

An analysis of emergency department-boarded patients awaiting inpatient beds

Şule Yakar¹ , Levent Avşaroğulları² ,

1 University of Health Sciences Kayseri City Training and Research Hospital, Department of Emergency Medicine, Kayseri, Turkey

2 Erciyes University Faculty of Medicine, Department of Emergency Medicine, Kayseri, Turkey

Abstract

Background: Emergency department (ED) overcrowding and boarding are the most important factors that affect health services and quality of care all over the world. The objective of this study is to evaluate the length of stay of patients boarded in the ED and to analyze patients' data in respect to the length of stay.

Methods: This prospective study was carried out in a one-year period. The study included patients older than 18 years old who stayed in the ED more than 3 hours after the decision to transfer the patient to the relevant department due to unavailability of vacant inpatient beds. The mode of arrival to the ED, demographic features, the length of stay, clinical course, and outcomes were recorded and statistically analyzed.

Results: A total of 1750 patients were included in the study. Thirty-five percent of patients stayed more than 24 hours in the ED. Department of Infectious Diseases admitted the highest number of the patients (22.5%). Patients' need for Intensive Care Unit, departments awaited to admit patients, and patients' Emergency Severity Index were compared to patients' length of stay and Charlson Comorbidity Index. Differences between groups were statistically significant ($p < 0.05$).

Conclusions: Insufficient number of inpatient beds is a major factor contributing to the ED boarding and overcrowding, which may have various unfavorable effects on both patient safety and functionality of EDs. Multidisciplinary solutions are required to overcome the problem.

Keywords: Boarding, Emergency Department, Overcrowding, Prolonged Wait Times.

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Corresponding Author:

Şule Yakar, University of Health Sciences Turkey Kayseri City Training and Research Hospital, Department of Emergency Medicine, Kayseri, Turkey
E-mail: suleeee85@hotmail.com



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INTRODUCTION

Emergency departments (ED) admit patients without any restrictions of social security or policies (1). Insufficient number of inpatient beds and inability for hospitalization is the leading factor among numerous factors affecting ED crowding (2,3). Some other factors are increasing number of patients, increasing number of the elderly and critically ill population, insufficient ancillary staff, delayed responses to consultations, insufficient number of ED beds, delayed laboratory and radiological results, and social security problems (4,5). Inpatient bed insufficiencies may be caused by the low ratio of number of nurses to those of patients, isolation measures, delayed cleaning services after patient discharge, inadequate examination and care services in bedridden patients, and delayed discharges after acute health care (6).

The term “boarding – i.e. awaiting transfer to an inpatient bed” is used for patients who remain in the ED after the patient has been admitted or placed into observation status at the facility, but has not been transferred to an inpatient or observation unit (7). Extended stays in EDs cause serious problems such as increased workload, delays in diagnostic and treatment processes, and decreased quality of healthcare (5,8). Furthermore, providing care to patients in critical conditions who cannot be transferred to inpatient beds and have to await in the ED has transformed EDs into so-called “pseudo-Intensive Care Units (ICU)” (9). ED crowding is known to cause dispatching ambulances to other hospitals, delayed transport of patients with acute cardiac conditions, and patients leaving the hospital without being evaluated (10). Moreover, overcrowded EDs lead to burnout, demoralization, and eventually workforce loss of ancillary staff (2,5,11). Recently, ED crowding has led to several studies analyzing features and length of stay of patients in ED (8,12).

This study focuses on boarding time of patients admitted to the ED and analyses the patients’ data in respect to the length of stay. Additionally, possible solutions for boarding and its effects are discussed.

MATERIALS AND METHODS

This study was approved by the clinical research ethics committee of the Erciyes University Faculty of Medicine (Date: 24.01.2014 number: 2014/43).

This prospective study was performed in the Department of Emergency Medicine, Faculty of Medicine, Erciyes University in a one-year period between April 2014 and March 2015 after approval of the ethical committee. The patient group consisted of 1750 patients with a boarding time in ED more than three hours due to unavailability of vacant inpatient beds. Data on demographical features, mode of admittance (i.e. via ambulance, referral from another clinic, or direct admittance), date and hour of admittance, complaints, comorbidities, diagnoses, boarding time, Glasgow Coma Scale, Emergency Severity Index (ESI), Charlson Comorbidity Index (CCI), and outcome of the patients were collected and recorded using standard forms. Additionally, the department of consultant physician, procedures performed in the ED, undesired events that would occur in the ED, and patients needing isolation and indications for isolation were also recorded on the forms.

ESI is a triage algorithm which stratifies patients from the most to the least urgent medical condition by leveling them from 1 to 5 based on acuity of patients and resources needed (13). CCI is a comorbidity score based on additional diseases and age groups of patients (14). Statistical analyses were performed with SPSS 16.0 and SPSS 22.0 statistical packages for Windows.

Patients’ boarding durations were grouped into specific time intervals, which were compared to CCI, ESI, department to be transferred, and need for ICU. Nonparametric tests (Kruskal-Wallis Test and Mann-Whitney U Test) were used to analyze differences between median values of groups, which were not normally distributed.

RESULTS

Of 1750 patients, 959 (54.8%) were male. The median age was 66 ± 17.5 years. Age and gender differences were not statistically significant. Ambulance was the most frequent mode of admittance (56.3%). Of these patients, 967 were transferred to our ED via state-based ambulance service. Complaints or symptoms such as fever, loss of appetite, chills, malaise, etc. were categorized as “general symptoms”. Respiratory system complaints were the most common chief complaint with a rate of 28.5% and the most common comorbid disease was hypertension with a rate of 29.7%. Demographic data, clinical features, ESI, and CCI scores of the patients are listed in Table 1.

Table 1. Demographic and clinical characteristics of the patients

	n: 1750	%
Mode of arrival		
Direct	1186	67.8
Referrals from polyclinics or outpatient facilities	57	3.3
Intra-city referral	416	23.8
Out-of-city referral	91	5.2
Chief complain		
Trauma	37	2.1
Eyes/Ears	13	0.7
Cardiovascular	34	1.9
Mental	321	18.3
Respiratory	498	28.5
Genitourinary	92	5.3
Digestive	428	24.5
Skin	66	3.8
Musculoskeletal	100	5.7
General symptoms	377	21.5
Other	39	2.2
Comorbidities		
Congestive heart failure	66	3.8
Valvular disease	32	1.8
Coronary artery disease	214	12.2
Peripheral vascular disease	13	0.7
Hypertension	519	29.7
Diabetes mellitus (DM)	299	17.1
Anemia	72	4.1
Neurological diseases	196	11.2
Chronic pulmonary disease	316	18.1
DM with complications	17	1
Cancer	378	21.6
Renal failure	107	6.1
Liver failure	80	4.6
Coagulation deficiency	13	0.7
Obesity	18	1
Weight loss	35	2
Fluid-electrolyte disorders	26	1.5
Alcohol abuse	8	0.5
Drug abuse	27	1.5
Depression / Psychosis	23	1.4
Emergency severity index score		
1	125	7.1
2	1027	58.7
3	598	34.2
Charlson score		
0	175	10
1	77	4.4
2	256	8.9
≥3	1342	76.7

In our study, 70.3% of the patients were hospitalized. ICU was indicated in 500 cases (28.6%), and more than one department decided for hospitalization in 386 cases (22.1%). The most common diagnosis of the patients was pneumonia with a rate of 26.9%, and the department of infectious diseases (22.5%) was the department that

admitted the highest numbers of patients. Diagnoses, primary departments for transfer, and outcomes are listed in Table 2. Conditions such as diabetic ketoacidosis, urolithiasis, renal infarcts, traumatic causes, oncological conditions, and hematological disorders were categorized as “other conditions”.

Table 2. Diagnosis, primary indicated department for hospitalization and final status of patients

	n	%
Diagnosis		
Cerebrovascular disease	261	14.9
Pneumonia	471	26.9
Pulmonary thromboembolism	100	5.7
Urinary system infections	166	9.5
Cellulitis	38	2.2
Gastrointestinal system bleeding	107	6.1
Cholelithiasis	149	8.5
Acute renal failure	84	4.8
Pyelonephritis	13	0.7
Angioedema	8	0.5
Pneumothorax	14	0.8
Diabetic foot	11	0.6
Sepsis	136	7.8
Hepatic encephalopathy	31	1.8
Pancreatitis	61	3.5
Drug intoxication	29	1.7
Schizophrenia	6	0.3
Heart failure	5	0.3
Fluid-electrolyte disorders	12	0.7
Peritonitis	12	0.7
Other conditions	442	25.3
Primarily indicated department for hospitalization		
Internal Medicine ICU*	178	10.2
Anesthesia ICU	24	1.4
Neurology	272	15.5
Chest Diseases	362	20.7
Infectious Diseases	394	22.5
Cardiology / Endocrinology	14	0.8
Gastroenterology	265	15.1
Nephrology	59	3.4
Hematology	51	2.9
Oncology	20	1.1
General surgery	24	1.4
Thoracic Surgery	24	1.4
Neurosurgery	22	1.3
Psychiatry	18	1
Other(Orthopedics, Urology, Plastic Surgery)	23	1.3
Outcome		
Discharge from ED	125	7.1
Left from own request (consent)	58	3.3
Exitus in the ED	4	0.2
Referral to another hospital	333	19
Hospitalization	1230	70.3

The most common consulting departments were infectious diseases (39.1%), pulmonary diseases (25%), gastroenterology (20.5%), and neurology (17.9%). Cardiovascular surgery was the least common consulting department with 13 patients (0.7%). After boarding, the patients were hospitalized most commonly at departments of gastroenterology (12.5%), infectious diseases (12.4%), and pulmonary diseases (10.5%).

The number of boarding patients increased in spring months with 224 patients (12.7%) in March, 217 (12.4%) in April, and 186 (10.6%) in May. In October, there were only 70 boarding patients (4%), which was the lowest number. It was thought that the number of inpatients increased in the spring months, because of the most common complaint of the patients was from the respiratory system and the rate of concomitant chronic pulmonary disease was high (18.1%) in our study.

Additionally, procedures performed in the ED, undesired events that occurred during boarding, and need for isolation were evaluated. The most common indication for isolation was febrile neutropenia with a rate of 4.6%, and inadequate nursing care services were determined as the most common undesired event with a rate of 27.9%. The most common procedure performed in ED was blood product transfusion with a rate of 9.6%. Inserting an urethral catheter or nasogastric or orogastric tube, abscess drainage, dialysis, apheresis, and cardiopulmonary resuscitation were categorized in "others group" (Table 3).

Table 3. Isolation indications, procedures performed in the ED and complications

	n	%
Isolation indications		
VRE-positivity*	44	2.5
Febrile neutropenia	80	4.6
Tuberculosis	2	0.1
Viral infection	15	0.9
Immunosuppression	22	1.3
Agitation	10	0.6
Procedures performed in ED		
Intubation	54	3.1
Central venous catheter	102	5.8
Dialysis catheter	56	3.2
Nephrostomy catheter	7	0.4
Endoscopy	69	3.9
Endoscopic Retrograde Cholangiopancreatoduodenography	34	1.9
Percutaneous Transhepatic Cholangiography	4	0.2
Tube thoracostomy	19	1.1
Thoracentesis	33	1.9
Paracentesis	23	1.3
Transient pacemaker	1	0.1
Non-invasive mechanical ventilation	84	4.8
Tissue plasminogen activator use	5	0.3
Central venous pressure measurement	44	2.5
Blood product transfusion	168	9.6
Bronchoscopy	5	0.3
Lumbar puncture	15	0.9
Cystostomy	4	0.2
Other	342	19.5
Undesired events		
Missed home medication	104	5.9
Treatment delays	167	9.5
Delay/lack of interventional procedures to be performed in the inpatient departments	281	16.1
Inadequate nursing care services	489	27.9
Inappropriate regimen-diet	151	8.6
Not being able to be monitored	48	2.7
Others group	257	14.7

*Vancomycin-resistant enterococci

Date and time of admittance, indications of hospitalization, boarding time, and total length of stay in the ED were summarized in Table 4. It was determined that 23.5% of the patients admitted to the hospital most frequently between 16:00-20:00 hours, and 37% of the patients' length of stay in the emergency department was 12-24 hours after hospitalization decision.

Table 4. ED arrival time and length of stay in the ED

	n	%
Arrival times		
08:00-12:00	308	17.6
12:00-16:00	382	21.8
16:00-20:00	412	23.5
20:00-24:00	367	20.9
00:00-04:00	188	10.7
04:00-08:00	93	5.3
Length of stay after hospitalization decision		
3-12 hours	490	28
12-24 hours	649	37
24-48 hours	414	23.6
48-72 hours	122	7.5
72-96 hours	40	2.2
More than 96 hours	25	1.4
Total length of stay		
3-12 hours	286	16.3
12-24 hours	664	37.9
24-48 hours	510	29.1
48-72 hours	195	11.1
72-96 hours	56	3.1
More than 96 hours	39	2.2

The patients were divided into two groups as (i) patients needing ICU (28.6%) and (ii) patients not needing ICU (71.4%). Median CCI of patients needing ICU was 4.3±2.2 and their median length of stay in the ED was 26.5±22.3 hours; median CCI of patients not needing ICU was 3.9±2.2 and their median length of stay in the ED was 31.2±23.3 hours. Comparison of the two groups regarding CCI of the patients and their length of stay in the ED showed statistically significant results (p<0.05). Neither ESI score 4 nor 5 was obtained in our patients. Consequently, the patients were divided into three groups regarding their ESI level (Table 1). Median CCI of patients with ESI level-1 was 5 and length of stay in the ED was 17.9 hours, median CCI of patients with ESI level-2 was 4 and length of stay in the ED was 23.2 hours, median CCI of patients with ESI

level-3 was 4, and length of stay in the ED was 22.1 hours. Comparison of the three groups regarding the length of stay in the ED and CCI was statistically significant ($p < 0.001$).

DISCUSSION

A leading factor for ED overcrowding is patients' extended length of stay in the ED due to insufficient inpatient beds, which increases the number of boarding patients (2). Moreover, overcrowding causes medical errors, delayed care services, and decreased quality of medical care (9,15,16). To our knowledge, there is no study evaluating boarding patients in particular. Therefore, we discussed our findings with studies focusing on ED admittances of various categories. The main complaint at the time of admission in our study was mostly related to the respiratory system (28.5%) and gastrointestinal system (24.5%). On the other hand, chest pain was the most common complaint in another study focusing on the patient population of another university hospital ED in Turkey (12). McCarthy et al. (17) examined patients' charts of four trauma center-qualified hospitals to evaluate the impact of ED crowding and found that patients were admitted mostly due to trauma. Since patients of traumatic origin or with chest pain have a very short boarding time in our hospital, these patients form only a small part of our study group (2.1% and 1.9%, respectively).

Singer et al. (18) evaluated the relationship between boarding time in the ED and mortality and found that hypertension was the most common comorbidity (41.5%). Hypertension was also the most common comorbid condition in our study (29.7%). Mahsanlar et al. (4) also determined hypertension as one of the most common comorbidities in their study focusing on patients in the monitored care (monitored observation) unit in the ED.

Pneumonia was the most common disease requiring hospitalization. Consistently, the departments of infectious diseases (22.5%) and pulmonary diseases (20.7%) were the departments which admitted the highest numbers of patients. Satar et al determined that cardiology was the most common department to hospitalize the patients since cardiac conditions were the most common form of admission in their study focusing on patients older than 65 years old (19). Kekec et al. (20) found a high incidence

of hospitalization into surgical ICUs in their study evaluating older patients admitted to the ED. In our study, boarding times for surgical departments and cardiology department were found rather short. This may be due to that a separate ICU for each surgical department has been established in our hospital and the ICU in the cardiology department contains sufficient beds, which ensures rapid hospitalization to these departments.

In a study on admittance of whole patients to the ED, Kilicaslan et al. (12) reported that consultations were mostly obtained from departments of cardiology, orthopedics and traumatology, and internal medicine. In our study, pneumonia was the most common diagnosis in boarding patients (26.9%). Therefore, infectious diseases (39.1%) and pulmonary diseases (25%) were the most common departments, from which consultations were obtained. There was a low rate of consultations obtained from surgical departments because of the low number of surgical cases in the boarding patient group in our study (12.6%).

Literature data suggest that delayed transfer to the ICU causes performing acute medical care to stabilize the patient and follow-up procedures in EDs instead of ICUs (21). In our study, rates of blood transfusion and introducing a central venous catheter were higher, 9.6% and 5.8%, respectively, and one patient received a temporary pacemaker in the ED. Svenson et al. (21) described a high incidence of introducing a central venous catheter (36.2%). Moreover, low incidence of temporary pacemaker placement in our patient group is probably due to the short transfer time to the cardiology ICU. Green et al. (22) described orotracheal intubation as the most common invasive procedure in their study evaluating patients transferred from the ED to the ICU (64%). Our study included patients transferred to not only ICUs but also regular wards, this may explain why intubation rate was found to be lower (3.1%) among all the invasive procedures.

Ramlakhan et al. (23) reported that most of the undesirable events occurring in EDs were avoidable (55-82%). We found out that the most common undesired events in our patient population were inadequate nursing care services and lack or delay of timely performance of in some invasive procedures to be performed in the inpatient departments (27.9% and 16.1%, respectively). High rate

of inadequate nursing care services in our study may be due to insufficient number of ancillary staff, continuing patient admissions to ED, necessity to provide care to new patients with the same team, and focusing on the acute condition of the patients. Liu et al. (24) reported a higher incidence of missing out home treatment compared to our study (17.9% vs. 5.9%). Length of stay in the ED is a factor considered in evaluating the quality of medical care. As it extends, quality of care was found to decrease (9). In our study, average boarding time was 24.6 hours. However, 2005 report of Centers for Disease Control and Prevention suggested an average boarding time of 210 minutes (4). Also, National Health Service strategized and advocated that >90% of the patients visiting the ED should be seen, evaluated, investigated, diagnosed, and disposed (admitted / discharged) within 4 hours of arrival to the ED (25). In our study, 35% of patients had a boarding time of more than 24 hours, which occurred due to the insufficient number of beds in inpatient wards as reported before in some studies (6).

This present study also evaluated ESI and CCI scores of patients. To our knowledge, there is no study in the literature focusing on the relationship between boarding time in the ED and these two indexes. Our results revealed an ESI level-2 in 59.2% of patients and CCI score of 5 in 21.1%. ESI is an algorithm based on resource needs (12, 26). This study does not contain patients with ESI level-4 or 5 because our study group mainly consists of patients needing hospitalization and a wide number of resources.

Liu et al. (24) stated that most of the patients in their study had a CCI of 0. CCI index of our patient population was mainly high (Table 1). This may be explained due to the fact that vacant inpatients beds were not available even for our critical or comorbid patients. Similarly, McCarthy et al. (17) suggested that a high ESI may be related to longer boarding time. They reported a lower rate of patients with ESI level-1 (7%) in their study and stated that these patients had a shorter length of stay in ED. We obtained a similar ratio in our patients with an ESI level-1 (7.1%). The simulation study of Hoot et al. (27) revealed that patients with ESI level-1 have an increased chance of hospitalization. This finding is consistent with our finding in the patients with an ESI level-1. The study of Lauks et al. (28) showed patients with ESI level-2 to 4 had mildly extended boarding time. In our study the percentages

of the patients with ESI level-2 and 3 were 58.7% and 34.2% respectively. No patients with ESI level-4 or 5 were detected.

To prevent intense workload of ED, solutions such as changing the timing of elective surgeries, transferring boarding patients to hallways with beds to clear out primary intervention and treatment areas, increasing number and capacity of inpatient wards, and balancing ratio of patient hospitalization vs. discharge have been proposed (5,29). Studies confirmed that elective surgeries are one of the factors in extended ED stays (7). Accordingly, in our hospital, reserving ICU beds for elective surgeries has been found to be a considerable cause for insufficient ICU beds for emergency patients. Postponing elective surgeries and prioritizing emergency cases by regulations may be recommended. Another factor is accepting patients from other departments or outpatient services instead of patients awaiting in ED. Oray et al. (30) found a statistically significant decrease in the number of boarding patients in the ED after the use of "Electronic Blockage System" (EBS) compared to the period before the use of EBS ($p=0.0001$). EBS appoints empty inpatient beds, reserves these beds for boarding ED patients, and prevents the hospitalization of patients from outpatient services. EBS seems to be an effective solution for ED crowding. Furthermore, additional ICUs or wards outside the ED which would not be administratively connected to the ED may be designed particularly for keeping boarding patients until transfer. Health care staff and consulting physicians may follow and treat boarding patients in these units (9,31).

In conclusion, there is no simple solution for ED boarding. Instead of focusing only on the insufficient number of beds, a multidisciplinary and broad-scoped solution should be proposed. Hospital and city administrations should be included to address these problems.

Declarations

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This study was approved by the clinical research ethics committee of the Erciyes University Faculty of Medicine (Date: 24.01.2014 number: 2014/43).

REFERENCES

- Weiss SJ, Derlet R, Arndahl J, Ernst AA, Richards J, Fernández-Frackelton M, et al. Estimating the Degree of Emergency Department Overcrowding in Academic Medical Centers: Results of the National Emergency Medicine Department Overcrowding Study (NEDOCS). *Acad Emerg Med*. 2004;11:38-50.
- Richardson DB, Mountain D. Myths versus facts in emergency department overcrowding and hospital access block. *Med J Aust*. 2009;190:369-74.
- Erenler AK, Akbulut S, Guzel M, Cetinkaya H, Karaca A, Turkoz B, et al. Reasons for Overcrowding in the Emergency Department: Experiences and Suggestions of an Education and Research Hospital. *Turk J Emerg Med*. 2016;14:59-63.
- Mahsanlar Y, Parlak I, Yolcu S, Akay S, Demirtas Y, Eryigit V. Factors Affecting the Length of Stay of Patients in Emergency Department Observation Units at Teaching and Research Hospitals in Turkey. *Turk J Emerg Med*. 2016;14:3-8.
- Olshaker JS, Rathlev NK. Emergency department overcrowding and ambulance diversion: The impact and potential solutions of extended boarding of admitted patients in the emergency department. *J Emerg Med*. 2006;30:351-6.
- Asplin BR, Magid DJ, Rhodes KV, Solberg LJ, Lurie N, Camargo CA. A conceptual model of emergency department crowding. *Ann Emerg Med*. 2003;42:173-80.
- Laam LA, Wary AA, Strony RS, Fitzpatrick MH, Kraus CK. Quantifying the impact of patient boarding on emergency department length of stay: All admitted patients are negatively affected by boarding. *J Am Coll Emerg Physicians Open*. 2021;2:e12401.
- Veen D, Remeijer C, Fogteloo AJ, Heringhaus J, Groot B. Independent determinants of prolonged emergency department length of stay in a tertiary care centre: a prospective cohort study. *Scand J Trauma Resusc Emerg Med*. 2018;26:81.
- Trzeciak S, Rivers EP. Emergency department overcrowding in the United States: an emerging threat to patient safety and public health. *Emerg Med J*. 2003;20:402-5.
- Cowan RM, Trezeciak S. Clinical review: Emergency department overcrowding and the potential impact on the critically ill. *Crit Care*. 2005;9:291-5.
- Farahmand S, Karimialavijeh E, Vahedi HS, Jahanshir A. Emergency medicine as a growing career in Iran: an Internet-based survey. *World J Emerg Med*. 2016;7:196-202.
- Kilicaslan I, Bozan H, Oktay C, Goksu E. Demographic properties of patients presenting to the emergency department in Turkey. *Turk J Emerg Med* 2005;55-13.
- Mirhaghi A, Kooshar H, Esmaeili H, Ebrahimi M. Outcomes for Emergency Severity Index Triage Implementation in the Emergency Department. *Journal of Clinical and Diagnostic Research*. 2015;9:4-7.
- Charlson score [accessed June 13th, 2013]. Available from: URL: http://touchcalc.com/calculators/ccj_js - on line calculator (Date of access: 05/02/2014).
- Hsu CM, Liang LL, Chang YT, Juang WC. Emergency department overcrowding: Quality improvement in a Taiwan Medical Center. *J Formos Med Assoc* 2019;118:86-93.
- Hoot NR, Banuelos RC, Chathampally Y, Robinson DJ, Voronin BW, Chambers KA. Does crowding influence emergency department treatment time and disposition? *J Am Coll Emerg Physicians Open*. 2020;2:e12324.
- McCarthy ML, Zeger SL, Ding R, Levin SR, Desmond JS, Lee J, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Ann Emerg Med*. 2009;54:492-503.
- Singer AJ, Thode HC, Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;18:1324-9.
- Baz U, Satar S, Kozaci N, Acikalin A, Gulen M, Karakurt U. Geriatric patient admissions to emergency service. *JAEM* 2014;13:53-7.
- Kekec Z, Koc F, Buyuk S. Review of Geriatric Patients Hospitalization in Emergency Department. *Turk J Emerg Med*. 2009;8: 21-4.
- Svenson J, Besinger B, Stapczynski JS. Critical care of medical and surgical patients in the ED: Length of stay and initiation of intensive care procedures. *Am J Emerg Med*. 1997;15:654-7.
- Green RS, Macintyre JK. Critical care in the emergency department: An assessment of the length of stay and invasive procedures performed on critically ill ED patients. *Scand J Trauma Resusc Emerg Med*. 2009;17:47.
- Ramlakhan S, Qayyum H, Burke D, Brown R. The safety of emergency medicine. *Emerg Med J*. 2016;33:293-9.
- Liu SW, Thomas SH, Gordon JA, Hamedani AG, Weissman JS. A pilot study examining undesirable events among emergency department-boarded patients awaiting inpatient beds. *Ann Emerg Med*. 2009;54:381-5.
- Verma A, Shishodia S, Jaiswal S, Sheikh WR, Haldar M, Vishen A, et al. Increased Length of Stay of Critically Ill Patients in the Emergency Department Associated with Higher In-hospital Mortality. *Indian J Crit Care Med*. 2021; 25:1221-5.
- Maleki M, Fallah R, Riahi L, Delavari S, Rezaei S. Effectiveness of Five-Level Emergency Severity Index Triage System Compared With Three-Level Spot Check: An Iranian Experience. *Arch Trauma Res*. 2015;4:e29214.
- Hoot NR, LeBlanc LJ, Jones I, Levin SR, Zhou C, Gadd CS, et al. Forecasting Emergency Department Crowding: A Discrete Event Simulation. *Ann Emerg Med*. 2008;52:116-25.
- Lauks J, Mramor B, Baumgartl K, Maier H, Nickel CH, Bingisser R. Medical Team Evaluation: Effect on Emergency Department Waiting Time and Length of Stay. *PLOS ONE*. 2016;11:e0154372.
- Yarmohammadian MH, Rezaei F, Haghshenas A, Tavakoli N. Overcrowding in emergency departments: A review of strategies to decrease future challenges. *J Res Med Sci* 2017;22:23.
- Oray NC, Yanturalli S, Atilla R, Ersoy G, Topacoglu H. A New Model in Reducing Emergency Department Crowding: The Electronic Blockage System. *Turk J Emerg Med*. 2016;14:64-70.
- Di Somma S, Paladino L, Vaughan L, Lalle I, Magrini L, Magnanti M. Overcrowding in emergency department: an international issue. *Intern Emerg Med*. 2015;10:171-5.