Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# Day 7 clinical indicators for predicting discharge destination in patients with prolonged ICU stays: implications for time-limited trials

**kana harada**

haradakana1124@gmail.com

International University of Health and Welfare

**shunya ikeda**

International University of Health and Welfare

**jun makino**

Tokyo Metropolitan Bokutoh Hospital

**Research Article**

**Keywords:**

**Posted Date:** May 28th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-9559184/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

**Additional Declarations:** No competing interests reported.

## Abstract

# Background

Prolonged intensive care unit (ICU) stays are associated with increased mortality and functional decline. Time-limited trials (TLTs) support decision-making under prognostic uncertainty; however, uncertainty may persist in some patients, leading to prolonged ICU care. Identifying clinical indicators that enable earlier reassessment may help prevent unnecessarily prolonged TLTs.

# Methods

We conducted a prospective observational study in the ICU of Tokyo Metropolitan Bokutoh Hospital between April 2022 and December 2023. Adult patients aged ≥ 20 years with ICU stays of at least seven days were included, while postoperative patients were excluded. Patients were categorized by discharge destination (home vs. non-home discharge). Clinical variables, including Sequential Organ Failure Assessment (SOFA) scores on days 1, 2, and 7, cumulative fluid balance, albumin and red blood cell consumption, vasopressor use, and comorbidities, were compared between groups.

# Results

Sixty-seven patients were included; 24 were discharged home and 43 were not. SOFA scores on days 1 and 2 did not differ significantly between groups. The SOFA score on day 7 was significantly lower in patients discharged home (4.92 vs. 8.48, $p < 0.001$). Lower fluid balance, albumin use, and vasopressor duration were also observed in the home-discharge group. Multivariate analysis identified hematologic malignancy or lymphoma, higher SOFA score on day 7, greater positive fluid balance, higher albumin consumption, and longer vasopressor use as independent predictors of non-home discharge.

# Conclusions

Among patients with prolonged ICU stays, clinical indicators assessed on day 7 were associated with discharge outcomes and may support prognostic evaluation during prolonged ICU care.

## Introduction

A prolonged stay in the intensive care unit (ICU) is associated with increased mortality and decreased activities of daily living (ADL) (1). To prevent prolonged ICU stays, timely clinical decision-making is essential. However, many patients admitted to the ICU are unable to participate in decision-making regarding their care plans because diagnoses and prognoses are often unclear at the time of admission. In addition, patients and surrogate decision-makers frequently experience emotional distress and fear of loss, which further complicates decision-making. To address these challenges, the concept of the time-

limited trial (TLT) was developed. A TLT allows patients, surrogate decision-makers, and clinicians to observe a patient's response to treatment over a defined period while postponing irreversible decisions (2–4).

Previous studies have shown that TLTs may reduce patient suffering and shorten the duration of intensive care. A qualitative study from the United Kingdom reported that ICU physicians and nurses perceived several benefits of TLTs, including reduced prognostic uncertainty, improved relationships with patients and families, and better preparation for end-of-life decision-making (5).

However, in patients with severe illness, diagnosis and prognosis may remain uncertain even several days after ICU admission, resulting in prolonged TLTs. Such prolonged TLTs may increase distress for patients and their families and lead to higher healthcare costs.

To avoid unnecessarily prolonged TLTs, earlier decision-making strategies are needed, even in the absence of a definitive diagnosis or prognosis. As a first step toward this goal, we examined the clinical characteristics of patients with prolonged ICU stays and explored factors associated with discharge outcomes.

# Methods

Design and setting

This prospective observational study was conducted in the ICU of Tokyo Metropolitan Bokutoh Hospital. In 2022, this ICU had 8 beds. Because the hospital has a separate emergency ICU, few patients were admitted directly from the emergency department to the ICU. Most patients were admitted following elective surgery or clinical deterioration in the general ward. Data were collected from patients admitted between April 2022 and December 2023.

Patients

Patients were eligible if they were aged 20 years or older and had an ICU stay of at least seven days. Patients who had undergone surgery were excluded.

Data collection

For each eligible patient, the following pre-ICU data were collected: age, sex, past medical history, and type of admitting department. During the ICU stay, we collected the Sequential Organ Failure Assessment (SOFA) score on days 1, 2, and 7; total fluid balance (L); albumin consumption over seven days (units); red blood cell (RBC) transfusion over seven days (units); duration of norepinephrine use over seven days (days); and duration of inotrope or vasopressor use over seven days (days). After ICU discharge, length of ICU stay, length of hospital stay, and hospital discharge outcomes were recorded. Total fluid balance was defined as cumulative net fluid balance during the first seven ICU days.

Outcome measures

The patients were divided into two groups: those who were discharged home (group Home) and those who were not (group Others). We examined variables associated with discharge destination.

Statistical analysis

Continuous variables were compared between the two groups using appropriate statistical tests. Student's t-tests were used for normally distributed continuous variables, and Wilcoxon rank-sum tests were used for non-normally distributed continuous variables. Categorical variables, including past medical history, were compared using chi-square tests.

Multivariate logistic regression analysis was performed to identify factors independently associated with the group Home discharge.

Variables showing significant differences in univariate analyses were further evaluated using multivariate analysis.

Because SOFA scores on days 1 and 2 were highly correlated, only the SOFA score on day 1 was included in the multivariate model. Similarly, because norepinephrine use and inotrope or vasopressor use showed strong collinearity, only norepinephrine use was included in the final analysis.

Statistical significance was defined as a p-value ≤ 0.05 with a 95% confidence interval. All statistical analyses were performed using appropriate statistical methods.

Ethics approval and consent to participate

Approval was obtained from the Ethics Committee of the Tokyo Metropolitan Bokutoh Hospital. Patients may withdraw their consent on an opt-out basis.

Outcome

Characteristics

67 patients were included in the study. The mean age was 67.8 years. The mean length of ICU stay was 14.4 days and the mean length of hospital stay was 45.0 days.

24 patients were discharged home (group Home), whereas 43 were not (group Others). The major admitting departments were cardiology (n = 15), hematology (n = 9) and pulmonology (n = 10) (Table 1).

# Results

There was no significant difference between two groups for SOFA scores on day 1 or 2. However, patients with a history of hematologic malignancy or lymphoma were significantly less likely to be discharged home. The SOFA score on day 7 was significantly lower in patients discharged home than in

those not discharged home (4.92 vs. 8.48, $p < 0.001$). The total fluid balance of the group Home was significantly lower than the group Others (0.046L vs 4.524L, $p < 0.001$). During the ICU stay, SOFA score on day 7, total fluid balance, albumin consumption over 7 days, duration of norepinephrine use, and duration of inotrope or vasopressor use differed significantly between the two groups (Table 2).

In multivariate analysis, a past medical history of hematologic malignancy or lymphoma, higher SOFA score on day 7, greater positive fluid balance, higher albumin consumption over seven days, and longer duration of norepinephrine use were independently associated with non-home discharge (Table 3).

## Discussion

In this study, poor discharge outcomes, defined as non-home discharge, were associated with a history of hematologic malignancy or lymphoma, higher SOFA score on day 7, greater positive fluid balance, higher albumin consumption, and longer duration of norepinephrine use. Notably, early severity indicators, such as SOFA scores on days 1 and 2, did not significantly differ between groups, whereas clinical indicators assessed on day 7 showed clear associations with discharge outcomes.

One of the key findings of this study is that clinical status at day 7, rather than at ICU admission or during the early phase of ICU care, was more strongly associated with discharge destination. During the early phase of critical illness, SOFA scores may not adequately reflect longer-term recovery potential. By contrast, the SOFA score on day 7 likely captures both the response to treatment and the persistence of organ dysfunction, thereby serving as a better prognostic indicator. From a clinical perspective, day 7 often represents a transition point at which expectations regarding recovery, prolonged organ support, or treatment limitations begin to crystallize. Our findings support the notion that this time point may be particularly useful for structured reassessment and shared decision-making.

Time-limited trials (TLTs) are designed to allow patients, families, and clinicians to defer irreversible decisions while observing a patient's response to treatment over a predefined period. However, when clinical improvement is ambiguous, TLTs themselves may become prolonged, potentially increasing emotional distress for families and moral distress for clinicians, as well as healthcare resource utilization. Our results suggest that reassessment at seven days after ICU admission may be appropriate when considering whether to continue a TLT. Persistently high SOFA scores, ongoing vasopressor requirements, and cumulative positive fluid balance may indicate poor discharge outcomes, even in the absence of a definitive diagnosis. These findings may support clinicians and surrogate decision-makers in discussions regarding ongoing care plans.

A past medical history of hematologic malignancy or lymphoma was strongly associated with non-home discharge, even after adjustment for clinical variables. This finding is consistent with previous reports showing poorer functional and discharge outcomes in critically ill patients with hematologic diseases (6–8). Importantly, this variable is a pre-ICU characteristic that can be incorporated into prognostic discussions early in the ICU course, complementing dynamic clinical indicators assessed during the ICU stay.

An important strength of this study is the use of discharge destination rather than mortality as the primary outcome. For many patients and their families, being able to return home and regain functional independence is a more meaningful outcome than merely surviving. Discharge destination reflects functional status and the need for institutional care.

This study has several limitations. First, the sample size was relatively small, which may limit statistical power and increase the risk of overfitting in multivariate analyses. Second, this was a single-center study conducted in an ICU that primarily admits patients from general wards, which may limit generalizability to emergency or trauma ICUs. Postoperative patients were excluded; however, this is unlikely to represent a major limitation because their ICU courses and discharge outcomes are strongly influenced by surgical indications and perioperative protocols that differ from those of medical ICU patients. Third, discharge destination is influenced not only by medical factors but also by social and institutional factors such as family support, which were not assessed in this study. Finally, long-term functional outcomes after hospital discharge were not evaluated.

## Conclusion

Among patients with prolonged ICU stays, clinical data obtained seven days after ICU admission, particularly SOFA score, fluid balance, vasopressor requirements, and pre-existing hematologic malignancy or lymphoma, were associated with discharge outcomes. These findings suggest that reassessment at day 7 may represent a clinically meaningful time point to support decision-making during prolonged intensive care, including time-limited trials.

## Abbreviations

ICU
intensive care unit
ADL
activities of daily living
TLT
time-limited trial
SOFA
Sequential Organ Failure Assessment
RBC
red blood cell

## Declarations

# Ethics approval and consent to participate

This study was approved by the Ethics Committee of Tokyo Metropolitan Bokutoh Hospital. All procedures were performed in accordance with the Declaration of Helsinki and relevant guidelines and regulations. The requirement for informed consent was waived due to the observational nature of the study, and an opt-out consent process was used as approved by the Ethics Committee.

# Consent for publication

Not applicable.

# Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

# Author Contribution

K.H. wrote the main manuscript text and S.I. supervised the study. All authors reviewed the manuscript.

# Acknowledgements

Not applicable.

# Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

## References

1. Hermans G, Van Aerde N, Meersseman P, et al. Five-year mortality and morbidity impact of prolonged versus brief ICU stay: a propensity score matched cohort study. Thorax. 2019;74(11):1037–45.
2. Kruser JM, Ashana DC, Courtright KR, et al. Defining the Time-limited Trial for Patients with Critical Illness: An Official American Thoracic Society Workshop Report. Ann Am Thorac Soc. 2024;21(2):187–99.

3. Chang DW, Neville TH, Parrish J, et al. Evaluation of Time-Limited Trials Among Critically Ill Patients With Advanced Medical Illnesses and Reduction of Nonbeneficial ICU Treatments. JAMA Intern Med. 2021;181(6):786–94.
4. Russwurm M. Time-Limited Trials in Intensive Care Medicine: A Tool for Avoiding Inappropriate Treatment. Dtsch Arztebl Int. 2025;122(7):180–5.
5. Bradley L, Alex W, Rachal M, Laura M. Time-limited trials: a qualitative study exploring the role of time in decision-making on the intensive care unit. Clin Ethics. 2019;15(1):11–6.
6. Chen CL, Wang ST, Cheng WC, Wu BR, et al. Outcomes and Prognostic Factors in Critical Patients with Hematologic Malignancies. J Clin Med. 2023;12(3):958.
7. Ferreyro BL, Scales DC, Wunsch H, et al. Critical illness in patients with hematologic malignancy: a population-based cohort study. Intensive Care Med. 2021;47(10):1104–14.
8. Munshi L, Dumas G, Rochwerg B, et al. Long-term survival and functional outcomes of critically ill patients with hematologic malignancies: a Canadian multicenter prospective study. Intensive Care Med. 2024;50(4):561–72.

## Tables

Tables are available in the Supplementary Files section.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- table.docx