The Mortality Index for Alcohol-Associated Hepatitis: A Novel Prognostic Score

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Abstract

Objective: To develop a new scoring system that more accurately predicts 30-day mortality in patients with alcohol-associated hepatitis (AH).

Methods: A cohort of consecutive adults diagnosed with AH at a single academic center from January 1, 1998, to December 31, 2018, was identified for model derivation. Multivariate logistic regression was used to create a new scoring system to predict 30-day mortality. External validation of this score was performed on a multicenter retrospective cohort.

Results: In the derivation cohort of 266 patients, the 30-day mortality rate was 19.2%. The following variables were found to be significantly associated with mortality on multivariate analysis: age ($P = .002$), blood urea nitrogen ($P = .003$), albumin ($P = .01$), bilirubin ($P = .02$), and international normalized ratio ($P = .001$). A model incorporating these variables, entitled the Mortality Index for Alcohol-Associated Hepatitis (MIAAH), achieved a C statistic of 0.86. Comparison of the accuracy of the MIAAH to existing prognostic models, including the Model for End-Stage Liver Disease and Maddrey Discriminant Function, showed that the highest concordance was achieved by the MIAAH and that this difference was significant. In the validation cohort of 249 patients, the MIAAH C statistic decreased to 0.73 and was found to be significantly superior to the Maddrey Discriminant Function but not to the Model for End-Stage Liver Disease.

Conclusion: The MIAAH competes with the current prognostication models and is at a minimum as accurate as these existing scores in identifying patients with AH at high risk of short-term mortality. Furthermore, the MIAAH demonstrates advantageous performance characteristics in its ability to increasingly accurately dichotomize patients into those at highest risk of death and those likely to survive.


Alcohol-associated hepatitis (AH) is an acute inflammatory process in the liver that occurs in patients who consume excessive amounts of alcohol.1,2 The disease ranges in severity from mild to severe.1,2 Whereas mild forms of the disease often improve with conservative treatment, severe disease is associated with significant short-term mortality.1,2 Disease severity can be quantified through the implementation of prognostic models, such as the Model for End-Stage Liver Disease (MELD); the Age, serum Bilirubin, INR, and serum Creatinine (ABIC) score; the Maddrey Discriminant Function (MDF); and the Glasgow Alcoholic Hepatitis Score (GAHS).3

Because of the broad range of disease severity in patients with AH, clinical decision-making for therapeutic intervention is dependent on these prognostic models. The best predictor of long-term mortality is alcohol abstinence.6 Despite decades of searching for alternative therapies, treatment options for patients with AH remain limited and of questionable efficacy.7,8 Patients with severe AH often present with features of systemic inflammatory response syndrome,
requiring hospitalization and aggressive supportive cares. The American Association for the Study of Liver Diseases guidelines recommend that AH patients with a MELD score above 20 or an MDF score of 32 or more be initiated on corticosteroid treatment. Furthermore, the Lille score is a “dynamic” predictive model that determines whether a patient is responding to such corticosteroid treatment. Despite this recommendation for administration of corticosteroids in patients with severe AH, there is no mortality benefit to corticosteroid treatment at 90 days, and those receiving corticosteroids have an increased risk of infection. There are many recent and ongoing clinical trials in the United States and other countries investigating additional therapies for AH, including immunologic agents. Finally, prognostic modeling is becoming increasingly intertwined into an emerging yet controversial topic in the field of hepatology, including whether patients with severe AH should receive early liver transplants. This clinical and ethical predicament highlights why a prognostic model with the strongest possible correlation for short-term mortality should be sought after. The available prognostic scores have suboptimal accuracy with area under the curve between 0.71 and 0.77. The purpose of this study was to create a novel prognostic score that is more accurate than the existing models in predicting 30-day mortality in patients with AH.

METHODS

Identification of Patients

Patients were retrospectively identified from a single tertiary care center from the Mayo Clinic in Rochester, Minnesota, from January 1, 1998, to December 31, 2018. A subsequent 249 patients from 2 external tertiary care centers, University of South Dakota and University of Kansas, who again met the inclusion criteria from January 1, 2009, to December 31, 2018, were used as an external validation cohort. Advanced Cohort Explorer and Advanced Text Explorer, applications for searching the electronic medical record, were used to generate a list of potential patients with AH by searching the medical record for the term alcoholic/alcohol-associated hepatitis. Supplemental Figure 1 (available online at http://www.mayoclinicproceedings.org) shows a flow chart of patient identification for the derivation cohort. Each medical record was manually reviewed by the research team to determine whether the patient met the National Institute on Alcohol Abuse and Alcoholism clinical criteria for probable AH and that this was the first presentation at this institution with the diagnosis. Patients not meeting the National Institute on Alcohol Abuse and Alcoholism criteria for probable AH were excluded from the analysis. The most common reason for exclusion was laboratory values (eg, total bilirubin) not meeting criteria. Approval for review of patients’ charts was obtained from the Mayo Clinic Institutional Review Board. Institutional Review Board approval was also obtained from the 2 centers providing patient data for the validation cohort. This study was conducted following the Strengthening the Reporting of Observational studies in Epidemiology guidelines.

Data Collection

After confirmation that each patient met the inclusion criteria, demographic data and laboratory values used in the calculation of the current prognostic scoring systems were collected. Additional clinically relevant variables were also collected. The end point was all-cause mortality within 30 days of initial presentation. Mortality at 30 days was determined by documented date of death in the electronic medical record. For those patients who did not have a documented date of death, the medical record was reviewed for documentation of follow-up visits for any reason beyond 30 days after presentation with AH to confirm that the patient was alive at 30 days. Accurint databases were used to confirm mortality at 30 days when confirmation by medical record review was not possible, as such follow-up was complete for all patients. All laboratory values abstracted were within 3 days of initial presentation.
presentation with AH, in either the inpatient or outpatient setting. In addition, the bilirubin level on day 7 was obtained if it was available; otherwise, the nearest bilirubin value available between days 4 and 10 was extracted.

**Survival Modeling**

Death at 30 days was measured as a binary outcome. The effects of laboratory parameters on 30-day mortality were analyzed by univariate logistic regression. Logistic regression was chosen for the analysis as follow-up was complete for the analyzed patients. The candidate variables for development of prognostic scoring were those that were significantly associated with mortality on univariate analysis \( (P < 0.05) \) and available for a sufficient number of patients for meaningful conclusions to be drawn. To lessen the influence of extreme laboratory values, creatinine was transformed to its natural logarithm. For the multivariate analysis, to determine a smaller subset of variables that would accurately predict survival, we used the backward elimination variable selection method, with the criterion for retaining variables in the model being \( P \) less than 0.05. Multivariate analysis was employed to develop a novel prognostic model entitled the Mortality Index for Alcohol-Associated Hepatitis (MIAAH). The odds ratios and \( C \) statistics of standard prognostic models in the prediction of 30-day mortality on the derivation data set were analyzed. A \( C \) statistic between 0.8 and 0.9 is considered excellent diagnostic accuracy, and a \( C \) statistic greater than 0.7 is considered clinically useful.\(^{17}\) The DeLong test was used to compare the \( C \) statistics between the existing prognostic models and the MIAAH in both the derivation and validation cohorts to determine whether the MIAAH performed differently compared with the existing models.

**Model Validation**

The model was validated in a large, multicenter retrospective cohort of patients with AH. There were 249 patients meeting the inclusion criteria from the University of South Dakota and University of Kansas who were used for model validation. To validate the model, we compared the external cohort’s actual mortality with predicted mortality. We also calculated indices of validity from the derivation cohort and applied them to the validation cohort, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the curve, for the MIAAH, MELD, and MDF. The optimal cut points were chosen such that the sum of sensitivity and specificity was maximized. The existing prognostic scores were calculated from their elemental components on the derivation and validation cohorts. The control prothrombin time was 11 seconds for both cohorts for calculation of MDF.

**Comparison of Model Accuracy Based on Corticosteroid Administration**

To determine whether the MIAAH performed differently in patients who received corticosteroids compared with those who did not receive corticosteroids for treatment of AH, the derivation and validation cohorts were individually dichotomized into those patients who received corticosteroids and those who did not. The MIAAH score was then applied to each group to identify any differences in its performance among patients on the basis of corticosteroid treatment.

**RESULTS**

**Characteristics of the Patients**

From the time span of 1998 to 2018, 279 patients met inclusion criteria for AH in the derivation cohort. Of these, 12 patients denied research authorization and 1 patient had liver transplant before the development of AH, and these patients were excluded from the study. Of the remaining 266 patients, 14 were excluded during model generation because of lack of necessary laboratory values to calculate the prognostic scores. Of the 252 analyzed patients, 2 patients underwent liver transplant before 30 days from the time of presentation and as such were considered to have the end point of death by 30 days as they would have
died without receiving liver transplant. Table 1 demonstrates the demographic data of the derivation and validation cohorts.

There were 266 patients in the derivation cohort and 249 patients in the validation cohort. The median age was 48 to 49 years and was not significantly different between the cohorts. Baseline variables were compared between the cohorts, and there was no significant difference between the derivation and validation cohorts in age and serum bilirubin, blood urea nitrogen (BUN), serum creatinine, and serum albumin concentrations. The international normalized ratio (INR) was significantly different between the cohorts, with a median value of 1.8 in the validation cohort compared with 1.6 in the derivation cohort. The median MELD score was not significantly different between the derivation and validation cohorts, 18.5 vs 19.3, respectively (P = .08). The MDF score was significantly lower in the derivation cohort than in the validation cohort, 44.5 vs 59.0 (P < .001).

More patients in the validation cohort received corticosteroids than in the derivation cohort, 29.7% and 21.4% (P = .03). The cumulative incidence of death in the 266 patients in the derivation cohort, considering the 2 transplants before 30 days as patients who would have died otherwise, was 19.2% (n=51). The cumulative incidence of death in the validation cohort was 12.9% (n=32). A comparison of the mortality rates between the derivation and validation cohorts using logistic regression to adjust for age found no significant difference in mortality (P = .08).

Univariate Analysis

Table 2 demonstrates the results of the univariate analysis. The derivation cohort was divided into 2 cohorts, 1 from 1998 to 2008 and 1 from 2009 to 2018, to compare whether there were differences in mortality during this 20-year period of patient presentation that would suggest significant practice changes over time. There was no difference in mortality between these 2 cohorts (P = .29), indicating that the survival rate in AH has not significantly changed during the past 20 years. Age, bilirubin, ln(creatinine), INR, prothrombin time, BUN, albumin, leukocyte count, and polymorphonuclear leukocyte count were significantly associated with mortality on univariate analysis. Of these variables, the polymorphonuclear leukocyte value was missing in 20.3% of patients and as such was not considered a candidate variable for multivariate analysis. Of the body mass index (BMI) categories, BMI between 30 and 34.99 kg/m² was significantly associated with mortality (P = .03); however, the other BMI categories were not significantly associated. Variables that were not significantly associated with mortality on univariate analysis included sex, race, sodium concentration, and lymphocyte count.

Multivariate Analysis

Of the univariate analysis variables, the following candidate variables were analyzed to create a novel prediction model: age, BUN, albumin, bilirubin, INR, and

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<th>TABLE 1. Characteristics of the Patients&lt;sup&gt;a,b,c&lt;/sup&gt;</th>
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<td><strong>Derivation cohort (N=266)</strong></td>
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<sup>a</sup>BMI, body mass index; BUN, blood urea nitrogen; INR, international normalized ratio; MDF, Maddrey Discriminant Function; MELD, Model for End-Stage Liver Disease.

<sup>b</sup>SI conversion factors: To convert bilirubin values to μmol/L, multiply by 17.104; to convert BUN values to mmol/L, multiply by 0.357; to convert creatinine values to μmol/L, multiply by 88.4; to convert albumin levels to g/L, multiply by 10.

<sup>c</sup>Categorical variables are presented as number (percentage). Continuous variables are presented as mean (standard deviation).
ln(creatinine). Using backward selection, age, BUN, albumin, bilirubin, and INR were significantly associated with mortality (Table 3). An increase in age by 10 years increased the risk of death by 82.2%. An increase in BUN by 1 mg/dL (to convert BUN values to mmol/L, multiply by 0.357) increased the risk of death by 2.3%. An increase in albumin by 0.1 g/dL (to convert albumin levels to g/L, multiply by 10) decreased the risk of death by 8.7%. An increase in bilirubin by 1 g/dL (to convert bilirubin values to mmol/L, multiply by 17.104) increased the risk of death by 4.2%. An increase in the INR by 1 unit increased the risk of death by more than 2.8-fold. This model achieved a C statistic of 0.86, meaning that it accurately predicted mortality more than 86% of the time. Because of the significance of leukocyte count on univariate analysis, this was added to the model created with the variables identified by backward selection, but the leukocyte count was not retained (P = .40).

### Comparison Between the MIAAH and Prior Prediction Models

In the derivation cohort, the MIAAH achieved a higher C statistic than the existing prognostic models. In comparison to the C statistic achieved by the MIAAH...
(0.86; CI, 0.82 to 0.91), the ABIC (C statistic, 0.85), MELD (C statistic, 0.82), MDF (C statistic, 0.78), GAHS (C statistic, 0.82), MELD-Na (C statistic, 0.82), and Lille (C statistic, 0.78) had lower C statistics. This difference was significant for the MELD, MDF, MELD-Na, and GAHS. However, this difference was not significant in comparison to the ABIC (P = .19) or Lille (P = .13) scores.

Using the C statistic with the end point of 30-day mortality, the area under the receiver operating characteristic curve for the MIAAH was compared with the prior prediction models (Figure 1).

External Validation
In the external validation cohort, the MIAAH achieved a C statistic of 0.73 (CI, 0.65 to 0.82). In the validation cohort, the MELD achieved a C statistic of 0.72 (CI, 0.63 to 0.80), and the MDF achieved a C statistic of 0.64 (CI, 0.55 to 0.74). Figure 2 demonstrates the receiver operating characteristic curves for the MIAAH, MELD, and MDF in the validation cohort. The DeLong test of P values comparing the MIAAH with the MELD showed no significant difference between the models (P = .61). The DeLong test of P values comparing the MIAAH with the MDF showed a significant difference between the C statistics (P = .01). The validation set was divided into quintiles based on the predicted probability of death. The MIAAH overpredicted the number of deaths, predicting 51 when 32 were observed. This overprediction was more prominent in the quintiles at higher risk of mortality (Supplemental Figure 2, available online at http://www.mayoclinicproceedings.org).

Performance Characteristics
Cut points were identified in the derivation cohort for the MIAAH, MELD, and MDF such that the sensitivity and specificity were maximized; these cut points were above −1.55, above 28, and above 49.35, respectively. Applying these cut points to the validation cohort, the MIAAH achieved a sensitivity of 75.0%, specificity of 66.4%, PPV of 25.3%, NPV of 94.6%, and C statistic of 0.71 (CI, 0.61 to 0.80). Applied to the validation cohort, the MELD achieved a sensitivity of 43.8%, specificity of 78.9%, PPV of 23.7%, NPV of 90.3%, and C statistic of 0.61 (CI, 0.50 to 0.72). For the MDF applied to the validation cohort, the sensitivity was 84.4%, specificity was 43.2%, PPV was 18.2%, NPV was 94.8%, and C statistic was 0.64 (CI, 0.54 to 0.73). A comparison of the application of the derivation identified cut points in the validation cohort showed that the MIAAH had a significantly higher C statistic compared with MELD (P = .03) but not compared with MDF (P = .11). To identify patients with extremely poor prognosis, specificity was maximized to 100%, corresponding to an MIAAH score of 3.9 or higher. This cut point successfully identified 100% of patients who survived 30 days; however, only 2 of 51 patients (3.9%) who died within 30 days had a score
above this threshold. Nevertheless, this cut point may be used to identify patients in whom treatment may be considered futile.

Effect of Corticosteroids

There were 57 patients (21.4%) in the derivation cohort and 74 patients (29.7%) in the validation cohort who received corticosteroids. Applying the MIAAH to the derivation cohort patients receiving corticosteroids demonstrated a C statistic of 0.76 (P=.01) compared with a C statistic of 0.89 (P<.0001) in patients not receiving corticosteroids (P=.02). In the validation cohort, the MIAAH again performed significantly better in those not receiving corticosteroids (P=.03). In patients not receiving corticosteroids, the MIAAH achieved a C statistic of 0.76 (P=.0002) compared with a C statistic of 0.684 (P=.50) in those receiving corticosteroids.

DISCUSSION

Here we explore a novel prognostic model in an attempt to improve the accuracy of short-term mortality prediction in patients with AH. The MIAAH achieved a significantly higher C statistic than the majority of existing prognostic scores, including the MELD and MDF, in the derivation cohort, demonstrating that it was more accurate in predicting 30-day mortality. Whereas the MIAAH did not perform significantly better in the derivation cohort in comparison with the ABIC or Lille score, this is thought to be resultant of a small sample size in which there are fewer events. The Lille score was calculated for all patients in the study regardless of corticosteroid administration, which is not the intended purpose of the Lille score. However, we elected to include the Lille score for comparison as the only validated dynamic assessment of prognosis in patients with AH. In the validation cohort, the MIAAH was significantly superior to the MDF (P=.01) but not the MELD (P=.61). The MELD proves to be a difficult prognostic model to surpass, and it has many benefits including overall clinician familiarity as well as similar accuracy to the other existing models, including now the MIAAH.

The decrease in the MIAAH C statistic between the derivation and validation cohorts is likely resultant of differences between the populations of patients as is often seen with the heterogeneous population in AH. Specifically, the INR and relatively the MDF were significantly higher in the validation cohort, and there was a trend toward a higher MELD score in the validation cohort compared with the derivation cohort despite no significant difference in mortality between the cohorts when adjusted for age. Therefore, the odds ratio for INR derived from the derivation cohort was less accurate in the validation cohort. Nevertheless, this difference in MDF score between the cohorts and trend in difference in the MELD score despite no difference in mortality again demonstrates the need for more accurate prognostication models for patients with AH.
Whereas the variables in the MIAAH have been previously identified in the existing prognostic scores, this combination of variables is novel (Supplemental Figure 3, available online at http://www.mayoclinicproceedings.org). Given the overlap of the serologic markers in the current prognostication models, it is unlikely that there will be a marked improvement in the accuracy of a prognostication model with serology alone. However, the MIAAH score is robust in that it was developed specifically for patients with AH, and the component variables of the MIAAH therefore are optimally suited for this population of patients. A point by point comparison of the MIAAH components to those of the existing models is as follows. In agreement with our study, age is a variable in the ABIC, Lille, and GAHS models. Serum creatinine is also part of the MELD, MELD-Na, Lille, and ABIC models, and the development of acute kidney injury has been reported to negatively affect short-term survival in patients with AH. One limitation of the use of creatinine as a marker of renal function is that hyperbilirubinemia is known to interfere with the serum creatinine assay, and the high prevalence of sarcopenia in patients with cirrhosis further limits the creatinine assay in patients with liver disease. Multiple studies in the literature of decompensated cirrhosis find that BUN is superior for prognostication in comparison to creatinine. Creatinine is also influenced by skeletal muscle mass, and the high prevalence of sarcopenia in patients with cirrhosis further limits the creatinine assay in patients with liver disease. Multiple studies in the literature of decompensated cirrhosis find that BUN is superior for prognostication in comparison to creatinine. Our study found that BUN is more closely correlated with mortality than creatinine, and as such, BUN was selected as a variable for the model. Albumin is incorporated into the Lille score and was also found to be significant in the MIAAH development. Albumin is a nonspecific marker of liver synthetic function and of overall health. Previous literature reported that protein-calorie malnutrition is highly correlated with AH severity and that standard supportive care can reverse these nutritional deficiencies. Total bilirubin concentration has been identified as likely to be the best test of true liver function and is incorporated into the MIAAH score. Finally, prothrombin time was excluded as a candidate variable in favor of INR, which has been found to have less laboratory variability. The INR does have its limitations as it is calibrated for patients receiving vitamin K antagonists, and therefore an INR score calibrated for patients with liver disease may be more suitable for prognostication calculation. However, because of the ubiquitous use of INR derived from patients receiving vitamin K antagonists, the MIAAH incorporates this variable rather than an INR derived specifically on patients with liver disease as this requires further clinical validation as well as practice change.

Prognostic modeling is integral in the determination of therapeutic intervention in patients with AH. Unfortunately, no pharmacologic therapies have been found to reduce 90-day mortality in severe AH, and only a small survival benefit at 30 days has been reported with prednisolone use. Our analysis finds that the MIAAH performed better in patients not treated with corticosteroids, which was most patients, compared with those treated with corticosteroids in both the derivation and validation cohorts. These results must overall be interpreted with caution, however, as further dichotomizing the cohorts led to fewer events (deaths), making the analysis difficult to interpret. Nevertheless, the MIAAH performs well regardless of corticosteroid administration and is therefore generalizable. Alcohol abstinence has been reported to be the best predictor of long-term survival in patients with AH. Alcohol abstinence has been reported to be the best predictor of long-term survival in patients with AH. We therefore restricted our end point to mortality at 30 days to control for alcohol relapse as a potential confounder. Owing to the absence of effective medical treatment, liver transplant is increasingly being considered for patients with severe AH. Clinical decisions about whether patients with severe AH need to be considered for early transplant are dependent on predictive models like the MELD, MDF, and Lille scoring systems. Considering the shortage of liver donors
and the possibility of spontaneous recovery with supportive care, it is imperative to have a prognostic model that accurately reflects which AH patients are most likely to die and are therefore in the greatest need of transplant.\textsuperscript{12,39}

Multiple models for AH prognostication already exist, but no single model has consistently been shown to be superior for prognostication.\textsuperscript{2,40} A comparison of the sensitivity analysis C statistics in the validation cohort found that the MIAAH performed significantly better than the MELD and no differently from the MDF. This indicates that the MIAAH is superior to the MELD in accurately dichotomizing which patients will die on the basis of cut points identified in the derivation cohort. The MIAAH demonstrates promise in its ability to accurately dichotomize patients by mortality risk while increasingly accurately identifying those at highest risk of death.

This study is limited in that the population of patients was primarily White and largely male; therefore, further studies are needed to evaluate this model in other races and in female patients to ensure generalizability. A text explorer coupled with manual validation was used to derive our cohort; therefore, it is possible that patients in whom the diagnosis of AH was not suspected, because of the lack of alcohol history or for other reasons, are not represented in this study. Eliciting and documenting a history of alcohol exposure remains a challenging aspect of the diagnosis of alcohol-associated liver disease.

Limitations of this study include its retrospective nature wherein we are unable to assess whether there is any dynamic component to this scoring system that may improve its performance. Recent literature again supports the concept of dynamic assessment in patients with AH, reporting that the trajectory of serum bilirubin concentration during the first week of presentation can be used to accurately predict 90-day survival.\textsuperscript{41} This is a notable limitation of our score, which is static in nature and could potentially be improved in the future with a dynamic component of laboratory analysis. The variables used in the MIAAH have previously been identified in prognostic models, and for this reason, it proves difficult to create dramatic improvement in model accuracy with various combinations of these serologic markers. Future studies evaluating the addition of biomarkers to existing prognostication models should be considered. Specifically, biomarkers of hepatic cell death and regeneration, immune response, metabolic change, and toxic metabolites that are being studied in patients with AH may serve as novel and targeted variables for future models.\textsuperscript{42} We hypothesize that the accuracy of the MIAAH could be improved with the addition of biomarker variables in the future. In addition, the current literature has reported that combining multiple prognostication models may lead to increased accuracy.\textsuperscript{43} Future advances in machine learning may allow various combinations of these prognostication models to be evaluated and ultimately combined to risk stratify this heterogeneous population of patients more accurately. Future directions include prospective validation of the MIAAH and validation in other populations of patients with alcohol-associated liver disease.

CONCLUSION

An ideal prognostic model is one that employs commonly available variables and is widely applicable.\textsuperscript{30,44} The MIAAH consists of laboratory variables and demographic data that are routinely obtained on admission in this population of patients, and it was validated in an external and multicenter cohort. Furthermore, the MIAAH improvement in prognostication is clinically relevant as it performed significantly better than the MDF. The ability of the MIAAH to perform more accurately than the MELD remains questionable, and this comparison of prognostic models demonstrates the difficulty in outperforming the MELD, particularly in the context of the MELD’s already widespread acceptance and overall familiarity. At a minimum, the MIAAH does compete with the MELD and outperformed the
MDF, which remains commonly used in clinic practice despite its less than desirable performance characteristics. Furthermore, this study finds that optimum prognostication will likely require a combination of prognostic models or the addition of novel variables, such as biomarkers. Whereas we anticipate that the MIAAH will continue to be refined over time, perhaps with the addition of a dynamic component or in conjunction with an existing model such as the MELD, this study finds that it is a novel and useful tool in assessing 30-day mortality risk in patients with AH.

SUPPLEMENTAL ONLINE MATERIAL
Supplemental material can be found online at http://www.mayoclinicproceedings.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: ABIC, Age, serum Bilirubin, INR, and serum Creatinine; AH, alcohol-associated hepatitis; BMI, body mass index; BUN, blood urea nitrogen; GAHS, Glasgow Alcoholic Hepatitis Score; INR, international normalized ratio; MDF, Maddrey Discriminant Function; MELD, Model for End-Stage Liver Disease.

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