Chinese Journal of Traumatology 23 (2020) 346–350

Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: http://www.elsevier.com/locate/CJTEE

Original Article

# Evaluation of the risk factors associated with emergency department boarding: A retrospective cross-sectional study

Yousef Nouri [a, *], Changiz Gholipour [b], Javad Aghazadeh [c], Shahriar Khanahmadi [d], Talayeh Beygzadeh [d], Danial Nouri [e], Mehryar Nahaei [f], Reza Karimi [d], Elnaz Hosseinalipour [d]

[a] Department of Emergency, Urmia University of Medical Sciences, Urmia, Iran
[b] Department of General Surgery, Tabriz University of Medical Science, Tabriz, Iran
[c] Department of Neurosurgery, Urmia University of Medical Sciences, Urmia, Iran
[d] Student Research Committee, Urmia University of Medical Sciences, Urmia, Iran
[e] National Organization for Development of Exceptional Talents, Urmia, Iran
[f] Department of General Surgery, Imam Khomeini Medical Center, Urmia University of Medical Sciences, Urmia, Iran

ARTICLE INFO

*Article history:*
Received 31 December 2019
Received in revised form
5 August 2020
Accepted 25 August 2020
Available online 9 September 2020

*Keywords:*
Risk factors
Emergency department boarding
Downstream ward overcrowding

ABSTRACT

*Purpose:* Boarding is a common problem in the emergency department (ED) and is associated with poor health care and outcome. Imam Khomeini Hospital is the main healthcare center in Urmia, a metropolis in the northwest of Iran. Due to the overcrowding and high patient load, we aim to characterize the rate, cause and consequence of boarding in the ED of this center.

*Methods:* All medical records of patients who presented to the ED of Imam Khomeini Hospital from August 1, 2017 to August 1, 2018 were retrospectively analyzed. Patients with uncompleted records were excluded. Boarding was defined as the inability to transfer the admitted ED patients to a downstream ward in ≥2 h after the admission order. Demographic data, boarding rate, mortality and triage levels (1–5) assessed by emergency severity index were collected and analyzed. The first present time of patients was classified into 4 ranges as 0:00–5:59, 6:00–11:59, 12:00–17:59 and 18:00–23:59. Descriptive, parametric and non-parametric statistical tests were performed and the risk of boarding was determined by Pearson Chi-square test.

*Results:* Demographic data analysis showed that 941 (58.5%) male and 667 (41.5%) female, altogether 1608 patients were included in this study. Five patients (0.3%) died. The distribution of patients with the triage levels 1–5 was respectively 79 (4.9%), 1150 (71.5%), 374 (23.3%), 4 (0.2%) and 0 (0%). Most patients were of level 2. Only 75 (4.7%) patients required intensive care. The majority of patients (84.2%) were presented at weekdays. The maximum patient load was observed between 12:00–17:59. Of the 1608 patients, 340 (21.1%) experienced boarding within a mean admission time of 13.70 h. Among the 340-boarded patients, 20.1% belonged to surgery, 12.1% to orthopedics, 10.9% to neurosurgery and 10.3% to neurology. The boarding rate was higher in females, patients requiring intensive care and those with low triage levels. Compared with the non-boarded, the boarded patients had a higher mean age.

*Conclusion:* The boarding rate is higher in the older and female patients. Moreover, boarding is dependent on the downstream ward sections: patients requiring surgical management experience the maximum boarding rate.



## Introduction

Emergency medicine provides the first-line health care and emergency department (ED) has the central role in the management of these patients. Time is a critical factor in the emergency settings, especially the waiting time for the first physician visit and the boarding time. Boarding is defined as the inability to transfer the admitted ED patients to a downstream ward in ≥2 h after

* Corresponding author.
*E-mail address:* yousef.nouri2018@gmail.com (Y. Nouri).
Peer review under responsibility of Chinese Medical Association.

https://doi.org/10.1016/j.cjtee.2020.09.002

admission order.[1] Boarding increases the overcrowding in the ED, which leads to inability of staff to adhere to the guideline-recommended treatment, reduces the quality of medical care and further results in a higher mortality rate.[2,3] On the other hand, a high bed occupancy rate in the downstream ward section and delayed admission are the major causes of ED boarding.

Imam Khomeini Hospital located in the Urmia, which admits the self and physician-referred patients from several hospitals in the West Azerbaijan province, Iran. Hence, overcrowding and boarding is a common feature in the ED of this center.[4] In this center, the admission order for hospitalization and/or discharge of patients is planned after referral and consultation with the specialist from downstream ward sections where patient will be admitted.[5] Because hospital bed is categorized as scarce resources, the beds are occupied in regular manner and bed provision for newly admitted patients is a time-consuming process.[6,7] As a result, management and appropriate allocation of beds reduce the waiting time, admission cancellation rate and boarding rate.[8] The bed management affects the ED throughput profoundly. Therefore ED specialists are actively involved in the bed managing and inpatient discharge to reduce boarding rate and poor outcome.[9] Any delay in the downstream wards specialist visit and admission order exacerbate the patent's flow and increase the boarding rate at the ED, which is associated with adverse outcome.[5,10]

The visit and time management is dependent on the triage levels of patients. Generally, intensive traumatic patients need more and fast measures to save lives. Therefore, boarding of these patients should be reduced as much as possible. Montgomery et al.[11] showed that trauma patients who were intubated and undergoing multiple diagnostic exams have a shorter boarding time. Boarding in these patients is associated with an increased hospital length of stay and higher intensive care unit (ICU) care and hospital mortality.[12]

At 2017, to reduce the boarding rate, the executive board of Imam Khomeini Hospital decided to offer the permission of patients' admission to the emergency medicine specialists. Therefore, we hypothesized that this plan may reduce the boarding rate and further, the patient's mortality rate. Hence, this retrospective study was conducted to evaluate the boarding rate as well as its causes and consequence in the ED of this hospital.

## Methods

In this effort, we conducted a retrospective cross-sectional study. The medical records of patients who presented to the ED of Imam Khomeini Hospital from August 1, 2017 to August 1, 2018 were enrolled in the study. Data analysis was performed by SPSS software version 23. The variables included age, gender, time of present, time of bed request, time of bed provision in the downstream ward, ward section (department or center in which patients were admitted as inpatient), mortality, need for ICU care, triage levels assessed by emergency severity index and boarding rate. The emergency severity index is the most used emergency triage system that discriminates the patient's condition for care prioritization. This index ranges from 1 to 5 where 1 indicates most acute patients and 5 least acute. Boarding is defined as patients staying at the ED for more than 2 h after admission order. Patients first present time was classified into 4 ranges as 0:00–5:59, 6:00–11:59, 12:00–17:59 and 18:00–23:59.

Descriptive analysis was performed and represented by charts, tables and figures. Parametric and non-parametric statistical tests were done to compare the means or medians of variables. The risk of boarding regarding outcomes was determined by Pearson Chi-square test. Similar tests were performed to other non-continuous variables. For all the tests, $p$ values less than 0.05 was considered statistically significant.

## Results

### *Descriptive analysis*

Documents of 1608 patients who referred to the ED during the study period were analyzed, including 941 (58.5%) males and 667 (41.5%) females. The mean age (years) of male and female patients was 41.39 ± 0.76 and 46.06 ± 0.89, respectively, indicating significant difference ($p = 0.001$). Only 75 patients (4.7%) were referred to ICU for intensive care. Five patients (0.3%) died and all of them were female. Time analysis showed that two of them admitted at weekdays, two at holiday and one on weekend; furthermore, two at daytime and three at night time.

Triage levels of all of the 1608 patients are depicted in Fig. 1A, where patients of triage level 2 being the most frequent condition with 1150 cases (71.5%). There are no patients of triage level 5. The majority of patients (1354 cases, 84.2%) were presented at weekdays (Fig. 1B). The time period with maximum and minimum patient's presentation were occurred between 12:00–17:59 and 0–5:59 respectively (Fig. 1C).

The average interval time between the admission order and the transfer to the relevant ward was 4.49 h (range 0–126.61 h). The mean boarding time was the mean time that patients stay at the ED after the 2 h deadline time. Those patients are who we considered as boarded patients. The highest boarding time belonged to the endocrinology and ophthalmology ward, with the mean time of 492.63 min and 448.49 min, respectively. While the shortest mean boarding time was observed in the burn center (54.75 min) and orthopedics wards (135.33 min).

In the study of the frequency of patient's distribution ward by ward (Fig. 2), the highest number of admissions was in the surgical

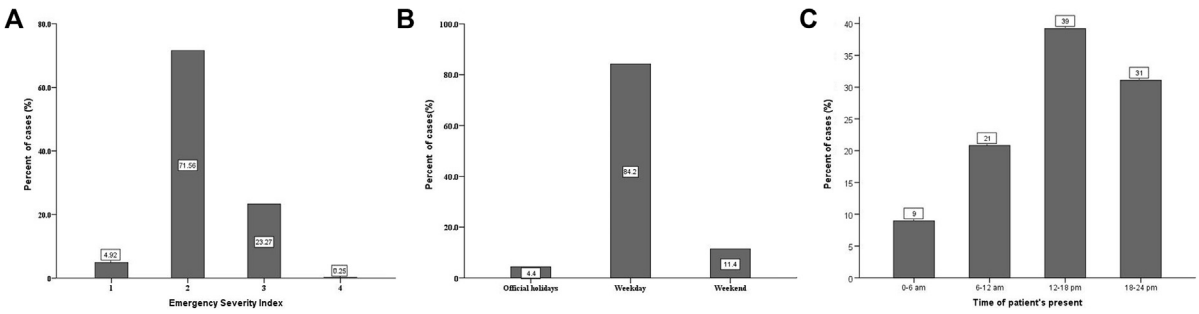
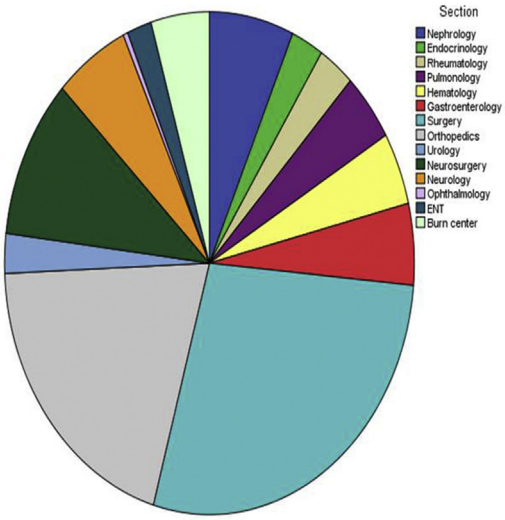



**Fig. 1.** Distribution of patients based on triage levels (A), presentation days (B) and time of present (C).




| Section | N | Percent (%) |
|---|---|---|
| Nephrology | 107 | 6.7 |
| Endocrinology | 41 | 2.5 |
| Rheumatology | 46 | 2.9 |
| Pulmonology | 71 | 4.4 |
| Hematology | 75 | 4.7 |
| Gastroenterology | 84 | 5.2 |
| Surgery | 450 | 28.0 |
| Orthopedics | 320 | 19.9 |
| Urology | 42 | 2.6 |
| Neurosurgery | 166 | 10.3 |
| Neurology | 95 | 5.9 |
| Ophthalmology | 6 | 0.4 |
| ENT | 31 | 1.9 |
| Burn center | 74 | 4.6 |
| Total | 1608 | 100.0 |

**Fig. 2.** The frequency of patients in different downstream ward sections.

and orthopedic wards with 450 patients (28.0%) and orthopedic 320 patients (19.9%) of patients respectively. The lowest number of admissions was related to the ophthalmology ward with 6 patients (0.4%). The relationship between the boarding time and the downstream ward type was statistically significant ($p < 0.001$).

*Boarding*

About 21.1% of patients (340/1608) experienced boarding and the rest 77.4% admitted within 2 h after admission order. The time (h) for admission at the downstream departments for the non-boarded was mean 1.15, median 0.82, minimum 0 and maximum 4.00; whereas the data for the boarded were mean 13.70, median 8.73, minimum 4.02 and maximum 126.62. Among the 340-boarded patients, 20.1% belonged to surgery, 12.1% to orthopedics, 10.9% to neurosurgery and 10.3% to neurology patients. Fig. 3 shows the distribution of boarded patients in terms of downstream ward sections.

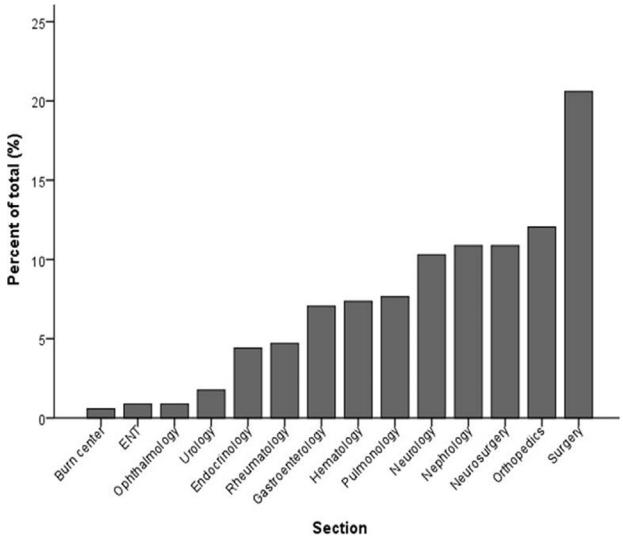
The rate of boarding is higher in patients who needed ICU care. Fig. 4 shows the cross tabulation of the time & triage levels and time & ICU need.

The mean age (years) of the boarded patients (49.04 ± 22.47) was higher than the non-boarded (41.84 ± 23.39). There is a negative association between age and triage levels. As shown in Fig. 5, elderly patients have lower triage levels and poor prognosis.

The mean times (h) that the male and female patients had stayed at ED were 3.49 ± 7.78 and 4.35 ± 9.24, respectively. The frequency of boarded patient is higher in the female gender than in male (Fig. 6).

*Trauma patients*

Among the wards, orthopedic department admit more trauma patients than others. About 12.8% of orthopedic patients experienced the ED boarding. Their triage levels were respectively 1, 2 and 3 in 1.9%, 43.1% and 54.7% of patients. The mean age was 32.83 years. The low triage level in orthopedic patients is not due to




| Section | Frequency | Percent(%) |
|---|---|---|
| Nephrology | 37 | 10.9 |
| Endocrinology | 15 | 4.4 |
| Rheumatology | 16 | 4.7 |
| Pulmonology | 26 | 7.6 |
| Hematology | 25 | 7.4 |
| Gastroenterology | 24 | 7.1 |
| Surgery | 70 | 20.6 |
| Orthopedics | 41 | 12.1 |
| Urology | 6 | 1.8 |
| Neurosurgery | 37 | 10.9 |
| Neurology | 35 | 10.3 |
| Ophthalmology | 3 | 0.9 |
| ENT | 3 | 0.9 |
| Burn center | 2 | 0.6 |
| Total | 340 | 100.0 |

**Fig. 3.** The frequency of boarded patients in different downstream ward sections.

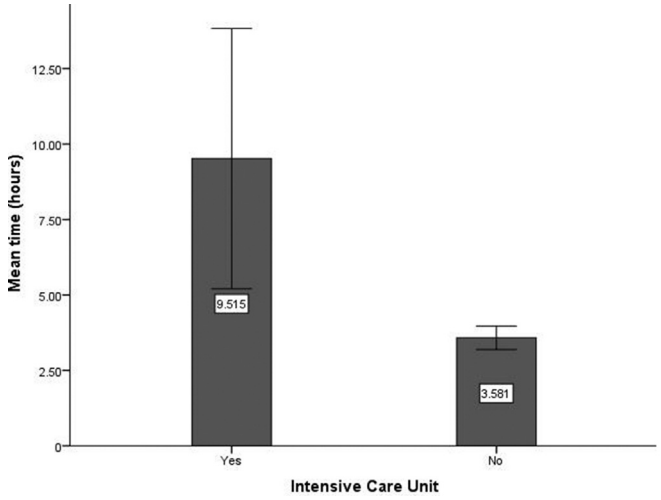



**Fig. 4.** The mean boarding time and need for intensive care.

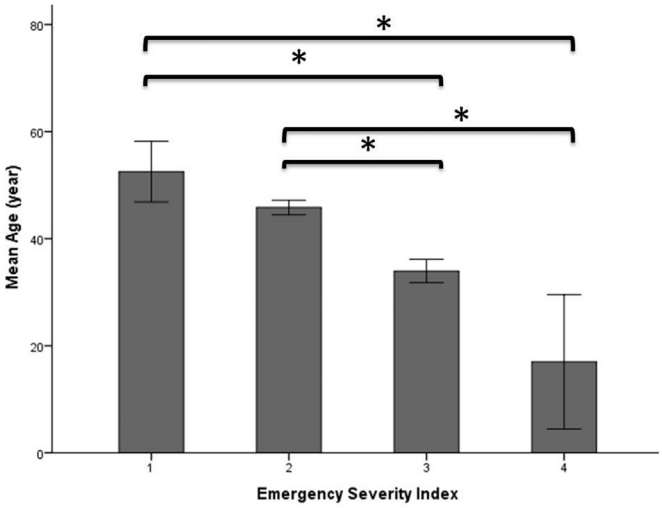



**Fig. 5.** Mean age of patients with different triage levels. * indicates significant different between two groups.

aging or elderly patients but the adverse conditions per se. The boarding rate showed no gender dependent pattern in this patient group ($p = 0.242$). The mean stay time in the ED for the boarded and non-boarded orthopedic patients was 1.07 h and 10.18 h, respectively.

## Discussion

In this study, we evaluated the boarding and other variables at the ED of Imam Khomeini Hospital, Urmia, Iran. The mortality rate is lower (0.3%) than other studies performed in Tehran, the capital of Iran, which reported the mortality rates of 0.9%–1.35%.[13,14] This difference may be explained by different geographic, demographic and population properties. We did not found a statistically significant relationship between mortality and other tome variables including weekdays *vs.* weekend or daytime *vs.* nighttime admission. However, meta-analysis of clinical findings showed that the weekend and night-time admission is associated with a higher mortality rate.[15–17] In addition, all our expired patients were female, which may be due to the small sample size of death. The patient's presentation was less during 0:00–5:59, which is similar to previously reported results by others.[18]

The frequency of patients with low triage levels and poor condition was higher than other studies.[19,20] This difference is probably due to the fact that poor condition patients from other centers in the province are referred to the studied hospital.

There is an association between the number of patients and boarding rate. In other word, as the number of referring patients increases, the boarding rate increases. For example, the number of surgery patients is higher than other downstream wards: the maximum boarding rate was observed in the surgery sections. As well as, the inpatient discharge delay, strangely affect the ED boarding. Therefore, reducing the boarding rate in the ED is dependent on effective collaboration between ED and downstream wards.[21]

Our finding also showed orthopedics, surgery and neurosurgery patients most frequently are referring patients in our center. Most of them are referred to our hospital due to trauma and related problems. On the other hand, the emergent management of severe trauma patients is more critical than high triage non-trauma patients. Therefore, the similar centers that admit trauma patients in large numbers should consider the boarding problem at the spotlight. In addition, not all of the orthopedic patients are trauma patients but the main complaint in most of them is trauma.

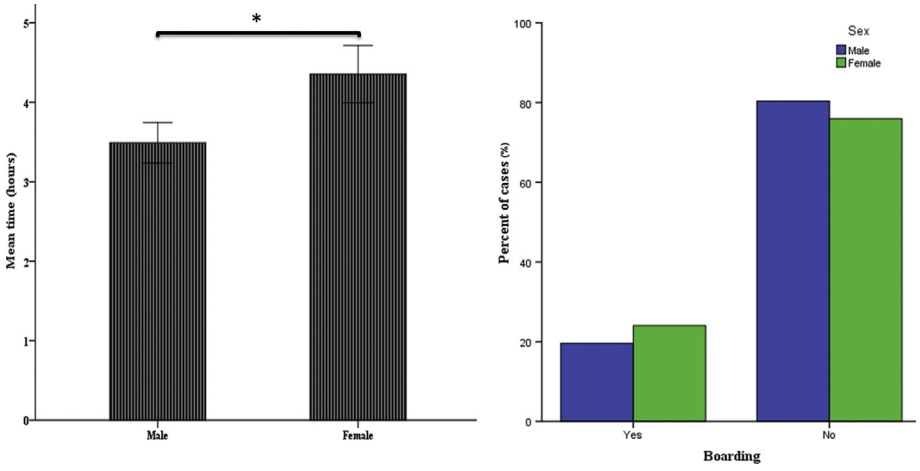



**Fig. 6.** Gender difference of ED patients boarding.

Our results showed that the boarding rate is higher in patients with poor prognosis including those admitted to ICU or with low triage levels. There are two reasons for this observation: first, poor condition patients need more time to reach a relative stable condition before transferring to the downstream wards; second, specialist for consultation further delay the boarding time. Because elderly patients had lower triage levels than younger ones, they experienced a higher boarding rate as well. Other possible reasons include poor doctor-patient interaction, emergency care overuse, etc.[22,23] Female patients had a longer stay at the ED and a higher boarding rate than the male patients, but the triage levels showed no significant difference between the two genders. Therefore, difference in the disease presentation, higher pain complaint and/or other etiology may justify this observations.[24,25]

In conclusion, the reduction of boarding rate by taking the measures may have good results in management of the older, female and poor prognostic patients who are susceptible to be boarded in the ED. Moreover, management of the downstream ward sections is a good strategy to reduce ED crowding and further the boarding problem. As well, preparation an orchestrated plan to effective collaboration of doctors and clinical practitioners will be helpful in management of ED boarding.

## Funding

All financial support provided by Urmia University of medical science. The fund number was IR.UMSU.REC.1396.280.

## Ethical Statement

This research performed by consideration of ethical standards of Ethics Committee, Urmia University of Medical Sciences and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## Declaration of Competing Interest

The authors declare that there are no conflicts of interest.

## References

1. Singer AJ, Thode Jr HC, Viccellio P, et al. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;18:1324–1829. https://doi.org/10.1111/j.1553-2712.2011.01236.x.
2. Di Somma S, Paladino L, Vaughan L, et al. Overcrowding in emergency department: an international issue. *Intern Emerg Med*. 2015;10:171–175. https://doi.org/10.1007/s11739-014-1154-8.
3. Morley C, Unwin M, Peterson GM, et al. Emergency department crowding: a systematic review of causes, consequences and solutions. *PloS One*. 2018;13, e0203316. https://doi.org/10.1371/journal.pone.0203316.
4. Enshaie A, Baghaei R, Rezaei S. Assessment of satisfaction among people accompanying patients in the case of services provided at emergency department of hospitals affiliated to Urmia University of Medical Sciences, Iran. *J Res Med Dent Sci*. 2018;6:140–146.
5. Lee RS, Woods R, Bullard M, et al. Consultations in the emergency department: a systematic review of the literature. *Emerg Med J*. 2008;25:4–9. https://doi.org/10.1136/emj.2007.051631.
6. Hasan Y, Parviz SS, Bahram N. Health System Reform Plan and performance of hospitals: an Iranian case study. *Mater Sociomed*. 2017;29:201–206. https://doi.org/10.5455/msm.2017.29.201-206.
7. Engelhardt Jr HT, Rie MA. Intensive care units, scarce resources, and conflicting principles of justice. *J Am Med Assoc*. 1986;255:1159–1164.
8. Schmidt R, Geisler S, Spreckelsen C. Decision support for hospital bed management using adaptable individual length of stay estimations and shared resources. *BMC Med Inf Decis Making*. 2013;13:3. https://doi.org/10.1186/1472-6947-13-3.
9. Howell E, Bessman E, Kravet S, et al. Active bed management by hospitalists and emergency department throughput. *Ann Intern Med*. 2008;149:804–811. https://doi.org/10.7326/0003-4819-149-11-200812020-00006.
10. Shen Y, Lee LH. Improving the wait time to consultation at the emergency department. *BMJ Open Qual*. 2018;7, e000131. https://doi.org/10.1136/bmjoq-2017-000131.
11. Montgomery P, Godfrey M, Mossey S, et al. Emergency department boarding times for patients admitted to intensive care unit: patient and organizational influences. *Int Emerg Nurs*. 2014;22:105–111. https://doi.org/10.1016/j.ienj.2013.06.004.
12. Chalfin DB, Trzeciak S, Likourezos A, et al. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. *Crit Care Med*. 2007;35:1477–1483. https://doi.org/10.1097/01.CCM.0000266585.74905.5A.
13. Alimohammadi H, Bidarizerehpoosh F, Mirmohammadi F, et al. Cause of emergency department mortality; a case-control study. *Emerg (Tehran)*. 2014;2:30–35.
14. Mirbaha S, Saberinia MA, Ghesmati S, et al. An epidemiologic study on emergency department mortality. *Adv J Emerg Med*. 2018;2, e43. https://doi.org/10.22114/AJEM.v0i0.105. Published 2018 Sep 2.
15. Pauls LA, Johnson-Paben R, McGready J, et al. The weekend effect in hospitalized patients: a meta-analysis. *J Hosp Med*. 2017;12:760–766. https://doi.org/10.12788/jhm.2815.
16. Han L, Meacock R, Anselmi L, et al. *Variations in Mortality across the Week Following Emergency Admission to Hospital: Linked Retrospective Observational Analyses of Hospital Episode Data in England, 2004/5 to 2013/14*. Southampton (UK): NIHR Journals Library; November 2017. https://doi.org/10.3310/hsdr05300.
17. Mohammed MA, Sidhu KS, Rudge G, et al. Weekend admission to hospital has a higher risk of death in the elective setting than in the emergency setting: a retrospective database study of national health service hospitals in England. *BMC Health Serv Res*. 2012;12:87. https://doi.org/10.1186/1472-6963-12-87.
18. Zeytin AT, Cevik AA, Acar N, et al. Characteristics of patients presenting to the academic emergency department in central Anatolia. *Turk J Emerg Med*. 2016;14:75–81. https://doi.org/10.5505/1304.7361.2014.91489.
19. Farrohknia N, Castrén M, Ehrenberg A, et al. Emergency department triage scales and their components: a systematic review of the scientific evidence. *Scand J Trauma Resuscitation Emerg Med*. 2011;19:42. https://doi.org/10.1186/1757-7241-19-42.
20. Maleki M, Fallah R, Riahi L, et al. Effectiveness of five-level emergency severity index triage system compared with three-level spot check: an Iranian experience. *Arch Trauma Res*. 2015;4, e29214. https://doi.org/10.5812/atr.29214.
21. Sayah A, Rogers L, Devarajan K, et al. Minimizing ED waiting times and improving patient flow and experience of care. *Emerg Med Int*. 2014;2014:981472. https://doi.org/10.1155/2014/981472.
22. Adelman RD, Greene MG, Charon R, et al. The content of physician and elderly patient interaction in the medical primary care encounter. *Commun Res*. 1992;19:370–380. https://doi.org/10.1177/009365092019003004.
23. Mohan D, Barnato AE, Rosengart MR, et al. Trauma triage in the emergency departments of nontrauma centers: an analysis of individual physician caseload on triage patterns. *J Trauma Acute Care Surg*. 2013;74:1541–1547. https://doi.org/10.1097/TA.0b013e31828c3f75.
24. Legramante JM, Morciano L, Lucaroni F, et al. Frequent use of emergency departments by the elderly population when continuing care is not well established. *PloS One*. 2016;11, e0165939. https://doi.org/10.1371/journal.pone.0165939.
25. Peck BM. Age-related differences in doctor-patient interaction and patient satisfaction. *Curr Gerontol Geriatr Res*. 2011;2011:137492. https://doi.org/10.1155/2011/137492.