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Original Research Article

Evaluating Mortality and Survival Patterns Among ICU Patients: Evidence from Two Years of Data at Jazan General Hospital

Article History:

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Abstract: ***Background***: Patient characteristics, disease severity, and care practices strongly influence ICU mortality. Improving critical care outcomes requires understanding local trends and risk factors. This two-year study examined sociodemographic, clinical, and system-related factors among ICU patients at Jazan General Hospital. ***Methods***: A retrospective observational study at Jazan General Hospital analyzed medical records of adult ICU patients over the past two years. Data included sociodemographic, admission sources, length of stay, mechanical ventilation dependence, system involvement, reasons for admission, comorbidities, and outcomes. Mortality was defined as death during ICU stay. Patient characteristics were summarized using descriptive statistics, while inferential statistics identified significant mortality factors through odds ratios and 95% confidence intervals. ***Results***: Of the 998 ICU admissions, 756 (75.6%) survived, and 242 (24.2%) died. One important cause of death was age, with patients over 90 years old having the greatest risk (48.3%, OR: 14.64, p<0.001). Widowed patients had a 46.6% death rate (OR: 10.08, p<0.001). Hospital referrals were linked to a 42.6% mortality rate (OR: 3.28, p<0.001). Higher mortality was linked to longer ICU stays (OR: 4.4 for >10 days, p<0.001), and the probability of death rose to 62.1% with mechanical ventilation (OR: 19.15, p<0.001). Additionally, pulmonary (39.5%, OR: 3.12) and neurological (38.4%, OR: 1.72) causes were associated with higher mortality. Hypertension (OR: 2.0, p=0.001) and solid malignancies (OR: 4.15) were linked to higher mortality. ***Conclusion***: ICU mortality was influenced by advanced age, illness severity indicators, admission source, system involvement, and the selected comorbidities. Prolonged ICU stays and mechanical ventilation were significant predictors of poor outcomes.

Keywords: ICU, Patient characteristics, Comorbidities, Mortality, Survival, Mechanical Ventilation.

INTRODUCTION

Intensive care units (ICUs) are central to the treatment of acutely ill patients, providing advanced supervision and life-sustaining care for those with life-threatening illnesses [1,2]. Though critical care practices have continued to improve, ICU mortality is still a significant health issue in the world, which indicates the intensity of illness, complexity of care, and inconsistency of patient-related and system-related variables [3,4]. Knowledge of mortality and survival rates in ICU patients is critical for assessing how effectively care is delivered, how resources are used, and how patients are affected, especially in limited-resource or high-demand healthcare settings [5].

Previous research has consistently shown that ICU outcomes depend on a combination of sociodemographic factors, clinical conditions, and treatment-related factors [6,7]. Age and gender have been extensively reported as significant predictors of survival, with older age groups having higher mortality rates due to greater comorbidity and reduced physiological reserve [8]. Strong predictors of mortality include admission source, ICU length of stay, and mechanical ventilation, which often reflect illness severity and late onset [9]. Moreover, organ- or system-based patterns of involvement can be useful for assessing disease burden and stratifying patients' prognosis in the critical care unit [10].

In Saudi Arabia, particularly in the southern regions, ICU mortality trends are relatively scarce, even as critical care services are on the rise. Jazan General Hospital serves a heterogeneous population with diverse socio-demographic factors and clinical presentations, making it a valuable setting to assess ICU outcomes. Generating local evidence is important because mortality and risk factor trends may differ from those in other areas, driven by differences in population characteristics, access to healthcare services, and clinical practices.

Based on this, the study was conducted to assess the mortality and survival rates of ICU patients at Jazan General Hospital over 2 years. By analyzing socio-demographic variables, admission site, ICU length of stay, mechanical ventilation, and system involvement, the study aims to identify factors that significantly impact patient outcomes.

MATERIAL AND METHODS:

Study design and setting:
The study used a retrospective observational design to assess mortality and survival rates among patients admitted to the intensive care unit at Jazan General Hospital.

Study Population and Criteria:
Medical records were reviewed to collect data for two years, covering all eligible adult ICU admissions during the study period. The target population was adult patients admitted to the ICU for medical or surgical reasons. For patients with multiple ICU admissions, only the first admission was included in the analysis. Incomplete records and patients missing essential outcome variables were excluded to ensure data reliability and analytical validity.

Data collection:
A structured data-collection form specifically designed for this study was used to gather data. These data were collected using the hospital's electronic health record system, Vida. The database contained routinely collected administrative data, health histories, discharge summaries, age, sex, and ICD-10 (International Classification of Diseases, 10th Revision) diagnoses.

The socio-demographic variables were age, gender, and marital status. The dependent variables included clinical and admission-related variables, the source of ICU admission, ICU length of stay, mechanical ventilation requirement, and the reported system involvement, which was classified by the primary organ system involved. The SOFA score was assessed within the first 24 hours after ICU admission. The outcome was defined as survivors and non-survivors; a survivor was transferred out of the intensive care unit, and a non-survivor was dead at the time of discharge from the intensive care unit.

Statistical data analysis:
Data were entered and analyzed using the Statistical Package for the Social Sciences (Version 27.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics, including means or medians for continuous variables and frequencies and percentages for categorical variables, summarized patient characteristics. Relationships with mortality were evaluated using inferential statistical tests, namely independent t-tests for continuous variables and chi-square and Fisher's exact tests for categorical variables. To identify independent predictors of intensive care unit mortality, a multivariate regression analysis was performed.

Ethical Considerations
The hospital's Ethics Committee and Institutional Review Board (IRB) approved it (No. 2510). For these ICU patients, these data are used secondarily. At all times, patient confidentiality was maintained. Because the study was retrospective, direct patient consent might not have been necessary, but ethical standards were adhered to when handling the data.

RESULTS:

Of the 998 ICU admissions included in the analysis, most patients survived their ICU stay. Of these, 242 (24.2%) died in the intensive care unit, and 756 (75.7%) were discharged alive.

There was a strong, significant correlation between ICU mortality and patient age. The reference group was the youngest patients, aged ≤ 30 years, who had the lowest mortality rate (6.0%) and the highest survival. Mortality increased with age, reaching 46.5% in patients aged 71 to 90 years and 48.3% in those over 90. Mortality risk increased significantly with age, with patients over 90 years having the highest risk (OR: 14.64, 95% CI: 6.0335.53; p<0.001).

Gender did not significantly correlate with mortality. Male and female patients had comparable survival rates, with no discernible difference in mortality (24.9% and 23.5%, respectively). The ICU results were significantly correlated with marital status. The reference group consisted of single patients with the lowest mortality rate (8.0). On the other hand, the mortality rate for patients who were married, divorced, or widowed exhibited an upward trend, with the mortality rate for widowed patients standing at 46.6%. These were statistically significant, and widowed patients had noticeably higher odds of dying (OR: 10.08, 95% CI: 5.7217.76; p<0.001). The mortality rate was similar between rural and urban patients, so residence status was not a significant factor. Even though the mortality rate was marginally lower in 2024 than in 2023, there was no statistically significant variation in mortality across admission Table 1

Table 1: Patient demographics and their relation with outcome

		Total		Outcome						
				Survivors		Non-survivors		P-value	Odd ratio (95% CI)	P-value
		Count	Column N %	Count	Row N %	Count	Row N %			
Age	≤ 30 years	267	26.8%	251	94.0%	16	6.0%	0.000*	Control	
	31-50 years	221	22.1%	193	87.3%	28	12.7%		2.28 (1.9-4.32)	0.012*
	51-70 years	266	26.7%	182	68.4%	84	31.6%		7.24 (4.10-12.77)	0.000*
	71-90 years	215	21.5%	115	53.5%	100	46.5%		13.64 (7.69-24.17)	0.000*
	Over 90	29	2.9%	15	51.7%	14	48.3%		14.64 (6.03-35.53)	0.000*
Gender	Male	547	54.8%	411	75.1%	136	24.9%	0.618	Control	
	Female	451	45.2%	345	76.5%	106	23.5%		0.93 (0.69-1.24)	0.618
Marital status	Single	276	27.7%	254	92.0%	22	8.0%	0.000*	Control	
	Married	540	54.1%	396	73.3%	144	26.7%		4.19 (2.61-6.75)	0.000*
	Divorced	64	6.4%	43	67.2%	21	32.8%		5.64 (2.86-11.12)	0.000*
	Widow	118	11.8%	63	53.4%	55	46.6%		10.08 (5.72-17.76)	0.000*
Residency	Rural	469	47.0%	350	74.6%	119	25.4%	0.435	Control	
	Urban	529	53.0%	406	76.7%	123	23.3%		0.89 (0.67-1.19)	0.435
Year of admission:	2023	488	48.9%	358	73.4%	130	26.6%	0.085	Control	
	2024	510	51.1%	398	78.0%	112	22.0%		0.78 (0.58-1.03)	0.085

P-values indicate statistical significance at $p < 0.05$

There was statistically significant in mortality rate across admission months. The mortality was higher in some months specially in March and June, at 39.0, 38.6 respectively. August on the other hand had the lowest mortality rate at 2.8. This result indicates the ICU mortality rate during the study period exhibit seasonal variation (Figure 1).

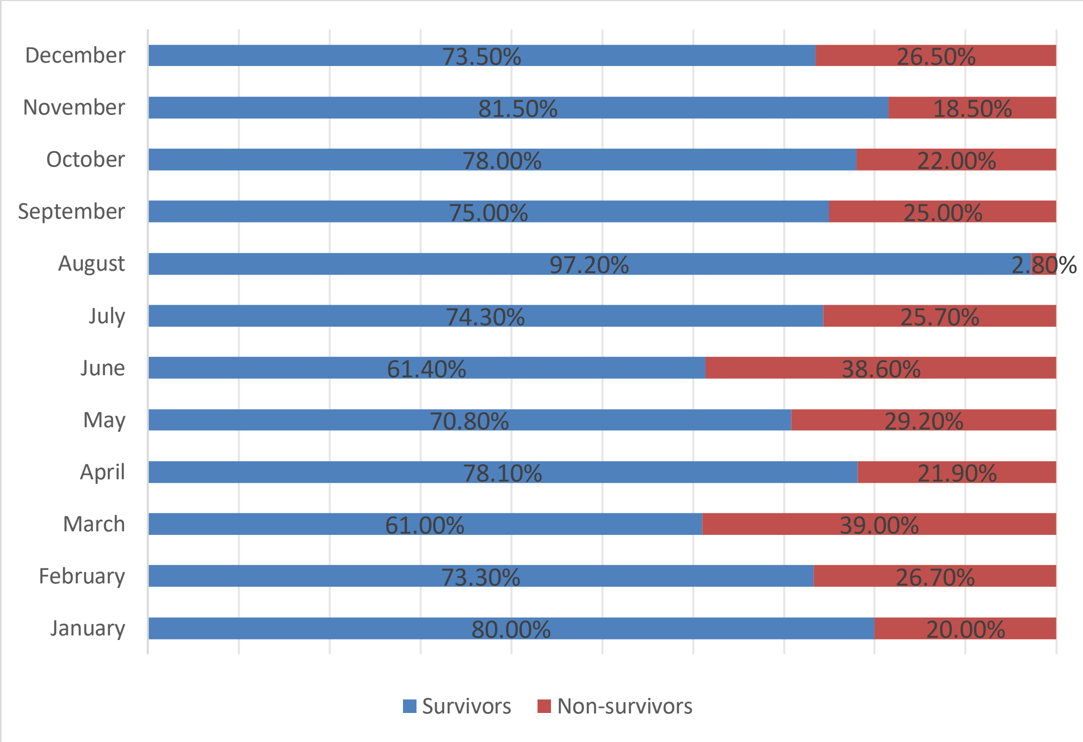

Figure 1: The relation between the date of admission per month and the mortality rate

ICU results showed a significant correlation with the source of admission. Patients admitted to medical wards or referred from other hospitals had a higher death rate than those who visited the emergency room. The highest mortality rate (42.6%) and a significantly higher risk of death (OR: 3.28, 95% CI: 2.29-2.294.69; p<0.001) were observed among patients referred from other hospitals. ICU length of stay was also strongly correlated with mortality. Patients who spent more than 10 days in the ICU had the highest mortality rate (50.0) and a significantly higher risk of death than those who stayed for ≤ 2 days (OR: 4.4, 95% CI: 2.79-6.92; p<0.001). Likewise, hospital length of stay was significantly associated with outcome, with lower mortality among patients who stayed 6–10 days than among those who stayed for very short periods. Mortality was strongly predicted by mechanical ventilation status. Mechanically ventilated patients had a significantly higher mortality rate of 62.1, compared with 7.9 among non-ventilated patients. A 19-fold increase in mortality was associated with mechanical ventilation (OR: 19.15, 95% CI: 13.3427.4-27.4; p<0.001). The classification of a disease as communicable or non-communicable did not significantly correlate with mortality; however, patients with communicable diseases had a higher mortality rate (Table 2).

Table 2: Clinical characteristics and their relation with mortality

		Total		Outcome						
				Survivors		Non-survivors		P-value	Odd ratio (95% CI)	P-value
		Count	Column %	Count	Row N %	Count	Row N %			
Admission source:	Emergency Department	639	64.0 %	521	81.5 %	118	18.5 %	0.000 *	control	
	Medical department	93	9.3 %	56	60.2 %	37	39.8 %		2.92 (1.84-4.62)	0.000*
	Surgical department	46	4.6 %	35	76.1 %	11	23.9 %		1.38 (0.68-2.81)	0.363
	Orthopaedics department	11	1.1 %	11	100.0 %	0	0.0%		0.19 (0.01-3.27)	0.253
	Obstetrical and Gynaecological Department	33	3.3 %	32	97.0 %	1	3.0%		0.14 (0.02-1.01)	0.052
	Referral from other hospitals	176	17.6 %	101	57.4 %	75	42.6 %		3.28 (2.29-4.69)	0.000*

Duration of ICU admission:	days	270	27.1 %	220	81.5 %	50	18.5 %	0.000 *	Control	
	3 – 5 days	417	41.8 %	337	80.8 %	80	19.2 %		1.04 (0.71-1.55)	0.8277
	6 - 8 days	129	12.9 %	100	77.5 %	29	22.5 %		1.28 (0.76-2.14)	0.3536
	8- 10 days	44	4.4 %	30	68.2 %	14	31.8 %		2.05 (1.01-4.15)	0.045*
	More than 10 days	138	13.8 %	69	50.0 %	69	50.0 %		4.4 (2.79-6.92)	0.000*
Length of Hospital Stay (LOS):	0 - 2 days	113	11.3 %	75	66.4 %	38	33.6 %	0.000 *		
	3 – 5 days	305	30.6 %	229	75.1 %	76	24.9 %		0.65 (0.41-1.04)	0.076
	6 - 8 days	176	17.6 %	148	84.1 %	28	15.9 %		0.37 (0.21-0.65)	0.000*
	8- 10 days	102	10.2 %	89	87.3 %	13	12.7 %		0.28 (0.14-0.58)	0.000*
	More than 10 days	302	30.3 %	215	71.2 %	87	28.8 %		0.79 (0.50-1.26)	0.341
Status regarding mechanical ventilation	Was on MV	301	30.2 %	114	37.9 %	187	62.1 %	0.000 *	19.15 (13.34-27.4)	0.000*
	Not on a mechanical ventilator	697	69.8 %	642	92.1 %	55	7.9%		Control	
Is the disease classified as communicable or non-communicable?	Non-communicable	939	94.1 %	717	76.4 %	222	23.6 %	0.075		
	Communicable	59	5.9 %	39	66.1 %	20	33.9 %		1.65 (0.94-2.89)	0.075

Statistical significance is indicated by p-values <0.05

Figure 2 shows the trends for infectious and communicable diseases; genitourinary, obstetrical, and gynecological diseases; cardiovascular diseases; respiratory diseases; gastroenterology and liver diseases; nephrology; endocrinology; neurology; self-harm; orthopedics; surgery; dermatology; and other conditions. A significant number of admissions were due to respiratory disease (234 [23.45%]), and 3.84% of those cases had mortality. Cardiovascular disease (118 [11.82%]) was the next most common cause of admission, and 1.12% of those cases had mortality.

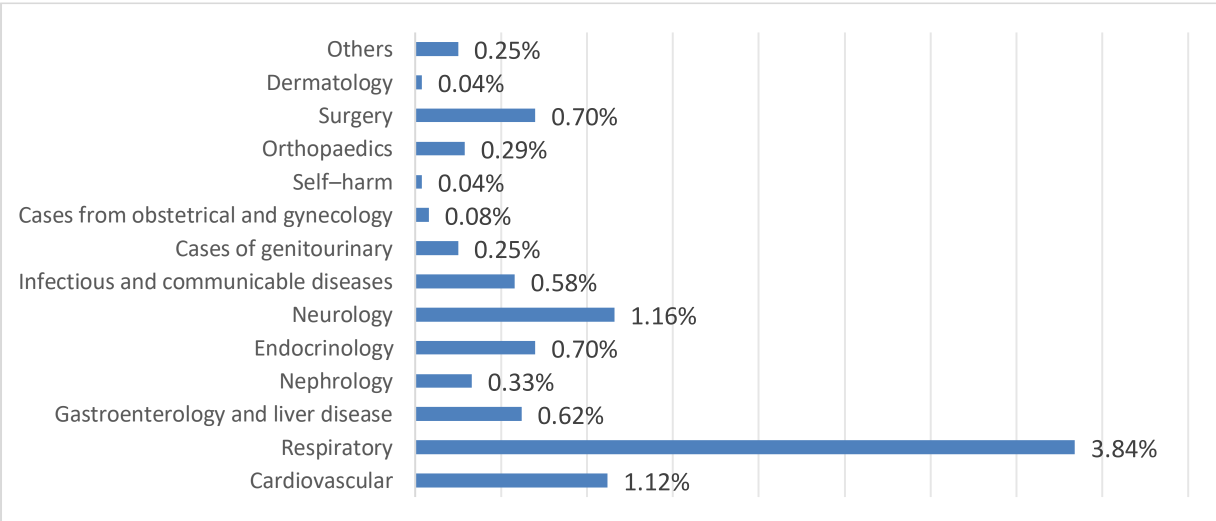

Figure 2. System involvement: total cases and mortality

Greater mortality was strongly associated with pulmonary and neurological reasons for ICU admission. The mortality rate was 39.5% among patients admitted for pulmonary causes, three times higher than among those with other causes (OR: 3.02, 95% CI: 2.224.08; p<0.001). Similar results were observed for neurological causes, which were also associated with higher mortality (38.4%; OR: 1.72, 95% CI: 1.132.63; p<0.001). The association with mortality in this cohort was not statistically significant for infectious causes and cardiovascular admissions. Notably, all patients admitted to the hospital because of self-harm survived, indicating that the mortality risk among this group is considerably lower (Table 3).

Table 3: Reasons for ICU and their relation with outcomes

		Total		Outcome						
				Survivors		Non-survivors		P-value	Odd ratio (95% CI)	P-value
		Count	Column %	Count	Row N %	Count	Row N %			
Infectious and communicable disease: specify	No	939	94.1%	717	76.4%	222	23.6%	0.075	Control	
	Yes	59	5.9%	39	66.1%	20	33.9%		1.65 (0.94-2.89)	0.075
Cardiovascular cause:	No	848	85.0%	638	75.2%	210	24.8%	0.366	Control	
	Yes	150	15.0%	118	78.7%	32	21.3%		0.82 (0.54-1.25)	0.366
Pulmonary causes:	No	702	70.3%	577	82.2%	125	17.8%	0.000*	Control	
	Yes	296	29.7%	179	60.5%	117	39.5%		3.02 (2.22-4.08)	0.000*
Neurological causes:	No	873	87.5%	679	77.8%	194	22.2%	0.000*	Control	
	Yes	125	12.5%	77	61.6%	48	38.4%		1.72 (1.13-2.63)	0.000*
The Causative Agents in Self-harm Behavior	No	970	97.2%	728	75.1%	242	24.9%	0.002*	Control	
	Yes	28	2.8%	28	100.0%	0	0.0%		0.05 (0.00-0.86)	0.002*

P-values indicate statistical significance at p < 0.05.

Several comorbidities were strongly associated with higher ICU mortality. Hypertension was associated with a mortality of 32.1% and an odds ratio of 2.0 (95% CI 1.52-2.74, p=0.001). Increased mortality was also observed with ischemic heart disease. Patients with solid malignancies and chronic liver disease had the highest mortality rates, exceeding 50%, and both disorders were significantly associated with death. Conversely, diabetes mellitus, chronic obstructive pulmonary disease, chronic kidney disease, and hematological malignancies were not significantly associated with mortality. Although the mortality proportion was higher in immunosuppressed patients, the association was not statistically significant. Overall, the comorbidity trend showed a higher mortality rate, but the combined relationship was not statistically significant (Table 4).

Table 4: Comorbidities and their relation with outcomes

		Total		Outcome						
				Survivors		Non-survivors		P-value	Odd ratio (95% CI)	P-value
		Count	Column %	Count	Row N %	Count	Row N %			
Diabetes	No	539	54.0%	398	73.8%	141	26.2%	0.127	Control	
	Yes	459	46.0%	358	78.0%	101	22.0%		0.79 (0.59-1.07)	0.127
HTN	No	590	59.1%	479	81.2%	111	18.8%	0.000*	Control	
	Yes	408	40.9%	277	67.9%	131	32.1%		2.0 (1.52-2.74)	0.000*
IHD	No	845	84.7%	650	76.9%	195	23.1%	0.042*	Control	
	Yes	153	15.3%	106	69.3%	47	30.7%		1.47 (1.01-2.15)	0.042*
Solid Malignancy	No	973	97.5%	745	76.6%	228	23.4%	0.000*	Control	
	Yes	25	2.5%	11	44.0%	14	56.0%		4.15 (1.86-9.29)	0.000*
COPD	No	968	97.0%	732	75.6%	236	24.4%	0.581		
	Yes	30	3.0%	24	80.0%	6	20.0%		0.77 (0.31-1.92)	0.581

Chronic liver disease	No	986	98.8%	751	76.2%	235	23.8%	0.006*	Control	
	Yes	12	1.2%	5	41.7%	7	58.3%		4.47 (1.4-14.2)	0.006*
CKD	No	908	91.0%	693	76.3%	215	23.7%	0.182	Control	
	Yes	90	9.0%	63	70.0%	27	30.0%		1.38 (0.86-2.22)	0.182
Haematological malignancy	No	994	99.6%	753	75.8%	241	24.2%	0.972	Control	
	Yes	4	0.4%	3	75.0%	1	25.0%		1.0 (0.10-10.0)	0.972
Immunosuppressed patients	No	988	99.0%	751	76.0%	237	24.0%	0.056	Control	
	Yes	10	1.0%	5	50.0%	5	50.0%		3.17 (0.91-11.0)	0.056
Comorbidities	No	340	34.1%	268	78.8%	72	21.2%	0.104	Control	
	Yes	658	65.9%	488	74.2%	170	25.8%		1.41 (1.03-1.93)	0.104

Statistical significance is indicated by p-values < 0.05.

DISCUSSION:

This research paper presents an in-depth analysis of mortality and survival rates among ICU patients admitted to Jazan General Hospital over two years and identifies demographic, clinical, and system-related variables that significantly influence ICU patient outcomes. The ICU mortality rate of 24.2% aligns with regional and international studies, where ICU mortality typically ranges from 20% to 30%, reflecting the high acuity and complexity of the critically ill population [11]. These results are consistent with several previous studies conducted in Saudi Arabia, including the study by Shaabi L et al. in Southwest Saudi Arabia, which reported an ICU mortality rate of 29.4% [12], and the study by Rosenthal V et al. among 10 Middle Eastern countries, including Saudi Arabia, that reported an ICU mortality rate of 21.0% [13].

Age was found to be one of the best predictors of mortality, with a clear stepwise increase in the death rate with age. Patients aged 71 years and older had significantly higher mortality, and the odds of death were higher than in younger patients. This observation is consistent with the extensive literature on critical care, which indicates that older age is associated with decreased physiological reserve, increased comorbidities, and greater intolerance to critical illness and invasive procedures [14-16]. Age-related mortality gradients have been observed to be similar across large multicentre ICU studies in various healthcare systems [17,18].

In this study, gender was not significantly associated with ICU mortality, consistent with several reports showing that, in the presence of disease severity and comorbidities, sex alone is not a significant determinant of ICU outcomes [19-21]. Marital status was significantly associated with outcomes, with widowed and divorced patients having higher mortality than single patients. Although marital status is not a direct clinical variable, prior research has shown that social support, living conditions, and delayed healthcare-seeking behaviors can influence disease severity at presentation and subsequent outcomes, especially among older and widowed individuals [22].

The seasonal variation in mortality, as shown in the monthly admission analysis, revealed very high rates in some months. Similar seasonal patterns have been reported in ICU populations. They are usually attributed to fluctuations in infectious disease incidence, environmental factors, extreme temperatures, and additional strain on healthcare systems during peak periods [23]. The source of admission was a significant determinant of outcome. Mortality was markedly higher among patients referred from other hospitals and those admitted from medical wards than among those admitted to the emergency department. This observation aligns with existing evidence that inter-hospital transfers often involve more acutely ill patients or late referrals, both of which are linked to worse outcomes [24].

The ICU length of stay was significantly correlated with mortality, particularly when it exceeded 10 days. Prolonged ICU admissions are often associated with more severe illness, nosocomial infections, and long-term organ support, all of which contribute to higher mortality [25,26]. Similarly, hospital length of stay is an indicator of the multifaceted interplay among disease severity, recovery patterns, and survivorship bias, in which patients who spend more time in the hospital may constitute a more robust subgroup [25]. The strongest predictor of mortality in this cohort was mechanical ventilation. The mortality rate among ventilated patients was significantly higher, with almost a nineteen-fold increase in the probability of death. This observation is supported by the existing literature, which generally accepts mechanical ventilation as a surrogate indicator of severe respiratory failure and the overall severity of critical illness [27]. Other complications, such as pneumonia and barotrauma, are also ventilator-associated and increase the risk of mortality [27].

Involvement of the respiratory and neurological systems contributed to a significant share of ICU admissions and deaths. Respiratory involvement, especially, was linked to the greatest mortality burden, consistent with global data showing that respiratory failure is a major cause of ICU admission and death [9]. Neurological involvement also carries a high mortality rate, indicating a poor prognosis for acute neurological insults, including stroke, traumatic brain injury, and altered consciousness [28].

Independent predictors of increased mortality included pulmonary and neurological reasons for ICU hospitalization, consistent with prior research identifying these factors as high-risk for critical care hospitalization [27,28]. Comorbid conditions were also important determinants. Hypertension and ischemic heart disease were associated, consistent with findings that cardiovascular comorbidities increase susceptibility to critical illness and impair recovery [29]. Importantly, patients with solid malignancies and chronic liver disease had especially high mortality rates, consistent with previous research pointing to poor ICU outcomes in patients with advanced malignancy and hepatic dysfunction caused by immune compromise and low physiological reserve [30].

This research was also limited in several ways that should be considered when interpreting the results. The retrospective design relied on the accuracy and completeness of medical records, which could have led to missing or misclassified data for the variables. As a single-centre study at Jazan General Hospital, the results may not be fully applicable to other health care facilities with different patient populations, case mix, and ICU resources. Only the available demographic and clinical variables were analysed, and significant disease severity indicators, such as standardized ICU scoring systems or detailed laboratory parameters, were not always recorded and therefore could not be considered. Moreover, because the study was observational, causality could not be determined, and residual confounding by unmeasured factors could have contributed to the observed relationships.

CONCLUSION

In conclusion, this paper highlights that age, severity-related factors (mechanical ventilation and a long ICU stay), the source of admission, system involvement, and the choice of comorbidities are the major determinants of ICU mortality at Jazan General Hospital. These results align with international evidence and underscore the need to stratify risks early, refer patients promptly, and implement targeted interventions for high-risk patients to improve survival and reduce ICU mortality.

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Conflicts of Interest: The author states that there are no competing interests.

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Abbreviation:
- ICU: Intensive Care Unit
- OR: Odd Ratio
- CI: Confidence Interval
- HTN: Hypertension
- IHD: Ischemic Heart Disease
- COPD: Chronic Obstructive Pulmonary Airway disease
- CKD: Chronic Kidney Disease

REFERENCES

1. Waydhas C, Riessen R, Markewitz A, et al. Recommendations on the structure, personnel, and organization of intensive care units. *Frontiers in Medicine*. 2023;10:1196060. doi:10.3389/fmed.2023.1196060
2. Marshall JC, Bosco L, Adhikari NK, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. *Journal of Critical Care*. 2016;37:270-276. doi:10.1016/j.jcrc.2016.07.015
3. Wang J, Li Q, Xie C, et al. Predicting In-Hospital mortality in Intensive care unit patients using causal SurvivalNet with serum chloride and other causal factors: Cross-Country study. *Journal of Medical Internet Research*. 2025;27:e70118. doi:10.2196/70118
4. Ohbe H, Satoh K, Totoki T, et al. Definitions, epidemiology, and outcomes of persistent/chronic critical illness: a scoping review for translation to clinical practice. *Critical Care*. 2024;28(1):435. doi:10.1186/s13054-024-05215-4
5. Gharibeh T, Abu-Helalah M, Alshraideh H, et al. Predictors of mortality in medical ICU patients: a retrospective study in a tertiary care center in Jordan. *Journal of Clinical Medicine*. 2025;14(12):4039. doi:10.3390/jcm14124039
6. Porter LL, Hazeleger L, Bos K, et al. Identifying distinct clusters of ICU survivors by integrating demographic, pre-admission quality of life, and clinical data: a large prospective cohort study. *Intensive Care Medicine*. 2025;51(9):1603-1614. doi:10.1007/s00134-025-08052-3
7. Perlaza CL, Mosquera FEC, Reyes SPM, et al. Sociodemographic, clinical, and ventilatory factors influencing COVID-19 mortality in the ICU of a hospital in Colombia. *Healthcare*. 2024;12(22):2294. doi:10.3390/healthcare12222294
8. Valenti M, Ceolin C, Rossato M, et al. The impact of age and frailty on hospitalization and

survival in older liver transplant recipients: a longitudinal cohort study. *Frontiers in Aging*. 2025;6:1539688. doi:10.3389/fragi.2025.1539688

9. Melaku E, Urgie B, Dessie F, Seid A, Abebe Z, Tefera A. Determinants of mortality of patients admitted to the intensive care unit at Debre Berhan Comprehensive Specialized Hospital: a retrospective cohort study. *Patient-Related Outcome Measures*. 2024;Volume 15:61-70. doi:10.2147/prom.s450502
10. Celik H, Pehlivan B, Pehlivan VF, Duran E. Prognostic value of inflammatory and metabolic biomarkers in ICU-Admitted trauma patients: a retrospective cohort study. *Medicina*. 2025;61(9):1530. doi:10.3390/medicina61091530
11. Wu Y, Huang S, Chang X. Understanding the complexity of sepsis mortality prediction via rule discovery and analysis: a pilot study. *BMC Medical Informatics and Decision Making*. 2021;21(1):334. doi:10.1186/s12911-021-01690-9
12. Shaabi LA, Mahfouz MS, Shamakhi AE, Alahdal FAA, Hakamy A, Rajhi F. Mortality Trends and characteristics in a tertiary hospital in Southwest Saudi Arabia: A 5-Year Retrospective study. *Medicina*. 2025;61(8):1334. doi:10.3390/medicina61081334
13. Rosenthal VD, Jin Z, Memish ZA, et al. Risk factors for mortality in ICU patients in 10 middle eastern countries: The role of healthcare-associated infections. *Journal of Critical Care*. 2022;72:154149. doi:10.1016/j.jcrc.2022.154149
14. Ismail AJ, Hassan WMNW, Nor MBM, Shukeri WFWM. The impact of age on mortality in the intensive care unit: a retrospective cohort study in Malaysia. *Acute and Critical Care*. 2024;39(3):390-399. doi:10.4266/acc.2024.00640
15. Frutuoso J, Coelho FDN, Antunes I, Póvoa P. Critical care challenges and Mortality Predictors in Older Adults: A Comprehensive Cohort analysis. *Cureus*. 2024;16(12):e76433. doi:10.7759/cureus.76433
16. Chung E, Chung KS, Leem AY, et al. Impact of age on mortality and transfer to long-term care in patients in an intensive care unit. *BMC Geriatrics*. 2023;23(1):839. doi:10.1186/s12877-023-04526-5
17. Vallet H, Guidet B, Boumendil A, et al. The impact of age-related syndromes on ICU process and outcomes in very old patients. *Annals of Intensive Care*. 2023;13(1):68. doi:10.1186/s13613-023-01160-7
18. Blancas R, Martínez-González Ó, Vigil D, et al. Influence of age and intensity of treatment on intra-ICU mortality of patients older than 65 years admitted to the intensive care unit. *European Geriatric Medicine*. 2012;3(5):290-294. doi:10.1016/j.eurger.2012.05.002
19. Merdji H, Long MT, Ostermann M, et al. Sex and gender differences in intensive care medicine. *Intensive Care Medicine*. 2023;49(10):1155-1167. doi:10.1007/s00134-023-07194-6
20. Yoshida Y, Gillet SA, Brown MI, et al. Clinical characteristics and outcomes in women and men hospitalized for coronavirus disease 2019 in New Orleans. *Biology of Sex Differences*. 2021;12(1):20. doi:10.1186/s13293-021-00359-2
21. Marella P, Ramanan M, Shekar K, Tabah A, Laupland KB. Determinants of 90-day case fatality among older patients admitted to intensive care units: A retrospective cohort study. *Australian Critical Care*. 2023;37(1):18-24. doi:10.1016/j.aucc.2023.07.039
22. Holm AL, Berland AK, Severinsson E. Factors that influence the health of older widows and widowers—A systematic review of quantitative research. *Nursing Open*. 2019;6(2):591-611. doi:10.1002/nop2.243
23. Richet H. Seasonality in Gram-negative and healthcare-associated infections. *Clinical Microbiology and Infection*. 2012;18(10):934-940. doi:10.1111/j.1469-0691.2012.03954.x
24. Kudlow P, Burns KE, Adhikari NK, et al. Inter-hospital transfers and outcomes of critically ill patients with severe acute kidney injury: a multicenter cohort study. *Critical Care*. 2014;18(5):513. doi:10.1186/s13054-014-0513-1
25. Shacho E, Yilma D, Goshu AT, Ambelu A. Adult intensive care unit nosocomial infections related deaths in Jimma medical center: a cause-specific Cox regression analysis. *BMC Infectious Diseases*. 2025;25(1):1745. doi:10.1186/s12879-025-12199-1
26. Rodrigues AR, Oliveira A, Vieira T, et al. A prolonged intensive care unit stay defines a worse long-term prognosis – Insights from the critically ill mortality by age (Cimba) study. *Australian Critical Care*. 2024;37(5):734-739. doi:10.1016/j.aucc.2024.03.001
27. Lezcano SM, De la Hoz MÁA, Corbi A, et al. Predictors of mechanical ventilation and mortality in critically ill patients with COVID-19 pneumonia. *Medicina Intensiva*. 2024;48(1):3-13. doi:10.1016/j.medin.2023.06.012
28. Dobson GP, Morris JL, Letson HL. Traumatic brain injury: Symptoms to systems in the 21st century. *Brain Research*. 2024;1845:149271. doi:10.1016/j.brainres.2024.149271
29. Phelps M, Christensen DM, Gerds T, et al. Cardiovascular comorbidities as predictors for severe COVID-19 infection or death. *European Heart Journal - Quality of Care and Clinical Outcomes*. 2020;7(2):172-180. doi:10.1093/ehjqcco/qcaa081

30. Assi HI, Halim NA, Alameh I, et al. Outcomes of Patients with Malignancy Admitted to the Intensive Care Units: A Prospective Study. *Critical Care Research and Practice*. 2021;2021:1-6. doi:10.1155/2021/4792309

