

Results of the Implementation of a Trauma Registry in a Peruvian Low Complexity Hospital: A 2-year Analysis

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RESUMEN

Introducción: El sistema hospitalario del Perú no cuenta con un sistema de datos de pacientes con lesiones traumáticas, afectando negativamente la prestación de servicios de salud. El objetivo fue describir los resultados de la implementación de un registro de trauma en el Hospital de Baja Complejidad Vitarte, en la región Este de Lima en Perú.

Métodos: Se realizó un estudio observacional, descriptivo y retrospectivo, utilizando el Registro de Trauma® de la Sociedad Panamericana de Trauma, entre mayo de 2018 y junio de 2020. Se utilizó el programa Stata v16 para el análisis estadístico.

Resultados: Se incluyeron 399 registros. La edad mediana fue de 27 años y el 72,2% fueron varones. El principal mecanismo primario fue trauma contuso (60,7%), producido principalmente por caídas y accidentes de tránsito. El 82,5% de las lesiones traumáticas estuvieron relacionados con la ingesta de alcohol. Las atenciones fueron más frecuentes entre las 0800 y 1200 horas, los domingos, a mediados de mes y en el mes de abril. Las lesiones más frecuentes fueron leves según los índices de trauma (IT) Revised Trauma Score y Kampala Trauma Score. Un Injury Severity Score >15 correspondió principalmente a casos de pacientes que requirieron transferencias a centros de mayor complejidad, principalmente por traumatismo encéfalo craneano.

Conclusiones: Las lesiones traumáticas en el Hospital Vitarte afectaron principalmente a varones jóvenes, con alta frecuencia de ingesta de alcohol en los pacientes lesionados. El tipo de trauma y el mecanismo de lesión no siguen un patrón específico, debido al nivel de complejidad del hospital. Los IT son herramientas útiles para determinar la gravedad de las lesiones y predecir la necesidad de transferencia a un centro de mayor nivel de complejidad y resolución. El Registro de Trauma® representa una estrategia necesaria para optimizar la atención de los pacientes con lesiones traumáticas a nivel local y nacional.

Palabras clave: Heridas y Traumatismos, Sistema de Registros, Cirugía, Perú.

ABSTRACT

Introduction: Peruvian public health system lacks data collection and processing strategies for patients who arrive at hospitals with traumatic injuries (TI), negatively affecting the provision of health services. The objective of this study was to describe the results of the implementation of a trauma registry in a low complexity hospital in Vitarte, located in the eastern region of Lima, Peru.

Materials and methods: An observational, descriptive, and retrospective study was conducted using the Trauma Registry® developed by the Panamerican Trauma Society (PTS) between May 2018 and June 2020. Stata v16 software was used for statistical analysis.

Results: A total of 399 records were included. The median age was 27 years, and 72.2% of patients were male. The main primary mechanism was blunt trauma (60.7%), mainly caused by falls and traffic accidents. Nearly 82.5% of TI were related to alcohol intake. Attendances were most frequent between 08:00 and 12:00 hours, on Sundays, in the middle of the month, and in April. The most frequent injuries were minor, according to the Revised Trauma Score (RTS) and Kampala Trauma Score (KTS). In the majority of cases, an Injury Severity Score (ISS) of >15 corresponded to patients requiring transfer to more developed health centers, mainly for traumatic brain injury.

Conclusion: Traumatic injuries (TI) in Hospital Vitarte affected mainly young males, with a high frequency of alcohol intake in injured patients. The type of trauma and the mechanism of injury did not follow a specific pattern due to the level of complexity of the hospital. Trauma indices are useful tools to determine the severity of injuries and to predict the need for transfer to a center of a higher level of complexity and resolution capacity. The Trauma Registry® represents a necessary strategy to optimize the care of injured patients locally and nationally.

Keywords: Injuries and trauma, Peru, Registration system, Surgery.

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INTRODUCTION

Trauma is defined as the set of injuries to organs or tissues caused by external agents and represents a major public health problem worldwide.¹⁻³ According to the World Health Organization, trauma shows a high morbidity and mortality rate in the young population, where >90% of deaths are associated with factors, such as low income, poor social infrastructure, and underdeveloped health systems.⁴

In Latin America, the neglected epidemic of trauma causes a high number of deaths and cases of permanent disability, which

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have a significant impact on the development of society and generates substantial economic losses.² Peru is not exempt from this reality as TI are the main causes of death in the population between 12 and 59 years of age, with 3,244 deaths recorded in 2018.⁵ However, the scarcity of adequate data to help us analyze the real burden of disease in trauma patients, prevents an accurate assessment and, therefore, an insufficient allocation of resources for appropriate care, resulting in high mortality and disability in an economically active population.⁶

The variability of TI represents a challenge for healthcare personnel in emergency departments. Thus, the initial assessment and management, as well as the follow-up of polytrauma patients until stabilization, are processes that essentially require constant evaluation and quality control to maintain a continuous improvement of the services which are provided to the community.⁵

In response to this need, trauma registries are created. Uniform and homogeneous information is entered by experts in an electronic database with well-defined variables. These variables include patient demographics, circumstances of the event, prehospital care, care received in the emergency area, description of injuries, complications, destination, and others, which will allow us to know the epidemiology of trauma and its trends, and will strategically help to achieve effective prevention and to improve the quality and efficiency of the services provided in emergency rooms, thus, optimizing trauma prevention and favoring the reduction of costs related to trauma care.^{5,7,8}

In this context, the trauma registry system® (TRS) of the PTS was implemented at Hospital Vitarte in May 2018 with the aim of reliably recognizing information related to local trauma. During the process, trainings were included for the staff in charge of data collection, including medical students, residents, and institution leaders. The main objective of the study was to describe the results of the implementation of the Trauma Registry® at Hospital de Baja Complejidad Vitarte, Ate, Lima Province, Peru, a public funds institution which covers the entire eastern region of Lima and treats patients from the districts of Ate, Santa Anita, Chaclacayo, Lurigancho, San Juan de Lurigancho, La Molina, Cieneguilla, and San Luis.

MATERIALS AND METHODS

An observational, descriptive, and retrospective study was conducted. All the available data related to patients who suffered TI and were attended in the emergency department of Hospital Vitarte during the period between 1st May 2018 and 30th June 2020 was included in the Trauma Registry® of the PTS.

For the organization of the TRS, a general coordinator (assistant surgeon), supervisors for the data entry and uploading process (surgical residents) and medical interns were assigned to fill out the data collection forms.

We worked only with entries with complete information uploaded to the TRS, regardless of age. The study variables were evaluated based on the information recorded. The TRS records were exported and analyzed with the Stata v16, where a descriptive analysis was performed—categorical variables were presented in relative and absolute frequencies, and numerical variables were presented with measures of central tendency and dispersion according to their type of distribution.

The present study was carried out with the authorization of Hospital Vitarte Research Committee and a local general coordinator.

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All the information from the virtual registry was entered by coding so that the database to be analyzed had no information that would lead to the identification of patients, preserving anonymity and protecting their personal data, which was stored in a different database, kept on a Universal Serial Bus device and saved in a special locked cubicle with access only for the researchers.

RESULTS

The present study included a total 399 registries of 462 patients included in the database. The median age was 27 years [Interquartile range (IR) 18–41] and 72.2% were male; the majority had a primary blunt mechanism, 21.7% were transferred to the hospital in an unspecified manner, and 17.6% by local police personnel.

Tables 1 and 2 show the epidemiological characteristics of those who were attended.

Table 2 indicates that most of the patients had polycontusion and suspected acute ethylism (82.5%), as well as other clinical features. Most patients assisted looking for medical attention on Sundays (20.6%) between 06:00 and 12:00 hours (29.8%), in the middle of the month, and in April (21.1%). Most events occurred on streets and avenues (40.9%) in Eastern Lima (92.7%).

Nearly 96% of the patients were admitted with stable vital signs, presenting a serious injury in approximately 40% of the cases, mainly in the head or neck and lower limbs (Fig. 1). Interestingly, 46.4% of the patients were discharged, but 19.29% were transferred to a more complex health center, mainly as a result of traumatic brain injury (Table 3).

DISCUSSION

The International Trauma Registry of the PTS is a software that encompasses multiple variables and allows the generation of reports according to the need for information.⁷ The use of this tool has allowed the monitoring of TI in different regions of the world, improving the efficiency and quality of care.⁹ However, in Peru, there was no previous continuous experience reported.

According to the latest situational analysis, Hospital Vitarte has a population of approximately 573,948 inhabitants, where 13.81% of the first 10 emergency consultations corresponded to TI.¹⁰ In this sense, the implementation of the Trauma Registry® was possible due to the initiative of the institution's surgery service, optimizing data capture by using a physical card, and then systematically filling in the system's data.

The Ministry of Health indicates that 66% of the population of Eastern Lima belongs to marginal urban areas.¹⁰ Hospital Vitarte is located near the main road to the central highlands and has a population of >88% with medium to low income,¹¹ a situation that clearly shows the influence of the socioeconomic reality of the region on the epidemiology of trauma.^{2,3,6} This situation is repeated in other low middle and low-income countries, such as ours.¹²

Table 1: Epidemiological characteristics of patients treated for TI (n = 399)

	Absolute	Frequency (%)
Age (years)		
<18	98	24.6
18 and 60	282	70.7
>60	19	4.7
Primary mechanism**		
Bruised	241	60.7
Penetrating	124	31.2
Burns	32	8
Event venue		
Streets and avenues	163	40.9
Domicile	126	31.6
Unspecified location	73	18.3
Industrial area	27	6.8
School	5	1.3
Commercial area	3	0.8
Outdoor places	1	0.3
Track and train station	1	1.3
Activities		
Other	164	41.1
Trip	161	40.4
Unknown	39	9.8
Work	31	7.8
Sport	2	0.5
Free time	2	0.5
Transportation**		
Unspecified	86	21.7
Police	70	17.6
Auto particular	68	17.1
Taxi	64	16.1
Three wheels	42	10.6
Public transport	27	6.8
Ground ambulance	20	5
Other*	20	5.1

*, <20 cases each; **, 02 lost data

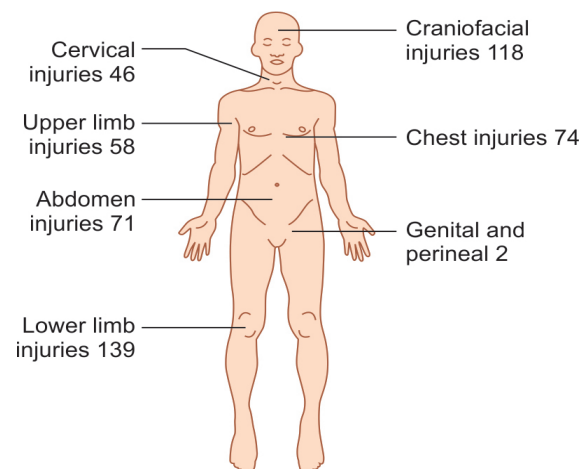
More than half of those treated lived in Eastern Lima, where injuries were associated with activities different than work or entertainment (41.1%) and with alcohol consumption. The events occurred mainly on streets and avenues. Although the evidence indicates a high association of the effects of alcohol with assaults, our data reports few cases of this phenomenon,¹³ our data report few cases of injuries due to violence (10.5%), being mainly of accidental origin.

In Peru, the problem of trauma is the main cause of morbidity and mortality in adult patients, causing a high level of disability in the economically active population,^{10,13} mainly due to traffic accidents.^{2,6} These results are congruent with global data.¹⁴⁻¹⁷ Furthermore, in our local experience, blunt injuries predominate (26.6%) as the primary mechanism of trauma, with the greatest number of cases due to falls between 06:00 and 12:00 hours, mainly on Sundays, similar to what has been reported in other regional studies.¹⁴⁻¹⁸

Table 2: Clinical characteristics of patients treated for TI (n = 399)

	Absolute	Frequency (%)
Glasgow scale		
Lightweight	356	89.2
Moderate	27	6.8
Severe	16	4
AVUP*^		
Alert	338	84.9
Not responding	16	4
Respond to voice	6	1.5
Respond to pain	38	9.6
Serious injuries^		
Only one	183	45.9
More than one	85	21.4
No	130	32.7
Diagnostics	70	17.5
Police contusion	53	13.6
Head trauma	50	12.5
Upper limb trauma	47	11.8
Lower limb trauma	40	10
Polytraumatized	34	8.5
Animal bite	24	6
Abdominal trauma	22	5.5
Chest trauma	20	5
Second-degree burn	39	9.6
Other**		

*AVUP, acronym in English of the escala "alert, verbal, pain, not responding"; **, diagnoses with <20 cases each; ^, 01 data lost

**Fig. 1:** Parts of the body most frequently affected by TI

The median age was 27 years (70.85% between 18 and 60 years), much lower compared to other recently published papers.¹⁴⁻¹⁷ The most of the affected population were male, which is in agreement with other regional series described in countries, such as Honduras,¹⁸ Chile,¹⁹ and Colombia,^{14,16,20} and other international publications, such as those from Pakistan,¹² Iran,¹⁷ and Malawi.¹⁵

Nearly 45.9% of the population had a serious injury, head or neck trauma, a situation that may be correlated with higher

Table 3: Disposition of patients with TI

<i>Disposal</i>	<i>Another destination</i>	<i>Referred</i>	<i>Mortuary</i>	<i>Operating room</i>	<i>Loud</i>
ISS index*					
<15	80 (25.1%)	44 (13.8%)	3 (0.9%)	13 (4.1%)	179 (56.1%)
Over 15	16 (20%)	33 (41.3%)	5 (6.2%)	20 (25%)	6 (7.5%)
RTS index**					
>7	83 (24.6%)	52 (15.4%)	0 (0%)	26 (7.6%)	177 (52.4%)
<7	13 (22.4%)	25 (43.1%)	6 (10.3%)	7 (12.1%)	7 (12.1%)
KTS index***					
	15 (13.5–15)	13 (12–14)	6 (0–6)	14 (13–15)	15 (5–16)

KTS, Kampala Trauma Score; RTS, Revised Trauma Score; *ISS, Injury Severity Score; ** other destination groups the provisions: emergency observation and hospitalization; *** registration groups the provisions—address, external consultation, and departure against medical advice

severity¹⁷ and mortality,¹⁵ especially when associated with some clinical parameters, such as the Glasgow Coma Scale value,^{21–24} but only 4% of the patients admitted had an Glasgow Coma Scale of ≤ 8 points and required hemodynamic stabilization measures, a figure lower than that reported in other experiences.^{23,24}

One study reported a mortality rate of >50% in patients prior to arrival at the hospital.¹² This percentage decreases if associated with the participation of trained personnel during transport and adequate means of transport.²⁵ Our results show only 5% of optimal transport (land ambulance), which may represent an important wake-up call for the prehospital health system at the local level.

However, some interesting initiatives have emerged, such as the experience of Uganda, where, through a prehospital first aid training program, they were able to train lay first aiders with skills that enabled them to improve initial trauma care and transport of polytrauma patients.²⁵ This information opens the debate on what would be the solution to the current conditions of developing emergency systems such as ours.

Three main indices were used (Table 3) to assess the severity of the TI. Firstly, the majority of patients who had an ISS score >15 were transferred to another center of greater complexity. It is interesting to note that, although the evidence correlates this cutoff point with major trauma,²⁶ in our series, less than half of the patients had a serious injury and more than half did not require specialized treatment (“discharge” disposition).

Second, with respect to RTS scores, those with lower values were admitted to the “operating room” or were “transferred.” The literature reports that an RTS score of <4 is associated with a survival rate of 50%.²⁷ In our data, this trend appears when the behavior of the group of patients who died is analyzed. Our data only follows this trend in the “mortuary” group, corresponding to the deceased. Also, there was a relation between a less favorable outcome and a lower KTS value. This can be clearly seen when the data of patients who were discharged or the corresponding to those who followed another path different than transfer is analyzed. This explains the evidence that a lower KTS score is associated with increased severity and mortality of TI.^{12,17}

It should be noted that our institution is categorized as a level II hospital and does not have critical care units (trauma, shock, and intensive care), so approximately one-fifth of those treated required referral for specialized management in a more complex hospital. In

addition, as there is no interhospital information system, we cannot be certain of the outcome of those who were finally treated in the institutions receiving the referrals.

Therefore, even though this study does not show formal mortality statistics, the analysis of the data could be used to implement safety and prevention measures for negative outcomes in institutions that do not specialize in trauma care, as in the case of Hospital Vitarte.

The main limitations of our investigation are similar to those of the local public health system. Firstly, the absence of critical units and subspecialties, which correlates with the categorization of the institution as low complexity, even though it receives a considerable number of cases with severe trauma, a situation that limits the receipt of economic resources to develop comprehensive care for polytrauma patients. In second place, the absence of an integrated interhospital system that allows for patient follow-up, which would favor the flow of information about mortality and severity of injuries of patients who were initially treated at Vitarte and were finally transferred to another facility. And finally, the shortage of permanently trained registrars and training programs, which limits the number of patients captured and reduces the quality of the information entered, leading to incomplete data and heterogeneity in the Trauma Registry®.

CONCLUSION

- Traumatic injuries (TI) in Hospital Vitarte mainly affected young men, with a high frequency of alcohol intake in injured patients.
- The type of trauma and mechanism of injury does not follow a specific pattern. This is due to the level of complexity of the hospital.
- Trauma scores are useful tools to determine the severity of injuries and to predict the need for transfer to a center of a higher level of complexity and resolution capacity.
- The use of trauma registries represents a necessary strategy to optimize the care of trauma patients at the local and national levels.

Recommendations

- All health facilities with a high incidence of TI should use a trauma registry to understand the local epidemiology of the disease.
- Trauma severity scores should be implemented to understand the severity of illness associated with TI and, thereby provide sufficient resources for adequate care.

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REFERENCES

1. RAE. Real Academia de la Lengua Española [Internet]. Diccionario de la Lengua Española. 2012 [cited 2012 Dec 7]. Available from: <http://www.rae.es/rae.html>
2. World Health Organization; Los traumatismos: el problema sanitario desatendido en los países en desarrollo [Internet]. [cited 2021 Jul 18]. Available from: <https://cc.bingj.com/cache.aspx?q=los+traumatismo+un+problema+sanitario+oms&d=4852583124109195&mkt=es-MX&setlang=es-ES&w=oOgatYOuypyeszMWKx3hdyx-2yRb-v-7>
3. Bieler D, Paffrath T, Schmidt A, et al. Why do some trauma patients die while others survive? A matched-pair analysis based on data from Trauma Register DGU®. *Chinese J Traumatol* 2020;23(4):224–232. DOI: 10.1016/j.cjtee.2020.05.001
4. Song F, Ma H, Wang S, et al. Nutritional screening based on objective indices at admission predicts in-hospital mortality in patients with COVID-19. *Nutr J* 2021;20(1):46. DOI: 10.1186/s12937-021-00702-8
5. Pino Sánchez FI, Ballesteros Sanz MA, Cordero Lorenzana L, et al. Quality of trauma care and trauma registries. *Med Intensiva* 2015;39(2):114–123. DOI: 10.1016/j.medin.2014.06.008
6. World Health Organization. GLOBAL STATUS REPORT ON ROAD SAFETY 2018 [Internet]. Vol. 3, Biomass Chem Eng. 2018. Available from: http://journal.stainkudus.ac.id/index.php/equilibrium/article/view/1268/1127%0Ahttp://publicacoes.cardiol.br/portal/ijcs/portugues/2018/v3103/pdf/3103009.pdf%0Ahttp://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0121-75772018000200067&lng=en&lng=
7. Mock C. WHO releases guidelines for trauma quality improvement programmes. *Inj Prev* 2009;15(5):359. DOI: 10.1136/ip.2009.024315
8. Society PT. Sociedad Panamericana de Trauma - Registro de Trauma [Internet]. [cited 2021 Jul 18]. Available from: <https://panamtrauma.org/Registro-de-Trauma/~spanish>
9. Moore L, Clark DE. The value of trauma registries. *Injury* 2008;39(6):686–695. DOI: 10.1016/j.injury.2008.02.023
10. Minsa. Hospital Vitarte. Análisis Situacional de Salud. 2013.
11. Instituto Nacional de Estadística e Informática (INEI). Planos Estratificados de Lima Metropolitana a Nivel de Manzanas 2020. Instituto Nacional de Estadística e Informática. 2020.
12. Tanoli O, Ahmad H, Khan H, et al. A pilot trauma registry in Peshawar, Pakistan – a roadmap to decreasing the burden of injury – quality improvement study. *Ann Med Surg* 2021;72:103137. DOI: 10.1016/j.amsu.2021.103137
13. Friedman K, Raymond J, Minnig MC, et al. Association between alcohol use and violence-related injury in emergency department patients in Moshi, Tanzania: analysis of a prospective trauma registry. *Lancet Glob Health* 2020;8(1):S18. DOI: 10.1016/S2214-109X(20)30159-5
14. Vallmuur K, Cameron CM, Watson A, et al. Comparing the accuracy of ICD-based severity estimates to trauma registry-based injury severity estimates for predicting mortality outcomes. *Injury* 2021;52(7):1732–1739. DOI: 10.1016/j.injury.2021.05.016
15. Tyson AF, Varela C, Cairns BA, et al. Hospital mortality following trauma: an analysis of a hospital-based injury surveillance registry in sub-Saharan Africa. *J Surg Educ* 2015;72(4):e66–e72. DOI: 10.1016/j.jsurg.2014.09.010
16. Monteverde E, Santero M, Bosque L, et al. A public-private collaborative model for a trauma program implementation: findings from a prospective trauma registry at 14 hospitals in Buenos Aires, Argentina. *Eur J Trauma Emerg Surg* 2021;47(6):1931–1937. DOI: 10.1007/s00068-020-01348-7
17. Saeednejad M, Zafarghandi M, Khalili N, et al. Evaluating mechanism and severity of injuries among trauma patients admitted to a hospital, the national trauma registry of Iran. *Chin J Traumatol* 2021;24(3):153–158. DOI: 10.1016/j.cjtee.2021.01.009
18. Rodríguez C, Bonilla-Escobar FJ, Restrepo-Lopera C, et al. A trauma registry experience from the main referral center of Honduras: A call for action. *Injury* 2019;50(4):883–889. DOI: 10.1016/j.injury.2019.03.022
19. Ramos Peris J, Ottolino Lavarte P, Muñoz Alarcón C, et al. Primer registro de trauma en Chile. Análisis de 2 años en un hospital público. *Rev Cir* 2021;73(1):59–65. DOI: 10.35687/s2452-45492021001703
20. Ordoñez CA, Rubiano J, Badiel M, et al. Epidemiología del trauma en dos hospitales de primer nivel de atención del suroccidente de Colombia. Reporte preliminar del registro internacional de trauma de la sociedad panamericana. *Panam J Trauma Crit Care Emerg Surg* 2014;3(1):11–15. DOI: 10.5005/JIP-JOURNALS-10030-1079
21. Botchey IM Jr, Hung YW, Bachani AM, et al. Understanding patterns of injury in Kenya: analysis of a trauma registry data from a National Referral Hospital. *Surg* 2017;162(6S):S54–S62. DOI: 10.1016/j.surg.2017.02.016
22. Chiang YT, Lin TH, Hu RH, et al. Predicting factors for major trauma patient mortality analyzed from trauma registry system. *Asian J Surg* 2021;44(1):262–268. DOI: 10.1016/j.asjsur.2020.06.014
23. González-Robledo J, Martín-González F, Moreno-García M, et al. Prognostic factors associated with mortality in patients with severe trauma: from prehospital care to the intensive care unit. *Med Intensiva* 2015;39(7):412–421. DOI: 10.1016/j.medine.2015.08.002
24. Ordoñez CA, Morales M, Rojas-Mirquez JC, et al. Trauma registry of the Panamerican trauma society: one year of experience in two hospitals in southwest Colombia. *Colomb medica (Cali)* 2016;47(3):148–154.
25. Delaney PG, Bamuleke R, Lee YJ. Lay first responder training in eastern Uganda: leveraging transportation infrastructure to build an effective prehospital emergency care training program. *World J Surg* 2018;42(8):2293–2302. DOI: 10.1007/s00268-018-4467-3
26. Cassagnol A, Marmin J, Cotte J, et al. Correlation between field triage criteria and the injury severity score of trauma patients in a French inclusive regional trauma system. *Scand J Trauma Resusc Emerg Med* 2019;27(1):71. DOI: 10.1186/s13049-019-0652-0
27. Ali Ali B, Fortún Moral M, Belzunegui Otano T, et al. Escalas para predicción de resultados tras traumatismo grave. *An Sist Sanit Navar* 2017;40(1):103–118.