Original Investigation

DOI: 10.4274/jarem.galenos.2025.57614

J Acad Res Med

Determinants of Mortality in Respiratory Intensive Care Units

Merve Ayyürek[1], Oral Menteş[2], Murat Yıldız[1]

[1]University of Health Sciences Türkiye, Ankara Atatürk Sanatory Education and Research Hospital, Clinic of Pulmonary Disease, Ankara, Türkiye
[2]University of Health Sciences Türkiye, Gülhane Faculty of Medicine, Department of Intensive Care Unit, Ankara, Türkiye

Cite this article as: Ayyürek M, Menteş O, Yıldız M. Determinants of mortality in respiratory intensive care unit. J Acad Res Med. [Epub Ahead of Print]

ABSTRACT

Objective: Respiratory intensive care units (RICUs) play a critical role in managing patients with severe respiratory conditions, including acute and chronic respiratory failure, severe lung infections, and pulmonary edema. Mortality-related factors in these specialized units may differ from those observed in general intensive care units. This study aims to identify these distinctions.

Methods: We conducted a retrospective analysis of 406 patients admitted to a tertiary-level RICU. Data collected included scoring metrics-such as the Acute Physiology and Chronic Health Evaluation (APACHE) II, Sequential Organ Failure Assessment, Glasgow Coma Scale (GCS), and Charlson comorbidity index-along with the hospital department from which cases were transferred, biochemical blood test results, and the types of respiratory support administered. These variables were assessed to identify factors associated with mortality.

Results: Mortality occurred in 69.1% of cases (n=244), while 30.9% (n=109) survived. Independent risk factors for mortality included higher APACHE II scores, lower GCS scores, the need for endotracheal intubation, inotropic support, reduced albumin levels, low hemoglobin levels, and elevated D-dimer levels. Notably, exacerbations of chronic obstructive pulmonary disease were associated with increased mortality compared to other primary pulmonary conditions (p=0.001). Furthermore, patients transferred from the emergency department demonstrated lower mortality than those transferred from other departments (p=0.001).

Conclusion: Mortality risk factors in RICUs share similarities with those in other intensive care units. However, RICUs also have unique risk determinants related to underlying respiratory disorders and specific biomarkers, such as D-dimer, underscoring the need for targeted management strategies in this patient population.

Keywords: Intensive care, mortality, risk factors, chronic obstructive pulmonary disease, D-dimer, respiratory

INTRODUCTION

Intensive care units (ICUs) are medical facilities, characterized by the intensive use of invasive interventions, advanced monitoring techniques, and the implementation of multidisciplinary treatment approaches, that admit patients with critically threatened vital functions. Respiratory ICUs, in particular, are critical areas for the treatment of respiratory diseases, including acute or chronic respiratory failure, severe lung infections, and pulmonary edema (1). The success of treatments administered in these units depends on numerous factors that directly influence patients' survival and quality of life. Key factors influencing the prognosis of patients receiving treatment in the ICU include age, underlying diseases, the need for and duration of mechanical ventilation, organ failure, the presence of infection, and comorbidities (2,3). However, various scoring systems have been developed to predict the prognosis of ICU patients. Scoring systems such as Acute Physiology and Chronic Health Evaluation (APACHE II) Sequential Organ Failure Assessment (SOFA), and Simplified Acute Physiology Score II aim to estimate the risk of mortality based on patients' physiological parameters (3). In recent years, the advancement of data science and artificial intelligence-supported models has enabled more precise methods for predicting mortality in ICU patients (4). However, the widespread adoption of these new methods in clinical practice may take time, highlighting the need to update existing scoring systems. Additionally, the number of specific studies focusing on respiratory ICU patients is limited, and the factors influencing mortality have not been fully elucidated in the literature (5).

Understanding the factors that predict disease prognosis and adverse outcomes can assist physicians in providing more effective guidance to patients regarding the expected course of their illness. The effectiveness of treatment and medical care is directly

ORCID IDs of the authors: M.A.: 0009-0000-7431-3673, O.M.: 0000-0003-3599-2719, M.Y.: 0000-0002-9625-9994.

Corresponding Author: Oral Menteş, MD,
E-mail: omentes@live.com

Received Date: 19.02.2025 **Accepted Date:** 07.05.2025
Epub: 01.07.2025

related to reducing patient mortality. Therefore, each clinic should aim to identify both favorable and unfavorable prognostic factors to reduce mortality rates among its patients.

In this study, we aimed to identify all clinical and biochemical risk factors affecting mortality in respiratory ICUs and to develop a model composed of the independent risk factors that influence mortality.

METHODS

This study was conducted with ethical approval from the University of Health Sciences Türkiye, Ankara Atatürk Sanatory Education and Research Hospital Scientific Research Ethics Committee, under (number: 2024-BÇEK/7, date: 28.02.2024). This study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants included in the study. In the study, the data of 406 patients who were admitted and monitored in the Respiratory ICU of Ankara University of Health Sciences Türkiye, Ankara Atatürk Sanatory Education and Research Hospital between December 1, 2021, and December 1, 2022, were retrospectively examined. Patients aged 18 and older were included in the study. In this context, a total of 353 patients for whom complete data were available were included in the study. Since exacerbations of respiratory diseases exhibit seasonal variability, all patients who were admitted to and discharged from the ICU or who died over the course of one year were included in the study. This approach aimed to minimize the impact of seasonal infectious processes on the overall risk factors for mortality in respiratory diseases. All patients who died due to their primary respiratory disease, either in the ICU or within 48 hours after discharge from the ICU, were classified under ICU mortality.

The ICU where our study was conducted did not admit patients infected with coronavirus disease-2019 (COVID-19). Additionally, patients who tested positive for COVID-19 by polymerase chain reaction after ICU admission were transferred to a dedicated COVID-19 ICU, and these patients were excluded from the study.

Surviving and deceased patients were compared, and the mortality rates and factors affecting mortality in the tertiary chest diseases ICU were analyzed. Patient data were retrieved from the hospital's healthcare database system.

The following variables were recorded: patients' ages, genders, primary diagnosis [COPD exacerbation, pneumonia, lung cancer (LC), interstitial lung disease (ILD), bronchiectasis, acute pulmonary thromboembolism, pulmonary tuberculosis, acute respiratory distress syndrome, and other pulmonary diseases], comorbidities [hypertension (HT), diabetes mellitus (DM), coronary artery disease (CAD)-arrhythmia, congestive heart failure, non-pulmonary malignancies, chronic kidney disease, neurological diseases, thyroid disorders, and other diseases], length of stay, mortality status, and the department from which the patient was transferred to the ICU (emergency department, other departments of the hospital, or other hospitals).

The status of endotracheal intubation (admitted intubated, intubated during follow-up, or re-intubated due to extubation failure), duration of intubation, tracheostomy status (admitted with tracheostomy or underwent tracheostomy), and type of respiratory support (non-invasive mechanical ventilation (NIMV), IMV, high-flow nasal oxygen, nasal oxygen, or transitioned from NIMV to IMV due to NIMV failure) were also documented. The following scores were calculated: APACHE II, SOFA, Glasgow Coma Scale (GCS), and modified Charlson comorbidity index (mCCI). Additionally, whether the patient received inotropic support during the ICU stay was recorded.

Laboratory parameters obtained at ICU admission were also collected, including arterial blood gases, creatinine, glomerular filtration rate, and blood urea nitrogen (BUN). Other parameters included aspartate aminotransferase, alanine aminotransferase, magnesium, calcium, chloride, sodium, potassium, and white blood cell count (WBC). Additionally, lymphocyte and neutrophil counts, hemoglobin (Hgb), hematocrit, platelet count, procalcitonin, C-reactive protein (CRP), lactate dehydrogenase, brain natriuretic peptide, D-dimer, and troponin levels were recorded.

The scoring systems were calculated based on the worst values obtained within the first 24 hours of ICU admission using data from the hospital's healthcare database system.

Statistical Analysis

Statistical analyses were performed using SPSS version XXVI (IBM Corp., Armonk, NY, USA). Descriptive statistical methods, including mean, standard deviation, median, frequency, percentage, and interquartile range (IQR) were employed to evaluate the study data. The normality of the distribution of quantitative variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests, as well as skewness-kurtosis tests and graphical methods. Following normality tests, continuous variables with normal distribution were presented as mean ± standard deviation, while those not normally distributed were expressed as median (IQR). For comparing two groups, the Independent Sample's t-test was used for quantitative variables with a normal distribution, while the Mann-Whitney U test was applied for variables that did not exhibit a normal distribution. For categorical variable comparisons, Pearson's chi-square test and Fisher's exact test were employed. To determine cut-off values for the parameters, diagnostic screening tests (sensitivity, specificity, positive predictive value, and negative predictive value) and ROC curve analysis was performed. To assess the statistical significance of differences between area under the curve (AUC) values, pairwise post hoc comparisons were conducted using Z-tests calculated from the standard errors of the AUC estimates. For multivariate analysis, the effects of other risk factors on mortality were evaluated using logistic regression analysis. For multivariate analysis, backward stepwise logistic regression was used to evaluate the effects of various risk factors on mortality, ensuring focus on the most relevant predictors while minimizing collinearity. A confidence interval of 95% was adopted for all statistical analyses, and a p-value of <0.05 was considered statistically significant.

RESULTS

Between December 2021 and December 2022, a total of 406 patients were admitted to the Level 3 Respiratory ICU at University of Health Sciences Türkiye, Ankara Atatürk Sanatory Education Training and Research Hospital. Of these, 12 patients were readmissions, and 41 were transferred to other hospitals, resulting in the exclusion of 53 patients from the study. Consequently, the study was conducted with 353 patients, of whom 34% (n=120) were female and 66% (n=233) were male. The ages of the patients ranged from 20 to 95 years, with a mean age of 70.21±11.64 years. Comorbid conditions among the patients were assessed, revealing, the three most common as follows: HT in 43.1% (n=152), CAD or arrhythmia in 30% (n=106), and DM in 27.8% (n=98) (Table 1).

Table 1. Descriptive variables

		n	%
Age (year)	Mean±SD	70.21±11.64	
Gender	Female	120	34.0
	Male	233	66.0
Source of admission to the intensive care unit	Emergency department	151	42.8
	The other department of hospital	139	39.4
	Another hospital	63	17.8
Primary pulmonary disease	COPD exacerbation	141	39.9
	Pneumonia	93	26.3
	Lung cancer	47	13.3
	ILD	24	6.8
	Bronchiectasis	5	1.4
	Acute PTE	18	5.1
	PTB	5	1.4
	ARDS	7	2.0
	Sepsis	7	2.0
	Other	6	1.7
•Comorbidities	HT	152	43.1
	DM	98	27.8
	CAD-arrhythmia	106	30.0
	CHF	65	18.4
	Extrapulmonary malignancies	27	7.6
	CRF	32	9.1
	Neurological diseases	38	10.8
	Thyroid diseases	16	4.5
	Other diseases	40	11.3

•Multiple diseases are observed
SD: Standard deviation, COPD: Chronic obstructive pulmonary disease, ILD: Interstitial lung disease, PTE: Pulmonary thromboembolism, PTB: Pulmonary tuberculosis, ARDS: Acute respiratory distress syndrome, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, CHF: Congestive heart failure, CRF: Chronic renal failure, IQR: Interquartile range

The APACHE-II scores of the patients ranged from 3 to 47, with a mean of 18.03±7.82 and a median of 17. The SOFA scores ranged from 0 to 17, with a mean of 4.81±3.70 and a median of 4. The results of the other intensive care scoring systems, including their mean and median values, are presented in Table 2. A total of 147 patients (41.6%) underwent IMV, including patients intubated upon ICU admission (n=55) and those intubated during their ICU stay (n=92). Additionally, NIMV was applied to 112 patients (32.3%). Forty-five patients were intubated and subsequently switched to IMV due to the failure of NIMV. The duration of intubation ranged from 1 to 45 days, with a mean of 7.18±7.66 days and a median of 5 days. The duration of ICU stay ranged from 1 to 54 days, with a mean of 6.94±7.73 days and a median of 4 days. 69.1% of the patients (n=244) survived, while mortality

Table 2. The distrubition of clinical data

		n	%
APACHE-II Score	Median (IQR)	17 (11)	
SOFA Score	Median (IQR)	4 (5)	
Modified Charlson comorbidity index	Median (IQR)	4 (3)	
GCS	Median (IQR)	15 (2)	
Duration of intubation (day) (n=147)	Median (IQR)	5 (3)	
İntubation	No	206	58.4
	Patients intubated upon ICU admission	55	15.6
	Patients intubated in the ICU	92	26.0
Patients with tracheostomy upon ICU admission	No	346	98.0
	Yes	7	2,0
Patients who underwent tracheostomy in the ICU	No	340	96.3
	Yes	13	3.7
Reintubation	No	329	93.2
	Yes	24	6.8
Respiratory support (n=347)	IMV	102	29.3
	NIMV	112	32.3
	HFNO	13	3.8
	Nasal O_2	75	21.7
	NIMV>IMV	45	12.9
Inotropic support	No	245	69.4
	Yes	108	30.6
Length of ICU stay (day)	Median (IQR)	4 (6)	
Mortality	No	244	69.1
	Yes	109	30.9

APACHE-II: Acute Physiology and Chronic Health Evaluation-II, SOFA: Sequential Organ Failure Assessment, GCS: Glasgow Coma Scale, IMV: Invasive Mechanical ventilation, NIMV: Non-invasive mechanical ventilation, HFNO: High-flow nasal oxygen NIMV > IMV: Patients who were intubated and followed with IMV due to NIMV failure

occurred in 30.9% (n=109) (Table 2). In patients transferred to the ICU from the emergency department, mortality rates were found to be significantly lower than those admitted from other hospital departments (p=0.001). Upon examining the primary respiratory disease diagnoses of the patients, it was observed that mortality rates were significantly higher in patients with a primary diagnosis of LC, while mortality rates were significantly lower in patients with a primary diagnosis of COPD exacerbation (p=0.001) (Table 3). As expected, mortality rates were significantly higher in patients who were already intubated upon arrival at the ICU, those who were intubated during their stay, and those who were re-intubated after extubation (p=0.001) (Table 4). The descriptive values and statistical significance of the biochemical blood test results between the groups with and without mortality are presented in Table 5.

The mCCI, APACHE II, SOFA, and GCS scoring systems were found to be effective in predicting mortality in patients in the respiratory ICU, similar to other intensive care populations. Higher scores on mCCI, APACHE II, and SOFA, along with a lower GCS, were significantly associated with mortality. The cut-off values derived from ROC analysis using these scoring systems, along with the AUC values, specificity, sensitivity, and negative and positive predictive values, are presented in Table 6, alongside the p-values. Based on binary logistic regression analyses conducted using the calculated cut-off values for these scoring systems, the risk of mortality was 2636 times higher in cases with a CCI level of 5 or above, 4896 times higher in cases with an APACHE II score of 20 or above, 3282 times higher in cases with a SOFA score of 5 or above, and 6841 times higher in cases with a GCS of 14 or below.

Post hoc comparisons of AUC values between the scoring systems were performed using a Z-test based on the standard error of AUC estimates. The comparison revealed that the APACHE-II score had a significantly higher AUC than the mCCI (p=0.045), whereas the differences between other scoring systems were not statistically significant (Table 7).

Table 3. Descriptive characteristics by mortality

n (%)		Mortality (-) (n=239)	Mortality (+) (n=114)	p-value
		n (%)		
Age (year)	Mean ± SD	70.03±11.52	70.57±11.94	[a]0.686
Gender	Female	88 (36.8)	32 (28.1)	[b]0.105
	Male	151 (63.2)	82 (71.9)	
Source of admission to the intensive care unit	Emergency department	117 (49.0)	34 (29.8)	[b]0.001**
	The other department of hospital	74 (31.0)	65 (57.0)	
	Another hospital	48 (20.1)	15 (13.2)	
Primary pulmonary disease	COPD exacerbation	110 (46.0)	31 (27.2)	[b]0.001**
	Pneumonia	65 (27.2)	28 (24.6)	[b]0.599
	Lung cancer	18 (7.5)	29 (25.4)	[b]0.001**
	ILD	12 (5.0)	12 (10.5)	[b]0.055
	Bronchiectasis	4 (1.7)	1 (0.9)	[c]1.000
	Acute PTE	15 (6.3)	3 (2.6)	[b]0.146
	PTB	2 (0.8)	3 (2.6)	[c]0.334
	ARDS	5 (2.1)	2 (1.8)	[c]1.000
	Sepsis	3 (1.3)	4 (3.5)	[c]0.219
	Other	5 (2.1)	1 (0.9)	[c]0.668
•Comorbidities	HT	107 (44.8)	45 (39.5)	[b]0.347
	DM	72 (30.1)	26 (22.8)	[b]0.151
	CAD-arrhythmia	73 (30.5)	33 (28.9)	[b]0.760
	CHF	47 (19.7)	18 (15.8)	[b]0.380
	Extrapulmonary malignancies	15 (6.3)	12 (10.5)	[b]0.160
	CRF	24 (10.0)	8 (7.0)	[b]0.355
	Neurological diseases	28 (11.7)	10 (8.8)	[b]0.404
	Thyroid diseases	9 (3.8)	7 (6.1)	[b]0.316
	Other diseases	29 (12.1)	11 (9.6)	[b]0.491

[a]Independent Samples t-test, [b]Pearson chi-square test, [c]Fisher's exact test
**p<0,01, •Multiple diseases are observed, COPD: obstructive pulmonary disease, ILD: Interstitial lung disease, PTE: Pulmonary thromboembolism, PTB: Pulmonary tuberculosis, ARDS: Acute respiratory distress syndrome, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, CHF: Congestive heart failure, CRF: Chronic renal failure, IQR: Interquartile range

Table 4. Clinical data by mortality

n (%)		Mortality (-) (n=239)	Mortality (+) (n=114)	p-value
		n (%)		
APACHE-II Score	Median (IQR)	15 (8)	22 (10.5)	[d]0.001**
SOFA Score	Median (IQR)	3 (4.75)	6 (6)	[d]0.001**
Modified Charlson comorbidity index	Median (IQR)	4 (2)	5 (4.5)	[d]0.001**
GCS	Median (IQR)	15 (0)	13 (7)	[d]0.001**
Duration of intubation (day) (n=147)	n	39	108	
	Median (IQR)	5 (0)	5 (9)	[d]0.308
Intubation	No	206(84.1)	0 (0)	[b]0.001**
	Patients intubated upon ICU admission	23 (9.3)	32 (29.6)	
	Patients intubated in the ICU	16 (6.6)	76 (70.4)	
Patients with tracheostomy upon ICU admission	No	232 (97.1)	114 (100)	[c]0.101
	Yes	7 (2.9)	0 (0)	
Patients who underwent tracheostomy in the ICU	No	233 (97.5)	107 (93.9)	[c]0.128
	Yes	6 (2.5)	7 (6.1)	
Reintubation	No	236 (98.7)	93 (81.6)	[b]0.001**
	Yes	3 (1.3)	21 (18.4)	
Respiratory support (n=285)	MV	3 (1.5)	37 (46.8)	[b]0.001**
	NIMV	108 (52.4)	4 (5.1)	
	HFNO	13 (6.3)	0 (0)	
	Nasal O_2	72 (35.0)	3 (3.8)	
	NIMV > MV	10 (4.9)	35 (44.3)	
Inotropic support	No	214 (89.5)	31 (27.2)	[b]0.001**
	Yes	25 (10.5)	83 (72.8)	
Length of ICU stay (day)	Median (IQR)	4 (5)	6.5 (12.5)	[d]0.116

[b]Pearson chi-square test, **p<0,0, [c]Fisher's exact test, [d]Mann-Whitney U test
APACHE-II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, GCS: Glasgow Coma Scale, IMV: Invasive mechanical ventilation, NIMV: Non-invasive mechanical ventilation, HFNO: High-flow nasal oxygen, NIMV>IMV: Patients who were intubated and followed with IMV due to NIMV failure, IQR: Interquartile range

Table 5. Laboratory findings by mortality

		Mortality (-) (n=239)	Mortality (+) (n=114)	p-value
pH	Mean±Sd	7.38±0.10	7.34±0.15	[a]0.005**
PO_2 (mm/Hg)	Median (IQR)	47 (32.5)	44.5 (30.5)	[d]0.230
PCO_2 (mm/Hg)	Median (IQR)	53 (34.75)	56 (35)	[d]0.360
HCO_3	Mean±Sd	31.50±8.62	30.80±10.40	[a]0.532
BE	Median (IQR)	5 (10)	3 (13)	[d]0.080
Creatinine (mg/dL)	Mean±Sd	1.15±0.62	1.27±0.87	[a]0.214
GFR (mL/min)	Mean±Sd	70.30±28.39	67.65±30.68	[a]0.425
BUN (mg/dL)	Median (IQR)	23 (17)	30 (32.5)	[d]0.001**
ALT (IU/L)	Median (IQR)	16 (18)	23.5 (54.5)	[d]0.002**
AST (IU/L)	Median (IQR)	21 (20)	32.5 (43.5)	[d]0.001**
LDH (IU/L)	Median (IQR)	258 (134.75)	330.5 (255.5)	[d]0.001**
Albumin (g/L)	Mean±Sd	32.00±5.20	27.49±5.55	[a]0.001**
Magnesium (mg/dL)	Mean±Sd	2.03±0.54	2.06±0.43	[a]0.646
Sodium (mmol/L)	Mean±Sd	138.89±4.64	139.47±6.53	[a]0.394
Potassium (mmol/L)	Mean±Sd	4.42±0.68	4.50±0.99	[a]0.422
Chloride (mmol/L)	Mean±Sd	98.57±8.49	98.47±8.14	[a]0.920
Calcium (mg/dL)	Mean±Sd	8.60±0.83	8.31±1.08	[a]0.013*

Table 5. Continued

		Mortality (-) (n=239)	Mortality (+) (n=114)	p-value
CRP (mg/L)	Median (IQR)	44 (80.75)	116 (129)	[d]0.001**
WBC (µL)	Median (IQR)	10000 (6902)	13030 (7810)	[d]0.001**
Lymphocytes (µL)	Median (IQR)	880 (755)	715 (765)	[d]0.028*
Monocytes (µL)	Median (IQR)	510 (457.5)	530 (510)	[d]0.238
Neutrophils (µL)	Median (IQR)	8460 (6710)	11275 (7905)	[d]0.001**
Eosinophils (µL)	Median (IQR)	10 (50)	10 (20)	[d]0.052
HGB (g/dL)	Mean±Sd	11.96±2.69	11.52±2.36	[a]0.134
HCT (%)	Mean±Sd	38.39±8.31	37.11±7.20	[a]0.159
Platelets (µL)	Median (IQR)	236000 (123750)	241000 (169500)	[d]0.398
Procalcitonin (µg/L)	Median (IQR)	0.1 (14)	0.4 (31)	[d]0.001**
BNP (ng/L)	Median (IQR)	181 (407.75)	142 (802)	[d]0.961
D-dimer (ng/mL)	Median (IQR)	1620 (2080)	3625 (6675)	[d]0.001**
Troponin (ng/L)	Median (IQR)	14 (40)	27 (91)	[d]0.001**

[a]Independent Samples t-test, [d]Mann-Whitney U test, *p<0.05, **p<0.01
IQR: Interquartile range, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, BE: Base excess, BUN: Blood urea nitrogen, GFR: Glomerular filtration rate, HCO_3: Bicarbonate, LDH: Lactate dehydrogenase, PCO_2: Partial Pressure of carbon dioxide, PO_2: Partial pressure of oxygen, BNP: B-type natriuretic peptide, CRP: C-reactive protein, HCT: Hematocrit, HGB: Hemoglobin, WBC: White blood cells

Table 6. Diagnostic screening tests and ROC curve results of mCCI, APACHE II score, SOFA score, and GCS measurements by mortality

	Diagnostic scan					ROC curve		p-value
	Cut-off	Sensitivity	Specificity	Positive predictive value	Negative predictive value	AUC	95% Confidence interval	
mCCI	≥5	57.02	66.53	44.83	76.44	0.667	0.605-0.730	0.001**
APACHE-II	≥20	60.53	76.15	54.76	80.18	0.736	0.679-0.792	0.001**
SOFA	≥5	63.16	65.69	46.75	78.89	0.727	0.671-0.782	0.001**
GCS	≤14	57.89	83.26	62.26	80.57	0.711	0.650-0.772	0.001**

**p<0.01
APACHE-II: Acute Physiology and Chronic Health Evaluation II, GCS: Glasgow Coma Score, mCCI: Modified Charlson comorbidity Index, SOFA: Sequential organ failure assessment, AUC: Area under the curve, ROC: Receiver operating characteristic

Table 7. Post hoc comparison of AUC values between scoring systems (Z-test results)

Model 1	Model 2	Z Score	p-value
mCCI	APACHE-II	-2.009	0.045*
mCCI	SOFA	-1.738	0.082
mCCI	GCS	-1.264	0.206
APACHE-II	SOFA	0.270	0.787
APACHE-II	GCS	0.743	0.458
SOFA	GCS	0.501	0.617

*p<0.05
mCCI: modified Charlson Comorbidity Index, APACHE-II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, GCS: Glasgow Coma Scale

Table 8. Logistic regression analysis of risk factors affecting the presence of mortality

	p-value	Odds ratio	%95 CI	
			Lower	Upper
APACHE-II score	0.021*	1.069	1.010	1.130
GCS	0.001**	1.211	1.084	1.354
Intubation (yes)	0.001**	95.437	27.755	328.160
Inotropic support (yes)	0.006**	3.278	1.415	7.589
Albumin	0.013*	1.106	1.022	1.198
Hemoglobin	0.028*	1.227	1.023	1.472
D-dimer	0.001**	1.005	1.003	1.010

**p<0.01, *p<0.05
APACHE-II: Acute Physiology and Chronic Health Evaluation II, GCS: Glasgow Coma Score, CI: Confidence interval

For the presence of mortality, factors that were significant or approaching significance in the univariate analysis were included in the logistic regression analysis, to develop a model with high significance and explainability. Accordingly, the effects of the following factors were subjected to backward stepwise logistic regression analysis: the presence of primary respiratory disease diagnoses of COPD exacerbation, LC, and ILD; APACHE II score, SOFA score, mCCI, and GCS; presence of intubation, administration of inotropic support, length of stay in ICU; and measurements of BUN, albumin, CRP, lymphocytes, Hgb, procalcitonin, D-dimer, and troponin. The model generated at the end of step 12 for the risk factors affecting mortality is presented in Table 8. After step 12 of the analysis, it was observed that the APACHE II score, GCS, presence of intubation, administration of inotropic support, and measurements of albumin, Hgb, and D-dimer significantly contributed to the model that affects mortality. The explanatory power of the model, with a coefficient of 91.7%, is considered very good. Accordingly, in patients monitored in respiratory ICUs, a high APACHE II score, low GCS, presence of intubation, administration of inotropic support, low albumin levels, low Hgb levels, and high D-dimer values are independent risk factors for mortality.

DISCUSSION

The mortality rates of patients in the respiratory ICU vary according to several factors. These factors include age, gender, the source of ICU admission, the primary diagnosed disease, comorbid diseases, laboratory parameters, and prognostic scoring systems. Various studies have demonstrated that age is a significant factor, increasing mortality in the ICU. Seferian and Afessa (6) reported that ICU admission rates in the older age group (over 85 years) were significantly higher compared to younger age groups, and these patients had more comorbidities. ICU admissions during the last six months of life were found to be much higher in patients aged 85 years and above compared to those in the 18-44 age group (6). In the study by Chung et al. (5), it was stated that age did not directly affect acute mortality; however, older patients had longer ICU stays and an increased need for long-term care after discharge. However, this study found no statistically significant difference in the mean age between surviving and deceased patients. This finding, which appears to contradict the literature, may be due to the high number of young patients with terminal LC in the respiratory ICU where the study was conducted. The literature supports that age alone is not a determining factor for mortality, and that patients' comorbidities and treatment processes should be evaluated along with their age (5,7).

The literature presents varying results regarding the impact of gender on mortality in patients admitted to the ICU. Seferian and Afessa (6) reported that male gender is associated with a higher rate of ICU admissions among elderly patients and that males tend to have longer ICU stays. However, in another study by Ceriana et al. (8), the mortality rates of female patients in respiratory ICUs were observed to be higher than those of males, although this difference was not statistically significant. In our study, despite the higher proportion of male patients, the effect of gender on mortality was not found to be statistically significant. Considering that Romo et al. (9) study identified female gender as a high-risk factor for mortality, while Ursavaş et al. (10) reported higher mortality rates in males, it can be concluded that the impact of gender on ICU mortality remains unclear, and further research is needed to clarify these findings (6-10).

In our study, mortality was higher in patients transferred from hospital clinics compared to those admitted from the emergency department. The literature also contains studies supporting this finding. Motzkus et al. (11) demonstrated that patients diagnosed with sepsis had higher mortality rates when admitted from hospital clinics. A similar finding was reported in the study by Valentini et al. (12) on patients in respiratory ICUs. However, Parpucu et al. (13) found that mortality rates were higher among patients admitted from the emergency department compared to those transferred from hospital clinics. These conflicting results may be due to differences in patient groups, patient profiles, and the severity of illness at the time of initial admission. In our study, we attribute the higher mortality observed in patients admitted to the ICU from hospital clinics because these patients did not respond well to initial treatments, making the management of the respiratory patients admitted from the clinics considerably more challenging.

Respiratory diseases are prominent among the reasons for ICU admissions, and our study identified COPD exacerbation, pneumonia, and LC as the most common causes of admission. Our findings indicate that the mortality rate is lower in patients with COPD exacerbation, but it is higher in patients with LC. No significant increase in mortality was detected in patients diagnosed with pneumonia. The literature supports some of our findings; for instance, Ursavaş et al. (10), demonstrated that the mortality rates of patients admitted to the ICU due to LC were higher than other patients. Çağlar et al. (14) reported that pneumonia has a significant impact on mortality. We believe that the strict protocols for treating respiratory failure, which have been implemented in our respiratory ICU for many years, may have contributed to the low mortality rates observed in COPD exacerbation patients in our study. These protocols include the use of new-generation non-invasive ventilation devices.

Comorbid conditions are known to be significant factors affecting mortality in the ICU. In our study, HT, CAD/arrhythmia, and DM were among the most common comorbidities; however, their impact on mortality was not found to be statistically significant. These findings are consistent with the study by Antonelli Incalzi et al. (15), which indicated that comorbidities do not increase mortality in patients with COPD.

Prognostic scoring systems are widely used to predict mortality in the ICU. The APACHE-II and SOFA scores are the most commonly utilized systems for assessing patients' mortality risk. In our study, we found that high APACHE-II and SOFA scores were significantly associated with mortality. The literature also supports these results. For instance, Godinjak et al. (16) noted that patients with an APACHE-II score above 27.5 had a significantly increased risk of mortality. Similarly, Naqvi et al. (17) found that both APACHE-II and SOFA scores were associated with mortality. In Naqvi et al. (17) study, it was shown that mortality significantly increased in patients with high APACHE-II scores, and SOFA scores also predicted mortality in a similar manner. Some studies have demonstrated that the SOFA score has higher discriminative power compared to the APACHE-II score, and both scoring systems aid in predicting mortality risk by assessing organ function and overall clinical status (18,19). Our study confirms the effectiveness of APACHE-II and SOFA scores in predicting mortality, and these findings are consistent with the existing literature. These scoring systems play a critical role in predicting mortality risk and managing patients in the ICU. Although the median APACHE II score (17) and median SOFA score (4) would correspond to expected mortality rates of approximately 20-25% and 15-20%, respectively, the observed mortality rate in our study was 30.9%. This discrepancy may be attributed to several factors, including the specific characteristics of the respiratory ICU population, the presence of underlying comorbidities, delayed referrals, disease severity not fully captured by the scoring systems, and post-COVID-19 pandemic effects on ICU admission profiles.

D-dimer and troponin levels are particularly associated with thromboembolic events and cardiac injury. Hu et al. (20) reported that D-dimer levels show a strong relationship with mortality, especially in patients admitted due to COPD exacerbations. An increase in D-dimer levels indicates that the coagulation system is activated and that the patient is at risk for thrombotic complications, which subsequently raises the risk of mortality. In our study, elevated D-dimer levels in patients were also found to be associated with higher mortality.

Study Limitations

Our study had several limitations. It was a single-center, retrospective study not specific to any disease. Patients' biochemical parameters were assessed with a single measurement at the time of ICU admission, and serial measurements were not performed. Vital signs at admission were not recorded. We did not have detailed information regarding disease severity, nutritional status, and quality of life prior to admission.

CONCLUSION

In our study, factors affecting mortality in the ICU were examined and compared with the literature. It was found that age, gender, the source of patient admission to the ICU, primary respiratory diagnosis, certain laboratory parameters, and prognostic scoring systems are significant in predicting mortality in respiratory ICUs. Our study produced results that are largely consistent with similar studies in the literature. However, differences in patient profiles and some results that vary according to clinical conditions indicate that such studies should be conducted with larger sample sizes and a focus on primary respiratory diseases. A better understanding of these factors may guide strategies aimed at reducing mortality in respiratory ICUs.

Ethics

Ethics Committee Approval: This study was conducted with ethical approval from the University of Health Sciences Türkiye, Ankara Atatürk Sanatory Education

Training and Research Hospital Scientific Research Ethics Committee, under (number: 2024-BÇEK/7, date: 28.02.2024).

Informed Consent: Informed consent was obtained from all participants included in the study.

Acknowledgement

This study is derived from Dr Merve Ayyürek's medical specialization thesis. Large Language Model (LLM), and chatbot technologies were utilized for grammar and spell-checking after writing the manuscript in English.

Footnotes

Author Contributions: Surgical and Medical Practices- M.Y.; Concept - M.Y.; Design - M.Y.; Data Collection and/or Processing - M.A.; Analysis and/or Interpretation - O.M.; Literature Search - M.A.; Writing - M.A.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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