# Development and Validation of a Novel Prognostic Model Combining MELD-Na Score and Neutrophil-to-Lymphocyte Ratio (NLR) for Predicting 28-Day Mortality in Hepatitis B-Related Acute-on-Chronic Liver Failure

## *A Single-Center Retrospective Cohort Study*

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## 1. BACKGROUND & OBJECTIVE

- Hepatitis B-related acute-on-chronic liver failure (ACLF) has high short-term mortality.
- MELD-Na score is widely used but does not reflect systemic inflammation.
- Neutrophil-to-lymphocyte ratio (NLR) is a simple, inexpensive marker of systemic inflammation.

### OBJECTIVE:

To evaluate admission NLR and develop/ internally validate a combined MELD-Na score and NLR model for predicting 28-day all-cause mortality in HBV-related ACLF.

## 2. METHODS

**Design** : Retrospective cohort study, January 2021 – December 2025.

**Population** : Adults ≥18 years with HBV-ACLF diagnosed by APASL (AARC) criteria.

**Data Collection** : Demographic, clinical, laboratory and virological data from electronic medical records.

**Primary Outcome** : 28-day all-cause mortality.

**Statistical Analysis** : Multivariable logistic regression to identify independent predictors. ROC curve analysis with AUC comparison (DeLong test). Internal validation by bootstrap (1,000 resamples).

## STUDY OVERVIEW

| Total Patients Analyzed | Male | Mean Age | 28-Day Mortality |
|---|---|---|---|
| **186** Patients with HBV-ACLF | 148 (79.6%) | **46.3 ± 11.7** years | **29.0%** (54/186) |

Overall 28-day mortality was 29.0% (54/186).

## 3. RESULTS

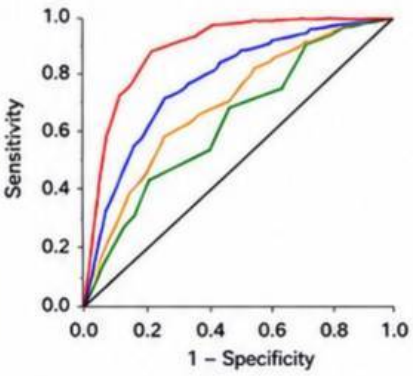
### 3.1 Baseline Characteristics: Survivors vs. Non-Survivors (Admission)

| Variable | Survivors (n = 132) | Non-Survivors (n = 54) | p value |
|---|---|---|---|
| NLR (median, IQR) | 7.3 (4.3 – 11.6) | 15.4 (9.6 – 23.2) | <0.001 |
| MELD-Na (median, IQR) | 23 (18 – 27) | 31 (26 – 36) | <0.001 |
| Ferritin (ng/mL, median, IQR) | 510 (260 – 910) | 1240 (650 – 2090) | <0.001 |
| Acute kidney injury, n (%) | 32 (24.2%) | 33 (61.11%) | <0.001 |

### 3.2 Independent Predictors of 28-Day Mortality (Multivariable Logistic Regression)

| Predictor | Adjusted OR (95% CI) | p value |
|---|---|---|
| MELD-Na > 28 | 4.11 (2.02 – 8.37) | <0.001 |
| NLR > 10 | 3.42 (2.17 – 6.83) | 0.001 |
| Acute kidney injury | 2.68 (1.29 – 5.54) | 0.008 |
| Ferritin > 800 ng/mL | 2.31 (1.18 – 4.52) | 0.015 |

### 3.3 Model Discrimination (ROC Curve Analysis)




| Model | AUC (95% CI) |
|---|---|
| Serum ferritin | 0.76 (0.69 – 0.83) |
| NLR alone | 0.80 (0.73 – 0.86) |
| MELD-Na alone | 0.83 (0.77 – 0.89) |
| **MELD-Na + NLR (combined)** | **0.90 (0.85 – 0.94)** |

The combined MELD-Na and NLR model showed significantly better discrimination than MELD-Na alone (DeLong test, $p = 0.02$).

## 4. KEY FINDINGS

Admission NLR is an independent predictor of 28-day mortality in HBV-related ACLF.

A combined model using MELD-Na score and NLR outperforms MELD-Na alone, NLR alone, and serum ferritin for 28-day mortality prediction.

This model uses simple, inexpensive, and widely available parameters, supporting feasibility for bedside use in routine clinical practice.

## 5. CLINICAL IMPLICATIONS

Enables early risk stratification at admission.

May guide escalation of care and appropriate timing of ICU referral.

Could support earlier referral for liver transplant evaluation in high-risk patients.

## 6. STUDY STRENGTHS

- Single-center, retrospective study with internal validation.
- Uses routinely available and inexpensive parameters.
- Robust statistical methods with bootstrap validation.
- Addresses the combined effect of liver dysfunction and systemic inflammation.

### ABBREVIATIONS:

**ACLF:** Acute-on-Chronic Liver Failure; **AARC:** APASL ACLF Research Consortium; **HBV:** Hepatitis B Virus; **MELD-Na:** Model for End-Stage Liver Disease Sodium; **NLR:** Neutrophil-to-Lymphocyte Ratio; **OR:** Odds Ratio; **CI:** Confidence Interval; **ROC:** Receiver Operating Characteristic; **ICU:** Intensive Care Unit.

### REFERENCES:

1. APASL ACLF Research Consortium (AARC) diagnostic criteria for ACLF.
2. Jalan R, et al. J Hepatol. 2014;61(5):1030–1047.