research Center, the oldest approved trauma research center in Iran and MOHME since 2016.[8] This study aimed to present the results of the pilot phase of the NTRI at Sina hospital as a referral university trauma center in Tehran, capital of Iran, and evaluated the preliminary data.

Materials and Methods

The NTRI was designed as a hospital-based multicenter prospective cohort study.[8] A 2-month pilot phase was performed at Sina hospital in Tehran, from August 1 to September 30, 2016.

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Case Definition

For all patients with one or more traumatic injuries in a defined diagnostic International Classification of Diseases, 10th Revision (ICD-10) code, the inclusion criteria was considered as one of the following: hospital length of stay (LOS) more than 24 hours, death after injury, or transfer from intensive care units of other hospitals.

Minimum Data Set

The Minimum Data Set (MDS) was previously developed for NTRI based on a structured literature review, two expert surveys, and three focus group discussions.[8] This exclusive data set contained 109 data variables including demographic information (n = 25), injury information (n = 18), pre-hospital information (n = 26), emergency department information (n = 25), injury severity (n = 3), diagnosis (n = 2), hospital procedures (n = 2), outcomes (n = 5), financial (n = 2) and quality assurance (n = 1).[8] The outcome information (length of hospital stay, ICU days, ventilator days, hospital discharge disposition, any death after hospital arrival) and the quality assurance information (hospital complications) were considered as the quality of care indicators.

Registry Process

From the included patients, data were extracted using the patient's profile, interview, physical examination, and HIS as the administrative database. Dedicated registrars with a professional medical profile (nurse) were trained about the registry process and the functioning of the registry platform for 3 days. Three trained registrars filled data forms and uploaded them to the NTRI web-based portal which was made using "C#.net 4" as a programing language and "SQL-server 2012 r2" as a server software. One trained reviewer checked the entered data for completeness, accuracy, and consistency. Another independent controller (a surgeon) assessed the accuracy of injury severity data including abbreviated injury scale (AIS), AIS pre-dot code, and injury severity score (ISS) according to guidelines published by the Association for the Advancement of Automotive Medicine.[9]

Quality Control

To ensure that high quality data would be achieved, the major elements of data quality including completeness, accuracy, precision, correctness, consistency, compatibility, and timeliness were be considered.[1] To achieve completeness, all necessary data were provided by trained registrars. They tried to resolve inquiries with treating physicians, and patients or their relatives. So that without filling all the fields, the verification and final registration were not carried out.

To attain the precision and accuracy, injury characteristics, and pre-hospital and emergency department information were directly collected via interview and patients' files as the verifiable sources. To accomplish the correctness and consistency, logic programming implemented in the software of the NTRI, including semantic rules, syntactic rules, temporal rules and rules for acceptable value range would be helpful for the correct data entering and some computations. In addition, data were rechecked by two independent reviewers for completeness, accuracy, and consistency. The supervisor oversaw all activities and responsibilities and also randomly checked the forms for accurate completion and review. For compatibility of data, we considered the technical aspects e.g. identical data structures, formats, and coding schemes. Achieving high-level timeliness, we provided dedicated registrars and necessary facilities, and coordinated with all hospital departments.

Statistical Analysis

Statistical analysis was performed in two descriptive and analytical parts. Descriptive analysis was done for quantitative variables using mean and standard deviation indexes, and for categorical and rating variables, absolute and relative frequencies were applied. In analytical analysis, chi-square test or Exact test and, if necessary, the OR index and confidence intervals were used to determine the relationship between qualitative variables. Ordinary Least Square (OLS) models were used to accurately determine the relationship between different independent variables and quantitative variables. Logistic regression models were used to accurately determine the relationship between different independent variables and categorical outcome variables like death. R2, Hosmer and Lemeshow test was used to assess the goodness of fit model. The significance level of all statistical tests was considered at 0.05.

Results

Of 477 patients with traumatic injury, 171 cases were included. 149 patients (87.1%) were male. The age ranged from 5 to 93 years with the mean (±SD) of 37.2 (±19.5) and median of 33 years. In terms of nationality, 11 non-Iranian patients (6.4%) were Afghans (10 persons) and Iraqis (1 person). 15.2% of the patients were illiterate and 7.1% had college education. One-fourth of the patients (43 persons) had a history of hospitalization due to trauma. 24% of injuries occurred on weekends or holidays. The most common mechanism of the injuries was road traffic crash (RTC) with 91 cases (53.2%) followed by fall, with 36 cases (21.1%). Standing height falls were more frequent than falls from height (91.8% vs. 8.2%). Amongst the 32 (18.7%) penetrating injuries, 10 cases were declared due to stab wounds, followed by gunshots in 3 patients. Regarding the location of injury, 109 injuries (63.7%) happened in streets and 33 injuries occurred (19.3%) at home. 69% of the injuries (118) were non-occupational. Use of alcohol, substance, and sedative drugs before injury event was recorded in 8 (4.7%), 12 (7%), and 44 patients

(25.7%), respectively. Figure 1 shows the percentage of injury occurrence during 24 hours of the day.

While 26.9% of the patient transfers to the hospital were done by private car, 66.7% of the patients (114) were transported by the emergency medical service (EMS) ambulances. The mean time (±SD) from call to ambulance arrival at the scene, and on-scene time was 8.3 (±5.8) and 15.6 (±8.6) minutes, respectively. The mean time interval (±SD) between injury occurrence and hospital admission, excluding referred cases, was 3.2 (±7.6) hours.

Bone fracture was the most frequent type of injury with 96 cases (56.1%) followed by laceration and contusion in 37 (21.6%) and 21 (12.3%) patients, respectively.

Severe but not life-threatening injuries (AIS score = 3) were the most common injuries (Figure 2).

The median ISS was 9 (range, 1–75). Table 1 shows the mechanisms of trauma based on the severity of injuries.

54.5% of the injuries with ISSs ≥ 9 were related to RTC (P = 0.046). Regarding the mechanism of trauma, falls were significantly more associated with ISSs ≥ 9 (P = 0.01).

The mean hospital LOS was 9.8 (±12.2) days. The final regression model showed the significant relationship between Glasgow Coma Scale (GCS), drug abuse, and ISS as independent variables and LOS (Table 2).

37 patients (21.6 %) were admitted to ICU, with 16 (17.6%) cases of RTC and 16 (44.4%) cases of fall (Table 3).

Regarding the type of falls, 21.2% of the patients with standing height falls were admitted to ICU whereas 40% of the falls from height resulted in ICU admissions.

ICU admission was insignificantly higher in non-Tehran citizens, women, and age above 60 years (Table 3). The median day of ICU LOS for RTC and fall patients was 23 and 11, respectively.

Eight patients (4.7%) died during hospitalization; 7 of the cases were male. The fatal injury mechanism was RTC and fall with 3 cases for each, followed by penetrating injuries with 2 cases. ISSs of 3 fatal RTC cases were 41, 75 and 75, respectively. Five patients died in the ICU and one patient died in the emergency department. There was a significant association between increasing age and ISS with death outcome (Table 4).

Total hospital cost for 171 patients was 450,387 USD were paid by RTC victims' insurance (53.8%), basic health insurance (34.5%), cash (7.6%), supplemental health insurance (1.8%), and other sources (2.3%). Based on an approved national policy, no out-of-pocket costs were incurred on RTC victims and they would be covered by RTC victims' insurance. While the mean household income for an Iranian urban household in 2015 was

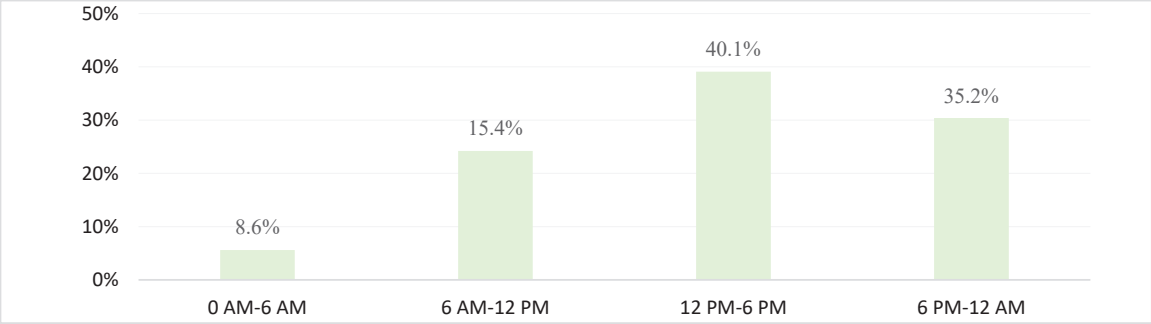

Figure 1. Percentage of Injury Occurrence During 6-Hour Periods of the Day.

Figure 2. Percentage of Injury Severity According to the Abbreviated Injury Scale.

Table 1. Mechanisms of Trauma Based on Injury Severity Score

Mechanism of Trauma	ISS<9 No. (%)	ISS≥9 No. (%)	Total No. (%)
Road traffic crash	43 (47.3)	48 (52.7)	91 (100)
Fall	11 (30.6)	25 (69.4)	36 (100)
Penetrating injury	22 (68.8)	10 (31.3)	32 (100)
Other	7 (58.3)	5 (41.7)	12 (100)
Total	83 (48.5)	88 (51.5)	171 (100)

Table 2. Final Regression Model of Relationship Between Hospital Length of Stay and Characteristics of Patients with Traumatic Injury

Variable	Base Level	95% CI OR	*P* Value
Age	0.08	-0.48–0.21	0.21
Gender	0.87	-5.04–6.79	0.77
Education	0.47	-0.02–0.97	0.06
GCS	-2.59	-5.04, -0.15	0.03
Marriage	2.86	-1.80–7.53	0.22
Alcohol consumption	-5.51	-13.55–2.52	0.17
Drug abuse	-7.67	-15.64–0.29	0.05
ISS	0.57	0.14–0.99	0.008

Abbreviations: GCS, Glasgow Coma Scale; ISS, Injury Severity Score.

equivalent to 7537 USD annually,[10] the mean hospital cost for each injured patient was 2,634 ± 3,317 USD.

Overall completeness of data was 98.03%. The most common missing data in this study were related to the ambulance arrival at the scene and on-scene times (67 cases), the vital signs at the emergency department (60 cases), and body mass index (20 cases).

Discussion

In this pilot study, we successfully implemented a system for gathering information related to patients with traumatic injury admitted at a major trauma center in Tehran. The first application of the NTRI at Sina hospital over 2 months showed that the majority of the 171 patients were male (87.1%). Also, death during hospitalization mainly occurred in men (87.5%). Naghavi et al showed that the burden of injuries from RTC and falls in men was about five and three times higher than those in women, respectively.[6] The average age of patients was 37.2 (±19.5)

Table 3. Relationship between ICU Admission and Characteristics of Patients with Traumatic Injury

Variable	Field Values	ICU Admission				*P* Value	OR	95% CI OR
		No	%	Yes	%			
Residency	Tehran	116	79.5	30	20.5	0.33	1.65	0.58–4.67
	Other cities	14	70.0	6	30.0			
Gender	Male	118	79.2	31	20.8	0.49	1.42	0.51–3.95
	Female	16	72.7	6	27.3			
Age (y)	<18	13	76.5	4	23.5	0.09	—	—
	18-49	98	79.0	26	21.0			
	≥50	23	76.7	7	23.3			
Marital status	Married	71	78.0	20	22.0	0.88	0.94	0.45–1.98
	Unmarried	60	78.9	16	21.1			
Education grade	Collegiate	12	100	0	0	0.06	1.28	1.17–1.40
	Non collegiate	112	77.8	32	22.2			
Body Mass Index	Thin	7	58.3	6	41.7	0.21	—	—
	Normal	63	84.0	12	16.0			
	Overweight	35	76.1	11	23.9			
	Obese	16	76.2	5	23.8			
History of hospitalization due to trauma	Yes	35	81.4	8	18.6	0.57	1.28	0.53–3.06
	No	99	77.3	29	22.7			
Time of injury occurrence	Day	71	78.0	20	22.0	0.42	0.72	0.32–1.59
	Night	59	83.1	12	16.9			
Injury occurrence in weekends or holidays	Yes	31	75.6	10	24.4	0.62	0.81	0.35–1.86
	No	103	79.2	27	20.8			
Injury Mechanism	Traffic accident	75	82.4	16	17.6	0.002	—	—
	Fall	20	55.0	16	44.4			
	Penetrating injuries	29	90.6	3	9.4			
	Other	10	83.3	2	16.7			
Occupational injury	Yes	45	84.9	8	15.1	0.16	1.83	0.77–4.33
	No	89	75.4	29	24.6			
Transport to hospital	Ambulance	94	82.5	20	17.5	0.15	—	—
	Private car	33	71.7	13	28.3			
	Other	7	63.6	4	36.4			
Alcohol consumption	Yes	120	77.9	34	22.1	0.52	0.50	0.06–4.24
	No	7	87.5	1	12.5			
Drug abuse	Yes	120	78.4	33	21.6	0.68	0.72	0.15–3.48
	No	10	83.3	2	16.7			
Sedative consumption	Yes	36	81.8	8	18.2	0.51	1.33	0.55–3.18
	No	98	77.2	29	22.8			
Time interval between injury occurrence and admission (min)	< 100	66	85.7	11	14.3	0.10	1.96	0.87–4.44
	≥ 100	61	75.3	20	24.7			

Table 4. Final Regression Model Evaluating Relationship between Death and Some Underlying Variables in Studied Patients

Variable	OR	95% CI OR	*P* Value
Age	1.11	1.00–1.22	0.03
GCS	1.11	0.35–3.44	0.85
ISS	1.38	1.01–1.88	0.04

Abbreviations: GCS, Glasgow Coma Scale; ISS, Injury Severity Score.

years, with the greatest number of patients between 15 and 49 years of age (127). Forouzanfar et al reported that injuries were the main causes of death among 15 to 49-year olds in Iran (23.6%) in 2010.[5] Hence, prevention programs for men in the above age group, as the most vulnerable individuals, should be emphasized.

In this study, the mean ISS was 8.6 and 9.4% of the patients had a major trauma (ISS > 12). Regarding the mechanism of trauma, RTC represented a remarkable proportion of the injuries with higher ISS. Based on a global report in 2011, Iran had the highest death rate of RTC in the world.[11] The age-standardized death rate of RTC in Iran was reported more than twice the world average.[5] In addition, almost 1.1% of the Iranians seek hospital care for RTC injuries annually.[12] On the other hand, falls were more significantly associated with more severe injuries which may be due to a higher probability of head injury.[13]

Based on Figure 1, most of the injuries occurred in afternoons and evenings. The increase in traffic volume, especially with end of daily traffic restrictions in the evening, could have a strong association with RTC.[14,15] Thus, medical services should be more readily available considering traffic fluctuation times. 66.7% of trauma patients and 64.7% of patients with ISS > 9 were transferred by EMS ambulances which indicated that availability and coverage of EMS as well as public awareness of EMS should be improved. In Switzerland, 84.2% of pre-hospital transport was handled by a physician staffed team.[16] In many EMS systems of developing countries, ambulances are used only for transportation and not as a critical care vehicle.[17] In this study, ambulance response time was acceptable (8.3 ± 5.8 minutes), but the mean time interval between injury occurrence and hospital admission, excluding referred patients, was lengthy (3.2 ± 7.6 hours). This latency could be due to delayed EMS calling, traffic volume, transportation without ambulance, and the time-consuming process of hospital admission. A short out-of-hospital time interval could increase trauma patients' survival.[18]

In our study, most types of injuries were severe orthopedic injuries, similar to reports from other cities of Iran and other countries.[16,19-21] Heim et al showed that orthopedic surgery was the main specialty involved in a trauma center.[16]

There was significant association between ISS and LOS (P = 0.008) and death (P = 0.04). Trauma scoring systems could be used as useful tools for patient triage, estimating the prognosis of trauma patients and standardized comparisons between different trauma centers.[22,23] Among the available trauma scores, ISS could be considered as the most common standard for prediction of death.[24]

A multicenter cohort study in Canada revealed the mean LOS of 8.6 days (95% CI: 8.6–8.7). While the mean ISS was 10, 24% of patients had a major trauma (ISS > 12), and 38% of the patients were 65 years or older.[25] In our study, the mean LOS was 9.8 ± 12.2 days with the mean ISS of 8.6, a major trauma in 9.4% of the patients, and age of 65 years or older in 9.4% of the patients. Our study's LOS might be affected by indirect transferring, comorbidities, substance abuse, and lack of proper diagnostic or therapeutic facilities. Moore et al showed that discharge destination, age ≥85 years, transfer status, injury severity, comorbidities, body region of the most severe injury, and mechanical ventilation were the strongest determinants of LOS.[25] The inclusion criteria of the patients could be important as well. Based on a Brazilian trauma registry, the average LOS was 6 days, while the inclusion criterion was only hospitalized patients admitted in the clinic of general surgery.[22] A registry from Kashan, located centrally in Iran, revealed the mean LOS of 3 days, whereas the referred patients were excluded.[26]

In our study, considering the mechanism of injury, patients with fall related injuries had more ICU admission. Falls from height caused more ICU admissions than standing height falls. This could be related to the presence of many of construction workers with a high incidence of injury in Tehran.[27] However, the median day of ICU LOS for RTC injuries was larger than fall injuries, similar to a Canadian study.[25]

In the present study, causes of injury-related deaths were RTC and fall with 3 cases for each, followed by penetrating injuries with 2 cases. Rasouli et al reported that RTC was the most common cause of injury-related deaths in Iran.[28] However, in elderly patients, RTC and fall are reported as the most common fatal injury mechanisms.[5,6,28-30]

The quality of data in a trauma registry could be enhanced by standardizing inclusion criteria, rigorous definitions of data, training and data gathering software.[1,2] We considered the major elements of data quality to ensure quality. Regarding precision and accuracy of data, the demographic details and the information related to diagnosis and hospital procedures were extracted from HIS. Therefore, physicians that complete patient files and ICD coders would have a vital role in precise and accurate documentation. For compatibility, data should be collected in a consistent and congruent fashion.[1] In our data set, the variables of injury information, hospital procedures, and diagnosis were entered based on ICD10. In addition, injury severities were entered and calculated according

Study Highlights

What is current knowledge?
Trauma registry is a dedicated database system for evaluating care delivered to injured patients with specific inclusion criteria.

What is new here?
The national trauma registry of Iran can be used to improve quality of trauma care and formulate targeted preventive strategies.

to the most frequently used coding system created by the Association for the Advancement of Automotive Medicine to classify and describe severity of injuries.[9,31] The compatibility would increase via standardizing data collection methods.

Timeliness or permanent accessibility of data was one of the most important challenges in this study. Due to diversity of departments that patient files were referred to, file tracking was often delayed, particularly for deceased cases. Also, repeated returning of files by reviewer to registrars for defect correction was time-consuming. It seems more effort should be placed on registrars' training to improve accuracy, consistency and timeliness. In total, successive rechecking by reviewers and supervisors ensured completeness, accuracy, and consistency of the information. In future, benchmarking validity should be done considering the dimensions of data quality assessment.

For national scale-up, we are launching the NTRI in selected hospitals involved in caring for trauma patients based on the approved strategy of NTRI and the experience gained from the present pilot study. Recruiting registrars, financing, and equipment supply are assigned to collaborative centers, but training registrars, implementation of a web-based portal, review and monitoring are executed at the Sina Trauma and Surgery Research Center.

The NTRI will allow the analysis of data at different time intervals, evaluation results of the changes in the care guidelines and protocols, promotion of services, and assessment of costs. Haider et al showed that trauma registry systems were highly useful in improving the quality of care given to injured patients.[32]

In conclusion, the pilot phase of the NTRI in Sina hospital showed that RTC was the leading cause of injury-related hospitalization followed by fall and penetrating injuries. RTC represented a remarkable proportion of the injuries with higher ISS. Although ambulance response time was acceptable, there was a lengthy time interval between injury occurrence and hospital admission. This study demonstrated a significant association between ISS with LOS and death. These findings can be used to improve quality of trauma care and formulate targeted preventive strategies.

Authors' Contribution

MSA were involved in planning and wrote the manuscript; MZ and PS conducted the project; VRM and ZG contributed to the design and implementation of the research; ML and MK supervised the work; ZH, KN, SB, SKH, MA and MKN provided and processed data; MA and PS conducted all statistical analyses; and all authors discussed the results and commented on the manuscript.

Conflict of Interest Disclosures

None.

Ethical Statement

The Ethics committee of Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, approved this study. As an opt-in informed consent approach, verbal acceptance was obtained from all patients. If a patient was not able to cooperate, the consent would be obtained from her/his relatives.

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