



Variability in intensive care unit length of stay after liver transplant: Determinants and potential opportunities for improvement

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ABSTRACT

Purpose: Recovery after liver transplant (LT) requires extensive resources, including prolonged intensive care unit stays. The objective of this study was to use an assessment tool to determine if LT recipients remain in ICU beyond designated indications.

Methods: Records from 100 consecutive LTs performed in a single institution were retrospectively reviewed. An admission, discharge, and triage screening (ADT) tool was utilized to assess the indications for each ICU day. Data collected included demographics; pre-, intra-, and post-operative course; and complications. Days not meeting ADT criteria were considered additional ICU days.

Results: 100 patients: mean age 55 years (range 24–78 years) and mean MELD score 30 (range 6–47). Three recipients who died within one week were excluded. Forty-eight (49.5%) patients had a total of 75 additional days on initial ICU stay. Univariate analysis revealed no significant differences between patients with and without additional days. 12/97 (12.4%) patients returned to ICU including 5/48 and 7/49 with and without additional days.

Conclusion: Nearly half of the LT recipients remained in ICU an average of 1.6 additional days. Monitoring of organ function appeared to be the most common reason. Opportunities to improve resource utilization could include transfer to an intermediate/progressive care (“step-down”) unit.

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1. Introduction

Liver transplantation (LT) constitutes the definitive treatment for end-stage liver disease. Since 2000, there have been over 5000 liver transplants performed per year in the United States, with an increasing number annually and 8082 LTs performed in 2017 [1]. The vast majority of patients who undergo LT require critical care during their postoperative period. This is especially true in areas with high average Model for End-Stage Liver Disease (MELD) scores at the time of transplantation, where patients often require critical care both before and after LT. Post-operatively, these critically ill patients frequently have prolonged intensive care unit (ICU) stays [2,3]. With advances in the field, the expectations for ICU length of stay (LOS) following LT have decreased from an average of 5–6 days of ICU care for routine post-op cases in the 1990's to shorter stays in more recent years (median of 2–3 ICU days) [4–6]. This is driven in part by centers that utilize fast-tracking, evidence-based protocols for select LT recipients, resulting in similar outcomes with minimal or absent ICU stays postoperatively [7,8].

LT recipients often have extended ICU stays due to a variety of complex conditions, organ dysfunction, and need for hemodynamic monitoring. As intensive care beds remain a limited and costly resource, proper identification of patients who no longer benefit from ICU care is paramount to optimizing the value of care. Some studies have aimed to identify pre-transplant factors that are associated with ICU LOS, while others have tried to develop scoring systems to determine the likelihood of successful fast-tracking to the surgical ward [8,9]. Pre-transplant MELD score, extended operating time, high vasopressor requirement, pre-LT dialysis, pre-operative ICU admission, high-grade hepatic encephalopathy, and hepatopulmonary syndrome are some of the factors that have been previously associated with increased ICU utilization and LOS [9–12]. Common postoperative complications that can lead to increased use of critical care resources include infections, renal impairment requiring renal replacement therapy, respiratory failure, graft dysfunction, and neurological complications such as delirium [11–14].

Despite efforts to reduce intensive care utilization, significant variability in ICU LOS after LT is reported, with median stays ranging from 2 to 10 days depending on center volume and severity of patient illness [6]. Clinical judgment and consensus building among surgeons and critical care specialists are major determinants in transferring LT recipients

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to a lower level of care. Once recipients no longer need acute interventions such as ventilatory support, vasopressors, or continuous renal replacement therapy, continued ICU stay relies on clinical judgment. While strict monitoring of hemodynamic status, graft function, and unexpected complications are crucial in the early postoperative period to have optimal outcomes, continuous reassessment in an ICU is not always required. The purpose of this study was to use a novel clinical assessment tool to determine if LT recipients remain in the ICU longer than indicated, as well as to categorize reasons for variances in ICU LOS among these patients.

2. Materials and methods

A retrospective analysis was conducted on 100 consecutive adult LT recipients who underwent transplantation between April 2016 through February 2017 in a single liver transplant center. Institutional Review Board (IRB) approval was obtained prior to initiation of the study. All recipients were transferred to the same ICU immediately following LT. Three patients were excluded from the study due to early death, which was defined as death within 1 week of transplantation. The following demographic data were collected: age, gender, ethnicity, and etiology of liver disease. Preoperative data included requirement for ICU care, need for renal replacement therapy or ventilatory support, vasopressor requirement, and calculated MELD score prior to LT. Intraoperative data collected included length of surgery, transfusion requirement, simultaneous liver-kidney transplantation (SLK), warm ischemia time (WIT), cold ischemia time (CIT), type of biliary reconstruction, and use of arterial or venous conduit. Postoperative data included length of ICU stay, critical care interventions including duration of ventilatory support, renal replacement therapy, vasopressors, return to ICU, transfusions, reoperation, and complications.

An ICU Admission, Discharge, and Triage (ADT) screening tool, previously developed at the same institution was utilized to assess the indication for ICU stay on a daily basis (Fig. 1) [15]. The ADT tool criteria were established as part of a multi-professional group consensus consistent with the recently published ICU admission, triage, and discharge guidelines produced by the American College of Critical Care Medicine (ACCM) [16]. The screening tool assessments included the following indications for ICU stay: need for acute care interventions such as ventilatory support and continuous renal replacement therapy (CRRT), frequency of clinical assessment not available on the general care unit, need for medications or expertise only available in the ICU, or continued clinical instability despite interventions. Each post-transplant day on initial ICU stay was reviewed by the authors to establish the reasons for which the patient was kept in the ICU, including records of daily notes, consultations, medications, procedure reports, laboratory testing, and records pertaining to hemodynamics, oxygen support, and renal replacement therapy. Days that failed to meet criteria presented in the ADT screening tool were considered “additional” ICU days.

For statistical analysis, a single-variable model was used to analyze dichotomized continuous variables and categorical variables using the chi-square test, with a predetermined alpha level of significance of 0.10. Univariate logistic regression analysis was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) to establish the relationship between multiple preoperative, intraoperative, and postoperative factors and LT recipients experiencing additional ICU days (Table 1). Statistical analysis was performed using the SAS software, version 9.4 (SAS Institute Inc., Cary, NC).

3. Results

The study population included 97 LT recipients with a mean age of 55 years (range 24–78 years), of which 63% were male. The mean calculated MELD score at the time of transplantation was 30 (range 6–47). Sixty recipients (62%) were in the ICU prior to LT due to acute

complications of chronic liver disease, including hepatic encephalopathy, volume overload, hypotension, renal or respiratory failure, and variceal hemorrhage. Fourteen of the recipients underwent combined liver-kidney transplantation. One recipient experienced graft loss requiring re-transplantation during the same hospital admission.

There was a total of 672 post-LT ICU days, with an average of 6.9 days per LT. Of those, there were 592 days on initial ICU stay (median = 4 days, SD = 10.8, range = 1–99) and 80 days on readmission to ICU. Forty-eight recipients (49.5%) were determined to have additional ICU days on initial stay, while the remaining 49 (50.5%) were appropriately transitioned to a lower level of care as per the ADT tool. The 48 patients that stayed longer had a total of 75 additional ICU days for an average of 1.6 additional days per LT recipient. Twelve of the 97 (12.4%) patients were readmitted to the ICU during the same hospital stay, spending an average of 6.7 days on readmission. These included 5 among those who had additional ICU days and 7 in the group that had no additional days on initial ICU stay (Fig. 2). ICU readmissions occurred as early as 1 day and up to 21 days after discharge from ICU. Causes for readmission included sepsis ($n = 3$), hypovolemic shock ($n = 1$), neurologic complications ($n = 4$), fluid overload related complications ($n = 3$), and following re-operation for bile leak ($n = 1$). As the primary focus of this study was on initial ICU LOS, additional days occurring only on readmission to ICU (8 additional days in 2/97 LTs) were excluded from the total additional ICU days for data analysis.

We examined the frequently reported variables that are typically associated with longer ICU stays to determine if they also impacted the number of potentially avoidable days in our patient cohort. For all of the preoperative, intraoperative, and postoperative variables included in the analysis, the univariate model revealed no statistically significant differences between patients with and without additional ICU days (Table 1). Therefore, no particular variable was found to be significantly associated with additional ICU days. This was an unexpected finding. Multivariate analysis was not indicated as the single-variate model failed to reveal significant results.

The incidence of primary non function (PNF) and early allograft dysfunction (EAD) were analyzed. PNF was defined as poor initial graft function requiring retransplantation or leading to death within 7 days of LT, without an identifiable cause of graft failure [17]. Early allograft dysfunction was defined as having one or more of the following: bilirubin ≥ 10 mg/dL on postoperative day 7, INR ≥ 1.6 on postoperative day 7, alanine aminotransferase (ALT) or aspartate aminotransferase (AST) >2000 IU/mL within the first 7 postoperative days [18]. In our cohort, no recipients experienced PNF, and 14 (14.4%; 6 with and 8 without additional ICU days) developed EAD. Among the latter, 5 patients had substantial evidence of EAD, with 2 patients having AST and/or ALT elevation >4000 IU/mL in the early postoperative period, and 3 patients with bilirubin >10 mg/dL on postoperative day 7. The other 9 recipients barely met EAD criteria, having AST or ALT elevation slightly >2000 IU/mL in the immediate postoperative period with rapid improvement and no further clinical evidence of graft dysfunction.

Complications following LT included biliary stricture in 13 patients (13.4%; 9 with and 4 without additional ICU days), post-operative hemorrhage (either hemodynamically significant bleeding or requiring reoperation for hematoma evacuation) in 6 patients (6.2%; 4 with and 2 without additional days), portal venous thrombosis in 2 (2.1%; no additional days), hepatic artery stenosis in 2 (no additional days), hepatic vein stenosis in 1 (1%; no additional days), and hepatic artery thrombosis leading to re-transplantation in 1 recipient (1%; no additional days). Reoperations occurred in 9 recipients, with no significant difference in the number of additional ICU days (6 with and 3 without additional days, $p = .28$) (Table 1).

In our cohort, overall one-year patient survival was 94%, with 6 patient deaths in the first year post-LT. Among these, three patients were excluded from the analysis due to early mortality for the following

ICU ADMISSION/TRANSFER SCREENING TOOL

Instructions:

- If "YES" to any of these questions, consider ICU admission
- If "NO" to all of these questions, consider transfer to the general care
- Please list any barriers to transfer in the comments section

Unit: 4S, 5I, 5W, 7E, 7W, 8W

Room number:

FIN:

Shift: Day (7AM – 7PM), Night (7PM – 7AM)

1) Does the patient require an ICU intervention? Yes No

If Yes, check off the reason:

- Ventilatory support – the need for ventilation including mechanical ventilation Chronic Acute
- BIPAP that the patient does not require at baseline
- CRRT
- IABP
- Intracranial pressure monitoring
- Invasive hemodynamic monitoring: Arterial line, pulmonary artery catheter
- Nitric Oxide
- ECMO
- Other _____

2) Patient requires a level/frequency of assessment and monitoring that a non-ICU floor cannot provide? Yes No

If Yes, check off the reason:

- Cardiac rate & rhythm requiring assessment/intervention every 15 minutes for more than 2 hours despite appropriate intervention
- Invasive monitoring: blood pressure pulmonary artery pressure intracranial pressure other
- Greater than every 2 hours for a period of 4 hours or longer assessment/Intervention
- Other _____

3) The patient condition has not improved despite intervention. Yes No

If Yes, check off the reason:

- Patient has not stabilized despite therapy
- Patient requires critical care expertise (CC MD or CC Nurse)
- Other _____

4) Patient requires medications or expertise that cannot be administered on a general care unit or not approved for specific general care units? Yes No

If Yes, check off the reason:

- Vasoactive drug Titrating Not Titrating
- ICU-only approved medication
- Other _____

Please list any Transfer Barriers: _____

Comments: _____

Fig. 1. ICU admission, discharge, and triage (ADT) screening tool.

Table 1
Univariate analysis of association between demographic and clinical variables and additional ICU days.

Variable	N	Extra days in ICU (%)	No extra days in ICU (%)	<i>p</i> ^a	OR (95% CI)	
Gender	Male	61	45.9	54.1	0.36	1.00 (ref)
	Female	36	55.6	44.4		1.47 (0.64–3.37)
Age	≤50	30	46.7	53.3	0.71	1.00 (ref)
	>50	67	50.8	49.3		1.18 (0.50–2.79)
Ethnicity	White	25	52.0	48.0	0.58	1.00 (ref)
	Hispanic	56	51.8	48.2		0.99 (0.39–2.55)
	Other	16	37.5	62.5		0.55 (0.15–1.99)
Diagnosis	Alcoholic	31	48.4	51.6	0.99	1.00 (ref)
	Viral (HBC, HCV)	26	50.0	50.0		1.07 (0.38–3.03)
	NASH	11	54.6	45.5		1.28 (0.32–5.09)
	Other	29	48.3	51.7		1.00 (0.36–2.74)
MELD	<30	37	48.7	51.4	0.90	1.00 (ref)
	≥30	60	50.0	50.0		1.06 (0.47–2.40)
Pre-op ICU care	No	37	48.7	51.4	0.90	1.00 (ref)
	Yes	60	50.0	50.0		1.06 (0.47–2.40)
Pre-op renal replacement	No	40	45.0	55.0	0.46	1.00 (ref)
	Yes	57	52.6	47.4		1.36 (0.60–3.06)
Pre-op vasopressors	No	68	48.5	51.5	0.77	1.00 (ref)
	Yes	29	51.7	48.3		1.14 (0.48–2.71)
Pre-op mechanical ventilation	No	90	47.8	52.2	0.23	1.00 (ref)
	Yes	7	71.4	28.6		2.73 (0.50–14.83)
Donor type	Deceased	85	47.1	52.9	0.20	1.00 (ref)
	Living	12	66.7	33.3		2.25 (0.63–8.04)
Liver/liver-kidney transplant	Liver only	83	47.0	53.0	0.23	1.00 (ref)
	Liver-kidney	14	64.3	35.7		2.03 (0.63–6.58)
Length of surgery	≤6 h	35	51.4	48.6	0.77	1.00 (ref)
	>6 h	62	48.4	51.6		0.89 (0.39–2.03)
CIT	≤8 h	51	56.9	43.1	0.13	1.00 (ref)
	>8 h	46	41.3	58.7		0.53 (0.24–1.20)
WIT	≤30 min	38	52.6	47.4	0.62	1.00 (ref)
	>30 min	59	47.5	52.5		0.81 (0.36–1.84)
Number of PRBC transfused	≤10 units	52	55.8	44.2	0.18	1.00 (ref)
	>10 units	45	42.2	57.8		0.58 (0.26–1.30)
Graft use	None	72	47.2	52.8	0.71	1.00 (ref)
	Aortic	15	53.3	46.7		1.28 (0.42–3.90)
	Venous	10	60.0	40.0		1.68 (0.44–6.45)
Biliary reconstruction	Duct-to-Duct	75	49.3	50.7	0.96	1.00 (ref)
	Roux-N-Y	22	50.0	50.0		1.03 (0.40–2.66)
Return to OR	No	88	47.7	52.3	0.28	1.00 (ref)
	Yes	9	66.7	33.3		2.19 (0.52–9.32)
Post-op mechanical ventilation	<2 days	60	46.7	53.3	0.48	1.00 (ref)
	≥2 days	37	54.1	46.0		1.35 (0.59–3.06)
Post-op vasopressors	<2 days	81	51.9	48.2	0.29	1.00 (ref)
	≥2 days	16	37.5	62.5		0.56 (0.19–1.68)
Post-op renal replacement	≤1 day	70	47.1	52.9	0.46	1.00 (ref)
	>1 day	27	55.6	44.4		1.40 (0.57–3.42)
Post-op PRBC transfusions	No	63	50.8	49.2	0.73	1.00 (ref)
	Yes	34	47.1	52.9		0.86 (0.37–1.99)
Post-op infections	No	86	50.0	50.0	0.78	1.00 (ref)
	Yes	11	45.5	54.6		0.83 (0.24–2.94)

^a Chi-square.

reasons: intraoperative hemodynamic collapse, severe heart failure immediately following LT (POD 0), and massive intracranial hemorrhage in early postoperative period (POD 3). One-year graft survival (non-censored for patient death) was 92% (8 graft failures: six patient deaths, one failure due to hepatic artery thrombosis and one due to ischemic cholangiopathy).

The reasons identified by the authors for additional ICU days were largely observational (Table 2). Close monitoring of neurologic status and renal function/volume status were the two most common reasons, together representing about 40% of the total additional ICU days. Monitoring of hemodynamics, pulmonary status, and hemoglobin/hematocrit levels were among other common reasons for additional ICU days, while other reasons constituting a minority included metabolic and/or electrolyte abnormalities. For approximately 29% of the total additional ICU days, no discernible clinical reason for requiring high-acuity care could be established by chart review. These patients without appreciable clinical reasons remained in the ICU in part due to logistic factors such as lack of available general care beds or delayed imaging for graft assessment.

4. Discussion

In most centers performing LT, recipients are routinely monitored in the ICU during the early postoperative period. Extended ICU stay in this patient population is not unusual and can occur due to preexisting conditions, intraoperative events, and complications. While all of these factors may necessitate longer ICU stays, our study aimed to determine how often LT recipients remain in ICU longer than may be indicated and to evaluate conditions that contribute to additional ICU days. The use of an ICU ADT screening tool allowed for the identification of additional ICU days for this group of LT recipients. Our study failed to identify statistically significant differences between patients with and without additional days in terms of a variety of preoperative, intra-operative, and post-operative factors (Table 1), which suggests the absence of significant measurable predisposing conditions that lead to ICU days when active critical care interventions or monitoring are no longer required. This finding was unexpected, given the well-described associations between many of these factors and prolonged ICU stays. Our results showed that a large portion of patients who no longer require

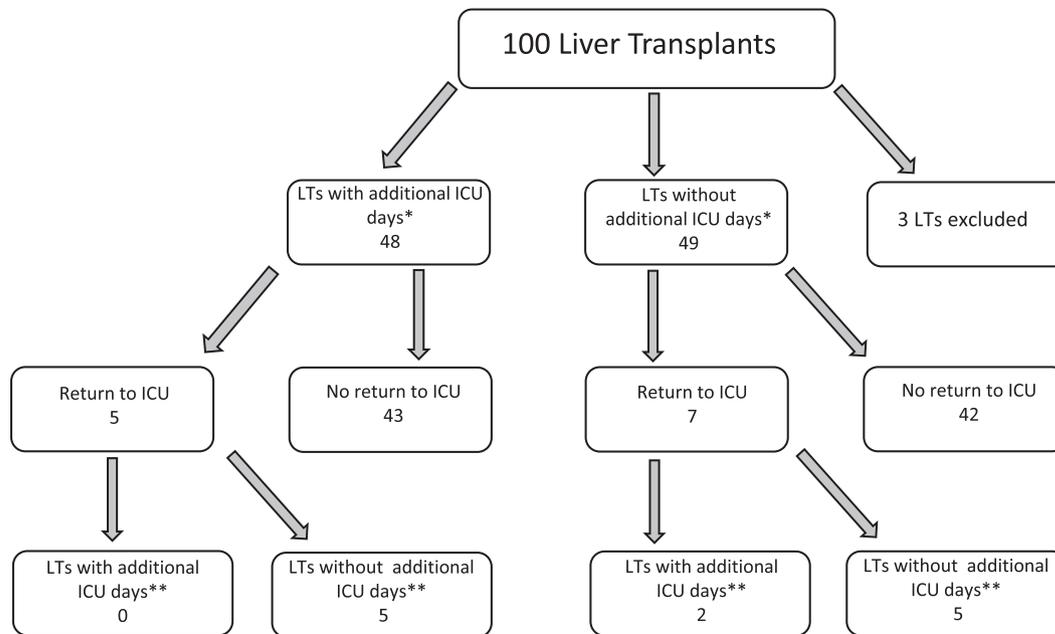


Fig. 2. Patients with and without additional ICU days following liver transplantation. *On initial ICU stay, **On ICU readmission.

acute care interventions remained in the ICU, with a variety of reasons accounting for the additional ICU days (Table 2).

Among these reasons, monitoring for renal dysfunction and respiratory complications played a significant contributing role. In our study, 23–27% of additional ICU days were attributed to monitoring of fluid status and renal function. A substantial portion of LT recipients remained in the ICU for frequent assessment of renal response following discontinuation of renal replacement therapy and treatment with diuretics. The incidence of renal non-recovery in patients requiring pre-LT renal replacement therapy has been reported between 9 and 32%, not only resulting in the need for chronic dialysis but also significantly impacting mortality [19,20]. Therefore, close observation for signs of inadequate renal recovery and timely implementation of appropriate interventions are important aspects of the postoperative care of these recipients. However, accurate monitoring of intake and output and adequate assessment of volume status should not prevent LT recipients from transferring out of the ICU. Similarly, monitoring of respiratory status and pulmonary care accounted for a significant portion of additional ICU days, as some of these patients remained in the ICU after respiratory stability was achieved. These included recipients who in the early postoperative period experienced volume overload causing mild respiratory compromise, pulmonary hypertension, need for frequent respiratory hygiene, and need for supplemental oxygen in two patients with hepatopulmonary syndrome. Adequate pulmonary hygiene including chest physiotherapy, incentive spirometry, respiratory treatments, frequent suctioning in recipients with artificial airways, high-flow oxygen

therapy for patients with hepatopulmonary syndrome, and prevention of fluid overload are measures that can reduce the incidence of respiratory complications following transition out of the ICU. While the majority of recipients in our study appropriately received critical care in the early postoperative period, improvement in their condition did not always translate into a timely transition to a lower level of care.

Monitoring of altered mental status and neurologic status was another important reason contributing to additional ICU days. In a study by Bhattacharya et al., as many as 25% of post-LT patients experienced delirium, which was associated with significantly longer ICU LOS and increased frequency of hospital acquired infections [14]. In our study, LT recipients who suffered from delirium, metabolic encephalopathy, or seizures at some point during the early postoperative contributed 17% of the total additional ICU days, despite the absence of manifestations of worsening condition. Routine use of one-to-one sitter and more frequent monitoring by the nursing staff in a progressive care unit could successfully address these concerns. Furthermore, monitoring of hemodynamic status, gradually decreasing hemoglobin/hematocrit levels without an obvious source of hemorrhage, metabolic abnormalities such as severe hyperglycemia and electrolyte disturbances, infectious complications, and increased hepatic chemistries without clinical evidence of graft dysfunction were also found to be contributing factors. Hemodynamic stability in the postoperative period can be affected by a variety of conditions, including subclinical hypovolemia, undetected hemorrhage, third-spacing, hypothermia, electrolyte and metabolic disturbances [21]. While maintaining hemodynamic stability is important for adequate hepatic graft function and appropriate organ perfusion, monitoring of hemodynamics can continue in a progressive care unit or dedicated surgical ward if there is no indication for invasive monitoring or evidence of instability.

The trajectory of inpatient care during hospitalization for LT recipients vary among centers. At our institution, approximately 60% of LT recipients require pre-transplant ICU care with most requiring renal replacement therapy and/or pressor support. In this particular study cohort, 62% of patients were ICU bound prior to LT. All recipients are transferred to ICU following LT with varying lengths of ICU stay dependent upon length of hemodynamic and/or ventilatory support. Once patients no longer require ICU care, they are transitioned to the post-LT ward. While fast-tracking protocols have been successfully implemented in some centers for select LT recipients, ICU monitoring following LT

Table 2
Reasons for additional ICU days.

Reason for additional days	# Additional days
Monitoring altered neurologic status	13
Monitoring hemodynamics or respiratory status	10
Pulmonary care and monitoring renal function	3
Pulmonary care and monitoring hemoglobin/hematocrit	5
Monitoring renal function/fluid status	17
Increased hepatic chemistries	3
Other	2
No discernible reason	22
Total	75

remains the standard for most institutions [22,23]. Minimizing ICU LOS could significantly improve resource utilization and must remain a priority in the care of these patients, especially in areas with high preoperative MELD scores. Beyond reduction in cost and improved allocation of limited resources, the benefits of shorter ICU stay are numerous, including minimization of circadian disruption with its deleterious effects on the autonomic and immune systems, decreased incidence of delirium, improved early mobilization, and decreased risk of infection that is associated with duration of ICU stay [24,25].

Measures to reduce additional ICU days include the creation of a dedicated progressive care or intermediate care post-LT surgical unit with a lower nursing to patient ratio, adequate frequency of assessment, and specialized training for the care of these patients. Following the guide to resource allocation of intensive monitoring and care suggested in the ACCM 2016 ICU ADT guidelines, patients needing nursing interventions (such as non-invasive ventilation, intravenous infusions, and/or titration of antiarrhythmic or vasodilator medications), laboratory workup, and monitoring every 2 to 4 h can be monitored in an intermediate care unit with a nursing to patient ratio of 1:3 or less, while patients who need hourly or invasive monitoring and more intensive interventions such as invasive ventilation, vasopressors, extracorporeal membrane oxygenation, or continuous renal replacement therapy require care in an ICU setting with a nursing to patient ratio of 1:2 or less [16]. On the other hand, stable patients who need less frequent interventions (no more frequently than every 4 h) could be monitored in the general ward with a nursing to patient ratio of 1:5 or less [16]. Having an intermediate care unit could therefore allow transfer to lower level of care in a timely fashion while still having appropriate monitoring for common complications following LT. Considering the absence of discernible reasons in nearly one-third of additional ICU days, an intermediate care unit can also provide reassurance if physician concern regarding the care available on the general ward played a contributing role on prolonged ICU stay. Furthermore, the development and implementation of a specific checklist for post LT care could prove of significant value, defining the indications for ICU, intermediate care unit, and post LT-ward care for these patients. Further large-scale prospective studies can provide more information in regard to the feasibility, cost-effectiveness, and overall results of such measures.

It is important to point out several limitations in this study. Firstly, all the information collected was obtained retrospectively from documentation in the electronic medical records. While objective findings were readily available for analysis (such as vital signs and laboratory values), the detail, clarity, and importance of subjective clinical findings could not be categorized or assessed. Furthermore, this was a single-center study, which limits our findings as postoperative critical care practices vary significantly across centers. Prospective validation of the experimental approach, that is, randomizing the use of the ADT tool coupled with outcome measurement, was not conducted. Finally, while a decrease in the number of additional ICU days would likely lead to significant reduction in cost, expenditure analysis was not performed. Despite these limitations, to our knowledge, our study is the first of its kind to test a consensus triage tool to determine the appropriateness of ICU stay after LT and potential opportunities for improvement.

In summary, prolonged ICU care following LT is not uncommon. In many instances, the need for close monitoring of hemodynamics and the function of various organ systems contribute to additional ICU days, as assessed by an ADT tool. Adequate identification of LT recipients who no longer benefit from ICU care could help significantly to improve outcomes while reducing overall costs. Future areas to be studied include determining the most appropriate hospital environment for the care of patients who no longer require intensive care but remain in need of close monitoring, the feasibility of establishing specific measures that reduce or eliminate additional ICU days, and their overall impact in patient care.

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Conflicts of interest

The authors in this manuscript have no conflicts of interest to disclose.

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