Comparing MELD-3 and Child-Pugh Scores in Predicting 90-Day Readmission and Mortality in Patients with Liver Cirrhosis.

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ABSTRACT:

Objective: This comparative analysis aims to quantify the superior predictive performance of MELD-3 relative to Child-Pugh scores and to evaluate its implications for clinical decision-making and resource allocation in patients with liver cirrhosis.

Methodology: This prospective observational study was performed at the Department of Medicine, Dr. Ruth. K. M. Pfau, Civil Hospital, Karachi, Dow University of Health Sciences, from May 2025 to November 2026. 250 patients of decompensated cirrhosis of >18 years meeting the inclusion/ exclusion criteria were included. The data collection consisted of demographic information, and blood samples were taken, and scores were calculated at discharge and readmission within 3 months on a pre-designed proforma. Data analysis was done by using SPSS 25, and descriptive statistics were applied.

Results: Among 250 hospitalized patients, 20 (8%) died, and 230 (92%) survived. The mean Child-Pugh Score (CPS) increased from 8.68 ±1.92 at discharge to 9.87 ±2.06 at readmission. While the mean MELD 3.0 score rose from 17.83 ±8.10 to 21.00 ±9.26. Mortality was significantly associated with CPS at discharge (mean difference 1.27, p=0.004) and readmission (mean difference 1.87, p<0.001), as well as MELD-3 at discharge (mean difference 7.47, p<0.001) and readmission (mean difference 5.05, p=0.019). Logistic regression analysis identified CPS at readmission, MELD-3 at discharge and readmission, and CPS class as independent predictors of mortality.

Conclusion: CPS, particularly at readmission, demonstrated slightly better predictive accuracy, while MELD-3 remains a useful adjunct. A combined or dynamic approach may provide the most clinically meaningful risk stratification.

Key words: MELD 3, CPS, Decompensated Cirrhosis, mortality.

Cite as: Khan MM, Kumar D, Naim H, Rasheed T, Kumar P. Comparing MELD-3 and Child-Pugh Scores in Predicting 90-Day Readmission and Mortality in Patients with Liver Cirrhosis. J Muhammad Med Coll. 17(1) May-Oct 2026

Introduction:

The purpose of this comparative analysis is to define the predictive value of the Model on End-Stage Liver Disease 3.0 and Child-Pugh scores in predicting 90-day readmission rates and mortality of patients diagnosed with liver cirrhosis.[1] Cirrhosis is a progressive and chronic disease with a high prevalence having a great deal of mortality worldwide.[2,3] There is a high prevalence of hepatitis C in Pakistan.[4] The chances of readmission of decompensated liver disease within one year of discharge are around 45%.[5] Decompensated liver cirrhosis include hepatic encephalopathy, ascites, variceal bleeding and hepatocellular carcinoma, all of which have inferior outcomes unless a timely liver transplantation is performed.[6] Due to a lack of resources and the high cost of healthcare, the number and frequency of recurrent hospital admissions have been a major concern for public and private sector hospitals.[7.] These readmissions are associated with poor prognosis and increased mortality. [8,9]

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Received: August 2026, Revised: September 2026
Accepted: October 2026

Child-Pugh Score (CPC) has been widely used for prognostic assessment of cirrhotic patients, which exhibits substantial survival differences between its classes. However, the absence of measuring renal function decreased its clinical limits.[10,11] In 2024, Lin et al, compared MELD 3, MELD Na and MELD score in predicting mortality in cirrhosis. MELD 3 showed higher accuracy in predicting mortality at 30 days with a cut off >19, sensitivity of 67.4% and specificity of 82.4%.[12] In 2001, at the Mayo Clinic, Kamath et al proposed another model for the prediction of post-TIPPS survival, the MELD score based on creatinine, bilirubin, and INR.[13] Hyponatremia was used as a marker of portal hypertension in CLD that correlates with mortality by 5%.[10] Its accuracy has fallen because it underestimates mortality in females due to low serum creatinine, because of the reduced muscle mass. To fill this gap, Organ Procurement and Transplantation Network, (OPTN) suggested MELD 3 to predict ninety day mortality.[14] A study conducted in 2020 by Acharya et al, predicting 3-month mortality using CPC, MELD-Na, and MELD 3, demonstrated that CPC had superior discriminative ability compared to MELD-Na and MELD. CPC has Sn 76.19% and Sp 100%, MELD has Sn 81.63% and Sp 75%, and MELD Na with Sn 77.40% and Sp 83.3%.[15] Another study conducted by Lohana et al in 2022 predicted 3-month mortality and risk of readmission. His results showed CPC class C has an OR of 17.2 and AUC for MELD score 0.930, CI 0.892-0.959, with p <0.0001. Meld >17.5 showed 92% sensitivity and 79% specificity.[16] Decompensated liver cirrhosis increases the risk of mortality by 9.7 times; the median life expectancy is

2 years.[17] We aim to decide the prognostic values of MELD 3 vs. the CPS to estimate the risk of readmission and mortality.

Objective:

Taking into consideration the predictive accuracy of the MELD-3 and CPS scores in predicting ninety-day readmission and mortality in patients with decompensated chronic liver disease; the goal of this comparative analysis is to quantify the superior predictive performance of MELD-3 relative to Child-Pugh scores and to evaluate its implications for clinical decision-making and resource allocation in patients with liver cirrhosis.

Methodology:

This prospective observational study was conducted at the Department of Medicine, Dr. Ruth. K. M. Pfau, Civil Hospital, Karachi, during the period of (May 2025 to November 2026), after approval of the synopsis from the institutional review board of Dow University of Health Sciences with IRB number (IRB-4090/DUHS/APROVAL/2025/277). A total of 250 patients aged over 18 years, of either gender, known case of decompensated chronic liver disease as described above of any etiology diagnosed based on clinical examination, laboratory, and radiology and readmitted within 3 months of first discharge for any reason were included through non-probability convenience sampling. Patients with hepatocellular carcinoma, acute liver failure, HIV infection, hematological disorders, chronic kidney disease, coma secondary to cerebrovascular events, pregnancy, prior or existing liver transplantation, or a history of hepatotoxic drug use were excluded. Data collection includes Informed consent, demographic, and clinical details. Initial data about age, name, and date of admission were recorded on a pre-designed proforma. Blood samples were collected and sent to the laboratory for serum bilirubin, creatinine, PT/INR, sodium, and albumin. Ascites, jaundice, and encephalopathy were assessed on clinical examination and graded according to the above-mentioned scales. MELD-3 and CPS were calculated at discharge, and patients were followed up to track for any complications during this period.

SPSS version 25.0 was used for statistical evaluation. Continuous variables, such as age, MELD-3 score, and CPS, were reported as mean ±SD, whereas male/female gender, comorbidities, and clinical complications were reported as frequencies and percentages. The key outcomes are mortality and ninety-day hospital readmission. To assess how well MELD 3- and CPS predicted these outcomes, receiver operating characteristic (ROC) curves were generated, and the area under the curve (AUC) was calculated for each scoring system. Comparative analysis between groups (survivors vs non-survivors, readmitted vs non-readmitted) was done by using the independent t-test for continuous variables and the chi-square test for categorical variables. The independent variables of 90-day mortality and readmission had been identified using binary logistic regression analysis. A P-value of <0.05 was considered statistically significant.

Results:

There were 250 patients where male (n=170) outnumbered female (n=80) The overall age of the patients was 54.5 ±14.27 (23-81 years). Among all patients admitted to the hospital, 20 (8%) died, and 230 (92%) survived. Mean Child-Pugh Score (CPS) at the time of first discharge was 8.68 ±1.92 (5-14) and 9.87 ±2.06 (6-15) at the time of readmission, respectively. The average MELD 3.0 score at discharge was 17.83 ±8.10 (range 6-38), and at readmission, it was 21.00, SD 9.26 (range 8-40). The majority of patients were Child-Pugh Class C and then Class B as shown in table 1.

Table No 1: Demographic characteristics of study participants (n=250)

Variable	Value
Sample size	250
Age (years)	54.5 ± 14.27
Mortality	20 (8%)
CPS at discharge	8.68 ±1.92
CPS at readmission	9.87 ±2.06
MELD-3 at discharge	17.83 ±8.10
MELD-3 at readmission	21.00 ±9.26

Comparison between survivors and non-survivors demonstrated that non-survivors had significantly higher Child-Pugh Scores (CPS) and MELD-3 scores. Mortality was significantly associated with CPS at discharge (mean difference: 1.27, $p = 0.004$) and CPS at readmission (mean difference: 1.87, $p < 0.001$). Similarly, MELD-3 scores were significantly elevated among non-survivors at discharge (mean difference: 7.47, $p < 0.001$) and at readmission (mean difference: 5.05, $p = 0.019$). Logistic regression analysis identified CPS at readmission, MELD-3 at discharge, MELD-3 at readmission, and CPS class as independent predictors of mortality, see table no 2.

Table No 2: Logistic Regression Predictors of Mortality.

Variable	p-value	Odds Ratio
CPS at discharge	0.917	0.98
CPS at readmission	0.001	0.50
MELD-3 at discharge	0.001	0.83
MELD-3 at readmission	0.007	1.18
CPS class	0.029	5.55

As the ROC curves showed, the AUC of MELD-3 at discharge was 0.693, whereas the AUC of MELD-3 at readmission was 0.637, which is a weak predictive factor (Figure 1). On the same note, CPS recorded a 0.676 AUC at discharge and 0.751 AUC at readmission, indicating superior predictive validity at readmission (Figure 2).

Figure 1. ROC Curve for MELD-3 score.

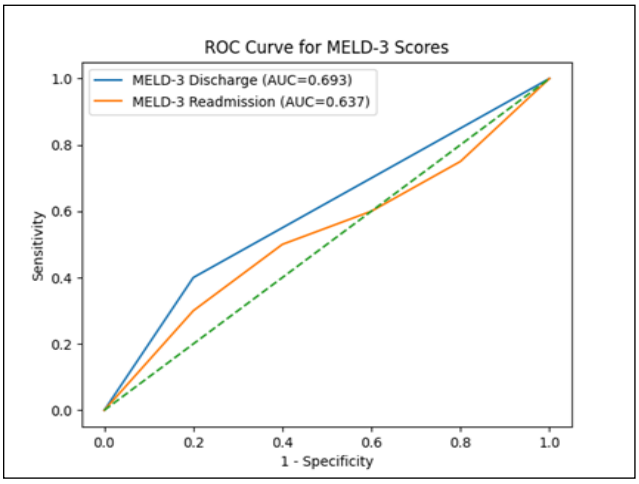
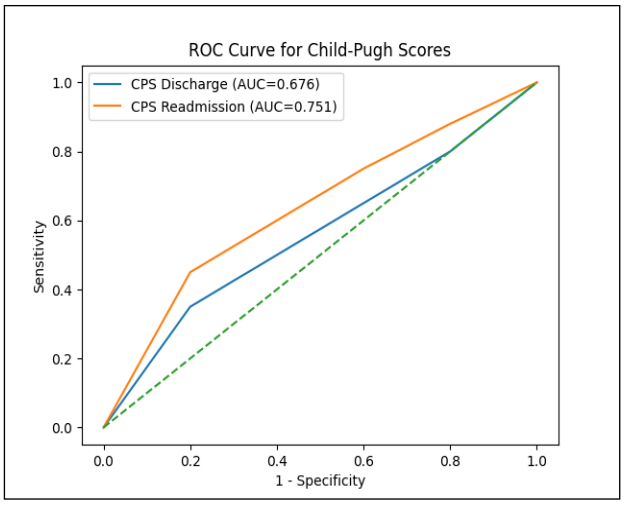


Figure 2. ROC Curve for Child-Pugh Scores.



Discussion:

Current study compared the prognostic value of MELD-3 and Child-Pugh Score (CPS) in predicting mortality among patients with decompensated chronic liver disease. The findings demonstrate that both scoring systems are significantly associated with mortality; however, their predictive performance varies depending on the timing of assessment and the individual parameters included in each scoring system. We found a decrease in overall in-hospital mortality; the rate in our study was 8%, which is lower than the anticipated mortality rate of 20% which was used in sample size estimation.[4] This difference may be due to variations in the severity of disease at presentation, better patient management, or differences in baseline patient characteristics.

A key finding of our study was that both MELD-3 and Child-Pugh (CPS) scores were significantly higher among non-survivors, underscoring their utility as prognostic tools. This observation is consistent with the work of Acharya et al.[10] who demonstrated that both scoring systems reliably predict short-term mortality. Importantly, short-term mortality, particularly within 90 days of discharge remains a critical concern, often reflecting episodes of acute decompensation that characterize advanced cirrhosis.[18] Our study contributes to the existing body of evidence by specifically evaluating MELD-3, a newer modification designed to address limitations of the traditional MELD score, including gender bias, while incorporating additional parameters such as albumin and sodium to enhance predictive accuracy.

At 90 days, the readmission rate was 35%, with hepatic encephalopathy and ascites being the most frequent causes, while the overall 90-day mortality was 15%.[19] Reported readmission rates in cirrhosis range between 10-50%, reflecting substantial healthcare costs and adverse patient outcomes.[20] In our study, the CPS at readmission (AUC 0.751) demonstrated superior predictive accuracy compared to CPS at discharge (AUC 0.676), underscoring the importance of dynamic reassessment in forecasting mortality and readmission. This finding reinforces the concept that cirrhosis is a gradually progressive disease, where frequent monitoring can improve outcomes. Conversely, MELD-3 at discharge (AUC 0.693) performed slightly better than at readmission (AUC 0.637), though with limited discriminatory power. Collectively, these results suggest that while MELD-3 remains a useful prognostic tool, CPS—particularly with repeated assessments—offers greater effectiveness in predicting patient outcomes.

Logistic regression analysis in our study identified CPS at discharge, as well as MELD-3 at both discharge and readmission, as independent risk factors for mortality. A high CPS was particularly significant (OR 5.55), reaffirming that advanced liver disease remains a strong prognostic marker. Consistent with this, Lohana et al.[16] demonstrated a strong association between mortality and CPS class C (OR 17.2). These findings highlight the need for repeated follow-ups, as single-point assessments may lack reliability—explaining why CPS at discharge alone showed limited accuracy in logistic regression analysis. Binary logistic regression identified three distinct predictors of mortality that can be used to stratify patients according to risk. Among these, CPS class demonstrated the strongest association with mortality (OR 5.55), confirming that end-stage liver disease remains a major determinant of prognosis. This finding aligns with prior evidence, including the study by Lohana et al.[16] which reported a markedly higher risk of death in patients with CPS class C (OR 17.2), thereby supporting the external validity of our results. Importantly, single-point follow-up assessments are not reliable for outcome prediction. While CPS at discharge did not achieve notable significance, CPS at readmission showed measurable differences, underscoring the necessity of periodic monitoring as chronic liver disease evolves over time. In current study female patients (n = 80) demonstrated nearly threefold higher mortality compared to males (n = 170), with rates of 12.5% versus 4.3%, respectively. This disparity underscores a gender-based difference in outcomes; however, it may partly reflect the smaller proportion of female patients within the cohort, which could influence the observed percentages.

In the current study, female patients (n = 80) demonstrated nearly threefold higher mortality compared to males (n = 170), with rates of 12.5% versus 4.3%, respectively. This disparity underscores a gender-based difference in outcomes; however, it may partly reflect the smaller proportion of female patients within the cohort, which could influence the observed percentages. Notably, recent evidence has highlighted sex-based differences in cirrhosis outcomes. For instance, a large population-based study by Suu et al.[21] reported significant gender disparities in long-term mortality among patients with cirrhosis, thereby supporting the external validity of our findings.

The predictive accuracy of both scoring systems was acceptable, though not exceptional (AUC > 0.80). This suggests that MELD-3 and CPS are reliable tools; however, clinicians should avoid relying on them in isolation. Optimal prognostication requires integration with detailed clinical examination, timely follow-ups, and careful consideration of additional factors such as infection status, nutritional condition, comorbidities, and the patient's overall functional capacity. Addressing these elements in conjunction with scoring systems is essential to maximize outcomes and enhance predictive accuracy.

By utilizing bedside scoring systems such as MELD-3 and CPS, high-risk patients can be identified at an early stage. In Pakistan, where liver transplantation is not widely accessible, these tools provide a practical means of prioritizing care within limited resources. Through early risk stratification, clinicians can optimize patient management, reduce preventable readmissions, and lower mortality rates. Ultimately, this approach has the potential to substantially ease the burden on the healthcare system.

Strengths and Limitations:

Our study has several notable strengths, including a relatively large sample size (n = 250), a prospective design, and the use of comparative and regression analyses to determine prognostic outcomes. Moreover, it provides valuable local data in a setting where literature on MELD-3 remains limited.

Nonetheless, certain limitations should be acknowledged. First, the study was conducted at a single center, which may restrict the generalizability of the findings. Second, long-term outcomes could not be assessed due to the relatively short follow-up period. Third, important variables such as cirrhosis etiology, differences in treatment strategies, and complications (e.g., infections, portal hypertension) were not incorporated, all of which may influence mortality. Finally, although our primary intention was to analyze readmissions, the results presented here emphasize fatality rates, which may not fully capture the burden of recurrent hospitalizations.

Conclusion:

We conclude that both MELD-3 and Child-Pugh (CPS) scores are reliable and important tools for anticipating mortality in end-stage liver disease. However, CPS particularly when calculated at readmission demonstrated superior predictive accuracy, whereas MELD-3 remains a valuable adjunct. Employing these scores simultaneously or through periodic monitoring may provide the most effective means of stratifying patients according to risk.

Acknowledgement: We acknowledge that the AI tool Chat GPT helps in grammatical correction and word alignment.

Ethical Permission: Dow University of Health Sciences, Karachi, Pakistan, ERC approval letter No. IRB-4090/ DUHS/APROVAL/2025/277.

Conflict of interest: There is no conflict of interest between the authors.

Financial Disclosure/Grant Approval: No funding agency was involved in this research.

Data Sharing Statement: The corresponding author will provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

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Darshan Kumar	Conceptualization, Formal analysis
Huda Naim	Writing original draft, Review
Tazeen Rasheed	Methodology, Data analysis
Pawan Kumar	Investigation, writing and review