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ORIGINAL ARTICLE

Predicting early hospital admissions for emergency department patients at the time of triage

Shahad M. Al-Ashgar[1*], Mohammed K. Almolhis[2], Omer W. Al Dhasee[2], Rama A. Alraheili[3]

ABSTRACT

Objective: This study aimed to determine factors predicting hospital admissions at King Abdulaziz Medical City in the emergency department (ED), Rdiyadh, Saudi Arabia.

Methods: A retrospective study was conducted at the ED of King Abdulaziz Medical City among adult patients aged ≥14 years triaged in ED and arriving by either paramedic transport or self-referral and presented to ED from 01/01/2021 to 01/01/2022. The data were collected from the patient's medical records and a pre-designed checklist was prepared to collect data.

Results: The majority of patients (88.7%) arrived at the ED walk-ins, as for patient acuity, a substantial segment of the population (86.9%) fell into category 3. Exactly half of the patients reported no known comorbidities. The prior visit to the ED within the past 72 hours was documented in 12.3% of the cases. As for the patients' outcomes post-triage, a large proportion (78.4%) were discharged after their ED visit. The majority of emergency visits were associated with no complications (92.5%), while morbidity was reported among 4.2% and mortality among 3.4% of the visits. The rate of hospital admission was significantly higher among patients aged 25-34 years and 55-64 years, who arrived walk-in, who had patient acuity category "3" and who had no previous ED Visit <72 hours (p = <0.05).

Conclusion: It was found that being bedridden, having dementia, having no prior ED visits within 72 hours, and having end-stage renal disease on dialysis were risk factors for hospital admission.

Keywords: Predicting, early hospital admissions, emergency department, patients, time of triage.

Introduction

Emergency departments (EDs), which provide care to anyone in need at all times, play a crucial role in ensuring healthcare safety [1]. To guarantee that healthcare providers can provide the best treatment possible, effective patient management and precise resource forecasts are crucial. The early identification of patients who might need to be admitted to the ward or intensive care unit (ICU) is a crucial part of this process because it allows healthcare facilities to plan and allocate resources appropriately [2].

Making a disposition decision for a patient is a crucial part of caring for them in an ED. Determining whether a patient is ready for discharge or requires inpatient treatment for more assessment and stabilization is known as disposition [3]. Disposition represents the outcome of every ED case. It could entail a patient leaving without being seen, admission to the hospital, transfer to another facility, discharged home, or in some cases death occurs without consulting a doctor [3].

A multitude of clinical criteria, including diagnosis, severity, and response to treatment, as well as patient demographics, socioeconomic status, and health status, interact in a complicated way to impact disposition decisions in an ED [4]. Despite the widespread overuse of EDs, there is little data on a thorough assessment of the variables influencing disposition choices [5].

Correspondence to: Shahad Mohammed Al-Ashgar
*Consultant, Emergency Medicine, Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia.
Email: shahadalshgar@gmail.com
Full list of author information is available at the end of the article.
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The evaluation of disposition decision making in the ED is critical to understanding overutilization and overcrowding [5], increasing mortality and healthcare costs [6], and patient safety and quality of care [7].

Early ED patient disposition prediction can help reduce overall ED length-of-stay by telling ED staff about patients who are likely to be discharged so the treatment could be prioritized, or it can help reduce boarding delays by enabling earlier requests for inpatient beds [8].

With the sharp rise in public hospital capacity, using ED services is a typical practice in Saudi Arabia [5]. Research indicated that even in cases where free primary care is offered, individuals often choose to use EDs for preventable and non-urgent problems instead of going through these institutions [5,9]. Therefore, this study aimed to determine factors predicting hospital admissions at King Abdulaziz Medical City, Emergency Department, Riyadh, Saudi Arabia.

Subjects and Methods

A retrospective study was conducted at the ED of King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia, from 01/01/2021 to 01/01/2022. The inclusion criteria were adult patients aged ≥14 years triaged in ED and arriving by either paramedic transport or self-referral and presented to ED (either discharged from ED or admitted through ED) from 01/01/2021 to 01/01/2022. ED visits that did not result in a discharge or admission from the ED were excluded (i.e., dead-on-arrival, and absconded patients before the decision of admission or discharge were made, as these outcomes were not relevant to the study's objective).

The data were collected from the patient's medical records at the hospital data system. A pre-designed checklist was prepared to collect data about patient demographics, time of ED registration, nationality, mode of arrival (ambulance or walk in), time presented (day shift, afternoon or night shift), triage acuity, comorbidities [were recorded as pre-existing diagnoses at the time of ED visit and included hypertension (HTN), diabetes, chronic obstructive pulmonary disease (COPD), asthma, active cancer, congestive heart failure, dementia and bedridden, end-stage renal disease (ESRD)], ED visit outcome (mortality or morbidity), disposition (admission or discharge), repeat ED visits within 72 hours, and chief complain.

Triage acuity was assigned by the ED triage nurse following ED registration, not by a paramedic, using the canadian triage and acuity scale (CTAS). CTAS is an ordinal scale that ranges from 1 to 5, with a score of one indicating the most emergent (resuscitation) and five the least urgent (non-urgent) [10].

Data were statistically analyzed using the (SPSS) program version 26. To investigate the association between the variables, the chi-squared test (χ^2) was applied to qualitative data that was expressed as numbers and percentages. Multivariate logistic regression analysis was done to assess the risk factors (independent predictors) of admission among studied patients, where the odds ratio was calculated at a confidence interval of 95%. A *p*-value of <0.05 was considered statistically significant.

Results

The age distribution of the enrolled patients showed a broader range, with a pronounced representation of the younger adult population as individuals between 25 and 34 years constituted the largest age group at 26.7%. Females constituted 57.6% of the sample, and 93.9% were Saudi nationals. The majority of patients (88.7%) arrived at the ED walk-ins, as for patient acuity, a substantial segment of the population (86.9%) fell into category 3. Exactly half of the patients reported no known comorbidities. The most prevalent comorbidities were diabetes mellitus (DM) (29.3%) and HTN (29.1%). The prior visit to the ED within the past 72 hours was documented in 12.3% of the cases. As for the patients' outcomes post-triage, a large proportion (78.4%) were discharged after their ED visit while 21.6% required hospital admission. The majority of emergency visits were associated with no complications (92.5%), while morbidity was reported among 4.2% and mortality among 3.4% of the visits (Table 1).

The rate of hospital admission was significantly higher among patients aged 25-34 years and 55-64 years, who arrived walk-in, who had patient acuity category "3" and had no previous ED Visit <72 hours (p = <0.05). At the same time, the admission rate was significantly higher among patients who had any comorbidity including HTN, DM, ischemic heart disease, heart failure, COPD, were bedridden or had dementia or ESRD on dialysis (p = <0.05) (Table 2).

Non-association was found between visit outcomes and waiting time at ED (χ^2= 2,687, p-value = 0.261) (Table 3).

Multivariate logistic regression analysis was conducted to assess the risk factors (independent predictors) of admission among studied patients. It was found that having a patient acuity category "3", having no previous ED visit <72 hours, and being bedridden or with dementia or ESRD on dialysis were risk factors for hospital admission among studied patients (p = <0.05) (Table 4).

Discussion

Predicting factors that affect hospital admission among ED patients at the time of triage would likely help lower the morbidity and mortality rates as well as be implicated in several studies [10-13]. Admission rates were statistically significant among older patients, notably between 65 and 84 years of age. The majority of patients at KAMC were elderly and had concomitant conditions, which was the reason for their highest admission rate.

The literature has evidence of a strong correlation between higher admission rates and patients who were older than 50 years, which is in line with current study findings [13]. As it was demonstrated that admission rates increase linearly with age [10], patients' decisions to visit the ED can be partially explained by risk factors, including age and educational attainment [5,14,15].

Table 1. *Baseline characteristics of the enrolled patients.*

Characteristic	Frequency (Percentage) N (%)
Age (Years)	
14-24	67 (13.3)
25-34	135 (26.7)
35-44	87 (17.2)
45-54	53 (10.5)
55-64	70 (13.9)
65-74	53 (10.5)
75-84	30 (5.9)
85-94	10 (2.0)
Gender	
Male	214 (42.4)
Female	291 (57.6)
Nationality	
Saudi	474 (93.9)
Non-Saudi	31 (6.1)
Mode of arrival	
Walk-in	448 (88.7)
Ambulance	57 (11.3)
Patient acuity category	
1.00	10 (2.0)
2.00	12 (2.4)
3.00	439 (86.9)
4.00	41 (8.1)
5.00	3 (0.6)
Previous ED Visit <72 hours	62 (12.3)
No known comorbidities	255 (50.5)
Hypertension	147 (29.1)
Diabetes	148 (29.3)
Ischemic heart disease	43 (8.5)
Heart failure	20 (4.0)
Bronchial asthma	30 (5.9)
Chronic obstructive pulmonary disease	5 (1.0)
Bedridden or dementia	11 (2.2)
Active malignancy	14 (2.8)
End-stage renal disease on dialysis	13 (2.6)
Disposition	
Discharge	396 (78.4)
Admission	109 (21.6)
Visit outcome	
None	467 (92.5)
Morbidity	21 (4.2)
Mortality	17 (3.4)

According to a comprehensive analysis, up to 25% of all ED visits were made up of older patients who had clinical presentations of illness, a high frequency of cognitive disorders, and various comorbidities that made it more difficult to evaluate and manage them [16]. A comprehensive analysis that examined non-urgent cases in the ED found that although some studies indicated

Table 2. *Relationship between disposition (admission vs. discharge) and patient's demographics and clinical data.*

Characteristic	Disposition		χ^2	*p*-value
	Admission	Discharge		
	N (%)	*N* (%)		
Age				
14-24	12 (11)	55 (13.9)	56.89	**<0.001**
25-34	20 (18.3)	115 (29)		
35-44	8 (7.3)	79 (19.9)		
45-54	8 (7.3)	45 (11.4)		
55-64	20 (18.3)	50 (12.6)		
65-74	17 (15.6)	36 (9.1)		
75-84	16 (14.7)	14 (3.5)		
85-94	8 (7.3)	2 (0.5)		
Gender				
Male	48 (44)	230 (58.1)	0.15	0.692
Female	61 (56)	166 (41.9)		
Nationality				
Saudi	103 (94.5)	25 (6.3)	0.09	0.755
Non-Saudi	6 (5.5)	371 (93.7)		
Mode of arrival				
Walk-in	86 (78.9)	263 (91.4)	13.37	**<0.001**
Ambulance	23 (21.3)	34 (8.6)		
Time presented				
Afternoon shift (1,500-2,300)	47 (43.1)	122 (30.8)	0.592	0.052
Day shift (0,700-1,500)	35 (32.1)	148 (37.4)		
Night shift (2,300-0,700)	27 (24.8)	126 (31.8)		
Patient acuity category				
1.00	5 (4.6)	5 (1.3)	37.11	**<0.001**
2.00	9 (8.3)	3 (0.8)		
3.00	95 (87.2)	344 (86.9)		
4.00	0 (0.0)	41 (10.4)		
5.00	0 (0.0)	3 (0.8)		
Previous ED visit <72 hours				
Yes	40 (10.1)	22 (20.2)	8.06	**0.005**
No	356 (89.9)	87 (79.8)		
No known comorbidities				
Yes	74 (67.9)	176 (44.4)	18.79	**<0.001**
No	35 (32.1)	220 (55.6)		
Hypertension	63 (57.8)	84 (21.2)	55.44	**<0.001**
Diabetes	59 (54.1)	89 (22.5)	41.33	**<0.001**
Ischemic heart disease	20 (18.3)	23 (5.8)	17.25	**<0.001**
Heart failure	13 (11.9)	7 (1.8)	23.19	**<0.001**
Bronchial asthma	4 (3.7)	26 (6.6)	1.28	0.257
Chronic obstructive pulmonary Disease	4 (3.7)	1 (0.3)	10.18	**0.001**
Bedridden or dementia	9 (8.3)	2 (0.5)	24.1	**<0.001**
Active malignancy	6 (5.5)	8 (2)	3.85	0.05
End-stage renal disease on dialysis	12 (11)	1 (0.3)	39.43	**<0.001**

* Bold numbers indicate significant values.

Table 3. *Chi-square analysis for the association between visit outcomes and waiting time at ED.*

Visit outcome	Waiting time at ED		X^2	*p* value
	Less than 4 hours	4 hours or more		
None	158 (95.2%)	309 (91.2%)	2.687	0.261
Mortality	4 (2.4%)	13 (3.8%)		
Morbidity	4 (2.4%)	17 (5%)		

Table 4. *Multivariate logistic regression analysis was conducted to assess the risk factors (independent predictors) of admission among studied patients.*

Predictor	B	Wald	*p*-value	Odds ratio (OR) (CI: 95)
Age	0.09	0.93	0.335	0.9 (0.74-1.1)
Mode of arrival	0.28	0.56	0.454	1.33 (0.62-2.81)
Patient acuity category	1.19	16.34	**<0.001**	1.3 (1.16-3.53)
Previous ED visit <72 hours	0.68	4	**0.046**	1.5 (1.256-3.89)
No known comorbidities	0.43	2.48	0.115	1.54 (0.89-2.66)
Hypertension (Yes)	0.69	2.43	0.119	0.49 (0.2-1.19)
Diabetes (Yes)	0.46	0.12	0.273	0.763 (0.27-1.43)
Ischemic heart disease (Yes)	0.51	0.14	0.235	0.6 (0.25-1.39)
Heart failure (Yes)	0.61	1.14	0.286	0.53 (0.17-1.67)
COPD (Yes)	1.7	2.05	0.152	0.18 (0.01-1.87)
Bedridden or dementia (Yes)	2.44	7.89	**0.005**	1.08 (1/01-3.47)
ESRD on dialysis (Yes)	3.67	11.26	**0.001**	1 (1.03-3.21)

COPD= Chronic obstructive pulmonary disease; ESRD= End stage renal disease.

* Bold numbers indicate significant values

no age-related differences in non-urgent cases, younger patients actually arrived with more non-urgent conditions [5]. Non-urgent conditions, however, do not always imply that the patients were not admitted.

Although the current study findings on the prevalence of female hospital admissions were not statistically significant, the gender distribution among patients skewed towards females, who made up 57.6% of the cohort, surpassing the male percentage of 42.4%, similar findings were found in earlier research [10,12]. The current findings point to a mixed link between the patient's gender and the ED's disposition choice, which is in line with the data.

The multivariate analysis eliminated the link between the number of men admitted to a hospital bed and the bivariate analysis's finding that more men were admitted. Evidence, however, indicated that females were admitted at a higher rate than males [10]. A systematic analysis revealed that there was mixed evidence regarding the influence of gender, with almost half of the studies indicating that more men were presenting to the ED for non-urgent conditions [5]. Even though going to the ED does not automatically entail being admitted to a hospital bed, more research in Saudi Arabia is necessary to fully understand this finding.

Previous research has shown a substantial correlation between the admission rate across all PAC levels and paramedic transport [5,10,17]. Similar findings from the current study indicated that the method of arrival was a strong predictor of admission, with patients arriving by ambulance showed a roughly three-fold higher chance of admission than walk-in patients. A few studies looked at the mode of transportation as the only risk factor for an early admission, and it was found that it had an effect on the mortality rate [17]. In the current study, patients arriving by ambulance were not statistically significant and most of the patients included in the study were walk-in arrivals. This could be explained by the easy access to the KAMC ED and free-of-charge ambulance transfer in Saudi Arabia.

Patients who arrived during the afternoon shift had the greatest admission rates in the current study, however, this difference was not statistically significant. A prior study conducted in Japan found a similar outcome [18]. According to current research, patients who arrive at the ED with urgent clinical illnesses have a higher chance of being admitted to a hospital bed than those who arrive with less urgent conditions. Given that one would anticipate patients who visited the ED to have more urgent, serious problems, this finding seems sense. This result seems to be in line with the pattern of ED use, as earlier studies found that higher ED service consumption was more frequently linked to poor health status [19,20].

Compared to patients with a high-priority level, those triaged with a lower-priority acute level had a 72% reduced chance of being hospitalized [21]. Further evidence from current data points to a connection between comorbidities and hospital bed admission. Compared to patients without comorbidities, individuals with comorbidities had a higher chance of being admitted to a hospital bed [21]. This result is in line with data seen in literature from other nations. A previous study found that comorbidities such as high triglycerides, cholesterol, diabetes, HTN, and obesity were associated with hospital admissions [22]. In the US, comorbid conditions such as respiratory fever, cardiovascular disease, and other general medical presenting issues were associated with longer ED wait times for patients [23], as well as hospital bed admission [24]. Furthermore, patients with anemia and impaired consciousness predicted disposition, according to a Ugandan cohort research [25]. According to a survey of 174 EDs in France and Belgium, patients with chronic underlying disorders accounted for 81.4% of ED deaths, whereas patients with prior functional restrictions accounted for 46% [26]. This could suggest that the ill were the ones who wind up in hospital EDs and were given hospital beds.

About the revisit, a prior research study discovered that patients who have visited the ED within the last 72 hours were more than twice as likely to be admitted as those who have not visited the ED recently. Most patients who returned to the ED within 72 hours were admitted to the ICU, where their fatality rate rose [2].

The results of the visit were not significantly correlated with the amount of time spent waiting at the ED, according to the current study. Nonetheless, it was discovered that admissions made after 5 hours from the time of ED arrival were linked to a greater death rate [11]. In 2019, a different study from China demonstrated that in patients with sepsis who needed to be admitted to an ICU, a longer duration of stay in the ED was independently linked to a higher chance of hospital deaths [28]. The National Bureau of Economic Research and the Institute of Fiscal Studies simulated the harm caused by extended stays in the ED in England in 2018. What would have happened if the 4-hour NHS operational requirement had not been in place between 2011 and 2013 was the counterfactual question posed by the researchers. It was discovered that the ED 4-hour norm decreased 30-day patient mortality by 0.4%, or 14% of baseline [29].

In line with earlier research that found fatality rates within 30 days rise with lengthier stays in the emergency room [30]. Baek and colleagues conducted a recent domestic study which found that patients who stayed in the emergency room for less than 6 hours had a 0.6% higher death rate than those who stayed for more than 6 hours. This suggested that admitting critically ill patients to the hospital as soon as possible might have a negative impact on their mortality.

A limitation of the present study was the use of a retrospective study design and being a single-center study that could hinder the generalization of the study results [12].

Conclusion

According to the current study, 21.6% of the patients needed to be admitted to the hospital after their ED visit, while 78.4% were discharged. Furthermore, 4.2% of the visits recorded morbidity, and 3.4% reported fatality. Based on univariate analysis, patients between the ages of 25-34 years and 55-64 years who arrived as walk-ins, with a Patient Acuity Category "3" and no history of prior ED visits within 72 hours, being bedridden or having dementia, suffering from ischemic heart disease, heart failure, COPD, or were on dialysis had a significantly higher rate of hospital admission. While, a multivariate logistic regression analysis revealed that being bedridden, having dementia, having no prior ED visits within 72 hours, and having ESRD on dialysis were risk factors for hospital admission. It is strongly advised to conduct additional multicenter studies involving patients from various medical specialties to have a more complete picture of the circumstances surrounding the predictors of hospital admission at Saudi Arabia's ED.

Conflict of interest

All authors declare that there are no conflicts of interest regarding the publication of this article.

Consent to participate

Informed consent was obtained from the participants.

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Ethical approval

The ethical approval was obtained by the Ethic Research Committee of King Abdullah International Medical Research Center (KAIMRC) via reference number RYD-23-417780-24085. Dated: 12-02-2023.

Author details

Shahad M. Al-Ashgar[1], Mohammed K. Almolhis[2], Omer W. Al Dhasee[2], Rama A. Alraheili[3]

1. Consultant, Emergency Medicine, Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia
2. Resident, Emergency Medicine, Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia
3. Intern, Taibah University, Almadina Almunaara, Saudi Arabia

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