

Delay in Hospital Discharge of Trauma Patients: A Prospective Observational Study

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Abstract

Background: "Delayed discharge" is defined as patients who remain hospitalized beyond the time of being fit for discharge. There is no standardized amount of time defining delayed discharge documented in the literature, and there is a lack of evidence about this topic in Egypt. This study aims to identify the factors associated with discharge delays.

Methods: A prospective observational study included all trauma patients admitted to a University Hospital in Egypt over two months. The time of the decision of discharge and actual discharge time were recorded by reviewing patients' medical records. The patients and their caregivers were asked to fill in a questionnaire about the reasons for delayed discharge. Potential reasons for the delayed discharge were classified into system-related, medical and family-related factors.

Results: The study included 498 patients with a median age of 41 years (9 – 72). The median time until the actual discharge was three hours. System-related factors were documented in 48.8% of cases, followed by medical factors (36.3%), and family-related factors (28.1%). When controlling for age, gender and injury severity score using a logistic regression analysis, longer time to discharge (≥ 3 hours) showed a stronger association with medical factors [adjusted OR (95% CI) = 5.44 (2.73-10.85)] and family-related factors [adjusted OR (95% CI) = 7.94 (3.40-18.54)] compared to system-related factors [adjusted OR (95% CI) = 2.20 (1.12-4.29)].

Conclusion: Although system-related factors were more prevalent, medical and family-related factors appear to be associated with longer discharge delays compared to system-related factors.

Background

A "delayed discharge" is defined as a hospital inpatient who continues to occupy a bed beyond the time of being judged clinically fit for discharge by the responsible clinician. The discharge decision is usually made as part of a multi-disciplinary process and focuses on the needs of patients [1]. Other terms used to describe delayed discharge include 'inappropriate acute bed use' and 'bed blocker' of which the latter term is most frequently used [2].

Delays in discharge have raised numerous concerns over the past few years [3]. These include an increased risk of infection, a reduced quality of life particularly for elderly patients, and a potential waste of economic and human resources [4].

In the Netherlands, the percentage of acute care beds occupied by patients with a delay in discharge has been found to range between 15–50% [5]. In Scotland, approximately 1 in 12 (8.5%) beds in 2018–2019 was occupied by people whose discharge was delayed [6]. The National Health Service (NHS) of England experiences approximately £100 m per year in costs associated with delayed discharge [7]. The increased cost of delayed discharged was reported by different studies and was attributed to occupying beds,

needing to pay for nursing staff and other administrative costs [8–11]. In a study done by Thomas S et al in the USA, the total cost of delayed discharge per year was reported to be at about \$715,403 [9].

University hospitals in Egypt have a limited budget and they often provide free services to the public [12, 13]. Inappropriate bed use and prolonged stay increase the financial burden on the health services especially in Egypt, where hospital admissions account for a significant amount of total healthcare costs in Egypt [6–11, 13–15]. Therefore, improvements in acute care bed management could result in significant savings.

Delayed discharge is associated with adverse effects on the patients and an increased workload for the health care staff. At the patient level, there may be an increased risk of falls, hospital-acquired infections, mental health problems, and a reduction in the patients' mobility and ability to perform activities of daily living [5]. Data from the NHS found that there is evidence that people whose discharge is delayed more than 72 hours have worse outcomes than those who go home sooner [6].

As for the health care staff, delayed patients' discharge may be associated with stress and diversion from a primary focus on patient care [16].

Studies conducted in different countries, such as the USA, the UK and Canada, have found that delays in discharge are often related to difficulties in transferring patients to rehabilitation facilities or back home [6, 8–10, 17, 18]. Several studies have identified factors associated with delayed discharge and classified them into medical, familial and system-related [8, 19–22]. Delayed discharge is described as a multi-factorial problem that requires effective teamwork within the hospital and coordination between health care providers, caregivers at home and social care services [16].

Despite being a fairly common problem in healthcare settings; to our knowledge, there is no standardized definition of what constitutes delayed discharge in the literature. To address this issue, a clinical administrative panel (including four senior general surgery and orthopedic consultants, along with two senior nurses), agreed that "three hours" was the maximum acceptable time until actual patient discharge once a discharge order has been made. Since there is no fixed time documented in the literature for delayed discharge, and by monitoring and assessing the flow of work in the hospital, it was felt that three hours is a reasonable time to cover any final medical procedures and paperwork required before actual discharge. It is to be noted that delays associated with arrangements for referring the patient to rehabilitation facilities were not considered since the availability of such facilities is limited in Egypt.

This study aimed to document the amount of time taken for trauma patients to leave the hospital once the order to discharge had been made by the attending physician and to determine the factors associated with discharge delays. This could help provide evidence to the expert panel concerning the 3-hour cut off value set to define delayed discharge; and will also help start a quality control process to address discharge delays and their potential causes.

Methods

Study setting

This study was conducted at Ain Shams University Surgical Hospital which is one of the major tertiary and educational centers in Egypt. It has a total capacity of 520 beds and it offers free service to the public. It constantly receives new admissions as well as referrals from other health facilities. The occupancy rate ranges between 90% and 110%. Trauma cases are usually occupying around 40% of the total hospital capacity.

We limited our study to trauma cases, to allow for a focused analysis for the causes of delayed discharge.

Study design

A prospective observational study was conducted during two separate months (August 2016 and January 2017). These two months were randomly selected from the two main seasons in Egypt (summer and winter, respectively). The two seasons were represented in case there were differences in the pattern of admissions regarding age, gender, or injury severity score (ISS).

Study population

All admitted trauma patients (of all ages and both sexes) during the specified study duration were included. Patients were followed from admission until discharge. All included patients were discharged from the hospital wards to their homes. No patients were excluded from the study.

Study tools

An interview questionnaire composed of 14 questions was developed to collect data from patients and their caregivers. The collected data included age and sex, as well as data about the potential reasons for delayed discharge. These reasons were classified into system-related, medical, and family-related factors [8, 19-22]. System-related factors included: delayed paperwork, delayed consultation by other specialties before discharge, delayed written discharge order, and delays by nursing. Medical factors included: delayed wound dressing, delayed drainage tube removal, treatment of co-morbidities, stoma care and daily wound dressing for those who have complicated wounds and cannot manage to dress their wounds by themselves at home. Family-related factors included: delayed pick up from the hospital by relatives, living alone with single care, and living in remote areas.

A data extraction sheet was used to collect data from patients' medical records after the patients' discharge. Recorded data included the date of admission, date of discharge, length of hospital stay (LOS), whether surgery occurred, and whether the patient was admitted to the Intensive Care Unit (ICU). Data about the nature of the injury were collected to calculate the Injury Severity Score (ISS). Data about co-morbidities were collected to calculate the Charlson Co-morbidity Index (CCI) [23-27]. Additionally, the time of the decision to discharge (which is the starting point to calculate the delay time), the time the

discharge order was written, and the actual discharge time were recorded. Data collection tools were reviewed by the clinical administrative panel for face validity.

Statistical analysis

Statistical analysis was performed using SPSS version 23. Qualitative variables were presented in the form of frequencies and percentages. Ordinal variables were presented as medians with inter-quartile range (IQR). The Mann Whitney U test and Spearman correlation were used for univariate analysis of factors associated with delayed discharge. Binary multiple logistic regression analysis was used to examine the role of the three categories: system-related, medical, and family-related factors in prolonging time to discharge. Variables with p-values ≤ 0.05 were introduced simultaneously in the model. The final model was obtained by removing variables with the highest p-values one by one and using the Akaike information criterion (AIC) to select the model that fits the data best. The model with the lowest AIC value was selected.

Results

A total of 498 patients, 240 patients in summer and 258 in winter, were included in the study. There were no statistically significant differences between the patients admitted in August and those admitted in January regarding age, gender or ISS. The patients' median age was 41 years (IQR, 28–50) with a range of 9–72 years. Most patients 306 (61.4%) were males. Sixty percent of the patients underwent surgery, and 211 (70.57%) were admitted to the Intensive Care Unit (ICU). The median ISS was 12 (IQR, 1–20) and the median CCI score was 1 (IQR, 0–2) (Tables 1,2).

Table 1
Demographic characters of 498 trauma patients included in the study

		Number	Percentage
Gender	Male	306	61.4%
	Female	192	38.6%
OR admission	Yes	299	60.0%
	No	199	40.0%
ICU admission	Yes	211	42.4%
	No	287	57.6%
Season	Summer	240	48.2%
	Winter	258	51.8%
Discharge planning	Formal	396	79.5%
	Interdisciplinary	102	20.5%
Total		498	100%
OR, Operating room; ICU, Intensive care unit			

Table 2
Characteristics of the study population (N = 498)

	Median	IQR	Range
Age (years)	41	28–50	9–72
ISS	12	1–20	1–50
CCI	1	0–2	0–6
LOS (days)	4	1–8	1–28
Time to discharge (in hours)	3	2–6	0.25–336

IQR: Inter-quartile range, ISS, Injury severity score; CCI, Charlson Co-morbidity Index; LOS, length of stay

The median LOS was four days (IQR, 1–8 days), and the median time to discharge after the decision of discharge was made was three hours (IQR, 2–6 hours). The discharge of the nearly half (238 (47.79%)) of the patients was delayed for 3–10 hours after a discharge order has been made; and 89 (17.87%) were delayed for 24 hours or more. System-related factors were reported in 243 (48.8%) patients, followed by

medical factors that were reported in 181 (36.3%) patients. Family-related factors were reported in only 140 (28.1%) patients.

Univariate analysis showed that the median time to discharge was longer for females, patients who underwent surgery, patients admitted to the ICU, and patients with interdisciplinary discharge planning (Table 3). The median time to discharge was significantly longer for patients with delays related to the treatment of co-morbidities, stoma care, and daily wound dressing. All family-related factors were significantly associated with a longer median time to discharge. Among system-related factors, delayed consultation was the one associated with an increased median time to discharge (Table 4).

Table 3
Median time to discharge (in hours) described by demographic characters and type of care (N = 498)

		Time to discharge		P* value
		Median	IQR	
Gender	Male	3	1–5	< 0.001
	Female	5.5	3–24	
OR admission	No	2	1–3	< 0.001
	Yes	6	3–24	
ICU admission	No	2	1–3	< 0.001
	Yes	7	4–24	
Season	Summer	3	2–6	0.991
	Winter	3	2–7	
Discharge planning	Formal	3	2–5	< 0.001
	Interdisciplinary	24	5–48	
*Mann Whitney U test				

Table 4
Median time to discharge (in hours) by reasons for delay

Delay reason		Yes		No		P* value
		Median	IQR	Median	IQR	
Medical	Delayed wound dressing	4	3–6	3	2–7	0.054
	Delayed tube removal	4	2–6	3	2–7	0.688
	Treatment of co-morbidities	24	7–72	3	2–6	< 0.001
	Stoma care	48	48–48	3	2–6	< 0.001
	Daily wound dressing	72	48–72	3	2–6	< 0.001
Family	Delayed pick up	6	4–10	3	2–6	< 0.001
	Living alone	48	48–72	3	2–6	< 0.001
	Living in remote areas	17	6–24	3	2–5	< 0.001
System	Delayed paperwork	1	0.5–3	4	2–7	< 0.001
	Delayed consultation	6.5	5–24	3	2–6	< 0.001
	Delayed written discharge order	2	2–2	4	2–7	< 0.001
	Delays by nursing	3	2–6	4	2–7	0.374
Any medical related delay		6	4–48	3	1–5	< 0.001
Any familial related delay		6	5–24	3	1–5	< 0.001
Any system-related delay		3	1–4	5	3–24	< 0.001

*Mann Whitney U test, p ≤ 0.05 considered significant

There was a weak correlation between age ($\rho = 0.34$, $P < 0.001$), CCI ($\rho = 0.38$, $p < 0.001$), and time to discharge. Time to discharge was moderately correlated with ISS ($\rho = 0.61$, $P < 0.001$), and LOS ($\rho = 0.69$, $P < 0.001$)

A binary multiple logistic regression analysis showed that female sex and an ISS above 15 were associated with a prolonged delay in discharge of more than three hours regardless of other factors. When controlling for age, sex, and ISS, family-related factors and medical factors appeared to have a larger role in delaying discharge compared to system-related factors (Table 5).

Table 5
Logistic regression analysis for predictors of delayed discharge
(\geq 3 hours) following a discharge order

	B	P value	OR	95% CI for OR	
				Lower	Upper
Age 18–59 ^a	0.616	0.287	1.85	0.60	5.76
Age \geq 60 ^a	0.115	0.875	1.12	0.27	4.67
Female	1.042	< 0.001	2.84	1.70	4.74
ISS > 15	1.556	< 0.001	4.74	2.49	9.02
Medical delays	1.694	< 0.001	5.44	2.73	10.85
Familial delays	2.072	< 0.001	7.94	3.40	18.54
System delays	0.787	0.021	2.20	1.12	4.29
The dependent variable, delayed discharge \geq 3 hours					
^a Reference category is age < 18 years					

Discussion

There is no standard definition for delayed hospital discharge in the literature. One study in the USA used insurance Diagnosis Related Group-based time points [8], another study used a 24-hour cut off point to define delayed discharge [18]. Both studies acknowledged that discharge delay duration varies between practices and institutes.

In the current study, we calculated delays from the time of the decision of discharge until the patient left the hospital, which had a median of three hours. This went by the definition of acceptable delay set by the clinical administrative panel in our hospital.

In our study, age only correlated weakly with delayed discharge, whereas, in other studies, age was one of the factors that influenced delayed discharge [9, 10]. According to the NHS in Scotland, 69% of delayed discharges occurred in patients 75 years of age and older [6]. The current study was restricted to trauma patients who were relatively younger compared to mixed cases in other studies that included non-trauma patients as well as patients admitted for various medical indications of older age groups.

We found in our study that time to discharge for trauma patients was significantly longer for trauma patients with an ISS > 15. These patients were more likely to undergo surgery and be admitted to the ICU with a longer overall hospital stay, which was in turn associated with a delay in discharge. Other studies in the USA and Iran also showed similar results [9, 28]. In contrast, Hwabejire et al. in their retrospective study of 3237 trauma patients, found that ISS was not the main factor in delaying hospital discharge [8].

In the current study, system-related factors were reported in nearly half of the patients. This is relatively higher than a study in the United States has found; where only a quarter of patients experienced system-related delays [8]. Medical-related factors were reported in over one-third of the patients in the current study. Studies in the USA and the UK have similarly emphasized the role of medical-related delays to discharge [6, 8].

It is to be noted that other factors related to rehabilitation facility arrangements post-discharge were found to be strongly associated with discharge delays in the USA and the UK [5, 8–10, 18]. Such facilities are not as common in Egypt. The equivalent of this type of delay in the current study was family-related arrangements in terms of delayed pick up from the hospital by relatives, living alone with single care, and living in remote areas requiring a longer time to arrange for a proper transportation method. Family-related factors were reported by only a quarter of the patients in the current study; however, they were significantly associated with longer discharge delays compared to other factors. Despite being the least reported category in this study, family-related factors were five times more frequent than reported by the NHS in Scotland [5]. Compared to developed countries- where rehabilitation facilities are more widely available- post-discharge care is less institutionalized in developing countries. Since a lot of responsibility for post-discharge patient care is transferred to family members, hospital staff need to communicate more closely with patients' families to help them be more readily prepared to provide post-discharge care.

Payer related issues and insurance provider delays were among the main reasons for delayed discharge in the USA [8, 18]. But in the current study, the hospital offered free service to the patients, and hence, payment related issues were not encountered; although the situation might be different in other settings such as in private hospitals.

The hospital in which the current study was conducted is a major tertiary care center that provides free healthcare services for thousands of patients every year. So, delayed patients' discharge is a pressing issue that needs to be addressed to improve patient care and to avoid any excess costs.

Accordingly, we need to find appropriate solutions for medical and system-related delays. Solutions might include having junior doctors prepare discharge paperwork in advance for patients who are expected to be discharged, providing dedicated unit secretaries to appropriately care for the discharge paperwork, and increasing the nursing staff on the unit to finish all the required dressings and other pending medical issues that may delay discharge.

In the current study, family-related factors were the least commonly reported reasons for the delay; however, they were strongly associated with delays in discharge beyond three hours. One possible intervention to reduce family-related delays might be by providing earlier notice of discharge to patients and their families. There is also a need to facilitate rapid, proper, and safe transport of patients to their homes. Lastly, networking with the available nursing homes or rehabilitation facilities (although few) may benefit elderly patients, particularly those who live alone, so that they can find a safe environment to live (at least temporarily) following discharge.

One of the limitations of our study was that it included only trauma patients in one University tertiary center in Egypt. To fully understand the extent and pattern of hospital discharge delays in Egypt, more inclusive studies in other healthcare settings and other specialties are needed.

Since there is no sufficient evidence in the literature, additional studies are needed to determine what is an acceptable amount of time before tagging a discharge as delayed, so that there will be a target in the future for quality improvement.

Recommendations

We recommend accurately recording the timing of the discharge order and the actual time of discharge for every patient. A quality control process should be put in place to investigate all delays in discharge beyond three hours. A root cause analysis of the sources of delay should be performed, particularly for family-related delays.

Conclusion

The main reasons for delayed discharge in developing countries are different from those in developed countries. In our hospital, system-related were the most commonly reported in association with delayed discharge; however, medical factors and family-related factors were associated with longer delays. This study was conducted in one University hospital, thus further research is needed to examine discharge delays in other settings.

List Of Abbreviations

AIC: Akaike information criterion

CCI: Charlson Co-morbidity Index

ISS: Injury Severity Score

ICU: Intensive Care Unit

IQR: Inter-quartile range

LOS: Length of hospital stay

NHS: National Health Service

Declarations

Ethics approval:

The Institutional Review Board (IRB) of Ain Shams University, Cairo, Egypt. Date: 23/11/2014. Reference: IRB 00006379

The Institutional Review Board (IRB) of the University of Maryland, Baltimore, USA. Date: 04/02/2015. Reference: HP-00062968

Consent to participate: Not applicable.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Authors' contributions:

- **Islam ElAbbassy (IE):** Literature search, study design, data collection, data analysis, data interpretation, and writing the manuscript.
- **Wafaa Mohamed (WM):** Data analysis, data interpretation, and critical revision.
- **Maged El-Setouhy (ME):** Study design, data interpretation, and critical revision.
- **Jon Mark Hirshon (JMH):** Study design.
- **Mohamed El-Shinawi (ME):** Study design and critical revision.

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References

1. Delayed discharges definitions. and data recording manual © NHS National Services Scotland/Crown Copyright; 2012.
2. Hall D, Bytheway B. The blocked bed – definition of a problem. Soc Sci Med. 1982;16:1985–91.
3. Bryan K. Policies for reducing delayed discharge from hospital. Br Med Bull. 2010;95:33–46. <https://doi.org/10.1093/bmb/ldq020>.
4. Victor CR, Healy J, Thomas A, Seargent J. Older patients and delayed discharge from hospital. Health Soc Care Community. 2000;6:443–52.
5. 10.5334/ijic.650
Mur-Veeman I, Govers M. Buffer management to solve bed-blocking in the Netherlands 2000–2010. Cooperation from an integrated care chain perspective as a key success factor for managing patient flows. Int J Integr Care; 2011. doi: 10.5334/ijic.650. PMID: 21954373.

6. Delayed discharge in NHS Scotland. Annual summary of occupied bed days and census figures in NHS Scotland; 2019.
7. Collaboration for leadership in Applied Health Research and Care East of England (CLAHRC); 2018. <https://www.clahrc-eoe.nihr.ac.uk>.
8. Hwabejire JO, Kaafarani HMA, Imam AM, Solis C. Excessively long hospital stays after trauma are not related to the severity of illness: let's aim to the right target! *JAMA Surg.* 2013;148(10):956–61.
9. Thomas SN, McGwin JR, Rue G. LW. The Financial Impact of Delayed Discharge at a Level I Trauma Center. *J Trauma.* 2005 Jan;58(1):121–5. doi:10.1097/01.ta.0000130611.64983.a7.
10. Bai AD, Dai C, Srivastava S, Smith CA, Gill SS. Risk factors, costs and complications of delayed hospital discharge from internal medicine wards at a Canadian academic medical centre: a retrospective cohort study. *BMC Health Serv Res.* 2019;19:935. doi:10.1186/s12913-019-4760-3. Published online 2019 Dec 4.
11. Rojas-García A, Turner S, Pizzo E, Hudson E, Thomas J, Raine R. Impact and experiences of delayed discharge: a mixed-studies systematic review. *Health Expect.* 2018;2:41–56. doi:10.1111/hex.12619.
12. World Health Organization (WHO). Health Systems Profile- Egypt. 2006. apps.who.int/medicinedocs/documents/s17293e/s17293e.pdf. [Last accessed 2019 Feb 1].
13. Mahros OA, Gabr HM, Shehata YA, Soliman SS, Sharafeldin AY. Inappropriateness of Hospital Admission, Hospital Stay and Bed Utilization at Monufia University Hospitals, Egypt. *EFMJ* 2019; 113 – 28. doi: 10.21608/EFMJ.2019.70445.
14. Asghar Ghods A, Khabiri R, Raeisdana N, et al. Predictors of inappropriate hospital stay: experience from Iran. *Global journal of health science.* 2015 May;7(3):82–9.
15. World Health Organization. Annual report 2017: keep the world safe, improve health, serve the vulnerable / World Health Organization. Regional Office for the Eastern Mediterranean Health Journal p. WHO-EM/EGY/006/E.
16. Everall AC, Guilcher SJT, Cadel L, Asif M, Li J, Kulski K. Patient and caregiver experience with delayed discharge from a hospital setting: A scoping review. *Health Expect.* 2019;22:863–73. doi:10.1111/hex.12916. Epub 2019 May 17.
17. sticks? The Community Care Act
McCoy D, Godden S, Pollock AM, Bianchessi C. Carrot. and sticks? The Community Care Act (2003) and the effect of financial incentives on delays in discharge from hospitals in England. *J Public Health (Oxf).* 2007;29:281–7.
18. Sorensen M, Sercy E, Salottolo K, Waxman M, West TA, Tanner A, Bar-Or D. The Effect of Discharge Destination and Primary Insurance Provider on Hospital Discharge Delays Among Patients With Traumatic Brain Injury: A Multicenter Study of 1,543 Patients. *Patient Saf Surg.* 2020 Jan 6;14:2. doi: 10.1186/s13037-019-0227-z.
19. Bo M, Fonte G, Pivaro F, et al. Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients. *Geriatr Gerontol Int.* 2016;16(3):314–21.

20. Challis D, Hughes J, Xie C, Jolley D. An examination of factors influencing delayed discharge of older people from hospital. *Int J Geriatr Psychiatry*. 2014;29(2):160–8.
21. Chen A, Zagorski B, Chan V, Parsons D, Laan RV, Colantonio A. Acute care alternate-level-of-care days due to delayed discharge for traumatic and non-traumatic brain injuries. *Health Policy*. 2012;7(4):41–55.
22. Costa AP, Poss JW, Pierce T, Hirdes JP. Acute care in patients with long-term delayed-discharge: Evidence from a Canadian health region. *BMC Health Serv Res*. 2012;12:172-82.
23. de Groot V, Beckerman H, Lankhorst GJ, Bouter LM. How to measure comorbidity: a critical review of available methods. *J Clin Epidemiol*. 2003;56(3):221–9.
24. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–83.
25. Southern DA, Quan H, Ghali WA. Comparison of the Elixhauser and Charlson/Deyo methods of comorbidity measurement in administrative data. *Med Care*. 2004;42(4):355–60.
26. Sharabiani MT, Aylin P, Bottle A. Systematic review of comorbidity indices for administrative data. *Med Care*. 2012;50(12):1109–18.
27. Austin SR, Wong YN, Uzzo RG, Beck JR, Egleston BL. Why summary comorbidity measures such as the Charlson comorbidity index and Elixhauser score work. *Med Care*. 2015;53(9):e65–72.
28. Salehi O, Dezfuli SAT, Namazi SS, Khalili MD, Saeedi M. A New Injury Severity Score for Predicting the Length of Hospital Stay in Multiple Trauma Patients. *Trauma Mon*. 2016 Feb; 21(1): e20349. Published online 2016 Feb 6. doi: 10.5812/traumamon.20349.