Research Square

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# Is the waiting time for transfer to a palliative care unit associated with mortality?

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**Research Article**

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# Abstract

**Introduction/Aim**: Timely transfer from the intensive care unit (ICU) to the palliative care unit (PCU) improves symptom control, resource utilization, and end-of-life care quality, yet is often delayed by bed capacity and organizational constraints. While early palliative care consultation is well studied, the impact of ICU-to-PCU transfer waiting time on short- and medium-term mortality remains unclear. The aim of this study was to evaluate the relationship between PCU transfer waiting time and 90-day mortality (primary outcome) and 30-day mortality (secondary outcome) with other prognostic factors.

**Methods**: This single-center retrospective cohort study was conducted in a tertiary Anesthesiology ICU (October 2022–May 2026). Of 2292 ICU admissions, 93 adult patients who were transferred to the PCU were included in the study. The optimal cut-off value for waiting time was determined by ROC analysis; Kaplan-Meier survival analysis and multivariable Cox regression analyses adjusted for age, sex, ICU length of stay, APACHE-II, and NLR, along with subgroup analyses, were performed.

**Results**: In ROC analysis, a threshold of ≥ 7 days was found to be significant in predicting 90-day mortality (AUC = 0.723, 95% CI 0.620–0.826, sensitivity 65.2%, specificity 72.3%). Ninety-day mortality was 32.0% in the group with a waiting time of less than 7 days, rising to 69.8% in the group with a waiting time of ≥ 7 days (log-rank $p < 0.001$). In multivariable analysis, a waiting time of ≥ 7 days remained an independent predictor of 90-day mortality, irrespective of ICU length of stay (HR = 2.342, 95% CI 1.145–4.791, $p = 0.020$; ICU length of stay HR = 1.014, $p = 0.021$). Although 30-day mortality showed a significant difference in univariate Kaplan-Meier analysis (15.7% vs. 38.1%, $p = 0.005$), this significance was lost after multivariable adjustment (HR = 2.401, 95% CI 0.876–6.578, $p = 0.088$). The adverse effect of prolonged waiting time was consistent across most subgroups, but was attenuated among male and oncology patients.

**Conclusion**: Prolonged waiting time for transfer to the PCU is associated with increased 90-day mortality, independent of traditional clinical comorbidities. Reducing ICU-PCU transfer delays may represent a modifiable target for improving patient outcomes.


# 1. Background

Advances in the intensive care unit (ICU) and multidisciplinary treatment approaches have led to increased survival [1]. However, end-stage chronic diseases, organ failure, advanced-stage cancer, and frailty limit the potential benefits of the ICU. For these patients, the goals of care generally include symptom management, pain palliation, comfort, and enhancement of quality of life [2]. For all these reasons, the palliative care unit (PCU) has over time become integrated with the ICU [1, 2].

Timely discharge from the ICU to the PCU contributes to improved symptom control, appropriate utilization of resources, a comfortable end of life, and timely achievement of care goals [3, 4]. Moreover, transfer of these patients to the PCU within an appropriate timeframe is associated with less invasive treatment, lower cost, and a process more consistent with patients' values and preferences [3, 4].

Despite all these benefits, access to the PCU remains limited for patients receiving inpatient treatment at tertiary care centers. Limited bed capacity, increasing demand due to an aging population, and organizational barriers delay the transfer of patients from the ICU to the PCU [5].

Patients who remain in the ICU after a decision for PCU transfer has been made may continue to be exposed to invasive procedures, infection, and complications. This situation also affects critically ill patients awaiting ICU admission, increasing bed occupancy rates and, consequently, costs [6]. Although this aspect of healthcare delivery has been the subject of numerous studies, the effects of delays in transfer time on patient-centered short- and medium-term mortality, in particular, have been largely overlooked. Many studies have focused on early palliative care consultation, whereas the waiting time for transfer has not been adequately examined [7, 8, 9]. Whether organizational factors, such as delayed transfer to the PCU, provide additional information beyond traditional clinical variables remains uncertain.

## 2. Method

## 2.1. Human Ethics and Consent to Participate

The study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee of Ankara Etlik City Hospital, University of Health Sciences (No: AEŞH-BADEK-2024-813). Due to the retrospective nature of the study, informed consent statements from the patients were not obtained. Due to the retrospective study design, this study does not have a ClinicalTrials registration.

## 2.2. Study Design and Participants

This single-center retrospective cohort study was conducted at Ankara Etlik City Hospital, a tertiary care center. During the study period (October 2022–May 2026), a total of 2292 patients were admitted to the 16-bed Anesthesiology ICU. Of these, 93 adult patients who were transferred to the 60-bed PCU constituted the study cohort.

Patients aged 18 years and older, for whom 30- and 90-day all-cause mortality rates could be determined, were included in the study. Patients with unavailable mortality data or incomplete medical records were defined as the predetermined exclusion criteria. Ninety-three patients met the inclusion criteria and were included in the final analysis (Fig. 1).

## 2.3. Data Collection

Demographic characteristics, comorbidities, ICU admission diagnoses, disease severity scores, laboratory parameters, treatment-related variables, ICU length of stay, waiting time for transfer to the PCU, and clinical outcomes were retrospectively obtained from the hospital's electronic medical record system and archived patient charts.

## 2.4. Study Outcomes

The primary aim of this study was to evaluate the association between waiting time for transfer to the PCU and 90-day mortality in patients for whom a decision for transfer from a tertiary ICU to the PCU had been made. The secondary aim was to examine 30-day mortality and the clinical and prognostic factors associated with mortality.

# 2.5.Statistical analysis

Statistical analyses of the data obtained from the study were performed using IBM SPSS Statistics (Version 26.0, IBM Corp., Armonk, NY, USA) and open-source data science libraries (pandas, SciPy, statsmodels, lifelines) within the Python 3.10 programming language. The type I error rate (α) was set at 0.05 for all analyses, and a two-tailed $p < 0.05$ was considered statistically significant.

Descriptive Statistics and Assumption of Normality:

The conformity of continuous variables to a normal distribution was assessed using both visual methods (histograms and probability plots) and analytical methods (Shapiro-Wilk test). Continuous variables with a normal distribution were expressed as mean ± standard deviation (SD), while non-normally distributed variables were expressed as median and interquartile range (IQR; 25th–75th percentile). Categorical variables were presented as number (n) and percentage (%).

**Group Comparisons and Effect Sizes**:

Patients were divided into two groups based on waiting time (using the optimal cut-off value). For comparisons of continuous variables between groups, the Independent Samples t-test was used for data meeting parametric assumptions, and the Mann-Whitney U test was used for data not meeting these assumptions. Categorical variables were analyzed using the Pearson Chi-Square test or Fisher's Exact Test, depending on expected frequencies. To indicate the clinical significance of the comparisons, effect sizes were calculated: Cohen's d for the t-test, the r coefficient for the Mann-Whitney U test ($r = Z/\sqrt{N}$), and, for chi-square analyses, the Odds Ratio (OR) for 2×2 tables or Cramer's V for larger tables.

**Diagnostic Performance and Cut-off Point Analysis**:

ROC (Receiver Operating Characteristic) curve analysis was performed to determine the discriminative power of waiting time for discharge to the PCU in predicting 90-day mortality, as well as the optimal cut-off value. The cut-off point was determined using the Youden Index ($J = \text{Sensitivity} + \text{Specificity} - 1$), which represents the point at which the sum of sensitivity and specificity values is maximized. The overall accuracy of the test was assessed using the Area Under the Curve (AUC) and 95% Confidence Intervals (CI).

**Survival Analyses**:

Kaplan-Meier method was used to estimate patients' 30- and 90-day survival times (time-to-event data), and differences in the distribution of survival curves between groups were compared using the Log-Rank

(Mantel-Cox) test. Survival times were calculated up to the occurrence of the event or the end of the defined follow-up period (censoring).

A Multivariable Cox Proportional Hazards Regression model was constructed to identify independent prognostic factors that could influence mortality. Confounding factors that showed significance in univariate analyses or were known to be clinically important based on the literature (age, sex, ICU length of stay, APACHE-II score, and NLR [Neutrophil-to-Lymphocyte Ratio]) were entered into the model simultaneously (Enter method). The results of the analysis were presented as Hazard Ratio (HR) and 95% Confidence Intervals. The reliability of the models was tested using scaled Schoenfeld residuals and time-dependent covariate analyses, confirming that the proportional hazards assumption was not violated. Finally, subgroup analyses were performed to elaborate on the effect of waiting time across different clinical cohorts, and the findings were visualized using a Forest Plot.

# 3. Results

ROC (Receiver Operating Characteristic) analysis was performed to evaluate the discriminative power of waiting time for discharge to the PCU in predicting 90-day mortality status among the patients included in the study. The analysis revealed that waiting time had a statistically significant discriminative effect on 90-day mortality (AUC = 0.723, 95% CI: 0.620–0.826, $p < 0.001$).

The optimal cut-off point for predicting mortality was determined by calculating the Youden Index ($J$ = Sensitivity + Specificity − 1). Based on the coordinate analysis, the threshold value of 6.50, corresponding to the maximum Youden Index value (0.375), was taken into consideration, and a waiting-time cut-off of ≥ 7 days was adopted for clinical practice (Table 1). Using this threshold, the sensitivity and specificity of waiting time in predicting 90-day mortality were calculated as 65.2% and 72.3%, respectively (Fig. 2).

Table 1
Diagnostic accuracy of different cut-off points of waiting time for predicting 90-day mortality

| Cut-off (Days)* | Sensitivity | 1 - Specificity | Specificity | Youden Index (J) |
|---|---|---|---|---|
| 1.50 | 0.978 | 0.894 | 0.106 | 0.084 |
| 2.50 | 0.935 | 0.830 | 0.170 | 0.105 |
| 3.50 | 0.870 | 0.638 | 0.362 | 0.232 |
| 4.50 | 0.783 | 0.468 | 0.532 | 0.315 |
| 5.50 | 0.674 | 0.383 | 0.617 | 0.291 |
| 6.50 | **0.652** | **0.277** | **0.723** | **0.375** |
| 7.50 | 0.500 | 0.213 | 0.787 | 0.287 |
| 8.50 | 0.391 | 0.149 | 0.851 | 0.242 |
| 9.50 | 0.326 | 0.106 | 0.894 | 0.220 |
| 10.50 | 0.326 | 0.085 | 0.915 | 0.241 |
| 12.50 | 0.283 | 0.021 | 0.979 | 0.262 |
| 15.00 | 0.152 | 0.021 | 0.979 | 0.131 |

*ROC: Receiver Operating Characteristic; J: Youden Index. The optimal cut-off value was determined as $\geq$ 6.50 days (clinically applied as $\geq$ 7 days) based on the maximum Youden Index (J = Sensitivity + Specificity − 1). Positive state is defined as occurrence of mortality within 90 days. * Positive if Greater Than or Equal To.*

When groups were examined in terms of waiting time for discharge to the PCU, 53.8% (n = 50) of patients were found to have waited less than 7 days, while 46.2% (n = 43) waited 7 days or longer. When the two groups were compared in terms of clinical and demographic characteristics, the proportion of female patients was found to be significantly higher in the group waiting 7 days or longer (60.5% vs. 32.0%; p = 0.011, OR = 0.31). When biochemical parameters were examined, NLR was found to be statistically higher in the group with a longer waiting time (median 11.4 vs. 8.2; p = 0.028, r = 0.23).

In the group with a waiting time of 7 days or longer, the number of days spent intubated (median 10 days vs. 0 days; p = 0.019, r = 0.23) and ICU length of stay (median 24 days vs. 9.5 days; p < 0.001, r = 0.59) were found to be significantly higher compared to the group with a shorter waiting time. No statistically significant difference was found between the groups in terms of other disease severity scores (APACHE-II, SOFA) or comorbidity/intervention status (oncological admission, tracheostomy, RRT, pressure ulcer, etc.) (Table 2).

Table 2
Comparison of demographic and clinical characteristics of patients according to the optimal waiting time cut-off

| Variables | < 7 Days (n = 50) | ≥ 7 Days (n = 43) | p-value | Effect Size [95% CI] |
|---|---|---|---|---|
| Age, Median (IQR) | 73.5 (57.5–83.0) | 79.0 (70.5–85.0) | 0.132 | *r* = 0.16 |
| Gender (Female), n (%) | 16 (32.0%) | 26 (60.5%) | **0.011** | OR = 0.31 [0.13–0.72] |
| APACHE-II Score, Mean ± SD | 23.3 ± 6.3 | 23.7 ± 7.1 | 0.755 | *d* = 0.07 [-0.34–0.47] |
| SOFA Score, Median (IQR) | 6.0 (5.0–8.8) | 7.0 (5.0–10.0) | 0.398 | *r* = 0.13 |
| NLR, Median (IQR) | 8.2 (4.7–13.1) | 11.4 (7.4–18.2) | **0.028** | *r* = 0.23 |
| Albumin (g/dL), Median (IQR) | 29.0 (25.4–31.9) | 27.8 (23.9–30.9) | 0.538 | *r* = 0.06 |
| CRP (mg/L), Median (IQR) | 79.5 (43.5–140.8) | 102.7 (39.5–225.5) | 0.361 | *r* = 0.10 |
| Intubated Days, Median (IQR) | 0.0 (0.0–9.8) | 10.0 (0.0–22.5) | **0.019** | *r* = 0.23 |
| ICU Length of Stay (Days), Median (IQR) | 9.5 (7.0–16.0) | 24.0 (16.5–43.0) | **< 0.001** | *r* = 0.59 |
| Tracheostomy, n (%) | 15 (30.0%) | 21 (48.8%) | 0.100 | OR = 2.23 [0.95–5.21] |
| Renal Replacement Therapy, n (%) | 10 (20.0%) | 6 (14.0%) | 0.569 | OR = 1.54 [0.51–4.67] |
| Pressure Ulcer, n (%) | 20 (40.0%) | 21 (48.8%) | 0.518 | OR = 0.70 [0.30–1.61] |

*IQR: Interquartile Range; SD: Standard Deviation; OR: Odds Ratio; CI: Confidence Interval; APACHE-II: Acute Physiology and Chronic Health Evaluation II; SOFA: Sequential Organ Failure Assessment; NLR: Neutrophil-to-Lymphocyte Ratio; CRP: C-Reactive Protein; ICU: Intensive Care Unit. Normally distributed continuous variables were compared using Independent Samples t-test (reported as Mean ± SD with Cohen's d [95% CI]). Non-normally distributed continuous variables were compared using Mann-Whitney U test (reported as Median (IQR) with effect size r). Categorical variables were evaluated by Pearson's Chi-square or Fisher's Exact test as appropriate (reported as n (%) with OR [95% CI]). Statistically significant p-values (p < 0.05) are indicated in bold.*

## 90-Day Survival Analyses

In the group with a waiting time of < 7 days, the 90-day mortality rate was 32.0% (n = 16), whereas this rate rose dramatically to 69.8% (n = 30) in the group with a waiting time of ≥ 7 days (Table 3).

Table 3
Kaplan-Meier survival estimates for 90-day mortality according to the optimal waiting time cut-off

| Waiting Time Group | Total N | Events (n, %) | Censored (n, %) | Median Survival Time (Days)* | Log-Rank p-value |
|---|---|---|---|---|---|
| < 7 Days | 50 | 16 (32.0%) | 34 (68.0%) | Not Reached | **< 0.001** |
| ≥ 7 Days | 43 | 30 (69.8%) | 13 (30.2%) | 36.0 | |
| Overall | 93 | 46 (49.4%) | 47 (50.6%) | - | |

*"Not Reached" indicates that the median survival time could not be calculated because the cumulative survival probability for the < 7 Days group did not drop below 50% during the 90-day follow-up period. The difference between survival distributions was analyzed using the Log-Rank (Mantel-Cox) test.*

In the group with a shorter waiting time (< 7 days), the median survival time was not reached during the 90-day follow-up period, as the majority of patients survived. In contrast, the median survival time in the group waiting ≥ 7 days was found to be 36 days. When the survival curves of the groups were compared using the Log-Rank (Mantel-Cox) test, the difference was confirmed to be highly statistically significant ($p < 0.001$). Prolonged waiting time was found to markedly reduce patients' probability of 90-day survival (Fig. 3).

Multivariable Cox Proportional Hazards Regression analysis, incorporating potential clinical and demographic confounding factors (age, sex, ICU length of stay, APACHE-II score, and NLR), was performed to evaluate the independent effect of waiting time for discharge to the PCU on 90-day survival. The overall model constructed was found to be statistically significant (Omnibus $X^2 = 24.166$, $p < 0.001$).

According to the analysis results, even after adjusting for the patient's age, sex, APACHE-II disease severity score at admission, and NLR values, a longer waiting time (Group 1) was found to independently increase the risk of 90-day mortality by 2.34-fold (HR = 2.342, 95% CI: 1.145–4.791, $p = 0.020$).

Furthermore, ICU length of stay was also found to be an independent prognostic factor for survival, with each 1-day increase in ICU length of stay increasing the risk of mortality by 1.4% (HR = 1.014, 95% CI: 1.002–1.025, $p = 0.021$). None of the other variables included in the model (age, sex, APACHE-II, and NLR) showed a statistically significant independent effect on mortality ($p > 0.05$) (Table 4). These findings confirm that prolonged waiting time is a major risk factor predicting mortality, independent of patients' clinical status or disease severity scores.

Table 4
Multivariable Cox regression analysis for independent predictors of 90-day mortality

| Variables | B | SE | Hazard Ratio (HR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|---|---|
| Waiting Time Group | 0.851 | 0.365 | 2.342 | 1.145–4.791 | **0.020** |
| ICU Length of Stay (Days) | 0.014 | 0.006 | 1.014 | 1.002–1.025 | **0.021** |
| Age (Years) | 0.020 | 0.011 | 1.021 | 0.998–1.044 | 0.076 |
| Gender (Female vs. Male) | -0.016 | 0.347 | 0.984 | 0.498–1.942 | 0.962 |
| APACHE-II Score | 0.000 | 0.022 | 1.000 | 0.957–1.045 | 1.000 |
| NLR | 0.003 | 0.017 | 1.003 | 0.970–1.037 | 0.871 |

*B: Unstandardized regression coefficient; SE: Standard Error; ICU: Intensive Care Unit; APACHE-II: Acute Physiology and Chronic Health Evaluation II; NLR: Neutrophil-to-Lymphocyte Ratio. A multivariable Cox proportional hazards model (Method = Enter) was utilized to calculate Hazard Ratios (HR) and 95% Confidence Intervals (CI) for 90-day mortality. The overall model was statistically significant (Chi-square = 24.166, df = 6, p < 0.001). Statistically significant p-values (p < 0.05) are highlighted in bold.*

## 30-Day Survival Analyses

Kaplan-Meier survival analysis was performed to evaluate the effect of waiting time for discharge to the PCU on patients' early-period (30-day) mortality. The overall 30-day mortality rate among the total of 93 patients included in the study was found to be 25.8% (n = 24). In the group with a waiting time of < 7 days (n = 51), the mortality rate within the first 30 days was only 15.7% (n = 8), whereas in the group with a waiting time of ≥ 7 days (n = 42), this rate rose to 38.1% (n = 16).

According to the results of the Kaplan-Meier analysis, the estimated mean 30-day survival time in the group with a shorter waiting time (< 7 days) was calculated as 29.5 days (95% CI: 29.0–29.9). In contrast, the estimated mean survival time in the group with a longer waiting time (≥ 7 days) showed a marked decrease to 22.0 days (95% CI: 18.8–25.2) (Table 5). In both groups, since more than half of the patients survived within the first 30 days, the median survival time could not be reached.

Table 5
Kaplan-Meier survival estimates for early 30-day mortality according to waiting time

| Waiting Time Group | Total N | Events (n, %) | Censored (n, %) | Mean Survival Time (95% CI)* | Log-Rank X2 | p-value |
|---|---|---|---|---|---|---|
| < 7 Days | **51** | **8 (15.7%)** | **43 (84.3%)** | **29.5 (29.0–29.9)** | **8.004** | **0.005** |
| ≥ 7 Days | **42** | **16 (38.1%)** | **26 (61.9%)** | **22.0 (18.8–25.2)** | | |
| Overall | **93** | **24 (25.8%)** | **69 (74.2%)** | **26.1 (24.4–27.8)** | - | - |

**Time is given in days. CI: Confidence Interval. Median survival time was not reached for either group as the cumulative survival probability did not drop below 50% within the 30-day follow-up. The difference between survival distributions was analyzed using the Log-Rank (Mantel-Cox) test. Statistically significant p-values (p < 0.05) are indicated in bold.*

When the early-period survival curves of the two groups were compared using the Log-Rank (Mantel-Cox) test, the difference was found to be statistically significant ($X^2 = 8.004$, $p = 0.005$). These findings demonstrate that waiting 7 days or longer for the PCU statistically significantly reduces the probability of survival not only in the long-term 90-day period but also in the acute 30-day period (Fig. 4).

Multivariable Cox Regression analysis, incorporating clinical and demographic confounding factors (age, sex, ICU length of stay, APACHE-II score, and NLR), was performed to evaluate the independent effect of waiting time for discharge to the PCU on early-period (30-day) survival. The multivariable model constructed was found to be statistically significant overall (Omnibus Chi-square = 15.283, df = 6, p = 0.018).

When the analysis results were examined, although a waiting time of 7 days or longer (Group 1) was observed to increase the risk of mortality by 2.4-fold in the early 30-day period, this increase did not reach statistical significance after adjustment for the other variables (HR = 2.401, 95% CI: 0.876–6.578, p = 0.088). Similarly, neither ICU length of stay (HR = 1.012, p = 0.106) nor the other demographic/clinical characteristics included in the model (age, sex, APACHE-II, and NLR) showed an independent and statistically significant predictive effect on 30-day early mortality (p > 0.05) (Table 6).

Table 6
Multivariable Cox regression analysis for independent predictors of early 30-day mortality

| Variables | B | SE | Hazard Ratio (HR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|---|---|
| Waiting Time Group (≥ 7 Days vs. < 7 Days) | 0.876 | 0.514 | 2.401 | 0.876–6.578 | 0.088 |
| ICU Length of Stay (Days) | 0.011 | 0.007 | 1.012 | 0.998–1.026 | 0.106 |
| Age (Years) | 0.017 | 0.016 | 1.017 | 0.986–1.050 | 0.280 |
| Gender (Female vs. Male) | -0.519 | 0.494 | 0.595 | 0.226–1.565 | 0.293 |
| APACHE-II Score | -0.005 | 0.030 | 0.995 | 0.939–1.056 | 0.876 |
| NLR | -0.036 | 0.027 | 0.965 | 0.914–1.018 | 0.187 |

*B: Unstandardized regression coefficient; SE: Standard Error; ICU: Intensive Care Unit; APACHE-II: Acute Physiology and Chronic Health Evaluation II; NLR: Neutrophil-to-Lymphocyte Ratio. A multivariable Cox proportional hazards model (Method = Enter) was utilized to calculate Hazard Ratios (HR) and 95% Confidence Intervals (CI) for early 30-day mortality. The overall model demonstrated statistical significance (Chi-square = 15.283, df = 6, p = 0.018). None of the individual covariates reached the conventional threshold for statistical significance (p < 0.05) in predicting 30-day mortality.*

These findings indicate that the marked mortality difference observed at day 30 in the Kaplan-Meier analysis was influenced by multifactorial dynamics, and that the independent, statistically robust, major detrimental (cumulative risk) effect of waiting time on survival becomes fully apparent not in the early period but over the course of the 90-day follow-up.

The Proportional Hazards assumption was tested to confirm the reliability of the constructed Multivariable Cox Regression models. The time-dependent interactions and scaled Schoenfeld residuals of each independent variable included in the model (waiting time, age, sex, ICU length of stay, APACHE-II, and NLR) were examined. No crossing was observed between groups in the Kaplan-Meier survival curves, and no significant systematic deviation that would alter clinical interpretation was observed in the distribution of partial residuals over time. Accordingly, the constructed Cox models were considered to satisfy the proportional hazards assumption, and the obtained Hazard Ratios were accepted as stable/reliable throughout the follow-up period.

**Subgroup Survival Analysis**

Subgroup analyses were performed to evaluate the consistency of the detrimental effect of waiting 7 days or longer for discharge to the PCU on 90-day mortality across specific clinical and demographic subgroups. Univariate Cox Proportional Hazards models were constructed for each subgroup, and Hazard Ratios (HR) with 95% Confidence Intervals (CI) were calculated and visualized on a Forest Plot.

According to the analysis results, prolonged waiting time significantly increased the risk of mortality, independent of the patient's age (under 75 years or 75 years and older) and the presence of tracheostomy ($p < 0.05$). When sex subgroups were examined, prolonged waiting time markedly increased the risk of mortality in women (HR = 4.93, 95% CI: 2.12–11.47, $p < 0.001$), whereas this effect remained at the borderline of statistical significance in male patients (HR = 2.53, 95% CI: 1.00–6.45, $p = 0.051$).

Similarly, when patients' admission indications were examined, prolonged waiting time was found to have a very strong detrimental effect in patients admitted for non-oncological reasons (HR = 4.06, 95% CI: 1.96–8.44, $p < 0.001$). However, in patients admitted to the ICU for oncological reasons, although prolonged waiting time tended to numerically increase the risk of mortality by 2.08-fold, this effect did not reach statistical significance ($p = 0.205$) (Fig. 5).

# 4. Discussion

In this study, waiting time for transfer to the PCU was shown to be potentially associated with 90-day mortality. The 7-day threshold identified in the ROC analysis retained its significance in the Kaplan-Meier and multivariable Cox analyses. In patients who waited 7 days or longer, the risk of 90-day mortality was found to be approximately 2.3-fold higher. The fact that this association was independent of total ICU length of stay suggests that transfer delay may contribute to mortality independent of the patient's clinical status.

Although 30-day mortality was significant in the Kaplan-Meier analysis, it did not retain significance in the multivariable model. This may be related to limited statistical power due to the low number of events in the early period. Furthermore, the effect of transfer delay may become more pronounced over time rather than manifesting as early mortality.

Our findings are consistent with the studies of Temel and Zimmermann, which demonstrated the possible benefits of early access to the PCU on clinical outcomes [7, 10]. Various logistic and clinical barriers delaying transfer have been described in the literature, but the effect of these delays on mortality has not been clearly established [11, 12, 13, 14]. Hausner et al., on the other hand, examined early mortality following transfer to the PCU [15]. Our study differs from these previous studies in that it addresses transfer waiting time as an independent variable and evaluates its association with 30- and 90-day mortality through multivariable analyses. To the best of our knowledge, our findings represent one of the first studies to directly demonstrate the possible effect of PCU transfer delay on mortality.

In subgroup analyses, the effect of delay persisted in most groups but was not found to be significant in oncology patients. This may be related to the limited sample size or to goals of care being established earlier in oncology patients. The finding of a higher NLR and longer duration of intubation in the delayed transfer group suggests that these patients may be in a more severe clinical condition [16, 17, 18]. Nevertheless, the fact that the effect of waiting time persisted despite these variables losing

significance in the multivariable analysis supports the notion that the association cannot be explained by disease severity alone.

Consistent with the literature, our results suggest that reducing delays in transfer to the PCU through standardized protocols could improve not only resource utilization but also patient outcomes [19]. In addition to the survival differences between the ICU and PCU demonstrated by Irmak et al. in Turkey, our findings indicate that transfer time may also be a factor that can affect mortality [20].

The main limitations of this study include its single-center, retrospective design, limited sample size, and the wide confidence intervals in the subgroup analyses. These findings need to be confirmed by larger, multicenter, prospective studies.

## 5. Conclusions

Shortening the waiting time for transfer from the ICU to the PCU may be an important factor that could improve survival.

## Abbreviations

ICU
Intensive Care Unit
PCU
Palliative Care Unit
MV
Mechanical ventilator
NLR
Neutrophil-to-Lymphocyte Ratio. APACHE-II:Acute Physiology and Chronic Health Evaluation II
SOFA
Sequential Organ Failure Assessment score

## Declarations

# Definitions

Need for MV in the ICU: Indicates whether patients required invasive or non-invasive MV during their ICU stay.

# Declarations

The study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee of Ankara Etlik City Hospital, University of Health Sciences (No: AEŞH-BADEK-2024-813). Due to the retrospective nature of the study, informed consent statements from the patients were not obtained.

**Consent for publication**

Not applicable

**Competing interests**

The author declare no competing interests.

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# Author Contribution

SFK: Designed the study, analyzed the data, wrote the manuscript, and reviewed, edited, and approved the final version.

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No thanks included.

# Data Availability

Data are available from the Republic of Türkiye Ministry of Health and Etlik City Hospital upon reasonable request (https://www.saglik.gov.tr).

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# Figures

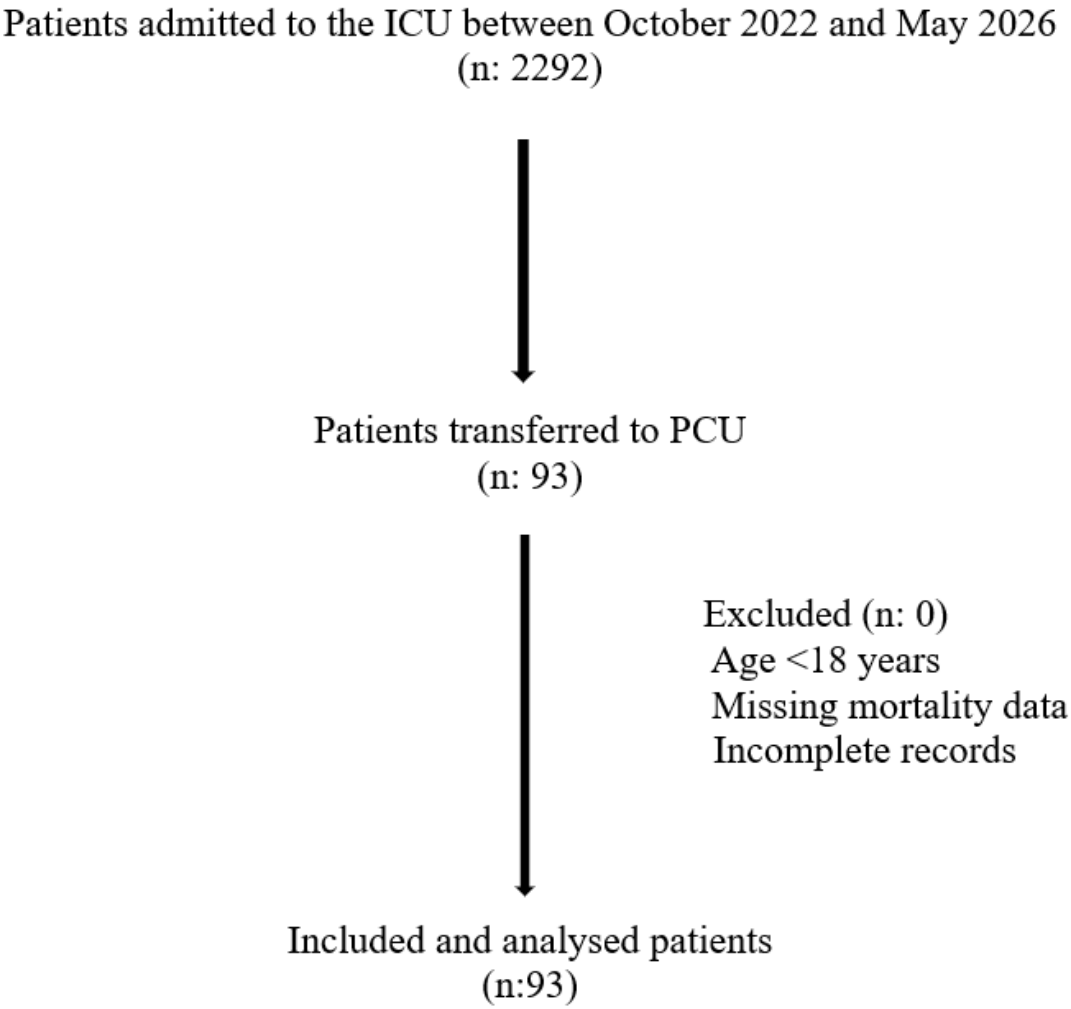



**Figure 1**

Flowchart

*ICU: *Intensive Care Unit, PCU: Palliative Care Unit*

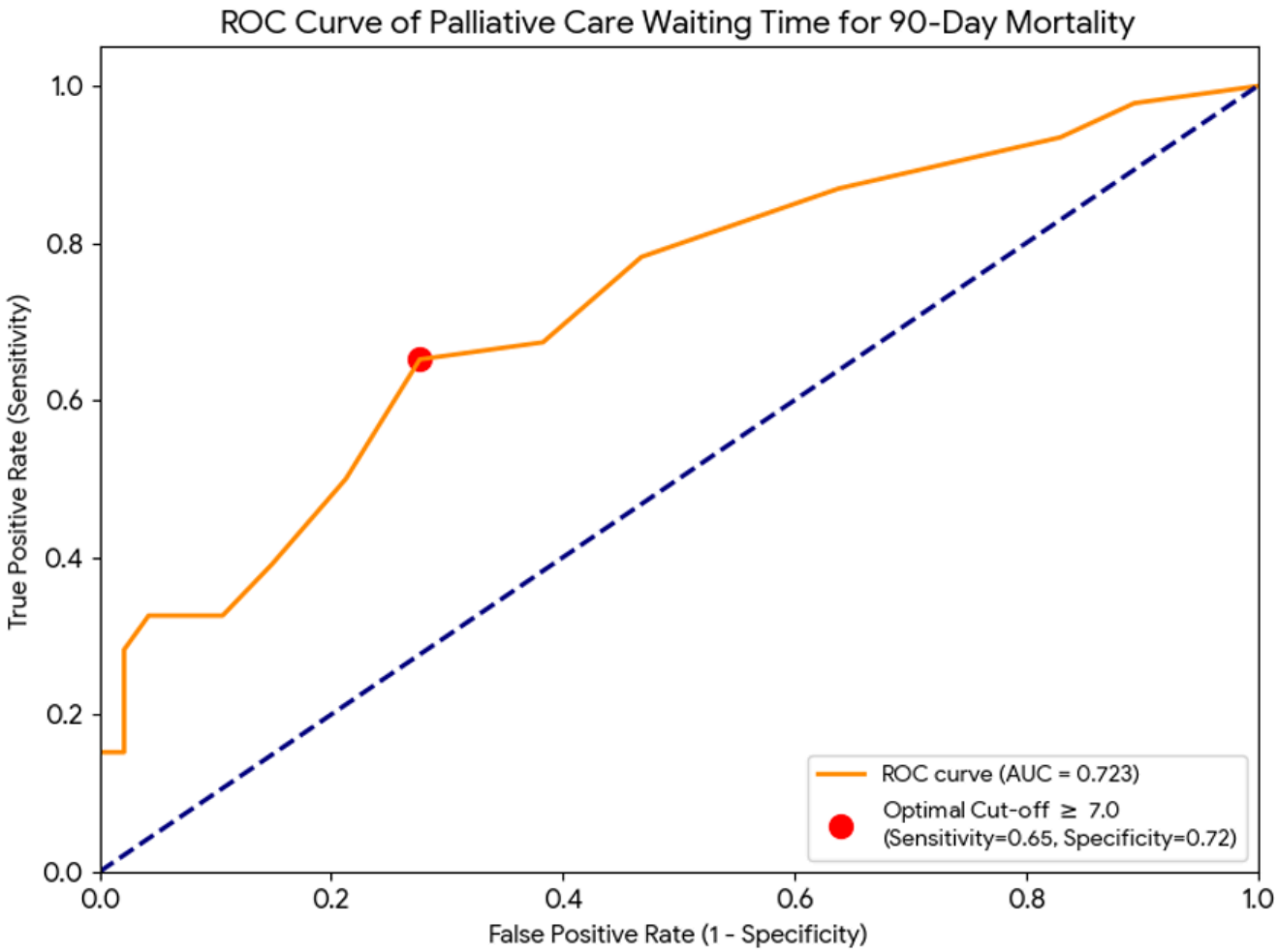



**Figure 2**

ROC Curve of Palliative Care Waiting Time for 90-Day Mortality

The optimal cut-off point is highlighted with a red dot (≥ 7 days), demonstrating a sensitivity of 65.2% and a specificity of 72.3%. The Area Under the Curve (AUC) is 0.723 (95% CI: 0.620 - 0.826, $p < 0.001$).

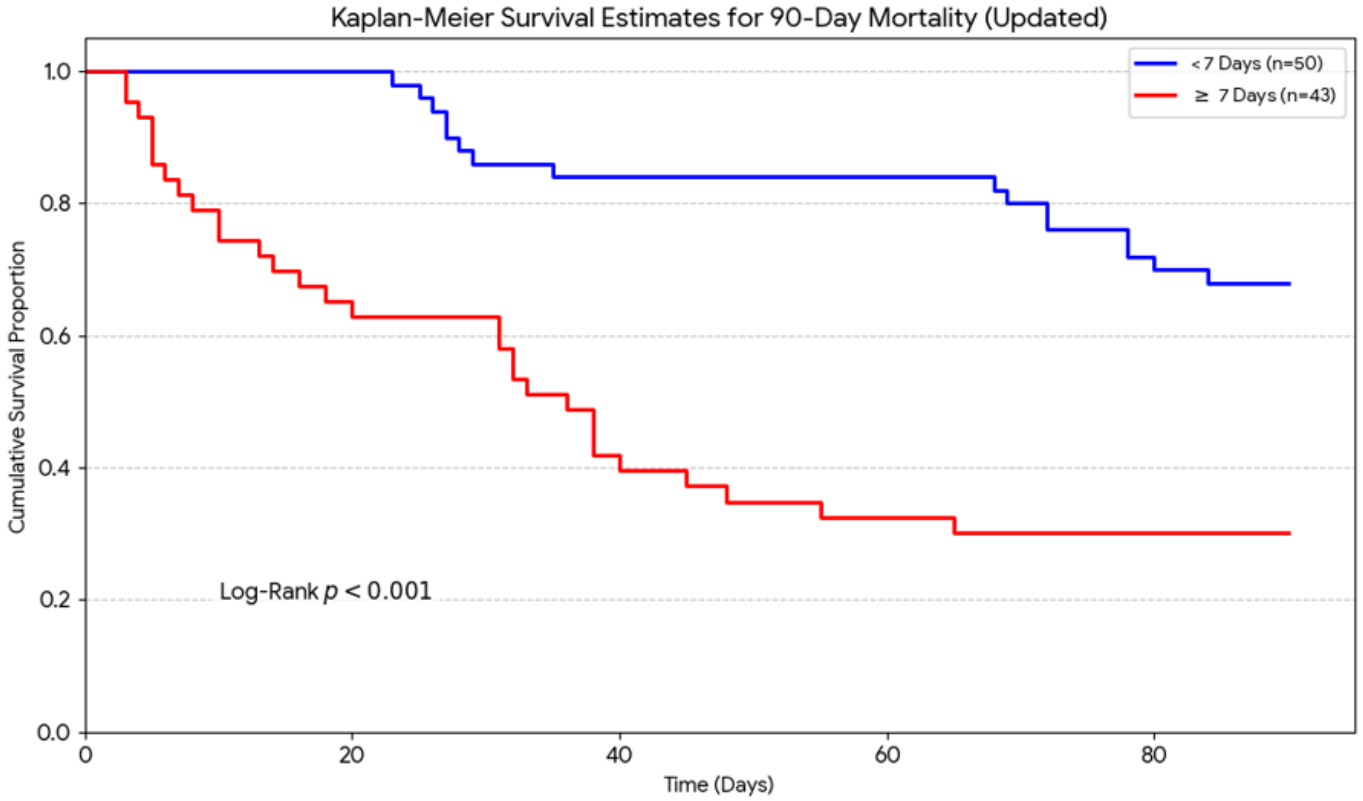



**Figure 3**

Kaplan-Meier Survival Curves of Palliative Care Waiting Time for 90-Day Mortality Kaplan-Meier estimates illustrating cumulative survival proportions over 90 days. The red line represents patients waiting ≥ 7 days, and the blue line represents patients waiting < 7 days for palliative care discharge. A statistically significant difference in survival was observed between the two groups (Log-Rank p < 0.001).

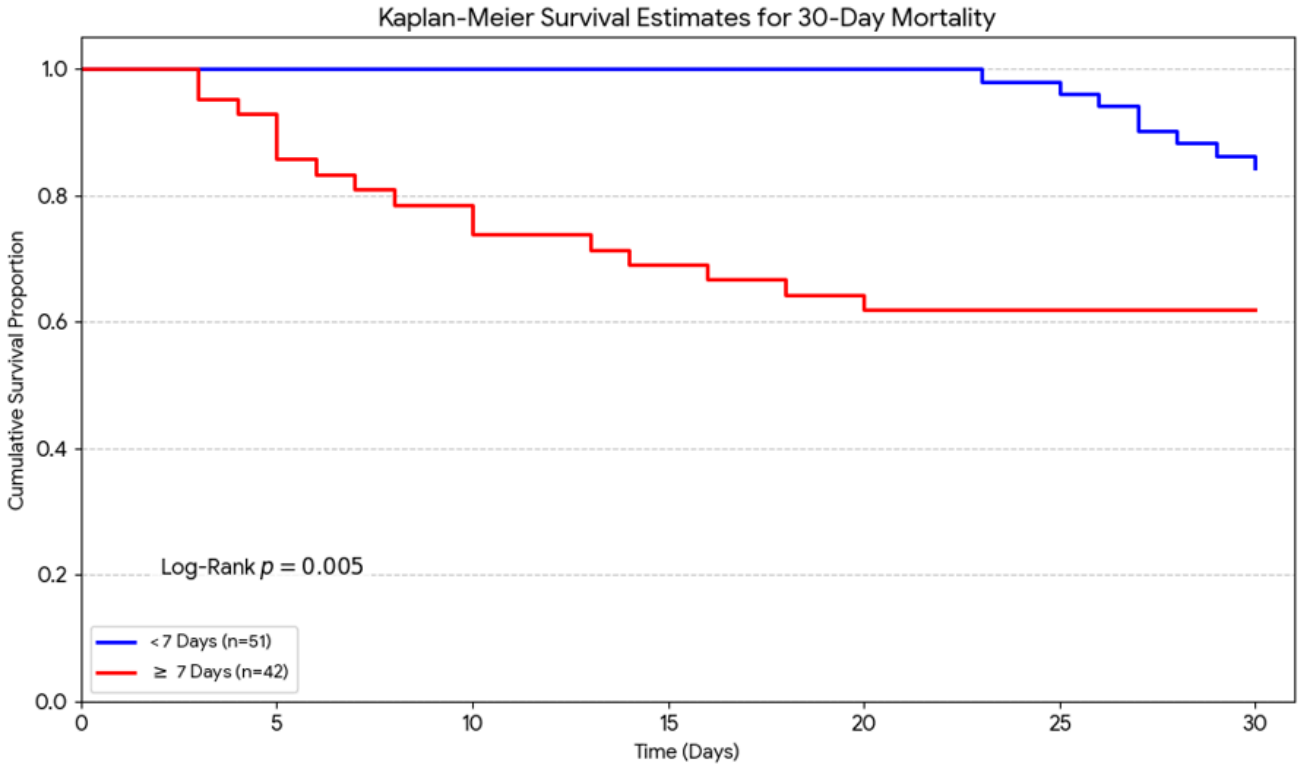



**Figure 4**

Kaplan-Meier Survival Curves of Palliative Care Waiting Time for 30-Day Mortality

Kaplan-Meier estimates illustrating cumulative survival proportions over the early 30-day period. The red line represents patients waiting ≥ 7 days, and the blue line represents patients waiting < 7 days for palliative care discharge. A statistically significant early survival disadvantage was observed in the prolonged waiting group (Log-Rank p = 0.005).

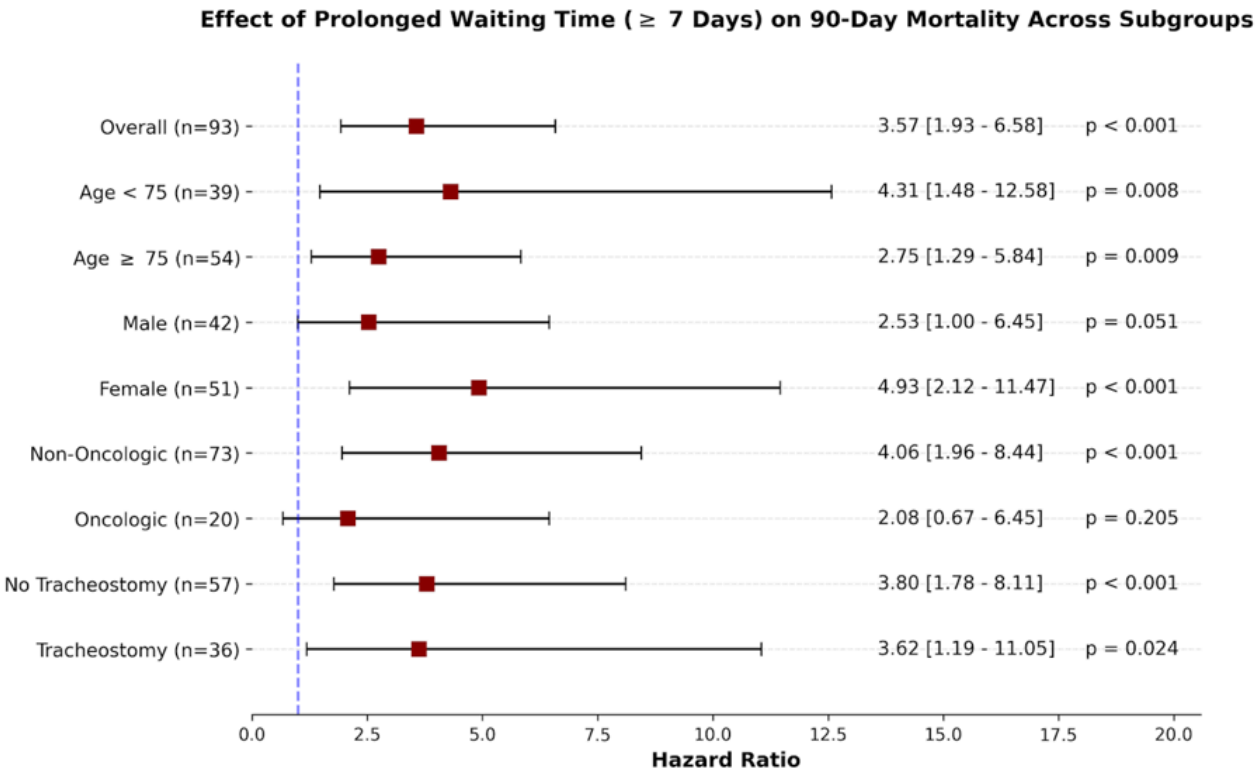



**Figure 5**

Forest Plot illustrating the effect of prolonged waiting time (≥ 7 days) on 90-day mortality across different clinical subgroups. Hazard Ratios (HR) and 95% Confidence Intervals (CI) were calculated using univariate Cox proportional hazards regression models for each subgroup. The vertical dashed blue line represents the line of no effect (HR = 1). The red squares denote the HR point estimates, with the horizontal black lines representing the 95% CIs. Prolonged waiting time was a significant predictor of mortality across most subgroups, with the exception of male patients (marginal significance) and those with oncologic admissions.