Zahedan J Res Med Sci. 2024 October; 26(4): e151648 https://doi.org/10.5812/zjrms-151648

Published Online: 2024 October 7

Research Article

Characteristics and Outcomes of Patients Admitted to Intensive Care Units in an Academic Hospital Northern Iran

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Received: 24 July, 2024; **Revised:** 21 August, 2024; **Accepted:** 1 September, 2024

Abstract

Background: Identifying risk factors that predict mortality in the intensive care unit (ICU) can lead to improved management of critically ill patients and help reduce mortality rates.

Objectives: This study aimed to identify the prevalence and risk factors that potentially contribute to predicting mortality in the ICU.

Methods: This cross-sectional study was conducted in the general ICU of an academic hospital in northeastern Iran from April 2019 to March 2023. Demographic and clinical data were retrieved from medical records, including age, gender, marital status, residency, length of stay in the ICU, level of consciousness, duration of mechanical ventilation (MV), and co-morbidities. The outcomes were categorized as death or discharge.

Results: Out of 8,650 admitted patients, 62.8% were discharged, and 37.2% died. The factors significantly associated with death included age (59.24 ± 21.9 years vs. 49.63 ± 23.32 years, $P < 0.0001$), female gender (42.7% vs. 57.3%, $P < 0.0001$), marital status (41.1% married vs. 58.9% unmarried, $P < 0.0001$), length of stay in the ICU (5.99 ± 9.09 days vs. 4.13 ± 6.55 days, $P < 0.0001$), Glasgow Coma Scale (GCS) of 3 - 5 (87.9% vs. 12.1%, $P < 0.0001$), duration of MV (4.86 ± 8.69 days vs. 1.09 ± 4.85 days, $P < 0.0001$), and co-morbidities (44.7% vs. 55.3%, $P < 0.0001$), which were confirmed by logistic regression analysis.

Conclusions: The prevalence of death in the ICU was 37.2%. Age, co-morbidities, cerebral vascular accident (CVA), GCS, duration of MV, and marital status were significantly associated with mortality.

Keywords: Intensive Care Units, Admission, Mortality

1. Background

The intensive care unit (ICU) is where patients with life-threatening conditions are managed. According to the Intensive Care Audit of Countries (ICON), the probability of death is statistically correlated with the income level of each country. Developing quality indicators, conducting audits, making necessary adjustments, and monitoring resources should all be required to ensure high-quality care (1, 2). A lack of essential resources, such as personnel, equipment, drugs, and supplies, as well as factors like infection, trauma, and patients' co-morbidities, contribute to higher ICU mortality rates. Several factors have a direct impact on treatment success and mortality rates in the ICU (3-5). A recent systematic review concluded that the high ICU mortality rates reported during the COVID-19 pandemic were largely due to the rationing of resources in overwhelmed hospitals (6).

Identifying the factors associated with increased ICU mortality will help to improve the management of critically ill patients. Since the quality of ICU care varies, and the findings of other research cannot always be generalized, it is essential for each center to be aware of its own situation. As no similar research has been conducted in Guilan province, this study was designed. The aim of the study is to assess the prevalence and variables associated with ICU mortality among patients admitted to the general ICU in an academic referral hospital in Guilan, northern Iran.

2. Objectives

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This study aimed to assess the prevalence and variables associated with the mortality rate among patients admitted to the general intensive care unit (GICU) in an academic referral hospital in Guilan, northern Iran.

3. Methods

This single-centered retrospective study was conducted at the General ICU of Poorsina Hospital, an academic comprehensive specialized hospital affiliated with Guilan University of Medical Sciences (GUMS), from 2019 to 2023. The ICU consists of 23 functional beds and mechanical ventilators. Data were collected using a structured checklist that included patients' socio-demographic characteristics, diagnosis at admission, presence of comorbidities, length of stay, and outcomes.

3.1. Verifiable Variables

The dependent variable in this study was ICU mortality, while the independent variables included age, sex, residency, marital status, and various comorbidities such as cancer, cardiac illness, hypertension, diabetes mellitus (DM), asthma, and chronic obstructive pulmonary disease (COPD). Additionally, the Glasgow Coma Scale (GCS) score, which evaluates ocular, verbal, and motor responses, was considered. The GCS scores were categorized as mild (GCS 13 - 15), moderate (GCS 9 - 12), and severe (GCS ≤ 8). Other independent variables included the number of days on mechanical ventilation (MV), the length of ICU stay, and the reasons for ICU admission. Based on the main outcome, either death or discharge, the patients were divided into two groups.

3.2. Statistical Analysis

Data analysis was conducted using SPSS version 22 (SPSS Inc., Chicago, IL). Continuous variables were expressed as means ± standard deviation, and categorical variables were described in terms of absolute and relative frequencies. Fisher's exact test, *t*-test, and chi-square test were used for analysis. To identify variables independently associated with mortality, multivariate logistic regression was performed. A significance level of less than 0.05 was considered statistically significant.

3.3. Ethics Considerations

This study was approved by the Ethics Committee in Research of GUMS under the ethics code IR.GUMS.REC.1402.357.

4. Results

Out of the 8,650 admitted patients, 62.8% were discharged, while 37.2% died. The average age of the patients was 53.2 ± 23.27 years, and 63.1% were men. Additionally, 64.3% of the patients resided in urban areas, 68.5% were married, and 57.5% had comorbidities. The average length of stay in the ICU was 4.82 ± 7.65 days. The demographic data of the patients and reasons for admission are shown in Tables 1 and 2. Comparisons between the death and discharge groups are presented in Tables 3 and 4.

Significant associations with increased mortality risk were found for several variables. Age was a key factor, with the deceased group averaging 59.24 ± 21.9 years, compared to 49.63 ± 23.32 years for those discharged ($P < 0.0001$). Female gender was more common in the deceased group (42.7%) than in the discharged group (57.3%, $P < 0.0001$). Married individuals were at a higher risk of mortality, with 41.1% of deceased patients being married, compared to 58.9% of those discharged ($P < 0.0001$). Additionally, a longer ICU stay was associated with a higher mortality risk, with the deceased group having an average stay of 5.99 ± 9.09 days, compared to 4.13 ± 6.55 days in the discharged group ($P < 0.0001$).

A GCS score of 3 - 5 was significantly associated with mortality, with 87.9% of the deceased patients in this range compared to 12.1% of the discharged patients ($P < 0.0001$). Mechanical ventilation was also a strong predictor of mortality. The deceased group had a longer duration of MV (4.86 ± 8.69 days) compared to the discharged group (1.09 ± 4.85 days, $P < 0.0001$). Comorbidities were present in 44.7% of deceased patients and 55.3% of discharged patients ($P < 0.0001$).

Logistic regression analysis revealed several independent predictors of mortality. Patients aged 21 - 40 had a 1.78 times higher risk of mortality than those aged less than 20 ($P < 0.0001$), while patients aged 41 - 60 had a 1.45 times higher risk ($P = 0.021$), and those aged over 80 had a 1.59 times higher risk compared to patients under 20 ($P = 0.009$). Female gender increased the risk of mortality by 1.39 times compared to males ($P < 0.0001$). Married individuals had a 1.22 times higher risk of mortality compared to single individuals ($P = 0.022$). Comorbidities increased the risk of mortality by 1.5 times ($P < 0.0001$).

Length of ICU stay also influenced mortality risk. A stay of 4 - 7 days increased the risk of mortality by 1.28 times compared to a one-day stay ($P < 0.0001$), while a stay of more than 7 days increased the risk by 1.5 times ($P < 0.0001$). Mechanical ventilation was another significant factor, with one day of MV increasing the risk of mortality by 21.8 times compared to non-intubated patients. Ventilation for 2 - 3 days increased the risk by

Table 1. Patients' Demographic Data

Variables	No. (%)
Gender	
Man	5461 (63.1)
Female	3189 (36.9)
Age (y) mean ± SD (min-max)	53.2 ± 23.27 (1 - 107)
Less than 20	842 (9.7)
21 - 40	2048 (23.7)
41 - 60	1969 (22.8)
61 - 80	2717 (31.4)
More than 80	1074 (12.4)
Residency	
Urban	5560 (64.3)
Rural	3090 (35.7)
Marital status	
Single	2725 (31.5)
Married	5925 (68.5)
Co-morbidities	
Yes	4972 (57.5)
No	3678 (42.5)
GCS	
3 - 5	1499 (17.3)
6 - 8	1193 (13.8)
9 - 12	2682 (31)
12 - 15	3276 (37.9)

Abbreviation: GCS, Glasgow Coma Scale.

17.51 times, and 4-7 days of ventilation increased the risk by 66.22 times ($P < 0.0001$). A GCS score of 3 - 5 increased the risk of mortality by 41 times, while a GCS score of 6-8 increased the risk by 1.93 times, and a GCS score of 9-12 increased the risk by 79 times compared to patients with a GCS score of 12 - 15 ($P < 0.0001$).

5. Discussion

This study identified that the ICU mortality rate in the GICU of an academic hospital in northern Iran was higher when compared to other international studies (4, 7, 8). ICU mortality rates have been reported at 18% - 21% in Brazil (9, 10), while Mayo Medical School reported a mortality rate of 8.2% among ICU patients (11). A similar study from Spain found a mortality rate of 52% among ICU patients, but it is important to note that this study only included patients above the age of 65 (8). Brunker et al. also emphasized the relationship between older age and the risk of mortality (12).

In the study by Rafiei Mehr (13), around 70% of the patients were discharged, and a statistically significant relationship was observed between admission status and mortality, which is consistent with our findings. Mohammadi and Haghighi's (14) study also reported that more than 70% of patients were discharged, and the study by Abrishamkar et al. (15) reported a mortality rate of 37.4%, which aligns with this study.

The findings indicated that 63.1% of ICU patients were men, and there was a statistically significant relationship between mortality and gender. In this study, female gender increased the probability of death by 1.39 times compared to men. Mohammadi et al. (14)showed that 66.5% of ICU patients were men, and Prin and Lie (16) reported that approximately 70% of their patients were men, both of which are similar to our findings. However, Rafieemehr et al. (13) found no significant statistical relationship between gender and mortality, which contrasts with our results. In the study by Izadi et al. (17), 89.5% of ICU patients were men, which is in line with our study, but they found no significant relationship between gender and clinical outcomes, which again differs from our findings.

Similar to our study, Khorramnia et al. (18) also found a significant relationship between gender and mortality. Additionally, an inverse and significant statistical relationship was observed between age and mortality, which was expected since increasing age is associated with more comorbidities and higher ASA (American Society of Anesthesiologists) classification. This

Table 2. Reasons for Admission and Residence Status of Patients

Variables	No. (%)
Reasons for ICU admission	
CVA	2259 (26.1)
Head trauma+multiple trauma	2003 (23.2)
Multiple trauma	1671 (19.3)
Other	772 (8.9)
Seizure	675 (7.8)
Poisoning	483 (5.6)
Sepsis	427 (4.9)
Head trauma	221 (2.6)
After surgery	139 (1.6)
Days of ICU stay; mean ± SD (min-max)	4.82 ± 7.65 (1 - 68)
1 day	4096 (47)
2 - 3 days	1766 (20.4)
4 - 7 day	1418 (16.4)
More than 7 days	1397 (16.2)
Days of MV; mean ± SD (min-max)	2.5 ± 6.8 (0 - 60)
No MV	5407 (62.5)
1 day	1407 (16.3)
2 - 3 days	579 (6.7)
4 - 7 days	476 (5.5)
More than 7 days	781 (9)

Abbreviations: CVA, cerebral vascular accident; MV, mechanical ventilation; ICU, intensive care unit.

association has been reported in other studies as well (13-15, 17).

In the study by Izadi et al. (17), no significant relationship was observed between age and mortality, which contrasts with our findings. This discrepancy may be explained by the fact that most of their study's patients were in the same age range of 16 to 30 years. In contrast, our study, similar to that of Moridi et al. (19), found that older age had a positive and significant relationship with length of stay, decreasing levels of consciousness, and the incidence of infection, all of which are predisposing factors for mortality. Prin and Li (16) also reported that poor outcomes were associated with older ages and comorbidities. A statistically significant relationship was found between mortality and underlying disease status, which increased the mortality rate by 1.5 times, confirming the results of Mohammadi and Haghighi's study (14).

Our study found that a GCS score in the range of 3 - 5 increased the risk of mortality by 10.41 times compared to patients with scores of 12 - 15. This finding aligns with Abrishamkar et al.'s study (15), which reported that brain trauma with a GCS score lower than 8 was a major factor in increasing mortality in ICU patients. Izadi et al. (17) similarly found that the chance of survival decreased by 0.65 for each point decrease in GCS.

In terms of admission causes, cerebrovascular accident (CVA) was the most common, followed by head trauma and multiple traumas. A statistically significant association was observed between admission causes and mortality rates. Mortality was higher among patients with CVA, post-surgery complications, and sepsis compared to trauma cases. This may be attributed to the fact that stroke patients were generally older and had more comorbidities. Additionally, during the period of this study, which coincided with the COVID-19 pandemic, only emergency surgeries and cancer-related surgeries were performed, while elective surgeries were postponed. As a result, surgical patients were often in worse health conditions, which likely contributed to higher mortality rates. Abrishamkar et al. (15) also identified respiratory failure as a major factor in ICU mortality, consistent with our findings, and Khorramnia et al. (18) similarly reported that longer ICU stays were associated with higher mortality rates.

As discussed, the results of different studies vary, underscoring the importance of conducting independent investigations at each center. The quality of care provided in different ICUs is influenced by several factors, including equipment availability, economic resources, the experience and knowledge of ICU staff, and their job satisfaction. Studies have shown that sociodemographic characteristics of the

Table 3. Factors Associated with Mortality [a]

Variables	Treatment Outcome Discharge	Treatment Outcome Death	P-Value [b]
Gender			< 0.0001
Male	3605 (66)	1856 (34)	
Female	1826 (57.3)	1363 (42.7)	
Age (y)	49.63 ± 23.32	59.24 ± 21.9	< 0.0001
Residency			0.886
Urban	3494 (62.8)	2066 (37.2)	
Rural	1937 (62.7)	1153 (37.3)	
Marital status			< 0.0001
Single	1943 (71.3)	782 (28.7)	
Married	3488 (58.9)	2437 (41.1)	
Co-morbidities			< 0.0001
Yes	2748 (55.3)	2224 (44.7)	
No	2683 (72.9)	995 (27.1)	
GCS			< 0.0001
3 - 5	181 (12.1)	1318 (87.9)	
6 - 8	453 (38)	740 (62)	
9 - 12	1822 (67.9)	860 (32.1)	
12 - 15	2975 (90.8)	301 (9.2)	
Days of ICU stay	4.13 ± 6.55	5.99 ± 9.09	< 0.0001
Not intubated patients	4752 (87.9)	655 (12.1)	< 0.0001
Days of MV	1.09 ± 4.85	4.86 ± 8. 69	< 0.0001

Abbreviations: MV, mechanical ventilation; ICU, intensive care unit; GCS, Glasgow Coma Scale.

[a] Values are expressed as No. (%) or mean ± SD.

[b] $P < 0.05$ was considered statistically significant.

Table 4. The Association Between the Reasons of Intensive Care Unit Admission and Mortality [a]

Reasons of Admission	Discharge	Death	P-Value [b]
Multiple trauma	1392 (83.3)	279 (16.7)	< 0.0001
Head trauma+multiple trauma	1304 (65.1)	699 (34.9)	
CVA	984 (43.6)	1275 (56.4)	
Seizure	542 (80.3)	133 (19.7)	
Other	392 (50.8)	380 (49.2)	
Poisoning	388 (80.3)	95 (19.7)	
Sepsis	207 (48.5)	220 (51.5)	
Head trauma	148 (67)	73 (33)	
Post surgery	74 (53.2)	65 (46.8)	

[a] Values are expressed as No. (%).

[b] $P < 0.05$ was considered statistically significant.

populations and their health status are also influential factors that affect patient outcomes (20).

5.1. Suggestions

Considering the significance of this issue and the lack of comprehensive studies, it is recommended that future research be conducted prospectively and in a multicenter format. This would allow for a more thorough assessment of additional variables and enable follow-up with patients after discharge. In this study, we categorized the outcomes into two groups: Death and discharge; however, we were unable to follow up with patients after discharge. Information about patient survival is much more critical than mere discharge status.

5.2. Limitations

This study provided valuable insights into the current conditions of a general ICU in an academic center. However, being a retrospective study, we acknowledge several limitations. Some medical files were excluded due to missing essential data, and the available data were restricted to what had been recorded in medical files. Another notable limitation was that the study period overlapped with the COVID-19 pandemic, which influenced medical strategies and patient care.

5.3. Conclusions

The findings of this study indicated that 62.8% of the patients were discharged, and 37.2% died—a mortality rate higher than the 12.2% reported in the United States. The most common cause of mortality in the General ICU was "CVA." Factors such as increased length of stay, extended days on MV, and older age were positively associated with a higher mortality rate. While a statistically significant relationship was observed between gender, marital status, and mortality rate, these factors are not practically useful as they are unmodifiable.

Acknowledgements

The authors would like to thank Anesthesiology Research Center members of Guilan University of Medical Sciences for their collaboration in this study.

Footnotes

Authors' Contribution: Study concept and design: M. H. and L. K.; drafting of the manuscript: Sh. Sh.; acquisition, analysis, or interpretation of data: L. K. and S. R.; statistical analysis: L. K; editing & review: L. K. and S. R.; investigation and resources: Sh. Sh.; study supervision: L. K. and M. H.

Conflict of Interests Statement: The authors declare that there is no conflict of interest.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: This study is approved under the ethical approval code of; IR.GUMS.REC.1402.357 .

Funding/Support: No support/funding was received for the present study from any organizations.

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