ORIGINAL ARTICLE

Association Between Long-Term Boarding in the Emergency Department and Mortality at the King Abdul-Aziz Hospital

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Abstract

Objective: To assess the association between boarding time in the emergency department (ED) and increased patient mortality at the King Abdul-Aziz University Hospital in Jeddah, Saudi Arabia.

Methods: A retrospective study was conducted on 28,066 patients admitted through the ED and discharged from January to December 2019 at the King Abdul-Aziz University Hospital in Jeddah, Saudi Arabia. Data on patients' demographics, age, nationality, arrival method, eligibility, triage level, and outcome (alive or dead) was collected from medical records.

Results: This study found a strong link between patient mortality and boarding time, with patients who died experiencing significantly longer boarding times than those who survived. The average boarding time for those who died was more than 12 hours, compared to only 2.2% of those who did not. Additionally, the death rate was higher among non-eligible and male patients. Patients with injuries or orthopedic diseases had a notably increased likelihood of boarding for more than 12 hours. Both long-term boarding and non-eligibility for management were risk factors for death among the patients studied.

Conclusion: This paper highlights the impact of protracted boarding times on patient outcomes and emphasizes the urgent need to take immediate steps to decrease ED boarding.

Keywords

Association, Boarding, Emergency, Mortality

INTRODUCTION

Emergency department (ED) overcrowding is a significant challenge for hospitals and is considered a hospital-wide problem[1]. It has been described as "the most serious issue confronting EDs in the developed world[2]." It is associated with poor quality of care and unfavorable events following ED assessment[3,4], leading to delays in treatment and high complication rates, which have increased the mortality rate[5–12]. Although unnecessary ED visits are thought to cause ED overcrowding, ED boarding seems to be the leading cause, characterized by patient waiting time in the ED after primary assessment and initial care[7,13,14]. ED boarding can have serious implications that are significant barriers to advanced medical treatment and lead to delays in time-sensitive procedures[14,15]. For example, the outcome in sepsis and septic shock patients can demonstrate a substantial change if seen in early target therapy[16,17]. Studies conducted in France, Greece, and Canada found that an increased length of stay and boarding in the ED is associated with increased mortality and comorbidity[17,18,19]. However, a large retrospective study showed prolonged stays in the emergency department may increase the risk of mobility problems for patients but not necessarily increase motility[20].

In the Kingdom of Saudi Arabia (KSA), ED non-emergency cases are considered the leading cause of ED overcrowding, adversely affecting healthcare providers, patients, and the country's economy[21]. In KSA culture, patients prefer to stay in the ED for better care. A 2018 study was conducted to identify the preferences of patients and their attendants regarding staying in the ED or being transferred to inpatient units. The results indicated that 59% of patients preferred staying in the ED due to the facilities and prompt attention provided by the staff. The study emphasized the importance of a timely transfer to inpatient units to reduce medical mistakes and complications, especially in overcrowded EDs. However, until now, there has not been enough data to support the idea that there is a clear relationship between an extended stay in the ED and mortality from local hospitals in KSA[22].

Given the controversy surrounding the issue and the limited number of studies conducted in KSA, this retrospective study aims to examine the association between boarding time in the ED and increased patient mortality at King Abdul-Aziz University Hospital in Jeddah, Saudi Arabia, in 2020–2021.

SUBJECTS AND METHODS

Study Design and Time Frame

This study was retrospective from 2020 to 2021.

Study Setting

The study was conducted at the Emergency Department (ED) of the King Abdul-Aziz University Hospital in Jeddah, Saudi Arabia. This tertiary care center serves the middl- and low-income population of Jeddah.

Study Population

All patients admitted to the hospital through the ED and discharged from January to December 2019 were included, leaving a sample size of 28,066 patients. Patients with missing data on the system, OB patients, and pediatrics were excluded.

Timeline

In this study, we will consider a stay in the ED for more than 12 hours to be a prolonged ED stay.

Data Collection

Data was collected from patients' medical records, including demographics, age, nationality, arrival method, eligibility, outcome, triage level, and whether they died or were still alive.

Statistical Analysis

Data was coded, tabulated, and analyzed using SPSS version 20 (Armonk, NY: IBM Corp.). Qualitative data was expressed as numbers and percentages, and the Chi-squared test ($\chi 2$) was used to test the relationship between variables. Quantitative data was expressed as mean and standard deviation (Mean ± SD), and the Mann-Whitney test was used for non-parametric variables. Binary logistic regression was used to assess the independent predictors of death in the ED. A p-value of < 0.05 was considered statistically significant.

RESULTS

The total number of patients enrolled in the study was 28,066 patients. Table 1 shows that the age of male participants was 34.17 ± 20.76 years, with 50.4% male and 78.7% Saudi nationals. 52.8% of patients had a

Table 1. Distribution of the studied patients according to their characters, arrival method, eligibility, outcome, triage level, and their fate

Variable	No. (%)
Age (mean SD)	34.17±20.76
Boarding time (mean SD)	4.35 ± 3.79
Gender	
• Female	13,919 (49.6)
• Male	14,147 (50.4)
Nationality	
• Saudi	22,095 (78.7)
• Non - Saudi	5,971 (21.3)
Triage level	
• Priority 1 - Resuscitation	327 (1.2)
• Priority 2 - Emergent	4,008 (14.3)
• Priority 3 - Urgent	8,039 (28.6)
• Priority 4 - Less Urgent	14,805 (52.8)
• Priority 5 – Non-Urgent	887 (3.2)
Arrival method	
• Ambulance	229 (0.8)
• Other (Arrival)	27,837 (99.2)
Eligible	
• No	25,543 (91.0)
• Yes	2,523 (9.0)
Arrival timing	
• am	16,302 (58.1)
• pm	11,764 (41.9)
Boarding time (mean ± SD)	4.35 ± 3.79
Fate	
• No death	27,655 (99.5)
• Death	411 (1.5)
Comorbidities	
• Heart disorders	4,582 (16.3)
• Hypertension	3075 (11)
• Diabetes mellitus	2,902 (10.3)
• GIT disorders	2,885 (10.3)
• Pulmonary disorders	3,590 (12.8)
• Neurologic disorders	2,145 (7.6)
• Musculoskeletal disorders	3,376 (12)
• Skin disorders	969 (3.5)
• ENT disorders	777 (2.8)
• Injury and orthopedic disorders	637 (2.3)
• Urinary disorders	577 (2.1)
• Thyroid disorders	653 (2.3)
• Blood disorders	587 (2.1)
• Fluid and electrolyte disorders	256 (0.9)
• Deficiency anemias	414 (1.5)
• Psychological disorders	631 (2.2)

triage level of priority 4 (less urgent), 99.2% arrived by a method other than ambulance, 91% were eligible for management in the ED, and 76.9% were discharged. For 77.1% of patients, the main responsible physician (MEP) was an emergency physician. The average boarding time was recorded as 4.35 ± 3.79 hours. Of all patient arrivals, 58.1% occurred during the day shift (7 pm to 7 pm), while 41.9% occurred during the night shift (7 pm to 7 am). The total mortality rate was found to be 1.5% for all arrivals. The most common comorbidities among patients were heart disorders (16.3%), followed by pulmonary disorders (12.8%) and musculoskeletal disorders (12%).

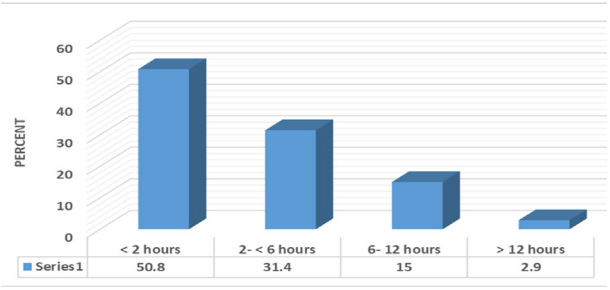


Figure 1. Distribution of the studied patients according to their boarding time.

Figure 1 shows that half of the participants (50.8%) had a boarding time of less than two hours, while 2.9% had more than 12 hours.

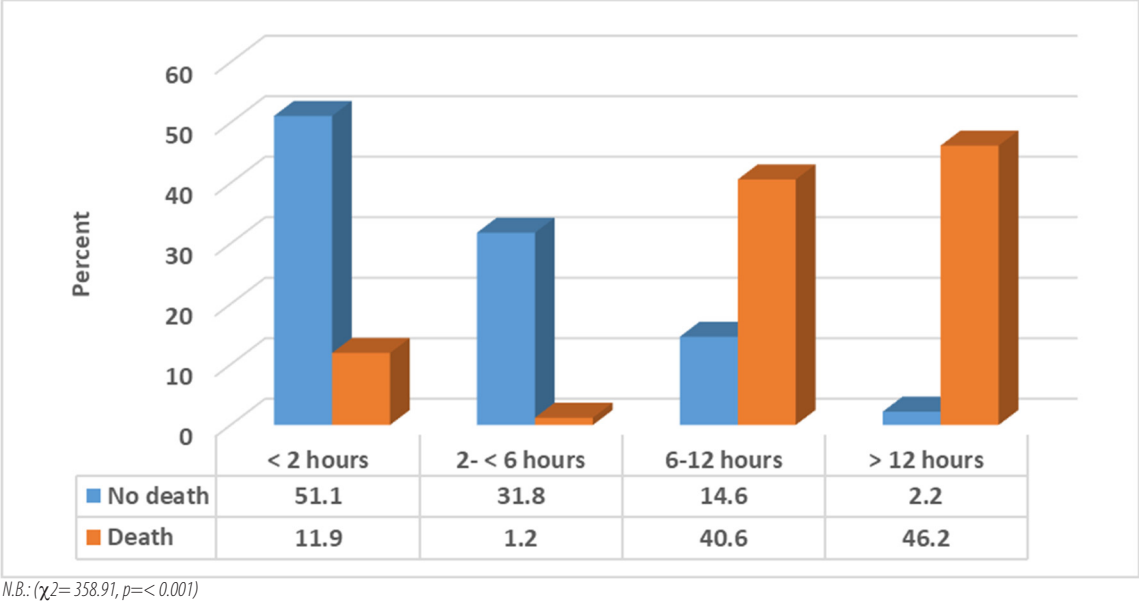
Table 2 shows that patients who died had a significantly higher boarding time (11.23 ± 5.56 hours) compared to those who did not die (4.24 ± 3.66 hours), with a *p*-value of < 0.001.46.2% of patients who died had a boarding time of more than 12 hours, compared to only 2.2% for those who did not die (Figure 2). Furthermore, there was a significant relationship between patients' deaths and their eligibility status, with a *p*-value of 0.006. However, no significant relationship was found between patients' deaths and their age, nationality, gender, arrival method, arrival timing, outcome, MRP, triage level, or comorbidities with a *p*-value of > 0.05.

Table 3 shows that male patients had a significantly longer boarding time of more than 12 hours compared to female patients. A non-significant difference was found between boarding time and patients' age, nationality, arrival method, eligibility, outcome, MRP, arrival timing, or triage level ($p = > 0.05$). Patients who had injuries or orthopedic disorders had a significantly higher percentage of those who had boarding time of more than 12 hours (5.2%), followed by those who had neurological disorders (3.8%) and those who had pulmonary disorders (3.5%) ($p = < 0.05$).

Table 2. Relationship between patients' death and their characters, arrival method, eligibility, outcome, triage level, and comorbidities

Variable	Death		Test	*p*-value
	Death	No Death		
Age	34.16 ± 20.74	35.11 ± 22.22	0.53*	0.59
Boarding time	11.23± 5.56	4.24 ± 3.66	24.4*	< 0.001
Gender • Female • Male	 213 (1.5) 198 (1.4)	 13706 (98.5) 13949 (98.6)	0.83**	0.36
Triage level • Priority 1 - Resuscitation • Priority 2 - Emergent • Priority 3 - Urgent • Priority 4 - Less Urgent • Priority 5 - Non-Urgent	 2 (0.6) 75 (1.9) 102 (1.3) 218 (1.5) 14 (1.6)	 325 (99.4) 3933 (98.1) 7937 (98.7) 14587 (98.5) 873 (98.4)	8.46**	0.07
Nationality • Saudi • Non - Saudi	 314 (1.4) 97 (1.6)	 21781 (98.6) 5874 (98.4)	1.34**	0.24
Arrival method • Ambulance • Other	 3 (1.3) 408 (1.5)	 226 (98.7) 27429 (98.5)	0.03**	0.84
Eligibility • No • Yes	 52 (2.1) 359 (1.4)	 25184 (98.6) 2471 (97.9)	6.93**	0.006
Arrival timing • am • pm	 16057 (98.5) 11598 (98.6)	 245 (1.5) 166 (1.4)	0.39	0.52

*N.B.: *χ^2 **Mann-Whitney test*



N.B.: (χ^2= 358.91, p=< 0.001)

Figure 2. Relationship between patients' death and boarding time.

Table 3. Relationship between boarding time and patients' characters, arrival method, eligibility, outcome, triage level, fate, and comorbidities

Variable	Boarding Time				Test	*p*-value
	< 2 hours	2- < 6 hours	6-12 hours	> 12 hours		
Age	34.28± 10.78	34.07 ± 20.54	34.06 ± 20.79	33.85 ± 22.58	3**	0.47
Gender Female Male	 7,123 (51.2) 7,126 (50.4)	 4,288 (30.8) 4,523 (32)	 2,132 (15.3) 2,068 (14.6)	 376 (2.7) 430 (3)	9.01*	0.02
Nationality Saudi Non - Saudi	 11,244 (50.6) 3,005 (50.3)	 6,894 (31.2) 1,917 (32.1)	 3,327 (15.1) 873 (14.6)	 630 (2.9) 176 (2.9)	2.26*	0.51
Triage level Priority 1 - Resuscitation Priority 2 - Emergent Priority 3 - Urgent Priority 4 - Less Urgent Priority 5 - Non-Urgent	 166 (50.8) 2,042 (20.9) 4,043 (50.3) 7,554 (51) 444 (50.1)	 99 (30.3) 1,216 (30.3) 2,570 (32) 4,642 (31.4) 284 (32)	 48 (14.7) 628 (15.7) 1,200 (14.9) 2,185 (14.8) 139 (15.7)	 14 (4.3) 122 (3) 226 (2.8) 424 (2.9) 20 (2.3)	9.2*	0.66
Arrival method Ambulance Other	 120 (52.4) 14,129 (50.8)	 62 (27.1) 8,749 (31.4)	 39 (17) 4,161 (14.9)	 8 (3.5) 798 (2.9)	2.46*	0.48
Eligibility No Yes	 1,299 (51.5) 12,950 (50.7)	 761 (30.2) 8,050 (31.5)	 379 (15) 3,821 (15)	 84 (3.3) 722 (2.8)	2.64*	0.3
Arrival timing am pm	 8,176 (50.2) 6,073 (51.6)	 5,179 (31.8) 3,632 (30.9)	 2,470 (15.2) 1,730 (14.7)	 477 (2.9) 329 (2.8)	5.95	0.11

*N.B.: *$\chi 2$ **Mann-Whitney test*

Table 4. Binary logistic regression analysis regarding the risk factors for death

Variable	Depression			*p*-value
	Beta	Wald	Exp. (B)	
Boarding time	1.86	839.82	6.46	< 0.001
Eligibility	0.36	5.08	1.43	0.02

Table 4 shows that binary logistic regression analysis found that long boarding time and non-eligibility for management were independent predictors of death among the studied patients.

DISCUSSION

The current research aimed to assess the association between boarding time in the ED and increased patient mortality at the King Abdul-Aziz University Hospital. Patients who died had a significantly longer boarding time than those who survived, indicating a highly significant link between death and boarding time. This study found that 46.2% of patients who died had a boarding time of more than 12 hours compared to 2.2% for those who did not die, with a statistically significant difference. Our results are similar to those of previous studies, which found lower mortality among patients transferred out of the ED in less than 6 hours[23,24,25].

About half of the participants (50.8%) had a boarding duration of less than two hours, while just 2.9% had a boarding time of more than 12 hours. Patients who were sicker and required more resource-intensive inpatient care had the greatest ED waiting time, according to a prior study. These excessive wait times are linked to a much longer length of stay in the hospital[19]. Another study found that patients who were in the ED for more than 4 hours before being transferred to an inpatient bed had a higher risk of dying in the hospital[17].

Singer et al.[26] discovered a similar link between patient fatality and boarding time. This study found that hospitalized patients who spent more than four hours in the emergency room were at a higher risk of severe health problems and mortality. Intas et al.[27] discovered that ED boarding for longer than 6 hours was linked to a higher risk of death in the hospital. Patients presenting to the emergency department during shifts with longer waiting times were linked to a higher risk of death and hospital admission in the near term, according to a study conducted in the United States[7].

Our study showed that patients with orthopedic or neurological disorders and injuries had a significantly higher percentage of boarding time of more than 12 hours (5.2%). This is because these patients require more time for stabilization and imaging. These findings are consistent with a study by Nori et al. that showed that the mean stay time in the ED for boarded and non-boarded orthopedic patients was 1.07 hours and 10.18 hours, respectively[28].

In the present study, 52.8% of the patients were non-emergency cases, and 99.2% were walk-in patients to the ED, considered the primary cause of ED overcrowding. This matter can affect health caregivers, care recipients, health supplies, and the country's economy[29]. Primary health care, staff clinics, family physicians, urgent care centers, and even home healthcare services can help in most circumstances. The current study found that 52.8% of the patients were non-emergency cases, and 99.2% were walk-in patients to the ED, which is the leading cause of ED overcrowding. This issue impacts healthcare providers, patients, medical supplies, and the country's economy[30]. However, alternatives such as primary health care, staff clinics, family physicians, urgent care centers, and home healthcare services can help in most situations. In Saudi Arabia, citizens have complete access to KAUH without any restrictions to receive free medical treatment for people of all ages, and medical services are available to everyone equally. The Ministry of Health serves primary health care through a network of regional health centers[31]. For the past 20 years, the government has funded new and innovative programs to ensure health facilities are available to all citizens at all care levels, including primary, secondary, and tertiary centers like KAUH ED, which accept referrals from various areas.

Furthermore, non-Saudi tourists accounted for 21% of all ED visits. According to current Saudi legislation, health insurance must cover all non-Saudis (excluding sponsored individuals) before filing their legal papers. Health insurance in Saudi Arabia requires the prior submission of documents, which includes all nationalities (excluding individual sponsorships) [30,32]. However, a previous study found that the sickest hospital patients are "frequent flyers." Their admission rates are the highest, their death rates are the highest, and their resource consumption is disproportionately high[33].

Various strategies can be used to alleviate ED overpopulation. Bedside registration and effective utilization of hospitalists are examples of internal departmental advances. Additional solutions include provider triage and provider scheduling optimization. Adding beds to the emergency room does not always solve the problem of boarding and overcrowding. Externally, smoothing elective (schedulable) admissions is likely the most important strategy for increasing capacity, reducing boarding, maintaining nurse-to-patient ratios, and improving ICU access. Early morning discharges from inpatient units also substantially decrease ED boarding[34,35]. Increased weekend discharges and improved weekend services will increase capacity and reduce boarding. When an institution's bed capacity is exceeded, a full-capacity strategy, in which inpatient units go over the census rather than boarding patients in the ED, is safer, preferable to patients, and reduces the duration of stay.

Limitations

Considering the limitations of the study design, a cause-and-effect relationship is difficult to establish. Retrospective data analysis also carries the risk of missing data or inaccurate entries.

CONCLUSION

This study discovered a significant association between patient death and boarding time, with patients who died having a significantly longer boarding time than those who survived. About 46% of patients who died had an average boarding time of more than 12 hours, compared to 2.2 percent of those who did not. The death rate was significantly higher among non-eligible patients and male patients, and those with injuries

or orthopedic diseases had a significantly higher percentage of those who had more than 12 hours of boarding time. Long-term boarding and non-eligibility for management were both risk factors for death among the patients investigated. The impact of protracted boarding times on patient outcomes is highlighted in this paper, highlighting the necessity for immediate steps and attempts to decrease ED boarding.

Conflicts of Interest

The authors have no conflicts of interest to declare. All co-authors have seen and agreed with the manuscript's contents, and there is no financial interest to report. The authors certify that the submission is an original work and is not under review at any other publication.

Disclosure

The authors did not receive any form of commercial support, either in the form of compensation or financial assistance, for this case report. The authors have no financial interest in any of the products, devices, or drugs mentioned in this article.

Ethical Approval

The study was approved by the Ethics Committee of the KAUH in Jeddah, Kingdom of Saudi Arabia, also known as the Institutional Review Board of Hospitals, under protocol number 313-22.

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