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Evaluation of risk factors for morbidity and mortality in intensive care unit readmissions

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MAIN POINTS

- Unplanned ICU readmission was strongly associated with increased in-hospital mortality, with a mortality rate of 66.7% among readmitted patients compared to 0% in controls.
- Independent predictors of mortality included higher APACHE II scores, lower serum albumin levels, and the presence of nosocomial infections.
- Dementia/Alzheimer's disease and cerebrovascular disease were significantly more common among readmitted patients, highlighting vulnerable subgroups.
- Identifying high-risk patients through clinical and laboratory parameters may guide early interventions, improve discharge planning, and reduce ICU readmission-related morbidity and mortality.

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ABSTRACT

Aim: Unplanned readmissions to the intensive care unit (ICU) are associated with poor clinical outcomes, prolonged hospital stays, and increased healthcare costs. Identifying the clinical and laboratory predictors of ICU readmission and its impact on in-hospital mortality remains critical for improving patient safety and optimizing utilization of the resources. This study aimed to investigate the factors associated with ICU readmission and evaluate its relationship with mortality in a tertiary-care hospital setting.

Materials and Methods: In this retrospective cohort study, data of 1347 patients followed in Pulmonary ICU between 2016 and 2024 were retrospectively evaluated. Data of 153 patients (75 patients readmitted and 78 control cases selected randomly who were not readmitted during the same hospitalization) were analyzed. The two groups -those with and without ICU readmission- were compared in terms of demographic characteristics, clinical parameters, comorbidities, nutritional status, and laboratory findings. Logistic regression analysis was used to identify predictors of mortality.

Results: Readmitted patients were older (p=0.001), had lower Glasgow Coma Scores (p<0.001), higher APACHE II scores (p<0.001), and longer ICU and hospital stays (p=0.002, p=0.006 respectively). They also required more vasopressors (p=0.004), mechanical ventilation (p=0.001), and sedation (p<0.001). Nosocomial infections were more frequent in this group (p<0.001). Univariate regression analysis revealed that ICU readmission, low serum albumin, nosocomial infections, use of vasopressors, and comorbidities such as dementia and cerebrovascular disease were significantly associated with mortality (p<0.05). In the Backward Wald model, albumin during hospitalization, nosocomial infection and APACHE II scores were independent risk factors for mortality (p<0.05).

Conclusion: ICU readmission is strongly associated with adverse clinical outcomes and increased in-hospital mortality. Identifying high-risk patients based on clinical and laboratory parameters---such as low serum albumin levels, presence of nosocomial infections, use of vasopressors, and comorbidities like dementia/Alzhiemer's disease---may facilitate early interventions and improve patient prognosis.

Keywords: Readmission, ICU care, Risk factors, Comorbidity, Mortality, Morbidity

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INTRODUCTION

Intensive care units (ICUs) are high-cost hospital settings where critical illnesses and complications are managed using advanced technologies and specialized staff. Their rational use is essential due to the substantial financial burden on hospitals and the healthcare system [1].

ICU readmission refers to the return of a patient to the ICU during the same hospitalization and is associated with adverse outcomes and increased health care costs [2]. Additionally, ICU readmissions result in longer hospital and ICU stays and are linked to higher morbidity and mortality rates [3-6]. ICU readmissions are also used as indicators of care quality. Although many scoring systems have been developed to minimize these readmissions, an optimal model has not yet been

established [7].

In intensive care units, the decision to transfer to the ward is made by intensivist. Despite the growing interest in decision support tools, the timing of discharge remains largely based on clinical judgment. This daily, complex process challenges both the ICU team and the attending physician [8]. Providing information about reasons for ICU readmission is important for preventing morbidity and mortality in critically ill patients and reducing the clinician burden.

ICU readmissions, adverse events in patients, and their impact on mortality are primarily studied in and supported by scientific articles [2]. However, such data are lacking in with limited resources. Investigating this issue in our tertiary care hospital, which treats many patients with chest diseases, is crucial for establishing data for Turkey. Therefore, this study aimed to identify risk factors for mortality and morbidity among patients readmitted to the pulmonary ICU.

MATERIALS AND METHODS

Study design

This retrospective observational study was conducted at Istanbul Sultan Abdulhamid Han Training and Research Hospital. This study aimed to investigate the clinical, demographic, and laboratory factors associated with ICU readmission in patients in the pulmonary ICU between 2016 and 2024.

Study population

A total of 1,347 patients who were admitted to the Pulmonary ICU between 2016 and 2024 were screened. Among them, 75 patients who were readmitted to the ICU within 48 h after discharge during the same hospitalization were identified as the readmission group. Additionally, 78 patients who were hospitalized in the pulmonary ICU only once during the same period were randomly selected and defined as the non-readmission group. Random sampling was performed to ensure a balanced sample size between the readmission and control groups using IBM SPSS Statistics version 30. Under the "Select Cases" module, the "Random sample of cases" option was utilized, and a total of n=78 non-readmitted patients were randomly selected from the dataset and included in the analysis as the control group. This method was chosen to minimize selection bias and enhance comparability between the groups.

Only patients aged 18 years were included in the study. Although patients with conditions such as dementia or Alzheimer's disease requiring palliative care were included, none of these patients were admitted from dedicated palliative care centers.

Patients who were admitted to other ICUs within the same hospital or to ICUs in other hospitals were excluded from the study. In addition, patients who were discharged upon their request and those with terminal-stage malignancies were excluded from the study.

Study parameters

Age, gender, comorbidities such as diabetes mellitus (DM), coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), arrhythmias, pulmonary and extrapulmonary malignancies, dementia/Alzheimer's disease, and cerebrovascular diseases (CVD), demographic and clinical characteristics of the patients, and laboratory findings (hemogram, blood biochemistry, inflammatory markers, and blood gas) at the time of admission and before discharge from the ICU to the ward were recorded. In addition, the Glasgow coma scale (GCS), APACHE II score, need for mechanical ventilation (MV), non-invasive mechanical ventilation (NIMV), vasopressor therapy, sedation, and dialysis during ICU stay were noted in patients admitted to the ICU. The number of hospital and ICU hospitalization days, number of MV and NIMV days, nutritional characteristics, and nosocomial infections were also recorded. The Prognostic Nutritional Index (PNI), which determines the nutritional status of patients, and the PIV, which reflects the inflammatory status of the patients, were also checked during hospitalization. Patients who were readmitted to the ICU (n = 75) and those who were not readmitted (n = 78) were compared in terms of the mentioned parameters.

Statistical analysis

The data obtained in the study were analyzed using the Statistical Package for the Social Sciences software. Continuous variables were presented as mean ± standard deviation (mean ± SD), and categorical data were presented as the number of affected individuals and percentage of the study population (%). For group comparisons, an independent samples t-test was used for parametric data, and a Chi-square test or Fisher's exact test was used for categorical variables. The Mann–Whitney U test was preferred for comparing variables that were not normally distributed. Univariate and multivariate logistic regression analyses were performed to determine the factors associated with mortality, and the effects of significant variables were reported with odds ratios (ORs), 95% confidence intervals (CIs), and p-values. The significance level was accepted as any p-value being < 0.05. No bootstrap resampling was performed in the statistical analysis.

Multivariable logistic regression analysis was performed using the backward Wald method. The relationships among independent variables were assessed using the variance inflation factor (VIF) values calculated under linear regression, and all VIF values were below 5, indicating no significant multicollinearity. Model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test, which demonstrated adequate fit ($p>0.05$). The discriminative ability of the model was assessed using a receiver operating characteristic (ROC) curve, and the area under the curve (AUC) was calculated.

The sample size was estimated using G*Power 3.1 software, assuming a 6% ICU readmission rate of 6%, a statistical power

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of 90%, a significance level of 5%, and three independent variables with a medium effect size (Cohen's $f^2 = 0.15$). Based on these parameters, a minimum of 1,243 patients and at least 75 ICU readmission events were required to achieve statistical significance.

RESULTS

General characteristics of the study population

The study included 153 patients, of whom 58.82% were female (n = 90) and 41.18% were male (n = 63). The mean age was 71.43 ± 14.32 years. Hospitalization to the ICU occurred in 54.9% of patients from the emergency department and 45.1% from hospital wards. The most common admission diagnosis was pneumonia (33.3%), followed by COPD exacerbation (20.9%) and pulmonary embolism (11.1%).

The need for vasopressors was observed in 35.95% of patients, MV in 18.3%, NIMV in 56.21%, and oxygen with HFNC in 16.45%. The following comorbidities were present: DM (31.37%), COPD (43.79%), HT (58.17%), CHF (29.41%), extrapulmonary malignancy (14.38%), lung cancer (9.15%), dementia/AD (12.42%), and CVD (10.46%). The comorbidity rate was high, with 94.12% of patients having at least one comorbid disease.

After the initial treatment, 70.59% of the patients was transferred to the ward within working hours. The most common reason for ICU readmission was hypoxic respiratory failure (64%), followed by hypotension/shock (22.7%). The mean length of ICU stay was 7.97 ± 8.29 days, and the total hospital stay was 1.92 ± 4.01 days. Patients were readmitted to the ICU after a mean of 8.21 ± 8.84 days.

Demographic, clinical, and laboratory findings of patients with and without ıcu readmission

The mean age was significantly higher in the readmitted group (75.25 ± 12.42 vs. 67.76 ± 15.13years; p=0.001). The GCS scores measured at initial hospitalization and during ICU discharge were significantly lower in the readmitted group (p<0.001). In addition, patients in this group had higher APACHE II scores at the time of hospitalization (23.75 ± 7.56 vs. 17.05 ± 6.20; p<0.001), higher rates of need for vasopressors (48% vs. 24.36%; p = 0.004), MV (29.33% vs. 7.69%; p = 0.001), and sedation (49.33% vs. 19.23%; p<0.001). The duration of MV, ICU stay, and hospital stay was significantly longer in this group (3.52 ± 8.78 vs. 0.29 ± 1.48 days; p<0.001, 10.53 ± 10.89 vs. 5.51 ± 3.03 days; p = 0.002, and 2.79 ± 4.94 vs. 1.09 ± 2.62 days; p = 0.006, respectively). Furthermore, the incidence of nosocomial infections was significantly higher in the readmission group than in the non-readmission group (52.70% vs. 5.13%; p<0.001). The mortality rate of these patients was 66.67%, whereas no mortality was observed in the group without readmission (p<0.001). The overall mortality rate of the cohort was 32.68%. Among comorbid diseases, dementia/AD (p = 0.006) and CVD history (p = 0.035) were more common in the readmission group (Table 1).

When laboratory findings were examined, serum albumin levels during both initial admission and transfer to the ward were lower in the readmitted group (p<0.001, p<0.001, respectively). Furthermore, the PNI was lower in the readmitted group at discharge (p<0.001). In contrast, the blood urea nitrogen (BUN) level at the time of admission (p = 0.003) and the fraction of inspired oxygen (FiO_2) demand (p = 0.007) were significantly higher in the readmitted group. The C-reactive protein level (p = 0.006) and pH value (p = 0.028) at the time of transfer to the ward were also higher in this group (Table 2).

Univariate and multivariate logistic regression analyses

According to Univariate Logistic Regression analysis, the variables found to be significantly associated with mortality were as follows: initial hospitalization GCS (OR=0.822, p<0.001), discharge before ICU GCS (OR=0.669, p<0.001), APACHE II score (OR=1.108, p<0.001), need for vasopressors (OR=2.433, p=0.013), duration of hospitalization (OR=1.132, p=0. 012), duration of ICU stay (OR=1.048, p=0.027), presence of nosocomial infection (OR=4.919, p<0.001), low serum albumin levels (OR=0.198, p<0. 001; OR=0.152, p<0.001 on transfer), high CRP (OR=1.004, p=0.046), history of dementia/Alzheimer's disease (OR=3.349, p=0.016) and history of CVD (OR=4.042, p=0.011). The number of MV days was significantly associated with mortality (OR = 1.051, p = 0.085) (Table 3).

Multivariate logistic regression analysis was performed using the backward Wald method. The initial model included the following clinically relevant variables: age, GCS score at ICU admission and discharge, APACHE II score, use of vasopressors, length of hospital and ICU stay, presence of nosocomial infection, serum albumin and CRP levels, and presence of dementia/Alzheimer's disease or CVD. After the stepwise elimination of non-significant variables, 3 variables independently affected mortality: APACHE II score (odds ratio [OR] = 1.095, 95% CI: 1.034-1.159, p=0.002), presence of nosocomial infection (OR = 2.746, 95% CI: 1.177-6.408, p=0.019) and albumin level measured during ICU admission (OR = 0.208, 95% CI: 0.095-0.459, p<0.001). These findings suggest that a high APACHE score and the presence of nosocomial infection increase mortality and that mortality increases as serum albumin levels decrease (Table 3).

The model's discriminative ability was assessed using an ROC curve, with an AUC value of 0.815. Model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test, which yielded a p-value of 0.367, indicating an adequate fit. All variance inflation factor (VIF) values ranged from 1 to 4.3, suggesting that no significant multicollinearity was present among the independent variables.

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Table 1. Clinical and demographic characteristics of patients with and without ICU readmission.

	Patients not requiring readmission (n=78) Mean±SD or n (%)	Patients requiring readmission (n=75) Mean±SD or n (%)	p-value*
Gender			0.595
Male	30 (38.46)	33 (44)	
Female	48 (61.54)	42 (56)	
Age	67.76 ± 15.13	75.25 ± 12.42	**0.001**
Site of ICU admission			0.065
In-Patient Ward	29 (37.18)	40 (53.33)	
Emergency Department	49 (62.82)	35 (46.67)	
Initial admission GCS score	14.56 ± 1.41	11.83 ± 4.14	**<0.001**
GCS before discharge	14.87 ± 0.54	13.17 ± 2.63	**<0.001**
APACHE II	17.05 ± 6.20	23.75 ± 7.56	**<0.001**
The Need for Vasopressors	19 (24.36)	36 (48)	**0.004**
Need for more than one vasopressor	1 (1.28)	2 (2.67)	0.615
Need for an MV	6 (7.69)	22 (29.33)	**0.001**
Number of MV days	0.29 ± 1.48	3.52 ± 8.78	**<0.001**
Need for NIMV	44 (56.41)	42 (56.00)	>0.999
Need for HFNC	12 (15.38)	13 (17.57)	0.886
Dialysis	3 (3.85)	4 (5.33)	0.716
Sedation	15 (19.23)	37 (49.33)	**<0.001**
Feeding			0.048
None	1 (1.28)	1 (1.33)	
Enterally	76 (97.44)	66 (88)	
Parenterally	0 (0)	5 (6.67)	
Enterally+Parenterally	1 (1.28)	3 (4)	
DM	19 (24.36)	29 (38.67)	0.083
CAD	22 (28.21)	18 (24)	0.683
COPD	38 (48.72)	29 (38.67)	0.276
HT	42 (53.85)	47 (62.67)	0.346
CHF	20 (25.64)	25 (33.33)	0.386
Rhythm Disorders	12 (15.38)	17 (22.67)	0.346
CRF	6 (7.69)	12 (16)	0.179
Extrapulmonary Malignant tumor	7 (8.97)	15 (20)	0.087
Lung Cancer	4 (5.13)	10 (13.33)	0.096
Dementia/Alzheimer Disease	4 (5.13)	15 (20)	**0.006**
CVD	4 (5.13)	12 (16)	**0.035**
One or more comorbidities	71 (91.03)	73 (97.33)	0.167
Days of hospitalization	1.09 ± 2.62	2.79 ± 4.94	**0.006**
Days in the ICU	5.51 ± 3.03	10.53 ± 10.89	**0.002**
hospital-acquired Infection	4 (5.13)	39 (52.70)	**<0.001**
Mortality	0 (0)	50 (66.67)	**<0.001**
Discharge to the ward			0.05
On working hours	61 (78.21)	47 (62.67)	
Out of Hours	17 (21.79)	27 (36.00)	
Not Known		1 (1.33)	

ICU: Intensive Care Unit, GCS: Glasgow Coma Scale, APACHE: Acute Physiology and Chronic Health Evaluation, COPD: Chronic Obstructive Pulmonary Disease, MV: Mechanical Ventilation, NIMV: Non-Invasive Mechanical Ventilation, HFNC: High-Flow Nasal Cannula, DM: Diabetes Mellitus, CAD: Coronary Artery Disease, HT: Hypertension, CHF: Congestive Heart Failure, CRF: Chronic Renal Failure, CVD: Cerebrovascular Disease. *Pearson's chi-squared test; Wilcoxon rank-sum test; Fisher's exact test.

DISCUSSION

In this study, patients who were readmitted to the ICU had higher mortality rates, and mortality was associated with certain comorbidities and prognostic, clinical, and laboratory findings.

In previous studies, the rate of re-admission to the ICU during the same hospitalization was 10% [2, 4]. In our study, this rate was as low as 5.56%, which may be due to the inclusion of only the pulmonary ICU. Not all patients requiring readmission were admitted to the pulmonary ICU; some were sent to other ICUs or hospitals, potentially lowering the readmission rate.

Patient discharge from the ICU is based on the experience and subjective assessment of the ICU physician [9]. There has been an increasing interest in scoring systems in recent days. Although scoring systems developed for the evaluation of ICU readmission and mortality, such as the Stability and Workload Index for Transfer (SWIFT), Sequential Organ Failure Assessment (SOFA), and Therapeutic Intervention Scoring System (TISS-28), have moderate accuracy [10],

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Table 2. Comparison of laboratory findings of patients with and without ICU readmission.

	Patients not requiring readmission (n=78) Mean±SD or n (%)	Patients requiring readmission (n=75) Mean±SD or n (%)	p-value*
At First Admission to the ICU			
CRP	86.04 ± 92.94	95.86 ± 93.55	0.256
PCT	4.54 ± 16.05	0.85 ± 2.36	0.633
pH	7.37 ± 0.09	7.38 ± 0.10	0.185
PO_2	104.91 ± 33.12	100.66 ± 33.86	0.409
PCO_2	46.59 ± 16.80	47.07 ± 17.16	0.745
FiO_2	55.71 ± 20.11	64.40 ± 22.56	**0.007**
Lactate	1.68 ± 0.72	1.77 ± 1.17	0.474
WBC	13,881.92 ± 12,127.87	14,183.07 ± 8,980.77	0.354
Neutrophil	12,237.82 ± 11,673.91	11,501.07 ± 6,638.79	0.762
Platelet	267,512.82 ± 95,791.54	264,760.00 ± 103,713.07	0.865
Albumin	3.46 ± 0.56	3.08 ± 0.54	**<0.001**
BUN	27.67 ± 18.21	37.51 ± 22.89	**0.003**
Cr	1.25 ± 1.34	1.18 ± 1.00	0.911
PNI	39.66 ± 7.11	40.76 ± 31.37	**0.012**
PIV	3,216.23 ± 7,470.75	2,549.58 ± 4,886.23	0.621
Before discharge from the ICU			
CRP	39.56 ± 45.41	53.32 ± 43.72	**0.006**
PCT	0.58 ± 1.88	0.26 ± 0.33	0.096
pH	7.44 ± 0.04	7.45 ± 0.06	**0.028**
PO_2	102.97 ± 29.38	104.59 ± 32.73	0.961
PCO_2	46.58 ± 11.23	45.47 ± 10.56	0.584
FiO_2	36.95 ± 8.52	36.73 ± 8.31	0.876
Lactate	1.32 ± 0.52	1.31 ± 0.53	0.635
WBC	9,642.44 ± 5,827.68	9,242.27 ± 4,765.75	0.969
Neutrophil	7,910.26 ± 5,844.76	6,974.40 ± 2,981.72	0.680
Platelet	255,435.90 ± 105,115.47	225,682.40 ± 117,752.56	0.063
Albumin	3.09 ± 0.47	2.75 ± 0.47	**<0.001**
BUN	23.06 ± 13.08	23.79 ± 14.86	0.964
Cr	0.91 ± 0.79	0.82 ± 0.70	0.169
PNI	36.27 ± 5.77	35.18 ± 18.70	**<0.001**
PIV	1,599.21 ± 3,057.26	1,014.54 ± 961.29	0.655

CRP: C-Reactive Protein, PCT: Procalcitonin, PO_2: Partial Oxygen Pressure, PCO_2: Partial Carbon dioxide Pressure, FiO_2: Fraction of Inspired Oxygen, WBC: White Blood Cell, BUN: Blood-Urea Nitrogen, Cr: Creatinine, PNI: Prognostic Nutritional Index, PIV: Pan-Immune Inflammation Value. *Wilcoxon rank sum test; Welch two-sample t-test.

Table 3. Univariate and multivariate analysis results on the risk factors for mortality.

Variables	Univariate		Multivariate*	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age	1.042 (1.013-1.072)	**0.005**		
GCS score at admission	0.822 (0.739-0.914)	**<0.001**		
GCS before discharge	0.669 (0.553-0.809)	**<0.001**		
APACHE II	1.108 (1.055-1.165)	**<0.001**	1.095 (1.034-1.159)	**0.002**
The Need for Vasopressors	2.433 (1.210-4.893)	**0.013**		
Need for an MV	1.181 (0.500-2.789)	0.705		
Days of MV	1.051 (0.993-1.111)	0.085		
Days of hospitalization	1.132 (1.027-1.248)	**0.012**		
Days in the ICU	1.048 (1.005-1.093)	**0.027**		
Nosocomial Infections	4.919 (2.308-10.482)	**<0.001**	2.746 (1.177-6.408)	**0.019**
Albumin level (first admission)	0.198 (0.097-0.401)	**<0.001**	0.208 (0.095-0.459)	**<0.001**
Albumin level (before discharge)	0.152 (0.065-0.358)	**<0.001**		
CRP (first admission) level	1.004 (1.000-1.007)	**0.046**		
PNI (before discharge)	0.994 (0.964-1.024)	0.682		
Dementia/Alzheimer Disease	3.349 (1.252-8.960)	**0.016**		
CVD	4.042 (1.377-11.866)	**0.011**		

OR: Odds Ratio, SE:Standard Error, CI: Confidential Interval, GCS: Glasgow Coma Scale, APACHE: Acute Physiology and Chronic Health Evaluation, MV: Mechanical Ventilation, CRP: C-Reactive Protein, PNI: Prognostic Nutritional Index, CVD: Cerebrovascular Disease. Note: Model fit assessed via Hosmer-Lemeshow test (p = 0.367). AUC: 0.815. Multicollinearity was evaluated via VIF, all < 5. *Backward Wald method.

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the clinician's opinion is still determinant in terms of easy applicability. In our study, we preferred the APACHE II score, which can be easily applied during hospitalization in all patients. The APACHE II score was higher in the group requiring readmission to the ICU, and mortality increased as the APACHE score increased. Our results support the literature [4, 11]. Therefore, we adjusted the APACHE II score for disease severity, which was included in the model as a potential confounder.

Patients requiring readmission were older, which is consistent with the literature [3, 4, 12]. Elderly patients tend to have higher frailty scores and are at greater risk for comorbidities than younger adults [12]. In our study, dementia/AD and CVD were particularly more common in the readmitted group. Low GCS both during admission and discharge to the ward was associated with neurological diseases. Another important question is whether these patients are better treated in palliative care than treated and/or readmitted to intensive care. Perhaps with improved palliative care centers, ICU admissions/readmissions can be reduced, together with costs, and patients who really need intensive care can be treated more effectively by reducing the length of stay in emergency departments. ICU hospitalizations account for 25%–40% of all health expenditures [13, 14].

Nutritional status is also more limited in elderly patients than in younger patients. Consistent with studies demonstrating that nutritional status is a prognostic marker for mortality [15], we observed lower albumin and PNI values in patients who were readmitted. However, low albumin levels may also be attributed to infection, as albumin is a negative acute-phase reactant, and nosocomial infections were more frequent in this group.

Vasopressor use increases in-hospital mortality, especially in elderly patients [15]. In our study, vasopressor use in ICUs was shown to increase mortality approximately 2.5-fold, in support of the literature.

Early discharge in ICUsis important to prevent intensive care infections and reduce costs. Prolonged ICU stay increases the risk of developing nosocomial infections [10]. In our study, both hospitalization duration and nosocomial infection rate were high in the readmission group. Klebsiella pneumoniae were the most common infectious agent, accounting for 25.6% of cases.

Respiratory failure and pneumonia are frequent causes of ICU readmission. Respiratory failure accounts for 18%–59% of all ICU readmissions [16]. This rate was higher in our unit because it is a pulmonary ICU. Because of hypoxic and hypercapnic respiratory failure, 70.7% of patients was readmitted to the ICU. We anticipate that such a high rate can be reduced with more participation of respiratory physiotherapists in the treatment.

Studies indicate that being discharged from ICUs during out-of-duty increases mortality [17]. Although we could not statistically prove this, the result supports this finding in our study. This has been attributed to a decrease in the number of staff and nurses working during off-duty hours. Another reason may be that waiting patients to be admitted to the emergency department may have led to early discharge from the ICU. Lack of nursing care and inappropriate treatment are among the preventable causes of ICU readmissions [18]. The key decision of the clinician is the optimal time for ward transfer.

These data reveal that ICU readmitted patients have worse clinical parameters and laboratory indicators, which are strongly associated with mortality. However, future multicenter randomized controlled studies with larger sample sizes are needed because this study is retrospective and includes a relatively small patient population.

Limitations

This study has certain limitations, the most notable being the relatively small sample size (n = 153). A larger sample size may be necessary in multivariable logistic regression models involving a large number of predictors to ensure model stability and statistical power. Although a power analysis was performed, the limited sample size may restrict the generalizability of the findings. Moreover, due to the lack of matching in the control group, differences may exist in certain confounding variables, which could have influenced the interpretation of the results.

This retrospective single-center study included only patients readmitted to the pulmonary ICU. Patients who were transferred to other ICUs were excluded, which may have led to an underestimation of the true ICU readmission rate. Therefore, the findings may reflect a limited perspective on overall readmission patterns.

CONCLUSION

Parameters such as the APACHE II score, serum albumin level, and the presence of nosocomial infection, which were found to be associated with mortality, may serve as valuable indicators for early risk stratification and the development of clinical management strategies in critically ill patients. Moreover, patients readmitted to the ICU had a higher risk of mortality, and readmission was closely associated with multiple clinical risk factors. Elderly patients and those with higher APACHE II and lower GCS scores and a history of dementia/AD may be at increased risk of readmission. Further multicenter studies should be performed to reveal risk factors for readmission and the benefit of close monitoring of high-risk patients, enhancing strategies for discharge planning, and improving transitional care, which may reduce readmissions and improve outcomes in critically ill patients more precisely.

Ethics Committee Approval: This study was approved by the Scientific Research Ethics Committee of the Ministry of Health, Istanbul Health Sciences University,

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Umraniye Training and Research Hospital (01.08.2024; B.10.1.TKH.4.34.H.GP.0.01/234). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: The study was retrospective, informed consent was not obtained.

Peer-review: Externally peer-reviewed.

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Author Contributions: AÇ: Materials, Data Collection and/or Processing, Analysis and/or Interpretation, Writing; ŞB: Conception, Design, Supervision, Critical Review.

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