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Missing Variables in Major Trauma Registry of Navarre

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Abstract

Trauma registries collect information on trauma patients according to inclusion criteria and help establish protocols to improve care. For a valid analysis of data, registries should be accurate, reliable and complete. The aim was to identify and assess the variables with the highest percentage of missing values in our registry and implement measure to avoid them.

Method: All cases registered at Major Trauma Registry of Navarra (MTRN), who met inclusion criteria (NISS>15) from 1 January 2010 until 31 December 2014 were selected and the optimal level of completeness was set ≥ 90% for each of the variables. The frequency and percentage of all variables included in the trauma registry was calculated.

Results: 834 patients were evaluated and was observed that the variables with the highest percentage of missing values were base excess (66%), normalization of time base excess (89%) and response times: Time from call to the resource activation (64%), Time from alarm to arrival at scene (80%), Time from arrival to departure from the scene (86%) and Time from alarm to hospital arrival (64%).

Conclusion: The level of completeness of the variables of MTRN is greater than 90% in all variables except response times and base excess. It must raise awareness about the importance of collecting these variables.

Keywords: Severe trauma; Missing values; Response time; Base excess

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Introduction

Like other records, trauma records collect data on trauma mechanisms, demographics details, pre-hospital data, hospital variables, information on diagnosis and treatment provided to patients who meet the inclusion criteria [1-5]. Thanks to the important contribution of these data protocols are established to improve care system severe trauma, which leads to a significant reduction in mortality and morbidity due to the traumatic event. Furthermore, these records allow comparison of results (benchmarking) between trauma systems, whether regional, national or international [6-10].

To this purpose, the recorded data should be reliable, accurate, and complete. Several studies have shown that the reliability of the most important result variables of such registries (injury encoding, severity of injury and survival) is high [11-13].

Several research teams have also shown that all trauma registries have different variables with incomplete values and this may be an obstacle to meaningful analysis of the data. Only, with 10% of missing data, if a multivariate analysis is performed with the "listwise" option, 59% of the data of the database is lost. This represents a reduction of statistical power and impaired type I error (consideration of a statistically significant difference when it really is not) [14].

For example, obtaining comprehensive data on response times, physiological data such as respiratory rate, Glasgow Coma Scale or base excess might be difficult [10, 11, 15-17].

However the number of missing values should be minimized especially variables related to patient prognosis such as respiratory rate and Glasgow Coma Scale used in the predictive model Trauma and Injury Severity Score (TRISS) and the model created by our group [18-21].

Navarre is a region in northern Spain with an area of 10,421 km^2 and a population of 637,000. The emergency medical services are managed by a coordination center, which mobilizes the resources to assist the accident victim (non-medicalized and

medicalized ambulances and helicopter) and deliver patients to the appropriate hospital emergency services. Navarre has a tertiary hospital working as a reference center for major trauma (Navarre Hospital Complex) and two county general hospitals (Hospital García Orcoyen of Estella and Hospital Reina Sofía of Tudela) [21].

In recent years, several publications of our group have been focused on the magnitude of the problem in our community and in different variables regarding the survival of our patients, however we still do not know the variables with the highest percentage of missing in our trauma registry [22].

It is important to know about these missing variables as the conclusions drawn from our studies are used to provide quality standards in our community and to compare our system with other systems.

The aim of this study was to evaluate the variables with the highest percentage of missing in our database and implement measures to prevent their lost.

Method

Major trauma registry of Navarre

Since 2010 the Healthcare System of Navarra has a Registry for major trauma called "Major Trauma Registry of Navarre (MTRN). This is a database strictly tailored to the variables and categories defined by Utstein style. The injuries suffered by each patient are entered using a computer application based on the Abbreviated Injury Scale (AIS), version 2008.

A Web application that allowed users to collaborate in the provision of data for trauma cases was developed to register patients. The users were the physicians in the inpatient and outpatient Emergency Services and Intensive Care Services of the Public Healthcare System of Navarre with approximately 150 users. The overall supervision and administration of the system was conducted by a data manager that ensured compliance with the inclusion criteria and the introduction of data for each patient.

A typical scenario of collaboration is as follows: A prehospital user identifies a possible case of trauma (personal data, date, receiving center) and prehospital information: Revised Trauma Score (RTS), score on the Glasgow Coma Scale, mechanism and intent of the injury, etc. Then a hospital user diagnoses the patient and completes the patient's records: Injury Severity Score (ISS), NISS, RTS, previous comorbidity. Then, the data manager supervises the inclusion criteria and maintains or removes the patient from the database, checks the variables and closes the case when the patient is discharged or dies.

Since a patient can be treated in different hospitals, the system supports the collaboration of several hospitals, enabling the possible management of transfers. Thus, a case of trauma may consist of several hospital records (one for each hospital) which the system summarizes according to a predefined algorithm after analyzing the different hospital records.

The legislation in force on safety and confidentiality of personal data were particularly taken into account for software development, and security measures classified as high level (data backup was performed in a different place to the server residence and encryption of the media containing this information) were implemented. Confidentiality was guaranteed using SSL 3.0/TLS 1.0 encryption. The system records access, date and time, and if access has been possible. As for authentication, each user received a signature file (provided by the system administrator) to enter the system and ensure their identity.

Design and sample size

All cases registered from January 1, 2010 until December 31, 2014 that met inclusion criteria (NISS>15) and all the Utstein variables **(Table 1)** were selected. In terms of quality, completeness level was selected ≥ 90% for each of the variables included.

The frequency and percentage of all variables included in the trauma registry was calculated. Utstein variables adjusted to our trauma registry are reflected in Table 1 [23, 24].

Statistics Calculations

The analysis was performed using IBM SPSS Statistics for Windows, Version 21.0. All the variables are described as ratios and percentages **(Table 2).**

Results

56 patients who did not meet inclusion criteria (NISS>15) were excluded. Finally, the sample included in this quality control was 834 patients, to whom the parameters defined in the methods section were evaluated. Table 2 shows the frequency and percentage of variables with the highest percentage of missing values.

Response times presented missing value of more than 60% in all their categories. The other variables with the highest percentage of missing values were 552 base excess (66%) and normalization time of base excess 739 (89%).

Discussion

This study shows that the variables with the highest percentage of missing values are response times and laboratory variables as (base excess and normalization time of base excess).

In a study of 10,180 trauma patients of "Victorian State Trauma Registry" collected between July 2003 and June 2008, 2,398 (24%) did not have all the variables necessary to calculate TRISS. Missing data were most often related to systolic blood pressure (6%), respiratory rate between (6-14%) depending on the hospitals, and Glasgow Coma Scale between 4 and 20% [13].

The latest report available of DGU-TR about patients treated until the end of 2013 shows that of the 32,039 trauma patients had lost values in their prehospital care, 9% did not have Glasgow, 13% did not have systolic blood pressure and 40% have no record of respiratory rate, 46% did not have a base excess value. As for response times there were only information about 11,121 times (35%) with regard to the time between the accident and hospital arrival [25].

Table 1 Variables of our database adjusted to the Utstein style.

Identification variables	
Age	Number
Sex	1. Male; 2. Female; 3 = Unknown
Date and hour of attention	Date and hour
Hospital	1. Complejo Hospitalario de Pamplona; 2. Hospital de Tudela; 3. Hospital de Estella
Prehospital data	
Dominant type of injury	1=Blunt; 2=Penetrating; 3=Unknown
Mechanism of injury	1=Motor vehicle injury; 2=Motorcycle injury; 3=Bicycle injury; 4=Pedestrian; 5=Traffic: other; 6=Shot by handgun, shotgun, rifle, other firearm of any dimension; 7=Stabbed by knife, sword, dagger, other pointed or sharp object; 8=Struck or hit by blunt object; 9=Low-energy fall; 10=High-energy fall; 11=Unknown
Intention of injury	1=Accident (unintentional); 2=Self-inflicted (suspected suicide, incomplete suicide attempt, or injury attempt); 3=Assault; 4=Other
CPR, GCS, RR, RTS Intubation Type of intubation	Number No; 2. Yes;1 Orotraqueal; 2. Vía aérea supraglótica; 3. Otros
Highest level of pre-hospital care provider	1=Level I. No field care; 2=Level II. Basic life support; 3=Level III. Advanced life support, no physician present; 4=Level IV. Advanced life support on-scene, physician field care
Tipo de transporte	1. Medicalized ambulance &/or helicopter; 2. None medicalized ambulance &/or helicopter 3. Private vehicle; 4. Others
Time from alarm to arrival at scene	The time from when the emergency call is answered (at the emergency call centre) until the first medical provider arrives at the patient
Time from alarm to hospital arrival	The time between when the alarm call is answered (at the emergency call centre) and when the patient arrives at the reporting hospital
Hospital variables	
Pre-injury ASA-PS Classification System	1=A normal healthy patient/ a patient with mid systemic disease; 2=A patient with moderate systemic disease; 3=A patient with severe systemic disease
Injuries according to AIS in each of the 6 anatomic regions	Number (1 to 6)
ISS, NISS, RR, GCS, BP, RTS, Coagulation: INR, Arterial base excess, Time until normal arterial base excess, Hb, (upon arrival at ED/hospital) Time to first CT scan	Number
Type of first key emergency intervention	1=Damage control thoracotomy; 2=Damage control laparotomy; 3=Extraperitoneal pelvic packing; 4=Limb revascularisation; 5=Interventional radiology; 6=Craniotomy; 7=Intracranial pressure (ICP) device
Highest level of care	1. ED, 2. Hospitalization; 3. Operation theatre, 4. ICU
Outcomes	
Discharge destination	1=Home; 2=Rehabilitation; 3=Morgue; 4=Another CCU (higher treatment level); 5=Another intermediate or low care somatic hospital ward
Glasgow Outcome Scale – at discharge from main hospital	1=Good recovery; 2=Moderate disability (disabled but independent); 3=Severe disability (conscious but disabled; depends on others); 4=Persistent vegetative state (unresponsive); 5=Death
Survival status	1=Dead; 2=Alive (30 days after injury)
Length of stay and mechanical ventilation	Number

CPR: Cardiopulmonary Resuscitation; GCS: Glasgow Coma Scale; RR: Respiratory Rate; SBP: Systolic Blood Pressure; RTS: Revised Trauma Score; ISS: Injury Severity Score; NISS: New Injury Severity Score; INR: International Normalized Ratio; Hb: Haemoglobin; ED: Emergency Department; ICU: Intensive Care Unit.

In the preliminary analysis of a year of severe trauma registry in Catalonia (TraumaCat) in which 1,106 patients were treated has shown that in 57% of cases did not have some of the three physiological parameters (blood pressure, systolic, respiratory rate, Glasgow Coma Scale) for the calculation of RTS [11].

Our data is significantly better in this area reaching almost 100% of hospital RTS values and only represents missingness of 4% in RTS prehospital values. This is because it is a highly controlled data base by the supervisor of the trauma registry system. Our population as mentioned above is of 637,000 inhabitants and the cases of polytrauma that are created are 20-25 per month. This makes that cases where we found some missing variables related to the RTS, are recovered consulting medical records.

In a recently published study of prehospital response times of our

Table 2 Frequency and percentage of variables with the highest percentage of missing values.

Variables	Cases	Missing values (n)	%
Prehospital			
RR	799	35	4
SBP	800	34	4
RTS	799	35	4
Response times			
Time from call to the resource activation	303	531	64
Time from alarm to arrival at scene	165	669	80
Time from arrival to departure from the scene	116	718	86
Time from alarm to hospital arrival	303	531	64
Prehospital alert	811	23	3
Inmovilización	833	1	0.1
Acceso venoso	832	2	0.2
Fluidotherapy	829	5	0.4
Oxygenation	830	4	0.5
In Hospital			
RR	833	1	0.1
SBP	832	2	0.2
RTS	832	2	0.2
Base Excess	282	552	66
INR	787	47	5
Time to normalization of Base Excess	95	739	89
Time to first CT scan	804	30	3
Type of first key emergency intervention	830	4	0.4

RR: Respiratory Rate; SBP: Systolic Blood Pressure; RTS: Revised Trauma Score; CT: Computerized Tomography.

community it concludes that response times are enough good to not to influence significantly the death of such patients [22]. The study had limitations as a relatively small sample in relation to major international databases, as well as a loss of 50% of cases where no response times are available.

This is because in our trauma registry response times are calculated automatically crossing databases through the times reflected in the software applications of Emergency System that manages all times since a call received by the Emergency System till they arrive at the hospital. The different intervals are obtained on the basis of time: time of call, time of arrival at the scene, time of departure from the scene and time of arrival at hospital [22, 26, 27]. This process is automatic and loses a significant number of cases because the only common identifier in both bases is the patient's name. Due to nervousness of emergencies situations in many occasions the name does not match between who give it and who type it in the system so the system discards both of them.

Soon we will incorporate into our software application the possibility to manually enter our response times and we expect raise to completing the 75-80% of cases.

Other variables with a high percentage of missing data are base excess and time normalization of base excess. Base excess or also known as metabolic acidosis is caused by the anaerobic metabolism due to hypoperfusion. The correction of acidosis requires bleeding control and optimization of tissue oxygenation, initially achieved by the replacement of blood and other fluids [28]. The failure of the normalization of metabolic acidosis for more than 48 hours is usually lethal between 86% and 100% of cases.

All trauma databases have problems to have values of normalization of base excess. In our registry, we have missing data of 66% of base excess and only 10% of these have normalization of base excess due to which it is not possible to know when the patient's acidosis is normalized. That is why despite being an important predictor of survival, it cannot be used [28].

Recently a polytrauma patient has been defined as a patient with ISS>15, AIS ≥ 3 at least 2 body regions and have at least one of five standardized pathological conditions (Glasgow Coma Scale [GCS] score ≤ 8), acidosis (base excess ≤ -6.0), coagulopathy (international normalized ratio ≥ 1.4/partial thromboplastin time ≥ 40 seconds), and age (≥ 70 years). In this study, metabolic acidosis also defined as base excess <6 [29].

Due to the prognosis value of base excess and normalization time of base excess it is essential if not almost compulsory its request in hospital care of polytrauma patients. After inclusion of excess bases in the definition of polytrauma, participants in trauma care should be informed about the importance of this laboratory value and include it in the protocols established for polytrauma care in our hospitals.

The actions therefore should be addressed to: To inform the results to teams that attends polytrauma patients and emphasizes the importance of collecting response times.

1. To sensitize the health workers who treat the trauma patient of the importance of base excess in patient prognosis and hence it is imperative that its request in hospital care of these patients.
2. Establishment of a hospital protocol that include all complementary laboratory values for a trauma patient.

In a study of 2,520 polytrauma of "Victorian State Trauma Registry" collected between July 2009 and June 2010, variables used to calculate TRISS were used to identify patients with the highest percentage of variables because in that registry they noted that the variables with the highest percentages of missing values were the Glasgow scale (16%), systolic blood pressure (6%) and respiratory rate (18%). After applying multiple imputation it was identified that the major predictor for missing values of these variables was hospital mortality [12].

However in our register, variables for the calculation of TRISS reach a completeness level greater than 90%. Although it is known that most trauma registries have important percentage of missing physiological data (Glasgow, FR, TAS) it has not yet developed any optimal approach to solve this problem. Prospective studies are needed in our trauma registry to identify predictors of loss of these values.

Limitations

First, we have relatively small sample of patients when compared with large international databases. Second, there are few studies published to evaluate the integrity of a trauma registry and therefore the lack of standard methods for quality control. Third, the effects of intubation, sedation, and alcohol intoxication on the RTS parameters could not be controlled for.

Conclusion

Ideally data collection is designed to not submit missing values, but all diseases records have missing values of its variables. Because of the importance of two variables (response times and base excess) identified in this study it is necessary to incorporate the above mentioned measures to increase the reliability of the results obtained from Major Trauma Registry of Navarre (MTRN).

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Author's contribution

All the authors have had significant involvement in the preparation, literature review and discussion of the conclusions of the article and agree with what is reflected in the manuscript.

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