Clinical Related Factors Associated with Mortality in Emergency Department at Selected Public Health Facilities in Embu County, Kenya

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ABSTRACT

Background: The clinical profile of patients is crucial in emergency departments to determine their severity and the urgency of their condition. Globally, early ED mortality is driven by non-communicable diseases, trauma, and cardiovascular disorders, often worsened by comorbidities and delayed care. Kenya's emergency department (ED) mortality rate is estimated to be 10-15%, with 1.9% of deaths within 72 hours.

Methods: This analytical cross-sectional study at selected public health facilities in Embu County, Kenya, combined quantitative and qualitative methods to examine factors influencing early mortality in EDs. Data were collected from 296 caregivers via structured questionnaires and from healthcare workers through key informant interviews. Quantitative analysis included descriptive statistics, Chi-square tests, odds ratios, and multiple regression ($p<0.05$), while qualitative data were thematically analyzed. Ethical approval, informed consent, and confidentiality were strictly maintained.

Results: The study identified key health-related predictors of mortality in the Emergency Department (ED). Patients with ≥2 prior ED visits had higher odds of death (OR=2.919, 95% CI: 1.466–23.894, p=0.044), and illness duration >48 hours increased mortality risk (OR≈2.9, $p<0.05$). Red triage (OR=5.813, 95% CI: 3.309–10.210, p=0.001), hypoxemia (OR=2.969, 95% CI: 1.570–20.417, p=0.009), active airway support (OR=3.662, 95% CI: 1.542–7.963, p=0.04), and AVPU unresponsiveness (OR=7.874, p=0.003) were significant. ANOVA showed the model explained mortality variance ($F=16.510$, $p<0.001$), confirming these factors' combined impact on ED outcomes.

Conclusions: The study concluded that mortality in the Emergency Department is significantly influenced by prior ED visits, prolonged illness, critical triage categories, hypoxemia, airway compromise, altered neurological status, and comorbidities such as hypertension and diabetes. These findings highlight the urgent need for improved emergency care, early intervention, and targeted management of high-risk patients.

Keywords: Emergency Department Mortality, Early Mortality, Pre-Hospital Care, Trauma, Non-Communicable Diseases

INTRODUCTION

The clinical profile, encompassing a patient's medical history, examination findings, and symptom progression, is crucial in the emergency department (ED) for assessing severity and urgency of care (Barbosa et al., 2023). Death shortly after ED admission is influenced by patient condition, hospital care quality, staffing, and pre-hospital factors. Globally, ED mortality varies widely, with non-communicable diseases, trauma, and cardiovascular disorders being leading causes (World Health Organization, 2021). Timely emergency care, modern infrastructure, and trained personnel are essential to reduce preventable deaths, particularly in regions with high trauma incidence and limited healthcare resources (Pickering et al., 2023).

In Tehran, Iran, cardiovascular disorders accounted for 39.2% of ED deaths, severe trauma 18.5%, and cerebrovascular accidents 17.7%, with patients presenting cardiovascular complaints exhibiting 7.3 times higher odds of death (Barbosa et al., 2023). Comorbidities such as hypertension and renal disease further increased mortality risks. In Albania, trauma predominantly affected young males, with motor vehicle accidents and falls being major contributors, and death rates rising with injury severity (Bucaj et al., 2021). Across low- and middle-income countries, delays in presentation, inadequate pre-hospital care, comorbidities, and the severity of illness or injury are major determinants of ED mortality. Non-communicable diseases and trauma consistently emerge as the leading causes of death, emphasizing the urgent need for improved emergency care systems, rapid triage, pre-hospital interventions, and targeted public health strategies to reduce preventable mortality (Pickering et al., 2023).

Studies across Botswana reported crude ED mortality rates ranging from 3.9% to 8.5%, with non-communicable diseases like stroke and chronic cardiovascular disorders accounting for the majority of deaths, while trauma-related deaths were mostly linked to road traffic accidents. Mortality was highest among patients under 65 years and often occurred after delayed presentation (Kershaw et al., 2023). In Kenya, emergency department mortality mirrors these patterns. An analysis of 11,443 death records in Nairobi revealed 10.6% were injury-related, predominantly among males aged 25–44 years (Ouma et al., 2022). Blunt force assaults accounted for 30.5% of deaths, followed by road traffic injuries (25.9%) and firearm-related injuries (15%) (Ngare et al., 2020). These findings indicate that young males are disproportionately affected, with trauma being the leading cause of early ED mortality.

METHODS

Study design

This study employed an analytical cross-sectional design integrating both quantitative and qualitative approaches. The cross-sectional design enabled the collection of data at a single point in time to examine associations between health system, patient-related, and health-related factors and early mortality in emergency departments (EDs). Quantitative data were collected using interviewer-administered structured questionnaires completed by caregivers of patients receiving emergency care, while qualitative data were obtained through key informant interviews (KIIs) with healthcare workers. The mixed-methods approach provided a comprehensive understanding of mortality determinants by combining statistical analysis with in-depth experiential insights. The study was conducted over a two-month period in selected public health facilities in Embu County, Kenya between July 2025 and August 2025.

Study setting and population

The study population comprised caregivers of patients receiving treatment in selected EDs and healthcare providers (nurses, clinical officers, and medical officers) working in those departments. Approximately 956 patients monthly require urgent care in the selected facilities. Inclusion criteria for caregivers were age 18 years and above and voluntary consent to participate. Healthcare workers were required to have worked in the county EDs for at least one month and to provide informed consent. Patients without caregivers and healthcare workers on leave during data collection were excluded.

Sampling

The sample size was determined using Fischer et al. (1997) formula at a 95% confidence level, 50% estimated proportion, and 5% margin of error, yielding a minimum sample of 275, after adjusting for a 10% non-response rate, the final sample size was 296 caregivers. A multistage sampling strategy was applied with Embu County selected by convenience sampling, and four sub-counties were purposively included. One Level 4 public facility per sub-county was selected using stratified random sampling, alongside one purposively selected Level 5 facility. Systematic sampling was then employed to select every third patient from daily ED registers after randomly identifying the starting point. Proportionate allocation ensured representation across facilities. Healthcare workers for KIIs were selected purposively, with sample size determined by data saturation.

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Research instruments

Data were collected using structured questionnaires and key informant interview guides. The caregiver questionnaire included sections on socio-demographic characteristics and factors associated with early mortality, primarily using closed-ended questions with limited open-ended responses. KIIs explored health system challenges influencing ED mortality. Instruments were reviewed by experts to ensure content validity and were pretested on 10% of the sample in a different facility to refine clarity and relevance. Reliability was assessed using test-retest procedures and Cronbach's alpha coefficients. All scales demonstrated acceptable internal consistency (α ranging from 0.777 to 0.814), indicating satisfactory reliability.

Data analysis

Quantitative data were coded and analyzed using SPSS version 30.0. Descriptive statistics summarized participant characteristics and study variables. Inferential analyses included Chi-square tests, odds ratios (ORs), 95% confidence intervals (CIs), and multiple regression modeling to assess associations between independent variables and early mortality, with statistical significance set at $p<0.05$. Qualitative data were transcribed, coded manually, and analyzed thematically. Findings were presented narratively and integrated with quantitative results to enhance interpretation.

Ethical considerations

Ethical approval was obtained from the Mount Kenya University Ethical Review Committee, with additional authorization from NACOSTI, Embu County authorities, and participating facilities. Written informed consent was obtained from all participants. Confidentiality and anonymity were maintained through coded identifiers and secure data storage. Participation was voluntary, and respondents were informed of their right to withdraw at any time without penalty. No incentives were provided, and no invasive procedures were involved.

RESULTS

Socio-Demographic Characteristics of study respondents

In terms of age distribution, the largest proportion of patients were aged 70 years and above, accounting for 49 (16.6%), 46 (15.5%) were 17 years or younger with patients in the age brackets of 30–39 years and 18–29 years being 45 (15.2%) and 44 (14.9%) respectively. The 40–49 age group comprised 39 patients (13.2%), while 37 (12.5%) were aged 50–59 years. In addition, 168 (56.8%) were males while females accounted for 128 (43.2%) (Table 1).

Table 1: Demographic Characteristics of study respondents

Characteristics		**Frequency**	**Percent**
Patients age	≤ 17 years	46	15.5%
	18-29 years	44	14.9%
	30-39 years	45	15.2%
	40-49 years	39	13.2%
	50-59 years	37	12.5%
	60-69 years	36	12.2%
	≥ 70 years	49	16.6%

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Patient gender	Male	168	56.8%
	Female	128	43.2%

Presence of Chronic Disease

Most of patients 103 (34.8%) in the study had hypertension, other chronic diseases included diabetes 62 (20.9%), HIV/AIDS 40 (13.5%), congenital conditions 9 (3.0%), and cancer 33 (11.1%) (Figure 1).

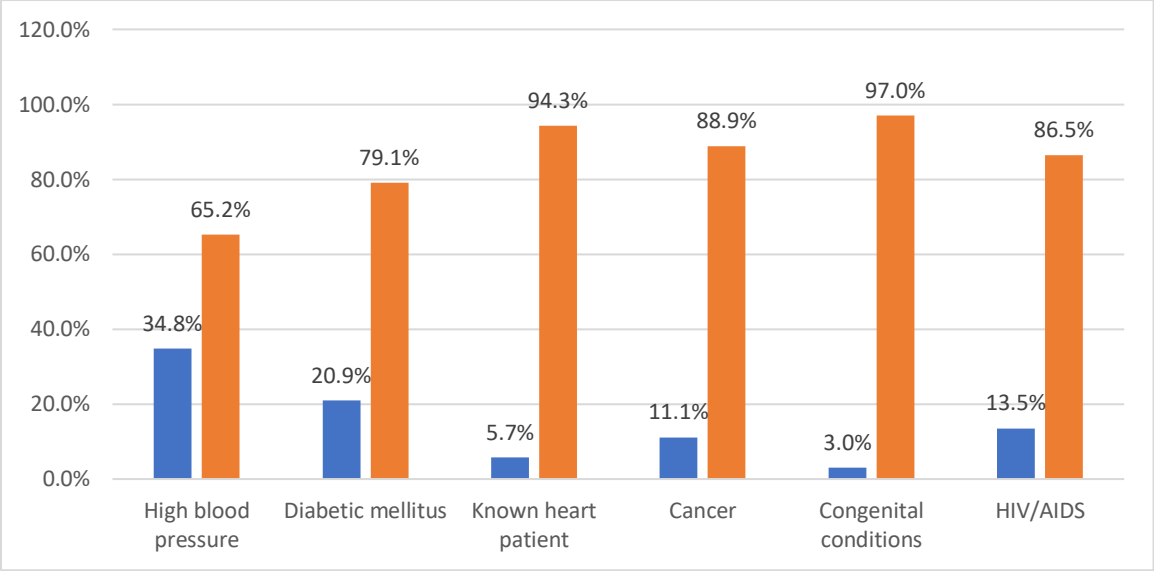

Figure 1: Presence of Chronic Disease

Diagnosis of Medical Causes

At least 48 (24.5%) of patients had infection/sepsis with 47 (24.0%), 39 (19.9%), and 8 (4.1%) were diagnosed with cardiovascular diseases, renal diseases, and oncological conditions respectively (Figure 2).

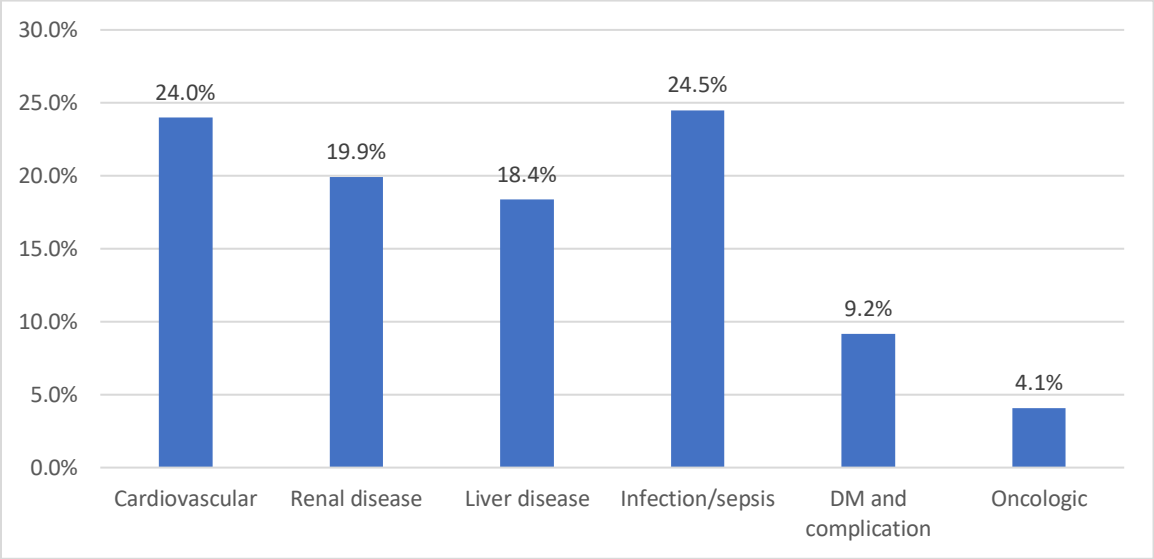

Figure 2: Diagnosis of Medical Causes

Treatment Offered in Emergency Department

At least two-third 182 (61.5%) were started on antibiotics with 115 (38.9%), 87 (29.4%), and 191 (64.5%) were on rapid resuscitation, nutritional support and supportive care respectively. At least 224 (75.7%) of patients

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survived the illness with mortality recorded among 57 (19.3%) patients of which 36 (63.2%) occurred during the day time, 10 (17.5%), 20 (35.1%), 16 (28.1%) and 3 5.3%) of mortality occurred on arrival, less than 1 hour, between 1-2 hours and more than 6 hours after arrival in ED (Table 2).

Table 2: Treatment Offered in Emergency Department

Characteristics		**Frequency**	**Percent**
Treatment offered	Rapid resuscitation	115	38.9%
	Antibiotics	182	61.5%
	Nutritional support	87	29.4%
	Supportive care	191	64.5%
Treatment outcome	Alive	224	75.7%
	Dead	57	19.3%
	Referred	15	5.1%
Time of death	Day time	36	63.2%
	Night time	21	36.8%
Length of stay in ED before death	< 60 minutes	10	17.5%
	1-2 hours	20	35.1%
	3-4 hours	16	28.1%
	5-6 hours	8	14.0%
	More than 6 hours	3	5.3%

Location of Death

More than half 34 (50.0%) of mortality in the emergency department occurred in red zone with 15 (26.3%) and 8(14.0%) occurred in orange zone and yellow and green zone respectively (Figure 3).

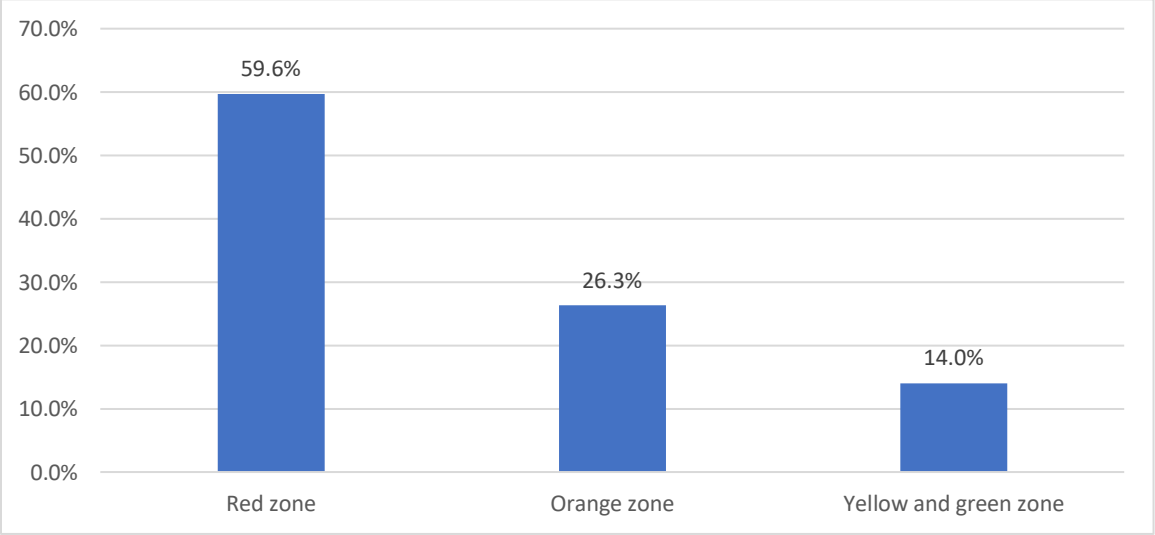

Figure 3: Location of Death

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Key informants noted that while most emergency patients receive timely antibiotics, supportive care, and resuscitation, the outcomes vary significantly based on illness severity and time of intervention. A substantial portion of deaths occurred within the first 48 hours, many on arrival, suggesting that patients are often critically ill by the time they reach the ED. Key informants mentioned that

"Most patients are started on antibiotics immediately, especially those suspected of having infections. But sometimes it's already too late, especially for those who arrive in shock or sepsis. We give supportive care and resuscitation, but it doesn't always reverse the damage done before arrival." (KII 1).

"Supportive care works best when it's started early. By the time some patients arrive, they're severely dehydrated, malnourished, or in multi-organ failure. We offer nutritional and fluid support, but sometimes that's not enough. We need to focus on education and referral linkages at the community level." (KII 4)

"Most deaths occur in the red zone — that's where we manage the most critical patients. It's an indicator that our triage system is accurate, but it also shows how critical these cases are. If we could catch these conditions earlier at the community or primary care level, many of them wouldn't end up in the red zone at all." (KII 8).

Health Related Factors of Mortality in Emergency Department

The findings reveal several key predictors of mortality among critically ill patients in the emergency department setting. Patients with two or more prior ED visits had significantly increased odds of death (OR = 2.919, 95% CI: 1.466–23.894, p = 0.044), the duration of illness before admission was another significant factor with patients who were sick for more than 48 hours to 1 week had nearly threefold higher odds of mortality (OR = 2.895, 95% CI: 1.265–8.675, p = 0.028), while those ill for more than one week had similarly elevated odds (OR = 2.987, 95% CI: 1.102–7.703, p = 0.024). Patients triaged as Red (OR = 5.813, 95% CI: 3.309–10.210, p = 0.001), with Orange (OR = 3.009, 95% CI: 1.998–9.542, p = 0.014), patients presenting with hypoxemia on admission (OR = 2.969, 95% CI: 1.570–20.417, p = 0.009), patients who required active airway support (OR = 3.662, 95% CI: 1.542–7.963, p = 0.040), and those with stridor had elevated risk (OR = 1.534, 95% CI: 1.047–3.854, p = 0.066) had significantly increased mortality. Neurological responsiveness assessed via the AVPU scale further demonstrated that unresponsive (U) patients (OR = 7.874, 95% CI: 0.216–12.528, p = 0.003), patients with refill time greater than 3 seconds (OR = 4.969, 95% CI: 1.570–20.417, p = 0.0001), the presence of pallor (OR = 2.969, 95% CI: 1.570–20.417, p = 0.005) and jaundice (OR = 5.525, 95% CI: 1.259–10.063, p = 0.037) were associated with increased mortality. Underlying conditions also played a critical role with patients with traumatic injuries (OR = 2.021, 95% CI: 0.725–5.633, p = 0.027), those with diabetes mellitus (OR = 1.247, 95% CI: 0.449–1.598, p = 0.038), and patients with high blood pressure (OR = 2.762, 95% CI: 0.165–7.741, p = 0.012) had increased mortality risk (Table 2)

Table 3: Health Related Factors of Mortality in Emergency Department

Variables		Mortality		OR	**95% CI**	**p-value**
		Yes	No			
Prior ED visits	No ED visits	10(6.0%)	157(94.0%)	Ref		
	One	27(30.3%)	62(69.7%)	0.626	0.237-1.651	0.344
	Two or more	20(50.0%)	20(50.0%)	2.919	1.466-23.894	**0.044**
Duration of illness	<4 hours	8(15.7%)	43(84.3%)	Ref		
	4-23 hours	11(21.2%)	41(78.8%)	1.261	0.615-2.584	0.098
	24-48 hours	9(11.3%)	71(88.8%)	1.957	0.256-1.086	**0.043**

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	>48 hours to 1 week	18(26.9%)	49(73.1%)	2.895	1.265-8.675	**0.028**
	> 1 week	11(23.9%)	35(76.1%)	2.987	1.102-7.703	**0.024**
Triage category	Red	14(26.9%)	38(73.1%)	5.813	3.309-10.210	**0.001**
	Orange	23(24%)	73(76%)	3.009	1.998-9.542	**0.014**
	Yellow	14(12.8%)	95(87.2%)	1.652	1.135-3.812	0.087
	Green	6(15.4%)	33(84.6%)	Ref		
Temperature on admission	Normal	12(10.9%)	98(89.1%)	Ref		
	Hypothermia	6(17.6%)	28(82.4%)	1.303	1.715-18.036	0.059
	Fever	39(25.7%)	113(74.3%)	1.958	1.189-6.245	0.051
Oxygen saturation	Hypoxemia	27(35.1%)	50(64.9%)	2.969	1.570-20.417	**0.009**
	Normal	30(13.7%)	189(86.3%)	Ref		
Airways	Clear	31(13.9%)	192(86.1%)	Ref		
	Stridor	13(31%)	29(69%)	1.534	1.047-3.854	0.066
	Need active support	13(41.9%)	18(58.1%)	3.662	1.542-7.963	**0.04**
AVPU	A	25(12.4%)	176(87.6%)	Ref		
	V	9(22.5%)	31(77.5%)	1.057	0.237-4.704	0.051
	P	9(24.3%)	28(75.7%)	1.901	0.454-7.946	**0.042**
	U	14(77.8%)	4(22.2%)	7.874	0.216-12.528	**0.003**
Cap refill	X	4(22.2%)	14(77.8%)	Ref		
	<2	33(16.5%)	167(83.5%)	0.112	0.018-3.654	0.154
	2-3	16(25%)	48(75%)	2.306	0.856-9.999	**0.008**
	>3	4(28.6%)	10(71.4%)	4.969	1.570-20.417	**0.0001**
Pallor	Yes	25(32.1%)	53(67.9%)	2.969	1.570-20.417	**0.005**
	No	32(14.7%)	186(85.3%)	Ref		
Jaundice	Yes	10(27.8%)	26(72.2%)	5.525	1.259-10.063	**0.037**
	No	47(18.1%)	213(81.9%)	Ref		
Major diagnosis	Traumatic	18(18%)	82(82%)	2.021	0.725-5.633	**0.027**
	Non-traumatic	39(19.9%)	157(80.1%)	Ref		

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High blood pressure	Yes	34(33%)	69(67%)	2.762	0.165-7.741	**0.012**
	No	23(11.9%)	170(88.1%)	Ref		
Diabetic mellitus	Yes	26(41.9%)	36(58.1%)	1.247	0.449-1.598	**0.038**
	No	31(13.2%)	203(86.8%)	Ref		

Key informants strongly agreed with the statistical findings, highlighting that several clinical and historical factors are reliable indicators of mortality risk in emergency settings. Critically ill patients who had multiple ED visits, prolonged illness duration, or arrived in red/orange triage categories were noted to have worse outcomes. Airway compromise and chronic conditions like hypertension, diabetes, and trauma further complicated prognosis. Informants emphasized the need for early detection, improved triage systems, and pre-hospital care to mitigate these risks and reduce ED mortality.

"Most of the patients who die in the ED have had prior visits. They come, get partially treated, and then return in worse condition. Repeated ED visits are a clear red flag……they suggest unresolved or worsening illness. That group definitely needs closer follow-up and early referral." (KII 3)

"Once a patient is triaged red or orange, you already know their chances are slim if intervention is delayed even a bit. Especially those with hypoxemia or who require airway support ….mmm….. they crash so fast. AVPU scores and capillary refill times tell you immediately who's in danger." (KII 5).

"It's not just what we see at admission…things like jaundice, pallor, or high blood pressure usually point to long-standing illness. When a diabetic or hypertensive patient arrives unstable, chances of recovery go down. We need more chronic disease management at community level to prevent ED deaths." (KII 8).

"The patients who are unresponsive on AVPU or need active airway management are usually the ones we lose. The delay in getting to us is the biggest killer. These signs are not new when they get here — they've been sick for days. We need better pre-hospital emergency systems." (KII 9).

Anova

The ANOVA results indicate that the multiple regression model predicting mortality is statistically significant. The model, which included 14 predictor variables, produced an F-statistic of 16.510 with 14 and 281 degrees of freedom, and a significance level of $p < .001$. This demonstrates that the combined predictors significantly explain variation in mortality outcomes. The regression sums of squares (20.771) compared to the total sum of squares (46.024) suggests that approximately 45% of the variance in mortality is explained by the model. Therefore, the included clinical and patient-related factors collectively provide a strong and meaningful prediction of emergency department mortality.

Table 4: ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20.771	14	1.484	16.510	<0.001[b]
	Residual	25.253	281	0.090		
	Total	46.024	295			
a. Dependent Variable: Mortality						
b. Predictors: (Constant), Diabetic mellitus, AVPU, Jaundice, Temperature on admission, Cap refill, Major diagnosis, Duration of illness, Triage category, High blood pressure, Oxygen saturation, Airways, Prior ED visits, Anaemia, Mechanism of injury						

DISCUSSION

The findings found that Patients with two or more prior ED visits were nearly three times more likely to die (OR = 2.919), suggesting that frequent ED utilization may reflect either poor access to effective primary care or a worsening underlying condition. This pattern has been similarly observed in studies such as Dode et al., (2022), where previous visits correlated with increased mortality, indicating that repeat visits may serve as a red flag for clinicians. Duration of illness also played a crucial role with patients ill for more than 48 hours up to a week (OR = 2.895) and beyond a week (OR = 2.987) were significantly more likely to die, consistent with findings from Workina et al., (2023), which emphasized that delays in seeking care, often due to poor health literacy or inadequate healthcare access, can severely worsen outcomes. The late presentation was also a common factor in studies from Ethiopia and Nigeria, where delayed arrival led to higher mortality within the first 72 hours (Obermeyer et al., 2020).

Triage categorization was one of the strongest predictors of mortality. Patients triaged as Red had the highest odds of death (OR = 5.813), followed by Orange (OR = 3.009), echoing Dode et al., (2022) findings, where high-acuity triage was strongly linked to early mortality. This affirms the validity of triage systems in risk stratification. Physiological parameters were also significant, hypoxemia, need for airway support, presence of stridor, and being unresponsive on the AVPU scale were all associated with higher mortality. For instance, unresponsive patients had nearly eightfold increased odds (OR = 7.874), mirroring findings by Kershaw et al., (2023), who identified respiratory failure and neurological compromise as major causes of early ED death. Similarly, delayed capillary refill (>3 seconds, OR = 4.969) and physical signs like pallor and jaundice were indicative of circulatory or systemic compromise, also aligning with patterns in the literature.

Underlying medical conditions such as hypertension (OR = 2.762), diabetes mellitus (OR = 1.247), and trauma (OR = 2.021) were significant contributors to mortality. This is in agreement with Barbosa et al., (2023), who found that cardiovascular disease and trauma were among the leading causes of ED mortality, with trauma alone increasing death risk 4.6-fold. Similarly, studies from Ghana and Uganda identified stroke, trauma, and infectious diseases like malaria as major contributors (Buunaaim et al., 2022; Newgard et al., 2023). However, some inconsistencies exist. For instance, while fever on admission showed increased mortality in this study, its odds ratio was relatively moderate compared to other variables. Kelen et al., (2021) found sepsis to be a leading cause of ED mortality, which would be expected to show stronger associations with fever.

CONCLUSION

The study showed that mortality in the Emergency Department (ED) is significantly influenced by identifiable health-related and clinical factors at presentation. The findings established that repeated prior ED visits, prolonged duration of illness before admission, and higher triage acuity (Red and Orange categories) were strong predictors of mortality. Physiological instability, including hypoxemia, need for active airway support, prolonged capillary refill time, impaired neurological responsiveness (AVPU), pallor, and jaundice, significantly increased the risk of death. In addition, underlying conditions such as traumatic injuries, hypertension, and diabetes mellitus were associated with elevated mortality risk. The ANOVA results further demonstrated that the combined predictors significantly explained variations in mortality outcomes, with approximately 45% of the variance in mortality accounted for by the model. This confirms that the identified clinical and patient-related factors collectively provide a strong and meaningful prediction of ED mortality.

The study therefore concludes that early mortality in the ED is largely determined by severity of illness at presentation, delayed care-seeking, physiological compromise, and pre-existing comorbidities. Strengthening early detection, timely intervention, effective triage systems, and aggressive management of critically ill patients is essential to reduce preventable deaths in emergency settings.

Suggestions

The Ministry of Health, in collaboration with county governments and hospital management teams, should strengthen emergency care systems to reduce preventable mortality in Emergency Departments (EDs). Clear national and county-level guidelines should be reinforced to standardize triage protocols, rapid assessment, and

immediate stabilization of critically ill patients. Emphasis should be placed on early identification and aggressive management of high-risk presentations, including hypoxemia, altered consciousness (AVPU), prolonged capillary refill, airway compromise, and severe triage categories (Red and Orange). Counties should prioritize adequate funding to ensure consistent availability of essential emergency equipment such as oxygen delivery systems, airway management supplies, and monitoring devices.

Healthcare facilities should invest in continuous professional development for ED staff, focusing on advanced life support skills, early warning systems, and rapid response to physiological deterioration. Regular simulation drills and mortality audits should be institutionalized to identify gaps in emergency response and improve clinical decision-making. Strengthening referral systems and pre-hospital care services is also critical to reduce delays in presentation, particularly for patients with prolonged illness duration before admission. Community-level interventions should promote early care-seeking behavior through public health education on recognizing danger signs and the importance of timely hospital presentation. Screening and routine management of chronic conditions such as hypertension and diabetes should be enhanced at primary care levels to reduce complications that contribute to ED mortality. Finally, a robust monitoring and evaluation framework should be established to track ED outcomes, analyze trends in mortality predictors, and guide evidence-based policy and resource allocation decisions aimed at improving survival in emergency settings.

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Declarations

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Conflict of interest: None declared

Ethical approval: The study was approved by the Mount Kenya University- Ethical Review Committee and a permission by National Commission for Science, Technology and Innovation, Kenya. Written consent was obtained from the participants.

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