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Model for End-Stage Liver Disease score predicts mortality in critically ill cirrhotic patients^{☆,☆☆}

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Abstract

Purpose—Cirrhosis is a common condition that complicates the management of patients who require critical care. There is interest in identifying scoring systems that may be used to predict outcome because of the poor odds for recovery despite high-intensity care. We sought to evaluate how Model for End-Stage Liver Disease (MELD), an organ-specific scoring system, compares with other severity of illness scoring systems in predicting short- and long-term mortality for critically ill cirrhotic patients.

Materials and methods—This was a retrospective cohort study involving seven intensive care units (ICUs) in a tertiary care, academic medical center. Adult patients with cirrhosis who were admitted to an ICU between 2001 and 2008 were evaluated. Severity of illness scores (MELD and Sequential Organ Failure Assessment [SOFA]) were calculated on admission and at 24 and 48 hours. The primary end points were 28-day and 1-year all-cause mortality.

Results—Of 19742 ICU hospitalizations, 848 had cirrhosis. Relevant data were available for 521 patients (73%). Of these cases, 353 patients (69.5%) were admitted to medical ICU (MICU), and

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the other 155 (30.5%), to surgical unit. Alcohol abuse and hepatitis C were the most common reasons for cirrhosis. Patients who died within 28 days were more likely to receive mechanical ventilation, pressors, and renal replacement therapy. Among 353 medical admissions, both MELD and SOFA were found to be significantly associated with both 28-day and 1-year mortality. Among the 155 surgical admissions, both scores were found to be not significant for 28-day mortality but were significant for 1 year.

Conclusions—Our results demonstrate that the prognostic ability of a variety of scoring systems strongly depends on the patient population. In the MICU population, each model (MELD + SOFA, MELD, and SOFA) demonstrates excellent discrimination for 28-day and 1-year mortality. However, these scoring systems did not predict 28-day mortality in the surgical ICU group but were significant for 1-year mortality. This suggests that patients admitted to a surgical ICU will behave similarly to their MICU cohort if they survive the perioperative period.

Keywords

Cirrhosis; Prognosis; Epidemiology; Outcome; Critical care; Organ dysfunction scores

1. Introduction

Cirrhosis is a common comorbid condition that complicates the management of patients admitted to an intensive care unit (ICU) [1]. Cirrhosis is estimated to be present in more than 1% of the general population and remains the 12th leading cause of death in the United States [2]. When admitted to an ICU, mortality for patients with cirrhosis is high [3]; recent data suggest greater than 37% ICU mortality and 49% hospital mortality [4,5]. Because of the poor odds for recovery despite aggressive interventions, several investigators have examined how scoring systems may be used to predict outcome and allocate resources in this cohort of ICU patients [6,7]. Much of this effort has focused on determining whether organ-specific scoring systems outperform traditional ICU scoring systems in predicting the risk of death.

Patients admitted to an ICU with cirrhosis make an ideal population to study how organ-specific scoring systems compare with overall severity of illness scoring systems. Two liver-specific models, the Child-Pugh classification and the Model for End-Stage Liver Disease (MELD), were originally created to predict the risk of death in patients with portal hypertension undergoing portosystemic shunts [8,9]. Although intended as a risk model for a specific clinical diagnosis, these models have been used to predict the risk of death in patients with cirrhosis in a variety of settings [10–12]. In particular, recent interest in evaluating the prognostic ability of the MELD score to predict the risk of short-term death in cirrhotic patients admitted to an ICU has garnered interest [10,13].

In this study, we sought to evaluate how MELD, an organ-specific scoring system, compares with other severity of illness scoring systems in predicting short- and long-term mortality for cirrhotic patients admitted to both medical and surgical ICUs (SICUs) over a 10-year span.

2. Methods

Patient data were extracted from the Multi-parameter Intelligent Monitoring in Intensive Care (MIMIC) database (version 2.6). This is a publicly available ICU database that was developed at the Massachusetts Institute of Technology and contains deidentified data from more than 30000 patients who were admitted to the ICUs at Beth Israel Deaconess Medical Center, a large, academic, tertiary medical center in Boston, MA, between 2001 and 2008. The institutional review boards from Massachusetts Institute of Technology and Beth Israel Deaconess Medical Center granted a waiver of informed consent.

The MIMIC database includes physiologic information from bedside monitors. These data (heart rate, blood pressures, etc) were validated by ICU nurses before entry into the database. The MIMIC also contains records of all laboratory values, nursing progress notes, intravenous medications, fluid intake/output, and other clinical variables. Other clinical data subsequently added to the database include pharmacy provider order entry records; admission records; discharge summaries; International Classification of Diseases, Ninth Revision, codes; imaging and ECG reports; and general demographic data (ie, dates of admission and discharge from the hospital/ICU, sex, weight, height, and ethnicity). Mortality data after hospital discharge were obtained from the state death records. Further description of the database is available at <http://mimic.mit.edu>.

Data extraction was conducted using Oracle SQL Developer version 3.0.02 (Oracle Corporation, Redwood Shores, CA).

2.1. Patient population

All adult patients who were admitted to a medical ICU (MICU or cardiac care unit [CCU]) or SICU (trauma or cardiothoracic ICU) with a prior diagnosis of cirrhosis were included for analysis. The diagnosis of cirrhosis was confirmed by the manual review of the charts. For our study, patients were determined to have cirrhosis based on either a prior clinical diagnosis included in the medical history or a histopathologic diagnosis from review of pathology reports. Patients who underwent liver transplantation were excluded. Patients were stratified by the year of admission (3 periods): 2001 to 2003, 2004 to 2006, and 2007 to 2008.

Severity of illness scores (MELD, Simplified Acute Physiology Score, and Sequential Organ Failure Assessment [SOFA]) were calculated on admission to the ICU and at 24 and 48 hours. In addition, the MELD score was calculated at discharge from the ICU. The Elixhauser comorbidity score was used as a comorbidity estimate [14]. The primary end points were 28-day and 1-year all-cause mortality.

2.2. Statistical analysis

The method of analyses for continuous variables was parametric. Nonparametric procedures were used if parametric assumptions could not be satisfied, even after data transformation attempts. Parametric model assumptions were assessed using normal plot or Shapiro-Wilk statistic for verification of normality and Levene's test for verification of homogeneity of variances. Categorical variables were tested using Pearson's χ^2 test for contingency tables or

Fisher exact test, as appropriate. Kaplan-Meier survival curve was built for the analysis of all-cause mortality at 5 years those who survived at least 28 days (landmark analysis).

To evaluate the ability of different scoring systems to discriminate 28-day mortality, we assessed c-statistics by analyzing the area under the curve (AUC) for receiver operating characteristic curve of the predicted death probabilities. These were derived from multivariate logistic regression models based on MELD, SOFA, and MELD + SOFA scores (all models were adjusted for age, sex, year of admission [3 time periods], and 28-day Elixhauser score). To evaluate 1-year mortality prediction, the same models were applied for 28-day survivors (landmark analysis) adjusted for age, sex, year of admission (3 time periods), and 1-year Elixhauser score. The analysis was performed separately for medical and surgical admissions.

We used the integrated discrimination improvement (IDI) approach to compare the discriminative ability of the different scoring systems and models [15] and relative IDI to assess the improvements' significance. Logistic regression models based on SOFA on admission were used as the reference score for 28-day mortality prediction (adjusted for age, sex, year of admission [3 periods], and 28-day Elixhauser score) and for 1-year mortality prediction (among 28-day survivors, adjusted for age, sex, year of admission [3 periods], and 1-year Elixhauser score).

The effect of introducing a new variable into the prediction model is usually assessed by demonstrating an improvement in c-statistics (AUC), which represents an improvement in the models' discriminatory abilities. However, for models that possess good discrimination and contain standard risk factors, the independent effect of the new variable has to be exceptionally high to improve the c-statistics. Net reclassification improvement and IDI methods are particularly useful in assessment of aforementioned prediction models incorporating new variables in situations where no meaningful improvement in the c-statistics was observed. These methods are based on the comparing the improvement in reclassification of subjects with and without event. Any increase in probability of the event as calculated based on the model with vs without the new variable for event subjects implies improved classification, and any decrease indicates worsening. The interpretation is opposite for subjects without the event. Integrated discrimination improvement is a result of the integration of these changes or, statistically speaking, the difference in discrimination slopes between 2 models—one with and the other without the added variable. Integrated discrimination improvement above zero means improvement in the discrimination, whereas below zero signifies worsening.

Relative IDI is calculated as the ratio of IDI over the discrimination slope of the model without the new variable. A model is concluded to be improved if the relative IDI was found to be greater than 1/the number of variables in the model [16].

Cox proportional regression based on last measured MELD (adjusted for age, 1-year Elixhauser score, alcohol use, hepatitis B, hepatitis C, varices, and sex) was used for multivariate analysis of 2-year mortality among the 28-day survivors (landmark analysis) of

both surgical and medical admissions. The regression was stratified by the patients' admission year (2001–2003, 2004–2006, and 2007–2008).

We calculated expected 3-month mortality based on admission MELD score using the report of Wiesner et al [17] and compared it with the observed mortality in our cohort. This calculation was done separately for medical and surgical admission.

All statistical tests and/or confidence intervals, as appropriate, were performed at $\alpha = .05$ (2 sided). All *P* values reported were rounded to 3 decimal places. The data were analyzed using IBM SPSS Statistics software (Armonk, NY).

3. Results

A total of 848 of 19742 ICU hospitalizations at Beth Israel Deaconess Medical Center between 2001 and 2008 had a diagnosis of liver cirrhosis. Of these 848 cases, all study relevant data were available for 508 patients. For patients with more than 1 hospitalization (100 patients), we randomly selected 1 to be included in the analysis. Of these cases, 353 patients (69.5%) were admitted to MICU, and the other 155 (30.5%), to surgical unit.

Patients were stratified into the 3 intervals (2001–2003, 2004–2006, and 2007–2008) to account for the possible secular trend in clinical approach and patients case mix. The following mortality trends were observed: for 28 days, 42/136 (30.9%), 84/313 (26.8%), and 16/59 (27.1%), respectively, for the 3 intervals ($P=.67$), and for 1 year, 75/136 (55.1%), 144/313 (46%), and 25/59 (42.4%), respectively, for the 3 intervals ($P = .13$).

Table 1 summarizes the baseline characteristics of this cohort divided to medical and surgical admissions. Although the 2 groups had a similar mean day 1 MELD score and 28-day and 1-year Elixhauser score, they did differ significantly ($P < .001$) on their day 1 SOFA score. Furthermore, 48-hour change in both MELD and SOFA scores was also significantly different ($P < .001$), being higher in the SICU group.

Hospitalization characteristics and clinical outcomes are summarized in Table 2. Although in-ICU mortality was not found to be significantly different between medical and surgical admissions ($P = .07$), in-hospital mortality and 1-year mortality were found to be higher among medical admissions (28.3% vs 18.1% for in-hospital mortality with $P = .01$ and 54.1% vs 34.2% with $P < .001$, respectively). The median length of ICU stay was shorter in medical admissions (7.5 vs 8.1 days; $P < .001$) but not for in-hospital stay (22.5 vs 27.5 days; $P = .17$).

Table 3 presents a multivariate logistic regression model for 28-day mortality with MELD and SOFA adjusted for age, sex, 28-day Elixhauser score, and year of admission (divided into 3 periods) and separated into medical and surgical admissions. Among 353 medical admissions, both MELD and SOFA were found to be significantly associated with 28-day mortality: MELD: odds ratio (OR) per point, 1.09; 95% confidence interval (CI), 1.05 to 1.13; $P < .001$; SOFA: OR per point, 1.17; 95% CI, 1.09 to 1.26; $P < .001$. Among the 155 surgical admissions, both were found to be not significant: MELD: OR per point, 1.04; 95% CI, 0.97 to 1.12; $P = .25$; SOFA: OR per point, 1.06; 95% CI, 0.92 to 1.22; $P = .42$.

Table 4 summarizes the 2-year Cox proportional hazards regression survival models in 28-day survivors ($n = 376$) based on last measured MELD score (adjusted for 1-year Elixhauser, alcohol use, hepatitis B, hepatitis C, varices, sex, and year of admission [divided into 3 periods]) split by medical and surgical admissions. Although in both medical and surgical admissions the last MELD score was found to be significant hazard factor, the hazard ratio (HR) per point was found to be larger among surgical admissions (1.16 vs 1.09; $P < .001$).

Fig. 1 presents the 28-day mortality prediction ability of the 3 logistic regression models based on admission MELD, SOFA, and MELD + SOFA (all adjusted for age, sex, 28-day Elixhauser, and year of admission) among medical (1A) and surgical (1B) admissions. Among medical admissions, logistic regression based on admission MELD + SOFA has the highest c-statistics (0.8), IDI (0.08), and relative IDI (0.57 with a threshold for clinical importance of 0.2) as compared with the same model based on admission SOFA (AUC of 0.76), suggesting that the discriminative capabilities of this model are better than that of the model based on SOFA. A model based on admission MELD alone proved to be better than SOFA-based model but less discriminative in terms of c-statistics (0.79), IDI (0.06), and relative IDI (0.42 with a threshold for importance of 0.2) than MELD + SOFA model. These models were less discriminative among surgical admissions with c-statistics of 0.64, 0.65, and 0.61 for MELD + SOFA, MELD, and SOFA, respectively (IDI relative to SOFA-based model: MELD + SOFA, 0.04; MELD, 0.03).

Fig. 2 presents the 1-year mortality prediction ability of logistic regression models based on admission MELD and SOFA (among 28-day survivors, adjusted for age, sex, year of admission, and 1-year Elixhauser) among medical (2A) and surgical (2B) admissions. Models based on admission MELD had reasonable discriminative abilities among both medical and surgical admissions (c-statistics: 0.77 and 0.71, respectively) and performed better compared with the same models based on SOFA (for medical admissions: IDI, 0.05; relative IDI, 0.31 with threshold for significance of 0.2, and for surgical admissions: IDI, 0.08; relative IDI, 1.2 with threshold for significance of 0.2). Among the models based on admission, SOFA seems to have good discriminative capabilities only among medical admissions (medical c-statistics of 0.76 compared with 0.61 for surgical admissions).

Table 5 summarizes the expected and observed 3-month mortality rates based on MELD score as well as standardized mortality ratio divided by medical and surgical admissions. For the calculation of the expected mortality, we used the original Wiesner (16) approach based on MELD. Overall 3-month observed mortality in our cohort was significantly higher than the predicted in both medical (42.2% vs 21.2%) and surgical (27.1% vs 17.5%) cohort.

4. Discussion

Our results demonstrate that the prognostic ability of a variety of scoring systems strongly depends on the patient population. In the MICU population, each model (MELD + SOFA, MELD, and SOFA) demonstrates excellent discrimination for 28-day mortality in cirrhotic patients, although the model combining MELD and SOFA scores was superior. These results are consistent with those observed recently by Cavallazzi et al [13]. However, these models did not perform well in predicting 28-day mortality in the SICU population. Among the

surgical critically ill, the acute nature of their presenting illness may respond more rapidly to therapy (as evidenced by greater improvement in both MELD and SOFA scores over 48 hours and less time receiving mechanical ventilation), which potentially limits their predictive ability.

In the cohort of 28-day survivors from both medical and SICUs, MELD and SOFA scores calculated at discharge from the ICU and adjusted for age, sex, year of admission, and Elixhauser score offer reasonable discrimination for the probability of 1-year mortality. Why did these scoring systems fail to predict 28-day mortality in the SICU group, but have discriminative ability at 1 year? It is possible that the SICU population behaves more similarly to their MICU cohort if they are able to survive the perioperative period.

We also showed that the response to initial ICU treatment, as assessed by an improvement in MELD and SOFA scores 48 hours after admission to the ICU, predicts improved 28-day mortality. This was observed in both the SICU and MICU. The magnitude of the decrease in score also correlates with 1-year survival. This result suggests that the relative change in either the MELD or SOFA score may be an important consideration when considering how aggressively to pursue ICU care. This finding is consistent with those of other studies that have demonstrated that the change in score over 48 hours predicts outcome [18,19].

These results conflict with prior work that showed general ICU models outperform liver specific scores such as the Child-Pugh and MELD [19–21]. Apparent discrepancies between our results and those of earlier studies may be due to differences in study population and their clinical characteristics. Despite comparable severity of illness scores, we chose to include both medical and surgical patients and to present results for both types of admissions. A strength of our study stems from the use of the IDI and relative IDI to substantiate our findings. The IDI, which allows for a more precise discrimination of risk, supports our findings that MELD score outperformed SOFA in predicting 28-day mortality.

Although both MELD and SOFA scores contain bilirubin and creatinine, the organ-specific nature of the MELD score appears to be more important than overall organ function in predicting survival. These results confirm prior suspicion that the severity of liver dysfunction is the main factor in predicting survival [22] in cirrhotic patients. As demonstrated in Table 5, the observed mortality is significantly higher than the expected mortality when referenced to the population from which the score was derived. This is, in part, due to the differences between the study populations.

In our patient population, overall ICU mortality (16.7%) and inhospital mortality (25.2%) were lower than previously reported. These results seemed to be unaffected by admission unit (18.7% and 12.3% for ICU mortality among medical and surgical admission, respectively, and 28.3% and 18.1% for inhospital mortality among medical and surgical admission, respectively). Also of interest was that cirrhotic patients who received mechanical ventilation had better survival than previously reported [22,23]. These findings may reflect recent improvements in critical care. However, in the subgroup of patients with a MELD score greater than 17, mortality results were similar to those observed in prior studies. In addition, overall 1-year survival was only 52.4% for patients with cirrhosis

admitted to an ICU. Thus, our results also demonstrate that the 1-year survival for patients with cirrhosis who are admitted to an ICU for any reason remains relatively low. Based on the Cox 2-year hazard regression analysis, the last measured MELD score and 1-year Elixhauser score were associated with increased risk of death.

The major strength of our study is the large number of patients with cirrhosis and the fact that we undertook manual chart searches to validate data; however, there are several limitations to our retrospective study. It is possible that we did not include all patients who were eligible because the presence of cirrhosis was identified by manual chart review. Thus, if the diagnosis was not included in the medical history or in pathology reports, patients were not eligible. In addition, we had complete data on only 508 of the 848 patients in the cohort, which could introduce bias. Residual confounding is always a limitation of observational studies. We were limited to the types of data collected; in particular, we were unable to determine the Child-Pugh classification, as some of the necessary clinical information was not available in the database. In addition, the number of SICU admissions was lower than MICU admissions (155 vs 353). Thus, sample size differences may act as a confounder and lead to less robust results in the SICU population.

The prognostic information obtained from any ICU scoring systems has yet to be used to either limit or continue aggressive support on an individual basis [24]. As these models continue to be refined, they may play an increasingly important role in guiding care.

5. Conclusion

In summary, this is the largest study to date that has examined the performance of severity of illness scoring systems to predict mortality in cirrhotic patients admitted to an ICU. Our results suggest that the severity of liver dysfunction, rather than overall organ function, is the main factor in predicting both 28-day and 1-year survival in patients with cirrhosis admitted to an MICU. In the surgical population, these models predict 1-year survival but are not useful for discriminating 28-day survival.

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Fig. 1.
 A, Receiver operating characteristic curve—28-day mortality (medical admissions). B,
 Receiver operating characteristic curve—28-day mortality (surgical admissions).

Score	Area under the curve	95% C.I	p-value	IDI	p-value	95% C.I	Relative IDI
MELD	0.77	0.72-0.82	<0.001	0.05	0.001	0.02-0.08	0.31
SOFA	0.76	0.71-0.81	<0.001	Reference Model			

*All models adjusted for age, gender, year of admission and 1 year EH.

* IDI is based on comparing the improvement in reclassification of subjects with and without event. Any increase in probability of the event as calculated based on the model with vs. without the new variable for event subjects implies improved classification, and any decrease indicates worsening. The interpretation is opposite for subjects without the event. IDI is a result of the integration of these changes, or statistically speaking the difference in discrimination slopes between two models-- one with, and the other without, the added variable. IDI above zero means improvement in the discrimination, while below zero signifies worsening.

* Relative IDI is calculated as the ratio of IDI over the discrimination slope of the model without the new variable. A model is concluded to be improved if the relative IDI was found to be greater than (1/the number of variables in the model)

In this case, the threshold for relative IDI is 0.2

Score	Area under the curve	95% C.I	p-value	IDI	p-value	95% C.I	Relative IDI
MELD	0.71	0.62-0.8	<0.001	0.08	0.001	0.03-0.12	1.2
SOFA	0.61	0.51-0.72	0.02	Reference Model			

*All models adjusted for age, gender, year of admission and 1 year EH.

* IDI is based on comparing the improvement in reclassification of subjects with and without event. Any increase in probability of the event as calculated based on the model with vs. without the new variable for event subjects implies improved classification, and any decrease indicates worsening. The interpretation is opposite for subjects without the event. IDI is a result of the integration of these changes, or statistically speaking the difference in discrimination slopes between two models-- one with, and the other without, the added variable. IDI above zero means improvement in the discrimination, while below zero signifies worsening.

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In this case, the threshold for relative IDI is 0.2

Fig. 2.

A, Receiver operating characteristic curve—1-year mortality probabilities in 28-day survivor (medical admissions). B, Receiver operating characteristic curve—1-year mortality probabilities in 28-day survivor (surgical admissions).

Table 1

Baseline characteristics of ICU patients (N = 508)

Characteristics	Medical admissions	Surgical admissions	P
No. of patients (%)	353	155	
Age, mean $\pm$ SD (y)	57.1 $\pm$ 12.48	56.88 $\pm$ 10.5	.84
Sex, male (%)	242 (68.8%)	119 (76.8%)	.07
Primary reason of admission, n (%)			
Hepatic related	187 (53%)	93 (60%)	<.001
Infectious	73 (20.7%)	16 (10.3%)	
Cardiovascular	21 (5.9%)	16 (10.3%)	
Respiratory	13 (3.7%)	2 (1.3%)	
Cancer	8 (2.3%)	11 (7.1%)	
Other	51 (14.4%)	17 (11%)	
Cirrhosis-related etiologies, n (%)			
Alcohol abuse	173 (49%)	53 (34.2%)	.002
Hepatitis C	88 (24.9%)	45 (29%)	.33
Hepatitis B	22 (6.2%)	16 (10.3%)	.11
Primary hepatic malignant neoplasm	26 (7.4%)	30 (19.4%)	<.001
Varices	121 (34.3%)	22 (14.2%)	<.001
Comorbidities, n (%)			
Congestive heart failure	80 (22.7%)	16 (10.3%)	.001
Hypertension	66 (18.7%)	43 (27.7%)	.02
Chronic pulmonary disease	39 (11%)	13 (8.4%)	.36
Diabetes without complications	77 (21.8%)	37 (23.9%)	.61
Diabetes with complications	7 (2%)	5 (3.2%)	.4
Renal failure	29 (8.2%)	5 (3.2%)	.04
Solid tumor	33 (9.3%)	52 (33.5%)	b.001
Coagulopathy	97 (27.5%)	23 (14.8%)	.002
Alcohol abuse	102 (28.9%)	34 (21.9%)	.1
Drug abuse	31 (8.8%)	8 (5.2%)	.16
Blood tests results			
Creatinine (mg/dL)	1.88 $\pm$ 1.43	1.53 $\pm$ 0.95	.001
Bilirubin (mg/dL)	6.29 $\pm$ 8.1	5.94 $\pm$ 6.03	.59
INR	2.06 $\pm$ 1.09	1.9 $\pm$ 0.68	.07
Sodium (mEq/L)	1.36 $\pm$ 4.12	1.38 $\pm$ 2.66	<.001
Clinical scores			
MELD	22.6 $\pm$ 10.1	21.44 $\pm$ 7.46	.75
MELD 48 h	−0.76 $\pm$ 3.79	− 2.77 $\pm$ 3.92	<.001
SOFA	8.61 $\pm$ 4.34	10.55 $\pm$ 3.84	<.001
SOFA 48 h	−1.08 $\pm$ 3.26	− 2.64 $\pm$ 3.04	<.001
28-day Elixhauser	6.54 $\pm$ 6.01	5.75 $\pm$ 4.79	.09
1-year Elixhauser	6.16 $\pm$ 5.21	5.99 $\pm$ 4.08	.52

INR indicates international normalized ratio.

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Table 2

Hospitalization characteristics and clinical outcomes

Characteristics		Medical admissions	Surgical admissions	<i>P</i>
Intensity of care	RRT during hospitalization	61 (17.3%)	18 (11.6%)	.11
	Use of vasopressors	124 (35.1%)	56 (36.1%)	.83
	Mechanical ventilation	167 (47.3%)	125 (80.6%)	<.001
Level of care, n (%)	CMO	50 (14.2%)	17 (11%)	.33
	All DNR	72 (20.4%)	18 (11.6%)	.02
	DNI	1 (0.3%)	1 (0.6%)	.52
LOS in days, median (IQ)	Hospital	22.5 (12.5–47.5)	27.5 (20–57.5)	.17
	ICU	7.5 (4.6–15.4)	8.2 (5.1–21.7)	<.001
Mortality, n (%)	In-ICU	66 (18.7%)	19 (12.3%)	.07
	Inhospital	100 (28.3%)	28 (18.1%)	.01
	1 year	191 (54.1%)	53 (34.2%)	<.001

DNR indicates do not resuscitate; DNI, do not intubate; LOS, length of stay; RRT, renal replacement therapy; CMO, comfort measures only; IQ, interquartile.

Table 3

Twenty-eight-day survival logistic regression model

Medical patients (n = 353)				Surgical patients (n = 155)			
Variable	OR	95% CI	P	OR	95% CI	P	P
MELD, per point	1.09	1.05–1.13	<.001	1.04	0.97–1.12	.25	
SOFA, per point	1.17	1.08–1.26	<.001	1.06	0.92–1.22	.42	

Model adjusted for age, sex, year of admission, and 28-day Elixhauser.

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Table 4

Two-year Cox regression for 28-day survivor medical patients

Medical patients (n = 240)				Surgical patients (n = 126)			
Variable	HR	95% CI	P	HR	95% CI	P	P
Last measured MELD, per point	1.09	1.06–1.12	<.001	1.16	1.09–1.23	<.001	<.001

Model adjusted for age, 1-year Elixhauser, alcohol use, hepatitis B, hepatitis C, varices, sex, and year of admission.

Table 5
Expected Vs. Observed 3 months mortality among medical and surgical admissions (N = 311)

MELD score						
		Medical patients				
		<9	10–19	20–29	30–39	>40
N		10	142	92	46	21
Expected	0 (1.9%)		9 (6%)	18 (19.6%)	24 (52.6%)	15 (71.3%)
Observed	0 (0%)		32 (22.5%)	51 (55.4%)	27 (58.7%)	19 (90.5%)
SMR	0		3.76	2.82	1.12	1.27
		Surgical patients				
		<9	10–19	20–29	30–39	>40
N		0	66	58	15	2
Expected	0 (1.9%)		4 (6%)	11 (19.6%)	8 (52.6%)	1 (71.3%)
Observed	0 (0%)		10 (15.2%)	14 (24.1%)	10 (66.7%)	1 (50%)
SMR			2.53	1.23	1.27	0.7

* expected score is based on the article of 'Model for End Stage Liver Disease (MELD) and allocation of Donor Liver' published on Gastroenterology 2003;124:91–96.