

ORIGINAL RESEARCH



Factors associated with prolonged emergency department length of stay in a resource-constrained setting

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Abstract

Prolonged length of stay (LOS) in the emergency department (ED) is a key factor in measuring ED crowding worldwide. This study aimed to identify factors associated with prolonged LOS in the ED to better understand these factors at our institution. This was a retrospective record review examining factors associated with prolonged emergency department length of stay (>6-hours). Data were collected from electronic medical records, including patient demographics, chief complaints, triage acuity level, medication administration, diagnostic testing, consultations and patient disposition. In 2019, we recorded a total of 36,068 patient visits at our ED. Of these, 6439 (17.9%) patients met our definition of prolonged ED LOS (more than 6-hours) and were included in our analysis. Using multivariate analysis, we found that consulting services carried the highest predictor for prolonged ED LOS, with an adjusted odds ratio (aOR) of 23.0 and 95% confidence interval (CI) of 20.4–25.8. Followed by medication administration (aOR 2.0, CI 1.8–2.3), laboratory investigations (aOR 1.7, CI 1.5–2.0), radiological studies (aOR 1.8, CI 1.6–2.0), and non-Saudi nationality (aOR 1.3, CI 1.2–1.4), all $p < 0.01$. ED LOS may be reduced by optimizing the process of laboratory/radiology testing and medication administration. More importantly however, implementing a timeframe monitoring system for consultations while emphasizing accelerated decision-making and disposition for patients can reduce ED LOS.

Keywords

Length of stay; Emergency department; Prolonged ED LOS; Factors

1. Introduction

Emergency department (ED) crowding is a pivotal indicator of the functioning of a health system. Such crowding may be inaccurately labeled as a problem with ED operations and efficiency. In fact, ED crowding status reflects not only individual department performance but the entire health system function. Emergency medicine is dedicated to the efficient evaluation of unscheduled, acute, undifferentiated and decompensated conditions. Therefore, its smooth functioning is crucial to providing this essential service, and its efficient operation is dependent not only on the ED but also on factors outside the control of the ED [1].

The number of ED visits to a single center in Eastern Saudi Arabia increased by approximately 30% between 2003 and 2005 [2]. The demand for ED services in the Kingdom of Saudi Arabia is expected to further increase with the country's current vision for development and improvement. The ED length of stay (LOS) is a key measure of ED throughput and has been identified as a major cause of ED crowding. ED LOS is defined as the time interval from the patient's arrival

to the ED to the time the patient physically leaves the ED [3]. Increased ED LOS has shown a negative impact on a variety of elements including increased patient morbidity and mortality, increased cost of treatment, delay in appropriate treatment, reduced patient satisfaction and lower adherence to standard guidelines and protocols. Ultimately, this leads to ED crowding [4, 5].

Multiple factors are associated with an increase in ED LOS, dependent upon each institution's unique processes. A study in 2003 found that patients categorized according to the Canadian triage acuity scale (CTAS) III and IV had the highest ED LOS due to diagnostic imaging, laboratory tests and specialty consultation [6]. A study in the Netherlands concluded that organizational factors, such as more consultations, testing in the ED and lower physician seniority were associated with longer ED LOS [7]. A variety of other studies revealed additional factors affecting ED LOS such as patient ethnicity, the timing of ED presentation, season of ED presentation, old age, insurance status, complexity of patient condition and ED physician treatment style [8, 9].

In this study, we aimed to determine the factors most as-

sociated with prolonged ED LOS at an academic emergency department in a developing healthcare system.

2. Methods

2.1 Study design

Retrospective analysis of patients presenting to the emergency department in 2019.

2.2 Study setting

This study was conducted at the King Abdulaziz University Hospital (KAUH), department of emergency medicine in Jeddah, Saudi Arabia (an academic institution with an annual emergency department census of 36,068 during 2019). All adult patients who visited the ED and were at least 14 years old were included in the study. At this age, the patient is treated as an adult, according to hospital administration. We excluded patients who left without being seen, aged less than 14 years, and were pregnant.

The ED is open 24-hours a day, 7 days a week, and is staffed by board-certified emergency physicians, residents, interns and registered nurses. This public hospital provides free medical care to Saudi nationals at all acuity scales. Non-Saudi nationals receive care only if they are critically ill or have eligibility for treatment, as determined by hospital administration. All medical and surgical care is free for patients who are accepted for treatment. Upon the completion of acute care for non-Saudi nationals and once deemed stable, these patients are either discharged or referred to another private facility for the completion of care if required.

The 6-hours cut off was selected based on the department’s policy definition for prolonged ED LOS. We collected the following data variables: patient demographics, age, sex, nationality and clinical variables including chief complaint, Canadian triage acuity scale (CTAS) levels, medication administration, investigations requested, radiological studies requested (computed tomography (CT) scan and ultrasound), patient disposition (admission vs. discharge), shift times and specialty consultations.

2.3 Statistical analysis

Data were entered into Microsoft Excel and thereafter transferred to the Statistical Package for Social Sciences SPSS version 21 (SPSS Inc., Chicago, IL, USA) for statistical analysis. We used frequencies and percentages to describe discrete variables and means and standard deviations to describe continuous variables. Pearson’s chi-squared test was used to compare categorical variables. Furthermore, we performed bivariate analysis to identify the factors that were included in our multivariate analysis. A *p*-value of < 0.05 was used in the bivariate analysis as an entry criterion for the multivariate model.

Multivariable regression analysis was used to calculate the odds ratio (OR) with 95% confidence intervals (CI) to identify independent risk factors for prolonged ED LOS. Statistical significance was set at *p* ≤ 0.05.

3. Results

3.1 Demographic and clinical data description

In 2019, 36,068 visits were registered at the King Abdulaziz University Hospital, Emergency department, of which 8776 (24.6%) left without being seen. Thus, 27,292 (75.7%) registered visits were treated in the ED. Of the patients treated in the ED, 4550 (12.6%) were admitted to inpatient units and 22,742 (63.1%) were discharged. In contrast, 6439 (23.6%) patients had a prolonged ED LOS (>6-hours), of those 3243 (50.4%) were admitted, and 3196 (49.6%) were discharged. In the other hand only 1307 were admitted to inpatient units in patients with ED LOS less than 6 hours (Figs. 1,2).

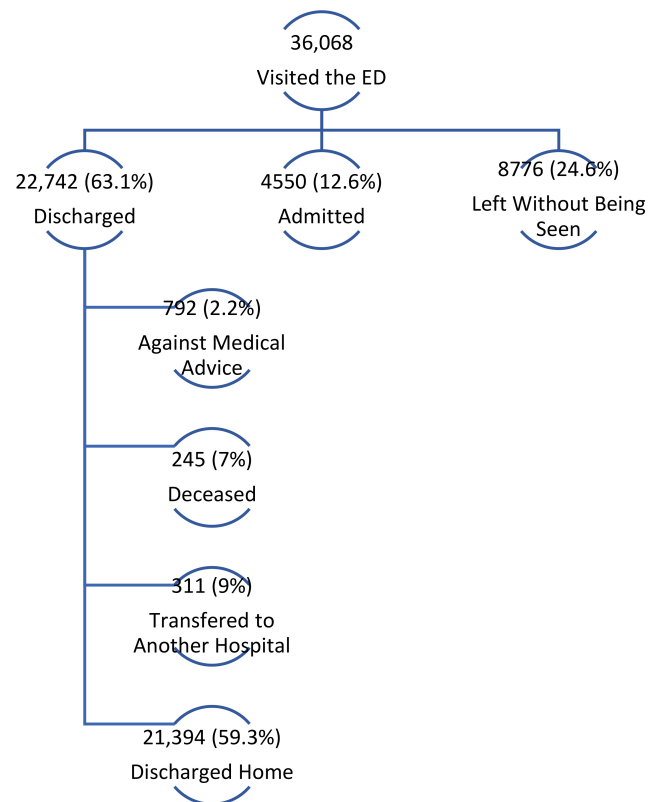


FIGURE 1. Breakdown of emergency department visits during 2019.

The demographic data showed a mean age of 54 ± 19 years. Of the 6439 patients with a prolonged ED LOS, 3378 (52.5%) were men and 3061 (47.5%) were women. Additionally, 3229 (50.1%) were Saudi nationals and 3210 (49.9%) were non-Saudi nationals (Table 1).

Upon examining the factors associated with prolonged ED LOS, 206 (3.2%) were triaged as CTAS level 1, 3054 (47.4%) as CTAS level 2, 2264 (35.2%) as CTAS level 3, 843 (13.1%) as CTAS level 4, and 72 (1.1%) as CTAS level 5. When categorizing patients with prolonged ED LOS based on arrival time to the ED, 1956 (30.4%) arrived in the morning shift (7 AM–3 PM), 2366 (36.7%) arrived in the evening shift (3 PM–11 PM), and 2117 (32.9%) arrived in the night shift (11 PM–7 AM). The most common chief complaint of patients with prolonged LOS was shortness of breath in 1291 (20%)

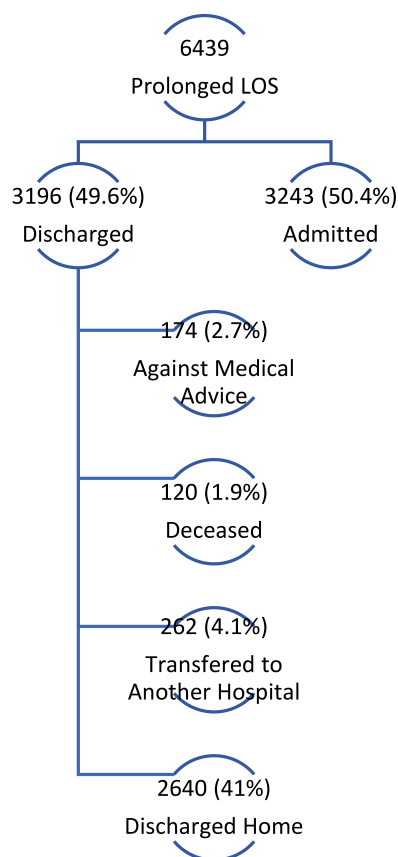


FIGURE 2. Breakdown of patients with prolonged emergency department (ED) length of stay (LOS).

TABLE 1. Patient characteristics stratified by emergency department length of stay.

Demographic factors	ED LOS > 6 h n (%)	ED LOS < 6 h n (%)
Total numbers of patient	6439 (23.6%)	20,853 (76.4%)
Gender		
Male	3378 (52.5%)	10,049 (48.2%)
Female	3061 (47.5%)	10,804 (51.8%)
Nationality		
Saudi	3229 (50.1%)	15,659 (75.1%)
Non-Saudi	3210 (49.9%)	5194 (24.9%)
Age	54.5 ± 20.1	44.6 ± 19.3

ED LOS: length of stay in the emergency department.

patients, followed by abdominal pain in 1251 (19.4%) patients. Other complaints, such as chest pain, altered mental status and fatigue, were slightly less common among patients with prolonged LOS (12.6%, 10.2% and 9.1%, respectively) (Table 2).

Radiological investigations were ordered for 5397 (83.8%) patients with prolonged ED LOS whereas 1042 (16.2%) patients with prolonged ED LOS had no radiological examination. Moreover, laboratory investigations were ordered for 6047 (93.9%) patients with prolonged ED LOS, whereas 392 (6.1%) patients with prolonged ED LOS did not have any laboratory investigations. Additionally, 5843 (90.7%) patients

with prolonged ED LOS received medications while in the ED, whereas 596 (9.3%) patients did not receive medications. Consultations with other medical services were ordered for 5437 (84.4%) patients with prolonged ED LOS (Table 2).

3.2 Multivariate analysis

A binary logistic regression was performed to determine the factors associated with prolonged LOS in the ED; the regression explained 62% (Nagelkerke R Square) of the variance in prolonged LOS and correctly classified 90% of the cases. Referral to other specialties ($p < 0.01$) had the greatest effect on prolonged LOS in the ED, as patients who were referred to different specialties were 23 times more likely to have prolonged LOS. The second notable factor was receiving medication ($p < 0.01$), which doubled the odds ratios of prolonged LOS. This was followed by ordering laboratory investigations ($p < 0.01$) and performing radiological studies ($p < 0.01$), which increased the chance of prolonged LOS by 1.8 and 1.7, respectively. In addition, non-Saudi nationals were significantly associated with an extended LOS by a factor of 1.3.

Other significant factors included an increase in age and female sex ($p < 0.05$), resulting in a minimal increase in LOS. However, we found that CTAS priority level, patient outcome, chief complaint and emergency room (ER) arrival shift was not significantly associated with prolonged LOS (Table 3).

4. Discussion

In this study, we aimed to examine the factors associated with a prolonged ED LOS (defined as >6-hours) at our institution.

During the one-year study period, we found that initiating specialty consultations from the ED were the highest predictor for prolonged ED LOS, which is consistent with previous studies published in 2003, 2018 and 2019 [6, 10, 11]. This finding can be explained by multiple factors, such as delays in responding to ED consultations, an unclear disposition plan, or an overwhelmed/understaffed specialty. To overcome these issues, it would be prudent to hold consulting/admitting specialties accountable for specific time measures for responding to ED consultations. Furthermore, in situations in which consultation teams are overwhelmed, we suggest balancing the distribution of patients among the consultation teams.

Choi *et al.* [12] found that admission decisions made by emergency physicians without specialty consultations remarkably reduced ED LOS without a negative impact on patient mortality or hospital LOS. Such policy changes should be considered in collaboration with hospital administration to reduce ED LOS, which is linked to increased mortality and morbidity [13].

Other factors predicting prolonged ED LOS in our study included receiving medications and undergoing laboratory or radiological investigations in the ED. A similar conclusion was observed in previous studies [6, 7, 10]. Decreasing unnecessary medication prescriptions and investigations in the ED may certainly reduce ED LOS. Moreover, monitoring the time to administration and turnaround times will introduce a culture of urgency in the ED. In a previous study, an analysis was

TABLE 2. Clinical factors stratified by emergency department length of stay.

Clinical Factors	ED LOS > 6 h n (%)	ED LOS < 6 h n (%)
CTAS		
Priority 1	206 (3.2%)	192 (0.9%)
Priority 2	3054 (47.4%)	1908 (9.1%)
Priority 3	2264 (35.2%)	5221 (25.0%)
Priority 4	843 (13.1%)	12,511 (60.0%)
Priority 5	72 (1.1%)	1021 (4.9%)
Outcome		
Admitted	3243 (50.4%)	1307 (6.3%)
Discharged	3196 (49.6%)	19,546 (93.7%)
Shift		
Day	1956 (30.4%)	6614 (31.7%)
Evening	2366 (36.7%)	8413 (40.3%)
Night	2117 (32.9%)	5826 (27.9%)
Chief complaint		
Abdominal pain	1251 (19.4%)	4717 (22.6%)
Chest pain	812 (12.6%)	2071 (9.9%)
Shortness of breath	1291 (20.0%)	1137 (5.5%)
Cough	157 (2.4%)	1164 (5.6%)
Dysuria	80 (1.2%)	264 (1.3%)
Back pain	56 (0.9%)	573 (2.7%)
Headache	235 (3.6%)	2041 (9.8%)
Altered mental status	659 (10.2%)	368 (1.8%)
Dizziness	349 (5.4%)	1230 (5.9%)
Fatigue	587 (9.1%)	2473 (11.9%)
Fever	431 (6.7%)	1485 (7.1%)
Swelling	259 (4.0%)	840 (4.0%)
Trauma	160 (2.5%)	1650 (7.9%)
Other	112 (1.7%)	840 (4.0%)
Radiology studies ordered		
Yes	5397 (83.8%)	13,482 (64.7%)
No	1042 (16.2%)	7371 (35.3%)
Laboratory investigations ordered		
Yes	6047 (93.9%)	9503 (45.6%)
No	392 (6.1%)	11,350 (54.4%)
Medications ordered		
Yes	5843 (90.7%)	7597 (36.4%)
No	596 (9.3%)	13,256 (63.6%)
Other services consulted		
Yes	5437 (84.4%)	18,747 (89.9%)
No	1002 (15.6%)	2106 (10.1%)

CTAS: Canadian triage acuity scale. ED LOS: length of stay in the emergency department.

TABLE 3. Multivariate regression analysis predicting prolonged emergency department length of stay (>6-hours).

Factor	Odds ratio (95% CI)
Age	1.006 (1.003–1.008)
Gender	
Male	Reference
Female	1.110 (1.024–1.215)
Nationality	
Saudi	Reference
Non-Saudi	1.327 (1.205–1.461)
CTAS level	
Priority 1	Reference
Priority 2	1.359 (1.001–1.845)
Priority 3	0.929 (0.681–1.268)
Priority 4	0.665 (0.481–0.921)
Priority 5	1.451 (0.959–2.196)
ER shift	
Day	Reference
Evening	0.811 (0.733–0.898)
Night	0.994 (0.894–1.105)
Chief complaint	
Other	Reference
Abdominal Pain	1.070 (0.807–1.419)
Altered Mental Status	1.295 (0.931–1.801)
Trauma	0.333 (0.237–0.468)
Back Pain	0.708 (0.457–1.096)
Chest Pain	0.467 (0.346–0.630)
Cough	1.071 (0.752–1.524)
Dizziness	0.947 (0.686–1.306)
Dysuria	0.697 (0.451–1.077)
Fatigue	1.325 (0.985–1.782)
Fever	0.985 (0.719–1.350)
Headache	1.334 (0.971–1.834)
Shortness of Breath	1.367 (1.011–1.848)
Swelling	0.607 (0.436–0.844)
Outcome	
Admitted	Reference
Discharged	0.994 (0.889–1.111)
Radiology investigation	
No	Reference
Yes	1.868 (1.675–2.084)
Laboratory test	
No	Reference
Yes	1.772 (1.534–2.046)
Receiving medication	
No	Reference
Yes	2.094 (1.865–2.351)
Consultation	
No	Reference
Yes	23.007 (20.486–25.837)

CI: confidence interval; CTAS: Canadian triage acuity scale; ER: Emergency Room.

performed to evaluate the effectiveness of turnaround time for radiology reports on ED radiographs. Implementation of such turnaround time decreased the mean ED LOS from 88.7 to 79.8 min [14].

Due to the free healthcare policy for Saudi nationals at our hospitals, non-Saudi nationals predicted a prolonged ED stay in our study (as majority of non-Saudi patients do not qualify for admission and extended treatment). Non-Saudi nationals who are not critically ill are advised to seek further care at hospitals linked to health insurance. Unfortunately, the majority of this patient population is unable to mobilize to seek care at other hospitals, and thus remain in the ED, where they continue to receive inpatient care. This finding is similar to that of Hosseinejad *et al.* [15], who found that patients with a lack of medical insurance stayed in the ED for longer periods.

Finally, while our results contrast with other earlier research [11, 16], they are like those of a study by van der Veen *et al.* [10]. The need for consultation, medication given and investigation ordered rather than the complexity of the patient's presentation or the requirement for admission are the cause of prolonged ED LOS.

The strengths of our study include its large sample size and long study duration. However, this study had several limitations. First, the retrospective nature of the study may not have accounted for all confounding variables. However, we attempted to reduce the confounding influence by performing a regression analysis. Second, inadequate documentation of certain timeframes, such as time to medication administration, laboratory turnaround time and radiology turnaround times, precluded us from determining the exact times. Third, our data were collected before the COVID-19 pandemic, so to ascertain its impact on ED LOS, further studies should be conducted to determine whether the pandemic influenced LOS. Fourth, it's possible that there are other factors that may have an effect on ED LOS, for example, bed availability and boarding time, and we recommend adding them to future studies.

5. Conclusions

Our study concluded that factors predicting prolonged ED LOS at our institution include specialty consultations, medication prescriptions, laboratory and radiology investigations, and non-Saudi nationals. Emphasizing the importance of reducing ED LOS and collaborating with other departments and hospital administration are key to improving patient flow within the ED.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

AMZ and AAF—designed the research study, analyzed the data and wrote the manuscript. AAB and IK—provided the patients data and revised the manuscript. All authors approved the version to be published and agreed to be accountable for all

aspects of the work.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This record-review study was approved by the Biomedical Ethical Unit of King Abdulaziz University, Jeddah, Saudi Arabia. Reference No 553-20. Due to the retrospective nature of the study and lack of patient identifiers, informed consent was waived. This study was in accordance with the Declaration of Helsinki.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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