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Understanding Factors Influencing Length of Stay for Seizure Patients in Emergency Departments

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ABSTRACT

Background: Seizures are frequent presentations in emergency departments (EDs) requiring comprehensive evaluation and management. Prolonged length of stay (LOS) for seizure patients can impact patient care and healthcare resource utilization. Understanding the factors influencing LOS in this population is crucial for optimizing ED operations. **Objective:** This retrospective study aimed to analyze the factors influencing the LOS of seizure patients presenting to the ED. **Methods:** The study was conducted at an academic tertiary care center with a busy ED serving a diverse patient population. A retrospective cross-sectional design was employed to analyze data from electronic medical records of seizure patients aged ≥18 years presenting to the ED between 1/1/2020 and 31/12/2022. Data were collected on patient demographics, clinical characteristics, including seizure type, medication adherence, comorbidities, and diagnostic interventions. Statistical analysis included chi-square tests and logistic regression to identify significant associations between variables and LOS. **Results:** Of the 121 seizure patients included, factors significantly associated with prolonged LOS (>4 hours) included generalized tonic-clonic seizures, non-compliance to medication, breakthrough seizures, and diagnostic interventions such as CT head scans and neurology consultations. Conversely, known cases of seizure and absence of comorbidities were associated with shorter LOS (≤4 hours). **Conclusion:** Our study identifies several factors influencing the LOS for seizure patients in the ED, providing insights for optimizing patient care and resource allocation. Strategies aimed at addressing these factors may lead to improved efficiency and better outcomes for seizure patients in the ED.

Keywords: Seizures, Emergency department, length of stay, patient outcomes, healthcare resource utilization.

1. BACKGROUND

In recent years, the prevalence of seizures as a presenting concern in emergency departments (EDs) has underscored the need for a comprehensive investigation into the factors influencing the length of stay for these patients. This is especially true considering that seizures pose a significant burden on healthcare systems due to their frequent occurrence in EDs and the utilization of different resources in managing these cases (1-4). The length of stay of patients in the ED is another important issue that is shown to adversely affect patient care (5). Emergency departments are under pressure to quickly yet effectively provide the necessary care needed without compromising on patient safety (6).

In seizure patients particularly, extensive workup and radiological imaging is required to reach a diagnosis with some of these diagnostic tests being inconclusive (7, 8). Furthermore, these additional workups are usually expensive adding on to the additional costs associated with the length of stay (9). The intricate nature of seizure cases necessitates collaboration among various healthcare professionals, such as neurologists and radiologists, elongating the duration of the ED stay (10). This diagnostic journey further empha-

		Frequency	Percent
Sex	Male	77	63.6
	Female	44	36.4
Age Mean (SD) = 37.8 (18.5)	< 20	11	9.1
	21–40	75	62
	41–60	20	16.5
	> 60	15	12.4
Nationality	Saudi	109	90.1
	Non-Saudi	12	9.9
Comorbidities	Epilepsy	60	49.6
	DM/HTN	6	5
	CKD	4	3.3
	Others	15	12.4
	None	36	29.8
Triage	II	4	3.3
	III	70	57.9
	IV	47	38.8
Blood Glucose	Mean (SD)	134.5 (80.1)	
Glasgow Coma Scale (GCS) at Arrival	Mean (SD)	15 (1.9)	

Table 1. Demographics and clinical characteristics of cases (n=121)

sizes the necessity of implanting cost-effective strategies to mitigate the financial strain as much as possible.

The prolonged ED stay for seizure patients not only impacts the efficiency of healthcare delivery but also has profound implications for the emotional well-being of both patients and their caregivers. The anxiety and uncertainty associated with the extended stay contribute to an overall negative patient experience, highlighting the need for strategies to minimize this psychological burden (11).

2. OBJECTIVE

While existing literature acknowledges the challenges, there remains a notable gap in understanding the specific factors impacting the length of stay for seizure patients in emergency settings. This study aims to address this gap by analyzing various determinants that contribute to the duration of patients' stays in the ED following seizures.

3. MATERIAL AND METHODS

This was a retrospective cross-sectional study on patients presenting to our institution's Emergency department either post-ictal or actively seizing. We included patients from our database of medical records who presented between January 1, 2020 and December 31, 2022. Our inclusion criteria were patients who had "seizure" , "post-ictal" , or "convulsions" under their chief complaint in our triage database, adults over the age of 16, and discharged from the ED with their length of stay explicitly mentioned. We excluded patients who were admitted, passed away, missing necessary data and variables, and left against medical advice. Figure 1 illustrates the selection process of patients.

Our research has obtained approval from the Institutional Review Board, with the approval number IRB-PGS-2023-01-317. This ensures compliance with ethical standards and regulatory requirements such as Helsinki Declaration of 1975, providing assurance to stakeholders and readers alike.

Statistical analysis

Data was analyzed by IBM SPSS.21. All categorical variables were presented as frequencies and percentages while all continuous data was presented as mean (±SD). Chi-square test was used to check the association between variables. Odds ratios were calculated by using logistics regression. Statistical significance was set at $P < 0.05$.

4. RESULTS

This study enrolled 121 cases of seizure aged ≥18 years who met our eligibility criteria, The mean (SD) age of patients was 37.8 (18.5) years. Majority of cases 75 (62%) had age between 21 – 40 years. Males were 77 (63.6%) of the study population, and 109 (90.1%) of patients were Saudis. The most common comorbidities was diabetes

Seizure disorders		Frequency	Percent
Complaint	History of Seizure	78	64.5
	New onset of seizure	12	9.9
	Convulsive SE	10	8.3
	recurrent Seizure	21	17.4
Seizure Type	Generalized tonic-clonic	68	56.20
	focal	2	1.65
	Status epilepticus	2	1.65
	Unknown	49	40.50
General Cause of Seizure	Non-compliance to medication	53	43.8
	Intoxication	3	2.5
	Structural	3	2.5
	Unknown	56	46.3
	Others	6	5
Specific Cause of Seizure	Breakthrough seizure	55	45.5
	Amphetamine	2	1.7
	Psychogenic	2	1.7
	Unknown	54	44.6
	Others	8	6.6
Medication	Diazepam	26	21.5
	Levetiracetam	32	26.5
	Valproic acid	10	8.3
	Carbamazepine	6	5
	Others	7	5.8
	None	40	33.1
Method of ED arrival	Ambulance	27	22.3
	Ambulatory	94	77.7
Length of Stay (Hours)	≤ 4	40	33.1
	> 4	81	66.9

Table 2. Distribution of Seizure disorders (n=121)

and hypertension 6 (5%) and CKD 4 (3.3%). The average GCS at arrival was 14.6 (1.9) (Table 1).

Out of total, 78 (64.5%) cases were presented with the history of seizure, 12 (9.9%) cases had new onset of seizure, and recurrent seizure was found in 21 (17.4%) cases and Convulsive SE in 10 (8.3%) cases. Generalized tonic-clonic was the most common seizure type found in 68 (56.2%) cases followed by unknown type in 49 (40.5%) cases, focal in 2 (1.65%) cases and Status epilepticus in 2 (1.65%) cases. Non-compliance to medication was the most common general cause of seizure found in 53 (43.8%) cases and Breakthrough seizure was the most common specific cause of seizure found in 55 (45.5%) cases. The average length of stay was 6.2 (4.04) hours. Length of stay > 4 hours was found in 81 (66.9%) cases and ≤ 4 hours in 40 (33.1%) cases (Table 2).

Univariate analysis was presented in Table 3. Cases with generalized tonic-clonic seizure were significantly associated with LOS > 4 hours 51 (63%) as compared to ≤ 4 hours 17 (42.5%) (p=0.032), cases with Non-compliance to medication had significantly long stay (>4 hours) 41 (50.6%) (p=0.037) and cases with Breakthrough seizure were also significantly associated with LOS > 4 hours 43 (53.1%) p = 0.0168. while cases without comorbidities were significantly associated with LOS ≤ 4 hours {17 (42.5%), p=0.031}. Known cases of seizure were also significantly associated with LOS ≤ 4 hours {31 (77.5%), p=0.035}, cases on without medication were significantly associated with LOS ≤ 4 hours {18 (45%), p=0.05}, cases who consulted with neurology significantly associated with LOS > 4 hours {58 (71.6%), p<0.0001} and cases with CT scan done also significantly associated with LOS > 4 hours {51 (63%), p<0.0001} while cases with longer LOS (>4 hours) had significant higher mean age 41.2 ±20.5 years (p<0.001) and significantly higher blood glucose 141.2 ±90.4 (p=0.018).

Multivariate analysis of significant variable in relation to the length of stay (≤ 4 hours Vs > 4 hours) is presented in Table 4. Higher Age, increased blood glucose, presence of comorbidities, generalized tonic-clonic seizure, non-compliance to medication, cases with CT scan done, cases who consulted with neurology and Breakthrough seizure were significantly associated with LOS > hours while known cases of seizure were significantly associated with LOS ≤ 4 hours.

5. DISCUSSION

The increasing prevalence of seizures in emergency departments has emphasized on the need to investigate factors influencing patient length of stay (1, 2). Seizures pose a significant burden on healthcare systems due to their frequent occurrence and resource utilization (3, 4).. In this study, we aimed to assess the different factors and their relations to patient length of stay.

Aging and the presence of comorbidities were significantly associated with an increased length of stay, potentially complicating the assessment and management

		Length of Stay (hours)		p-values
		≤ 4	> 4	
Sex	Male	29 (72.5%)	48 (59.3%)	0.154
	Female	11 (27.5%)	33 (40.7%)	
Nationality	Saudi	38 (95%)	71 (87.7%)	0.203
	Non-Saudi	2 (5%)	10 (12.3%)	
Triage	II (Emergent)	3 (7.5%)	1 (1.2%)	0.06
	III (Urgent)	25 (62.5%)	45 (55.6%)	0.47
	IV (Less Urgent)	12 (30%)	35 (43.2%)	0.16
Complaint	History of Seizure	29 (72.5%)	49 (60.5%)	0.19
	New onset of seizure	3 (7.5%)	9 (11.1%)	0.53
	Convulsive SE	3 (7.5%)	7 (8.6%)	0.83
	recurrent Seizure	5 (12.5%)	16 (19.8%)	0.32
Seizure Type	Generalized tonic-clonic	17 (42.5%)	51 (63%)	0.032
	Focal	1 (2.5%)	1 (1.2)	0.59
	Status epilepticus	0	2 (2.5%)	0.32
	Unknown	22 (55%)	27 (33.3%)	0.02
General Cause	Non-compliance to medication	12 (30%)	41 (50.6%)	0.037
	Intoxication	1 (2.5%)	2 (2.5%)	1
	Structural	2 (5%)	1 (1.2%)	0.2
	Unknown	25 (62.5%)	31 (38.3%)	0.012
	Others	0 (0%)	6 (7.4%)	0.07
Specific Cause	Breakthrough seizure	12 (30%)	43 (53.1%)	0.0168
	Amphetamine	0 (0%)	2 (2.5%)	0.31
	Psychogenic	0 (0%)	2 (2.5%)	0.31
	Unknown	25 (62.5%)	29 (35.8%)	0.01
	Others	3 (7.5%)	5 (6.2%)	0.78
Comorbidities	Yes	23 (57.5%)	62 (76.5%)	0.031
	No	17 (42.5%)	19 (23.5%)	
Known cases	Yes	31 (77.5%)	47 (58%)	0.035
	No	9 (22.5%)	34 (42%)	
Medications	Yes	22 (55%)	59 (72.84%)	0.05
	No	18 (45%)	22 (27.16)	
Neurology consulted	Yes	12 (30%)	58 (71.6%)	<0.0001
	No	28 (70%)	23 (28.4%)	
Ambulance or Ambulatory	Ambulance	9 (22.5%)	18 (22.2%)	0.95
	Ambulatory	31 (77.5%)	63 (77.8%)	
CT Head Done?	Yes	8 (20%)	51 (63%)	<0.0001
	No	32 (80%)	30 (37%)	
Age	Mean (SD)	30.9 ±10.7	41.2 ±20.5	<0.001
Blood Glucose	Mean (SD)	114.2 ±26.7	141.2 ±90.4	0.018
GCS on Arrival	Mean (SD)	14.7 ±1.4	14.5 ±2.1	0.51

Table. 3. Univariate analysis of demographics and Seizure disorders in relation to the length of stay (≤ 4 hours Vs > 4 hours) in patients with seizures. (n=121)

	Odds Ratios	95% CI for Odds Ratios	P-values
Age	1.042	(1.01 - 1.07)	0.007
Blood Glucose	1.008	(1 - 1.02)	0.245
Comorbidities	5.248	(1.37 - 20.04)	0.015
Known cases	0.161	(0.04 - 0.67)	0.012
Generalized tonic-clonic	2.3	(1.06 - 4.98)	0.035
Non-compliance to medication	2.392	(1.07 - 5.35)	0.034
Breakthrough seizure	2.64	(1.18 - 5.91)	0.018
Neurology consulted	4.4	(4.4 - 10.7)	0.001
Underwent a CT Head	5.2	(5.2 - 13.3)	0.001

Table-4: Multivariate analysis of demographics and Seizure disorders in relation to the length of stay (≤ 4 hours Vs > 4 hours) in patients with seizures. (n=121)

of seizures. Older individuals may require additional diagnostic tests, such as imaging or laboratory studies, to rule out underlying causes or contributing factors. One observational study comparing young and elderly patients presenting to the ED with seizures found that elderly patients often require more complex treatment and utilize more hospital resources than younger adults (12). Furthermore, S. M. Rhodes et al. discovered that elderly ED patients with behavioral health complaints exhibit high rates of cognitive impairment and multiple comorbidities, contributing to prolonged length of stay and heightened risk of adverse events (13). Conversely, C. Fernández Alonso et al. reported that age over 75 years is associated with a higher incidence of specific supplementary tests but not necessarily pharmacological intervention or extended hospitalization in emergency departments (14). Overall, coordinating care and addressing the complexities associated with aging and comorbidities can contribute to a prolonged stay in the emergency department.

Our findings highlight a significant association between medication adherence and prolonged ED stays. Previous studies have demonstrated that non-compliance with medication increases hospitalization rates and leads to more frequent emergency department visits (15). However, limited research exists on how medication adherence impacts the length of ED stay. Studies focusing on individual antiepileptic drugs (AEDs) have shown that drugs with higher adherence rates correlate with a lower rate of hospitalization and emergency department utilization (16). Additionally, patients experiencing breakthrough seizures were found to have a length of stay exceeding four hours, potentially attributed to non-compliance with antiseizure medication. V. Divino et al. reported that, after adjusting for AED adherence, cases of breakthrough seizures were associated with increased ED visits and hospitalization; however, no significant association was found between breakthrough seizures and length of inpatient stay (17).

Patients who had generalized tonic-clonic seizure type were significantly associated with increased length of stay, this could be due to that this type of seizure are often more severe than other types of seizures as they can lead to more significant postictal confusion, prolonged recovery times, and complications such as injuries from convulsions (e.g., fractures, head trauma) which require additional evaluation and treatment (18).

Furthermore, our findings revealed a significant correlation between the decision to order a CT head scan or consult neurology and an extended length of stay exceeding four hours for seizure patients in the emergency department. A similar study focusing on neuroimaging in seizure patients found that CT scans increased the length of stay by 1.5 hours in the ED (19). Additionally, consultations in general significantly impact LOS due to the involvement of additional personnel and services (20). This may be attributed to the necessity of additional diagnostic tests or specialist involvement, inevitably prolonging patients' ED stays. While these interventions are crucial for comprehensive evaluation and tailored management, they inadvertently contribute to delays in patient disposition. Another possible explanation could be incidental findings that prompt further testing, as seen in trauma cases where incidental findings significantly affect the length of stay (21).. Another proposed recommendation to decrease LOS in neurological cases is to have a neurologist present in the ED even after office hours (22).

Conversely, our analysis revealed a significant association between patients with a known history of seizures and a shorter LOS, specifically four hours or less, in the hospital setting. This was evidenced by 77.5% of known cases of seizure having a LOS of ≤4 hours (p=0.035). This could be explained by the finding that patients with a known history of seizures receive more efficient care due to existing management plans or familiarity with their condition, leading to a shorter LOS. This reasoning is supported by the findings of R. Mamensikiene et al. (23). Reduced LOS might also be attributed to lower levels of anxiety related to follow-up care advisement among patients with known epilepsy, demonstrating a propensity for proactive healthcare service utilization based on their familiarity with the healthcare system, as concluded by Leanne Rachel et al. (24).

One of the limitations of our study is its retrospective nature, which relies on data from medical records, potentially introducing selection and information biases which are all limitations inherent to such a design. Additionally, as the study involved a database, there is a risk of misdiagnosis or incomplete documentation, which could lead to inaccuracies in patient selection and decrease the representativeness of the sample. Furthermore, our study did not evaluate whether undergoing a CT head scan influenced patient management in relation to the observed increase in length of stay. This omission limits our ability to fully understand the clinical implications of ordering diagnostic tests such as CT scans and their impact on patient care and outcomes.

6. CONCLUSION

Our study highlights the association of various factors affecting the length of stay for seizure patients in the

emergency department. Seizure type, medication adherence, comorbidities, age, blood glucose levels, whether CT scans were ordered or neurology was consulted were all shown to be significant determinants of LOS. Importantly, while some of these factors are non-modifiable, understanding the collective impact of these factors is crucial to optimize patient care and resource utilization in the ED. By addressing these factors, healthcare providers can enhance the efficiency and quality of emergency healthcare delivery for seizure patients, ultimately improving outcomes and patient experiences. Further research is required to validate these findings and explore additional strategies for reducing LOS in seizure patients.

- **Research quality and ethics statement**: This study was approved by the Institutional Review Board with IRB number IRB-PGS-2023-01-317. The authors followed applicable EQUATOR Network (https://www.equator-network.org/) guidelines during the conduct of this research project.. We also certify that none of the authors is a member of the Editorial board of the Journal of Emergencies, Trauma and Shock.
- **Ethical statement**: The authors affirm that appropriate approval from the Institutional Review Board (IRB) was obtained for this study involving human subjects. Approval number IRB-PGS-2023-01-317.
- **Author's contributions**: Faisal A. AlGhamdi: Project administration, Conceptualization, Writing–original draft; Zeyad T. Alharbi: Conceptualization, Writing–original draft; Rakan S. Alharbi: Methodology, formal analysis, writing-original draft; Abdulmalek A. AlOmair: Writing–original draft, Conceptualization; Abdulrahman A. Alfryyan: Writing–original draft, Conceptualization; Omar A. AlGhamdi: Writing–original draft, visualization; Bader S. AlSolo: Writing–original draft, visualization; Omnia H. AlMomen: Writing–original draft, Conceptualization; Basmah Albloushi: Writing–original draft, visualization; Mariam Alosfoor: Writing–original draft, visualization; Mohammed Alghamdi: Writing–original draft, visualization; Nisreen H. AlMaghraby: Writing–review & editing, validation; Mohammed AlMulhim: Writing–review & editing, validation
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