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Journal

Liver International, 35(9)

ISSN

1478-3223

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Publication Date

2015-09-01

DOI

10.1111/liv.12792

Peer reviewed

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Liver INTERNATIONAL

Liver International ISSN 1478-3223

ORIGINAL ARTICLE

Clinician assessments of health status predict mortality in patients with end-stage liver disease awaiting liver transplantation

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Keywords
clinical judgment – health status – wait-list mortality

Abbreviation
MELD, model for end-stage liver disease.

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Received 10 December 2014
Accepted 22 January 2015

DOI:10.1111/liv.12792

Abstract

Background & Aims: The US liver allocation system effectively prioritizes most liver transplant candidates by disease severity as assessed by the Model for End-Stage Liver Disease (MELD) score. Yet, one in five dies on the wait-list. We aimed to determine whether clinician assessments of health status could identify this subgroup of patients at higher risk for wait-list mortality. *Methods:* From 2012–2013, clinicians of all adult liver transplant candidates with laboratory MELD≥12 were asked at the clinic visit: 'How would you rate your patient's overall health today (0 = excellent, 5 = very poor)?' The odds of death/delisting for being too sick for the transplant by clinician-assessment score ≥3 vs. <3 were assessed by logistic regression. *Results:* Three hundred and forty-seven liver transplant candidates (36% female) had a mean follow-up of 13 months. Men differed from women by disease aetiology (<0.01) but were similar in age and markers of liver disease severity ($P > 0.05$). Mean clinician assessment differed between men and women (2.3 vs. 2.6; $P = 0.02$). The association between clinician-assessment and MELD was $\rho = 0.28$ ($P < 0.01$). 53/347 (15%) died/were delisted. In univariable analysis, a clinician-assessment score ≥ 3 was associated with increased odds of death/delisting (2.57; 95% CI 1.42–4.66). After adjustment for MELD and age, a clinician-assessment score ≥ 3 was associated with 2.25 (95% CI 1.22–4.15) times the odds of death/delisting compared to a clinician-assessment score < 3. *Conclusions:* A standardized clinician assessment of health status can identify liver transplant candidates at high risk for wait-list mortality independent of MELD score. Objectifying this 'eyeball test' may inform interventions targeted at this vulnerable subgroup to optimize wait-list outcomes.

For patients with complications of end-stage liver disease such as refractory ascites, hepatic encephalopathy, or hepatocellular carcinoma (HCC), liver transplantation offers the only hope for a durable cure. Given the relative scarcity of deceased donor organs, patients listed for liver transplantation are prioritized for transplant by the Model for End-Stage Liver Disease (MELD) score. The MELD score is calculated from three routinely measured laboratory tests–serum creatinine, total bilirubin, and international normalized ratio (INR) for prothrombin time–and accurately predicts 90-day mortality in the absence of liver transplantation (1). The patient with the highest MELD score, and therefore highest predicted risk of death from liver disease, receives the next available liver offer.

While the MELD-based liver allocation system effectively prioritizes patients according to need (2), one in five candidates does not survive to undergo liver transplantation (3). One might assume that these patients died because they did not receive a liver offer in time (i.e. there are simply not enough livers relative to the number who need them). Yet the vast majority of patients who die or are delisted from the liver transplant wait-list receive a median of six liver offers per candidate (4), suggesting that organ scarcity is not the sole reason for wait-list mortality. Rather, patients who die or are delisted may represent a subgroup of cirrhotics who die too suddenly from an acute decompensating event or are deemed unlikely to survive liver transplant surgery when a liver offer becomes available. At the current time, however, identification of which of the

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Key Points

- While the current liver allocation system–based on the Model for End-Stage Liver Disease (MELD) score–effectively prioritizes most patients according to need, one in five candidates does not survive to undergo liver transplantation.
- Identification of which of the 16 000 patients on the US liver transplant wait-list are at highest risk remains elusive.
- A standardized clinician assessment of health status can identify liver transplant candidates at high risk for wait-list mortality independent of MELD score.
- Objectifying this 'eyeball test' may inform interventions targeted at this vulnerable subgroup to optimize wait-list outcomes.

16 000 patients on the US liver transplant wait-list is at highest risk remains elusive.

We hypothesized that a patient's overall health status, independent of liver disease severity, plays an important role in survival among cirrhotics awaiting liver transplantation. Those with poor health status are at higher risk of being deemed unsuitable for transplant surgery after clinical decompensation or suffer high vulnerability to rapid decompensation independent of their MELD score. In this study, we aimed to evaluate the prognostic ability of patients' overall health status, as assessed by their transplant clinician, to predict mortality in cirrhotics awaiting liver transplantation.

Methods

Study subjects, setting, and clinicians

The UCSF Institutional Review Board approved this study. All adult (≥18 years) patients with cirrhosis who were listed for liver transplantation at the University of California, San Francisco (UCSF) who had a calculated MELD score ≥12 within three months prior to their index outpatient visit to the UCSF Liver Transplant Clinic were eligible for enrolment in this study. Enrollment occurred from July 1, 2012 through March 31, 2014. This MELD cut-off was selected to create a cohort of patients with a tangible risk of wait-list mortality at any given time. Of the 356 patients who met eligibility criteria, 347 (97%) consented and enrolled in the study.

The UCSF Liver Transplant Program includes 400–500 active wait-list candidates at any given time, performing approximately 150 liver transplants annually. Each year, between 200 and 250 patients are *newly* listed for liver transplantation. There are 10 hepatologists who manage patients on the liver transplant wait-list–all ten participated in this study. Five were female. Five had <5 years of experience in general hepatology and transplant hepatology, two had between 5 and 10 years of experience, and the remaining three had ≥10 years of experience.

Self and clinician assessments

At the clinic visit, patients were asked to rate their general health status using the following question, derived from the National Health Interview Study, a nationwide survey conducted by the US Bureau of the Census (5) ('Self-Assessment'):

> 'Would you say your health in general is excellent (0), very good (1), good (2), fair (3), poor (4), or very poor (5)?'

On the same day as the clinic visit, the patient's hepatologist was asked to subjectively rate his or her patient's health using the following question ('Clinician Assessment'):

> 'We are interested in your general impression about your patient's overall health, as compared to other patients with underlying liver disease. How would you rate this patient's overall health today? Excellent (0), very good (1), good (2), fair (3), poor (4), or very poor (5)'.

At the same visit, information regarding demographics, medical comorbidities (e.g. hypertension, diabetes, coronary artery disease) identified in the electronic health record as a problem in the past medical history, degree of ascites as assessed by the primary hepatologist at the clinic visit, and laboratory tests within 3 months of the study visit were collected. Hepatic encephalopathy was classified as none/mild, moderate, or severe based on the patient's performance on the Numbers Connection Test Score of <60 s, between 60 and 119 seconds, or ≥120 s (6).

To help determine the extent to which medical comorbidities contribute to the clinician assessment score, the modified Charlson Comorbidity Index (CCI-OLT) was calculated for each patient. As described in the original paper by Volk *et al.*, the CCI-OLT is derived by the weighted sum of five medical comorbidities: coronary artery disease (by angiography or history of myocardial infarction; 2 points), diabetes (chronic hyperglycemia requiring outpatient medications; 1 point), chronic obstructive pulmonary disease (chronic lung disease requiring medications, forced expiratory volume in 1 s <1.5 L, or history of intubation for respiratory failure; 3 points), connective tissue disease (systemic lupus erythematosus, rheumatoid arthritis, scleroderma, or seronegative spondyloarthropathy; 2 points), renal insufficiency (serum creatinine of 1.5 mg/dl or greater at the time of clinician assessment; 2 points) (7).

Statistical analysis

The primary outcome in this study was a combined outcome of death prior to liver transplant or delisting for

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being too sick for transplant. The primary predictor in this study was clinician-assessment of health; the secondary predictor was patient self-assessment of his or her own health. To facilitate clinically relevant comparisons between the predictive abilities of MELD, clinician- and self-assessments of health, the 75%-ile values for each variable were used to identify those who had 'poor health': MELD ≥18, clinician-assessment score ≥3, and self-assessment score ≥4.

Pearson product-moment correlation coefficient and linear regression assessed the relationship between MELD, CCI-OLT, clinician- and self-assessment scores. Logistic regression models evaluated the association between clinician- or self-assessments of the patient's health status and death/delisting. Univariable logistic regression first identified factors that were associated with this outcome at a *P*-value <0.10. Backward stepwise regression was used to create the final multivariable model using a cut-off *P*-value <0.05. Given the clinical significance of liver disease severity in clinician-assessments and to examine the potential contribution of liver disease severity to clinician-assessments, MELD score was retained in the final model regardless of statistical significance. Collinearity was assessed using the variance inflation factor (<10 for all variables) (data not shown) in the final model suggesting a lack of multicollinearity. Area under the receiver operating characteristic curves (AUROC) evaluated the predictive power of clinician- or self-assessments of health status on wait-list mortality. Lastly, we performed a sensitivity analysis evaluating the association between clinician-assessments and death alone (without those who were delisted).

STATA® v11 (College Station, TX, USA) was used for all statistical analyses.

Results

Baseline characteristics

Baseline characteristics of the 347 patients with cirrhosis listed for liver transplantation are shown in Table 1. Mean age was 58 years. The majority of patients was non-Hispanic White (58%) and had chronic hepatitis C (48%) as their primary aetiology of liver disease; 22% had HCC. Mean body mass index (BMI) was 29. The proportion of patients with a history of hypertension and diabetes were 44% and 31% respectively. Mean follow-up time was 13 months and was similar by gender.

Women comprised 36% of the study cohort. Differences in baseline characteristics between women and men are shown in Table 1. Women differed significantly from men by aetiology of liver disease (HCV: 37% vs. 54%; NAFLD: 23% vs. 11%; Cholestatic: 25% vs. 8%). While there was a trend toward less HCC (16% vs. 25%), women and men were otherwise similar including by mean age (58% vs. 57 years), % non-Hispanic White (54% vs. 60%) or Hispanic White (31% vs. 25%), mean body mass index (BMI) [29% vs. 29 kg/m(2)], and % with hypertension (39% vs. 47%) or diabetes (31% vs. 31%). Mean CCI-OLT scores, a composite measure of medical comorbidities, was similar between men and women (0.80 vs. 0.77).

Markers of liver disease severity and assessments of health

Mean MELD for the outpatient cohort was 17; the proportion of patients with Child Pugh Class A, B, and C were 10%, 58%, and 32%. Markers of liver disease severity were similar between women and men, including mean MELD (17 vs. 16), mean albumin (3.0 vs. 2.9 g/dl), and proportion who were Child Pugh class A (10% vs. 9%), B (60% vs. 58%), and C (30% vs. 33%) (Table 2).

Mean clinician-assessment score was 2.4 for the entire cohort and mean self-assessment score was 3.2 ($P = 0.02$). Clinicians rated women in 'poorer health' (i.e., higher clinician-assessment score) compared to men (2.6 vs. 2.3; $P = 0.02$). On the other hand, women rated their own health with similar self-assessment scores compared to men (3.2 vs. 3.1; $P = 0.78$) (Table 2).

The associations between clinician- and self-assessments with MELD score were weak but statistically significant. Specifically, the correlation coefficient for the relationship between MELD and clinician-assessments was 0.28; for every one-point increase in MELD score, the clinician-assessment score increased by 0.08 (95% CI 0.05–0.11; $P < 0.01$). With respect to self-assessments, the correlation coefficient was 0.18; for every one-point increase in MELD score, the self-assessment score increased by 0.05 (95% CI, 0.02–0.08; $P < 0.01$). The associations between MELD and clinician-assessments or MELD and self-assessments were qualitatively similar in women and men (data not shown).

There was a significant relationship between Child Pugh Class and clinician- or self-assessments. Mean (SD) clinician assessment scores for patients with Child Pugh Class A, B, and C were 1.6 (1.2), 2.2 (1.2), and 3.1 (1.2), respectively, (test of trend $P < 0.01$). Mean (SD) self-assessment scores for patients with Child Pugh Class A, B, and C were 2.8 (1.1), 3.1 (1.1), and 3.4 (1.0), respectively, (test of trend $P = 0.02$). The association between the CCI-OLT and clinician assessment scores was statistically significant (coef 0.13, 95% CI 0.01–0.25; $P = 0.04$), but not with self-assessment score (coef 0.01, 95% CI −0.11–0.12; $P = 0.93$).

Outcomes and the predictive ability of clinician- and self-assessments

Patients were followed after the index outpatient visit for a mean (SD) of 13 (7) months, which was similar in women and men [13 (7) and 12 (7) months; $P = 0.41$]. By the end of follow-up, 53 (15%) patients died/were delisted for being too sick for liver transplant. Compared to patients with a clinician-assessment score

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Table 1. Baseline characteristics of the 347 patients with cirrhosis listed for liver transplantation

Characteristics*	All $n = 347$	Men $n = 223$ (64%)	Women $n = 124$ (36%)	*P*-value
Age, years	58 (8)	57 (9)	58 (9)	0.53
Race				
Non-hispanic white	58	60	54	0.66
Hispanic white	27	25	31	
Black	3	4	3	
Asian/PI	5	5	6	
Other	6	7	5	
Aetiology of liver disease				
HCV	48	54	37	<0.01
ETOH	18	21	13	
NAFLD	15	11	23	
AIH/Cholestatic	14	8	25	
Other	5	7	2	
Hepatocellular carcinoma	22	25	16	0.05
BMI, kg/m^2	29 (6)	29 (5)	29 (6)	0.97
Hypertension	44	47	39	0.13
Diabetes	31	31	31	0.98
CCI-OLT†	0.79 (1.1)	0.80 (1.1)	0.77 (1.0)	0.85
Follow-up time, months	13 (6-19)	13 (5-19)	13 (7-21)	0.41

*Mean (SD) or %.

†Modified Charlson Comorbidity Index, derived by the weighted sum of five medical comorbidities: coronary artery disease (by angiography or history of myocardial infarction; 2 points), diabetes (chronic hyperglycemia requiring outpatient medications; 1 point), chronic obstructive pulmonary disease (chronic lung disease requiring medications, forced expiratory volume in 1 second <1.5 litres, or history of intubation for respiratory failure; 3 points), connective tissue disease (systemic lupus erythematosus, rheumatoid arthritis, scleroderma or seronegative spondyloarthropathy; 2 points), renal insufficiency (serum creatinine of 1.5 mg/dl or greater at the time of clinician assessment; 2 points)[7].

Table 2. Liver disease severity, clinician- and self-assessments

Measure*	All $n = 347$	Men $n = 223$ (64%)	Women $n = 124$ (36%)	*P*-value
Markers of liver disease severity				
MELD	17 (4)	16 (4)	17 (5)	0.32
Albumin, g/dl	3.0 (0.6)	2.9 (0.6)	3.0 (0.6)	0.45
Sodium, mEq/L	136 (4)	136 (4)	136 (4)	0.55
Ascites				
None	66	65	67	0.13
Mild–moderate	31	30	32	
Severe	3	5	1	
Hepatic encephalopathy				
None	77	80	72	0.12
Mild–moderate	19	17	22	
Severe	3	2	6	
Child-pugh class				
A	10	9	10	0.84
B	58	58	60	
C	32	33	30	
Assessments of health				
Clinician-assessment†	2.4 (1.3)	2.3 (1.3)	2.6 (1.2)	0.02
Patient self-assessment‡	3.2 (1.1)	3.2 (1.1)	3.1 (1.1)	0.78

*Mean (SD) or %.

†On the day of the patient's clinic visit, the patient's primary hepatologist assessed health using a 6-point scale from 0 (excellent) to 5 (very poor), without knowledge of the patient's self-assessment score.

‡On the day of the clinic visit, the patient rated his or her own health on a 6-point scale from 0 (excellent) to 5 (very poor), without knowledge of the clinician-assessment score.

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<3, those with a clinician-assessment score ≥3 at their clinic visit died/were delisted more frequently (23% vs. 11%; $P < 0.01$). Among patients with MELD score <18, 21% (14/68) of those with clinician-assessment score ≥3 died/were delisted compared to 10% (17/163) with a clinician-assessment score <3 ($P = 0.04$); among those with MELD score ≥18, 26% (16/61) of those with clinician-assessment score ≥3 died/were delisted compared with 11% (6/55) of those with clinician-assessment score <3 ($P = 0.04$) ($P = 0.01$ for the comparison of all four groups; Fig. 1). There was no significant difference in rates of death/delisting in those with a self-assessment score ≥4 vs <4 (18% vs. 11%; $P = 0.17$).

In univariable logistic regression, clinician-assessment score ≥3 (OR 2.57; $P < 0.01$), MELD score (OR per point, 1.07; $P = 0.02$), age (OR per year, 1.04; $P = 0.03$), dialysis (OR, 3.30; $P = 0.04$), serum albumin (OR per g/dl, 0.63; $P = 0.08$), serum sodium (OR per mEq/L, 0.94; $P = 0.07$), and Child Pugh score (OR per point, 1.20; $P = 0.04$) were associated with death/delisting with a P-value <0.10 (Table 3). Self-assessment score ≥4, female gender, body mass index, aetiology of liver disease, HCC, ascites, encephalopathy, hypertension, and diabetes were not ($P > 0.10$ for each). In multivariable logistic regression, after adjustment for MELD score, only clinician-assessment score ≥3 (OR 2.25; 95% CI, 1.22–4.15; $P = 0.01$) and age (OR per year, 1.05; 95% CI, 1.01–1.09; $P = 0.03$) remained significant predictors of death/delisting (Table 3). The AUROC for the clinician-assessment score ≥3 to predict future death/delisting was 0.67 (95% CI, 0.60–0.75).

In a sensitivity analysis evaluating the association between clinician-assessments and death alone ($n = 36$), the odds of death remained significantly elevated in patients with a clinician-assessment score ≥3 vs. <3 in univariable logistic regression (OR 3.00; 95% CI 1.47–6.09; $P < 0.01$) and after adjustment for MELD and age (OR 2.46; 95% CI 1.18–5.11; $P = 0.02$).

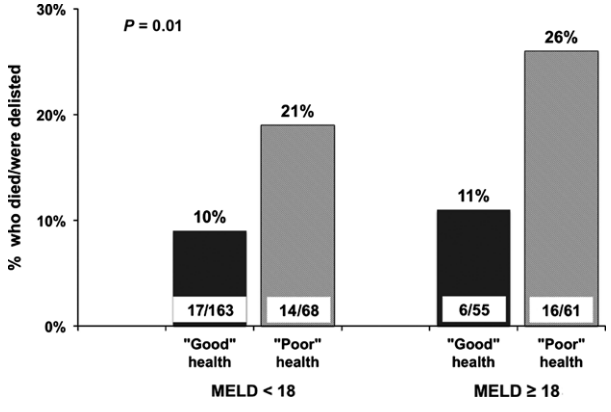

Fig. 1. Percent of wait-list candidates who died/were delisted by MELD (<18 vs. ≥18) and clinician-assessment (<3 vs. ≥ 3 out of 5) strata.

Discussion

One of the greatest challenges for patients with end-stage liver disease awaiting transplantation is facing the risk of death on the wait-list. While MELD score effectively prioritizes patients for liver transplantation (2), it falls short of providing patients with the information that they need to plan for this possibility and to make optimal decisions regarding transplant opportunities that may arise. There are several reasons for this. First, MELD score was originally developed to predict death within the next 90 days among patients with complications of end-stage liver disease (8), but the average candidate has often lived with the knowledge of cirrhosis for many years and waits over a year on the liver transplant wait-list (3). A patient with cirrhosis listed with a MELD score of 15, the median MELD at listing in the U.S (3), carries a relatively low predicted risk of 90-day mortality (6–8%) (9), even though his *eventual* mortality from complications of end-stage liver disease is nearly 100%. Second, patients progress to the top of the wait-list unpredictably and exponentially (10) with an acute decompensating illness (e.g. spontaneous bacterial peritonitis, esophageal variceal bleed) resulting in a sharp rise in MELD score in the 30 days preceding the final wait-list event. Therefore, patients may live with a low MELD score (and therefore low predicted risk of death) for months or years, not realizing that an ominous precipitous event may occur as soon as tomorrow. Lastly, in our MELD-based liver allocation system, as MELD increases along with the degree of sickness that a patient experiences, so does the probability of transplant. Conversations about the spectre of death at higher MELD scores are inevitably entangled with the promise of transplant, and patients and their families may be unprepared when transplant is no longer an option.

In this report, we explore a simple marker of prognosis in outpatients with end-stage liver disease on the liver transplant wait-list–a standardized assessment of overall health status made by the patient's primary hepatologist on a six-point scale. We demonstrated that the clinician-assessment score has a similar prognostic ability compared to MELD score with respect to the outcome of death/delisting in our cohort. Importantly, however, there was only a weak correlation between MELD and clinician-assessment scores. Our multivariable logistic regression model confirmed that clinicians were able to identify candidates who were particularly vulnerable to poor wait-list outcomes regardless of MELD score.

What exactly, then, does this 'eyeball test' capture, if not the manifestation of the liver failure itself? There is no doubt that the clinicians in this study based their assessments, in part, on the severity of liver disease, as determined by factors such as their patients' MELD scores and symptom burden reflective of the severity of portal hypertension. But clinicians

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Table 3. Univariable and multivariable analyses of predictors associated with death or delisting for being too sick for transplant in 347 liver transplant candidates

Covariates	Univariable* OR (95% CI)	*P*-value	Multivariable †OR (95% CI)	*P*-value
Clinician assessment score‡ ≥3	2.57 (1.42–4.66)	<0.01	2.25 (1.22–4.15)	0.01
Age, per year	1.04 (1.00–1.08)	0.03	1.05 (1.01–1.09)	0.03
Dialysis	3.30 (1.06–10.26)	0.04	–	
Serum albumin, per g/dl	0.63 (0.37–1.06)	0.08	–	
Serum sodium, per mEq/L	0.94 (0.87–1.00)	0.07	–	
Child Pugh score, per point	1.20 (1.01–1.43)	0.04	–	
CCI-OLT§, per point	1.11 (0.86–1.43)	0.41	–	

*All variables associated with *P*-value <0.1 in univariable analysis.

†Adjusted for MELD score.

‡On the day of the clinic visit, the patient rated his or her own health on a 6-point scale from 0 (excellent) to 5 (very poor), without knowledge of the clinician-assessment score.

§Modified Charlson Comorbidity Index, derived by the weighted sum of five medical comorbidities: coronary artery disease (by angiography or history of myocardial infarction; 2 points), diabetes (chronic hyperglycemia requiring outpatient medications; 1 point), chronic obstructive pulmonary disease (chronic lung disease requiring medications, forced expiratory volume in 1 second <1.5 litres, or history of intubation for respiratory failure; 3 points), connective tissue disease (systemic lupus erythematosus, rheumatoid arthritis, scleroderma, or seronegative spondyloarthropathy; 2 points), renal insufficiency (serum creatinine of 1.5 mg/dl or greater at the time of clinician assessment; 2 points)[7].

also likely incorporate other factors that they inherently 'know' contribute to mortality in all patients–with or without liver disease–such as advanced comorbidities (as evidenced by the significant association between CCI-OLT and the clinician assessment score), under-nutrition, sarcopenia, physical and/or psychosocial disability, and recent decompensating events. These factors do not necessarily parallel the perturbations in serum creatinine, total bilirubin, and INR that comprise the MELD score. Furthermore, given that the majority of wait-list candidates with cirrhosis experience acute hepatic decompensation just prior to their terminal wait-list event (e.g., death versus transplant), a patient's physiologic reserve to withstand the stress of this frequently dramatic event and become 'sick enough' to accelerate to the top of the wait-list without becoming too sick for transplant is critical to wait-list survival. The MELD score, although elegant in its simplicity as a metric of liver disease severity, was never intended to quantify physiologic vulnerability.

We intentionally asked clinicians to rate their patients' health rather than predict their wait-list mortality, as we felt that asking them directly to predict mortality could, theoretically, introduce bias in the estimates. Transplant hepatologists have the responsibility of delisting their patients if they feel that acceptable post-transplant outcomes cannot be achieved (i.e., the patient is too frail to survive the operation), but delisting could alter the association between the clinician-assessment score and wait-list mortality. However, in a sensitivity analysis using the outcome of death alone (without those who were delisted), a clinician assessment of poor health remained strongly predictive of death.

We acknowledge that there were relatively few outcome events available for analysis–despite a nearly two-year study period–as we included only outpatients in this study. This limited our ability to evaluate for interactions between clinician-assessments and covariates in the final model or further stratify our cohort to identify those in whom the clinician assessment may be particularly predictive. Another limitation is that each patient received an assessment from only one clinician, so we were unable to provide validation of minimal intra-observer variability for the standardized clinician assessment tool that we used in this study. In addition, our study did not include objective markers of non-liver related factors that impact mortality and, therefore, likely influence clinician assessments–such as sarcopenia, malnutrition, or cardiopulmonary reserve. Future studies that also include these objective metrics might provide greater insight into the factors that clinicians incorporate into the assessments of their patients. Lastly, one potential source of bias in this study is that we only studied patients who were listed for liver transplantation and clinicians may have excluded patients as candidates who they perceived as having poor health. Whether this simple tool has prognostic value for patients with end-stage liver disease in the non-transplant setting warrants further investigation.

Our study provides evidence to harness the power of this simple, readily performed assessment to identify the subgroup of wait-list candidates who would most benefit from additional healthcare resources, such as intensive physical therapy, nutritional support, aggressive multi-disciplinary management of comorbidities, and even home visits to ensure adequate support. At the same time, clinicians may use this information to encourage their patients to seek live liver donors or accept higher risk donor livers to accelerate the time to transplant and reduce their risk of death. While every transplant clinician hopes that their own patients will

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survive to transplant, a 'poor' clinician-assessment may serve as the springboard for the conversation to clarify a patient's end-of-life goals, in the event that they are, in reality, becoming too sick.

Clinicians perform the eyeball test every single time they see a patient, consciously or unconsciously. In this study, we operationalized this test in a six-point scale to standardize the assessments from one clinician to another, using prior studies evaluating clinician assessments of illness severity as our precedent (11, 12). In the US liver allocation system, transplant interrupts the prognostic trajectory of MELD scores. As such, wait-list mortality reflects the intersection of worsening liver disease severity with the physiologic inability to withstand an acute decompensating event, a 'prerequisite' for achieving a high enough MELD score to receive a liver offer in our current MELD-based liver allocation system. Integrating a standardized clinician-assessment into the routine evaluation of liver transplant candidates will help to identify those patients who are most vulnerable to this potentially catastrophic collision, providing the opportunity for timely interventions to optimize liver transplant wait-list outcomes.

Acknowledgements

Financial support: This study was funded by an American College of Gastroenterology Junior Faculty Development Award, P30AG044281 UCSF Older Americans Independence Center, R03AG045072 (NIA Grants for Early Medical and Surgical Subspecialists' Transition to Aging Research), and P30 DK026743 (UCSF Liver Center). These funding agencies played no role in the analysis of the data or the preparation of this manuscript

Conflict of interest: The authors do not have any disclosures to report.

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