LE SFIDE
DEL TRAPIANTO
DI FEGATO
NEL 2023

Loc. Ciocco **Lucca**
14-15 Aprile 2023

# Alto MELD e Trapianto di Fegato

## Alfonso Avolio

***Chirurgia Generale e del Trapianto di Fegato***
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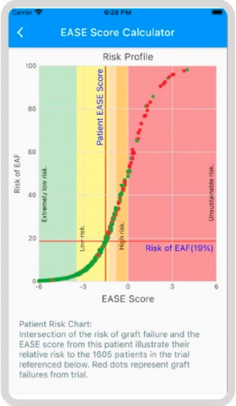
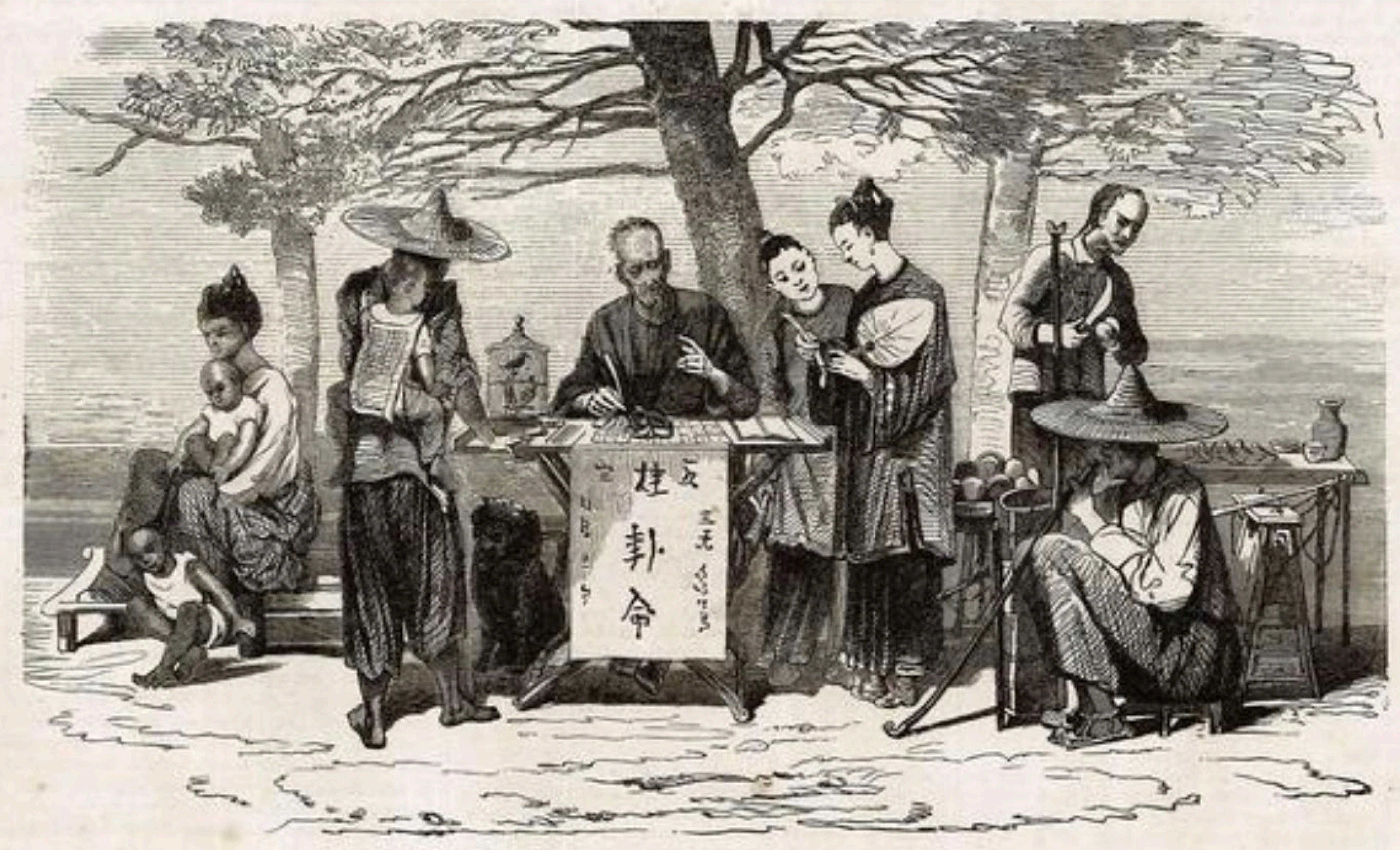
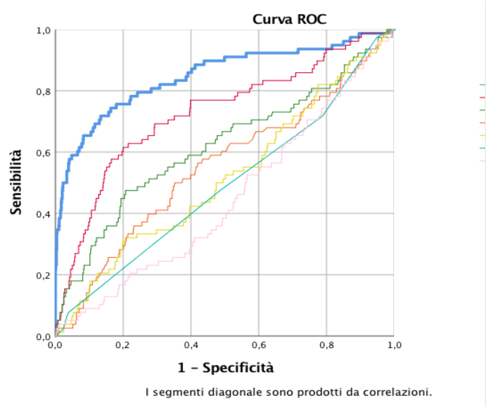


Patient Risk Chart:
Intersection of the risk of graft failure and the EASE score from this patient illustrate their relative risk to the 1605 patients in the trial referenced below. Red dots represent graft failures from trial.

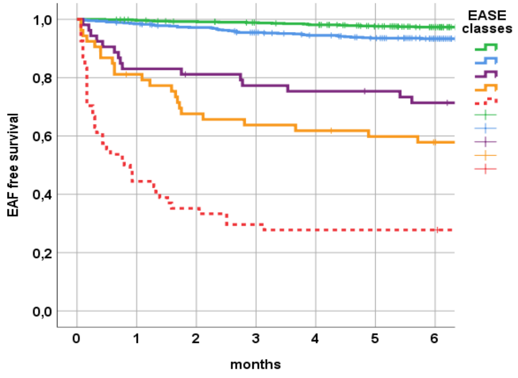
# PREDICTION of FUTURE by an old cinese fortune-teller



# CHARACTERISTICS of GOOD PROGNOSTIC SCORES

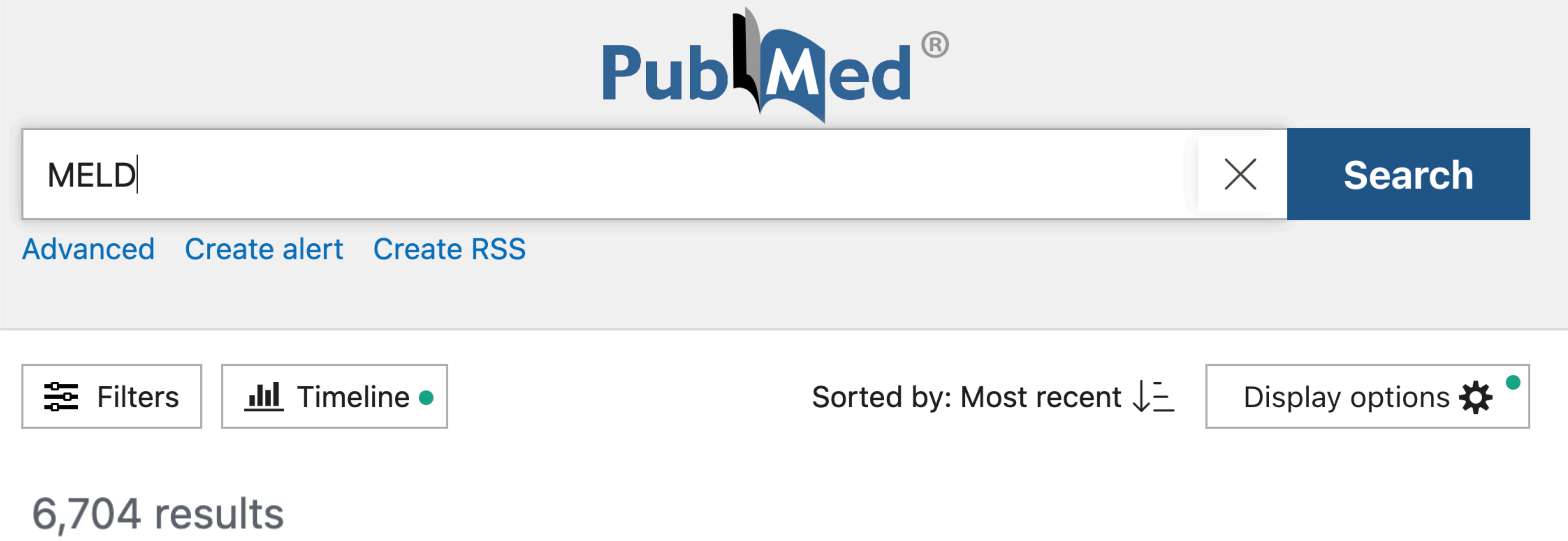


1. **ACCURACY:** capability to identify an outcome (ROC curve)



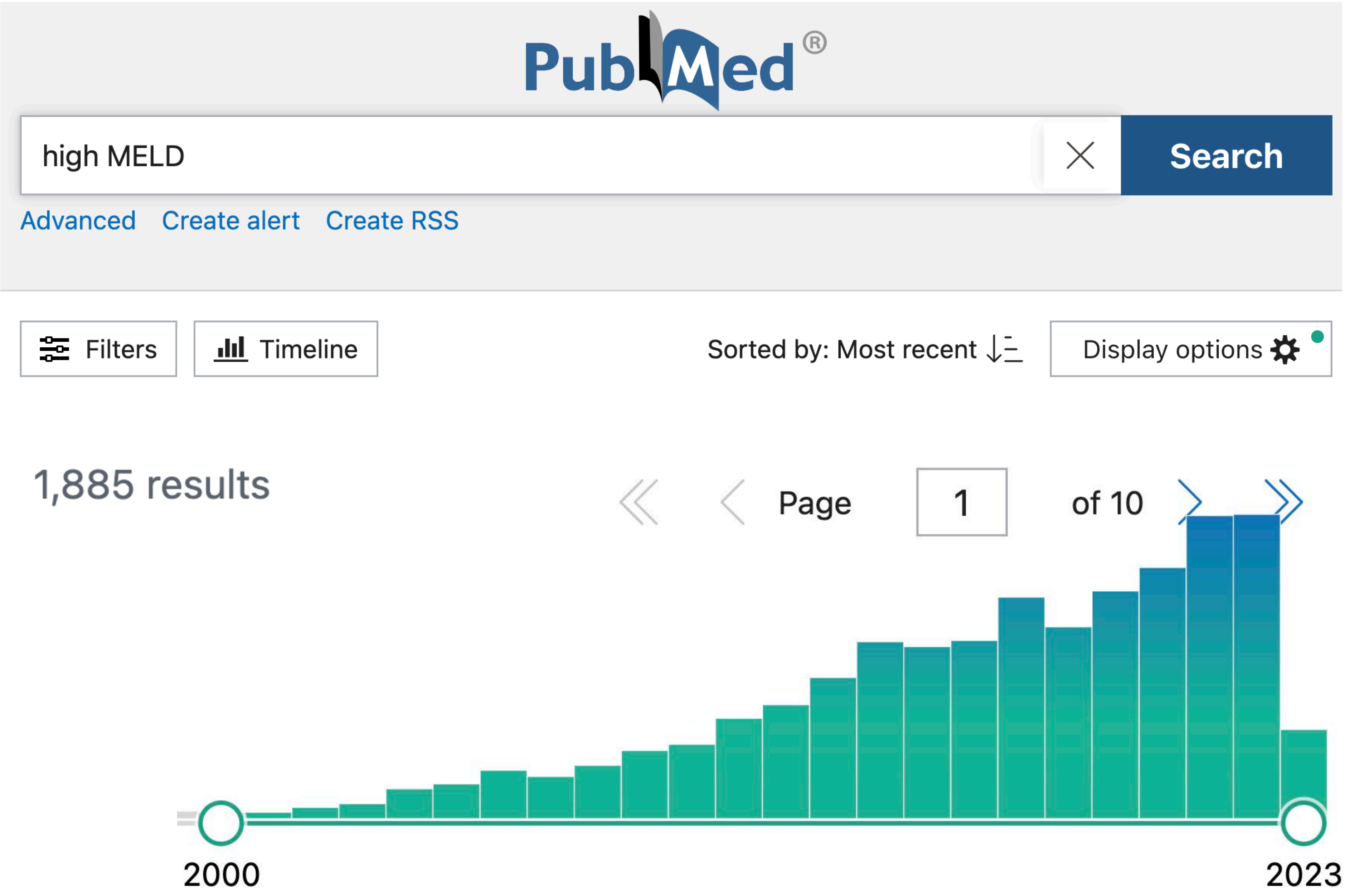
2. **DISCRIMINATION:** capability to separate the subclasses (Kaplan Meier)

3. **VALIDATION** (guaranties the reproducibility of the results)
   a. - internal validation
   b. - external validation
   c. - indipendent external validation



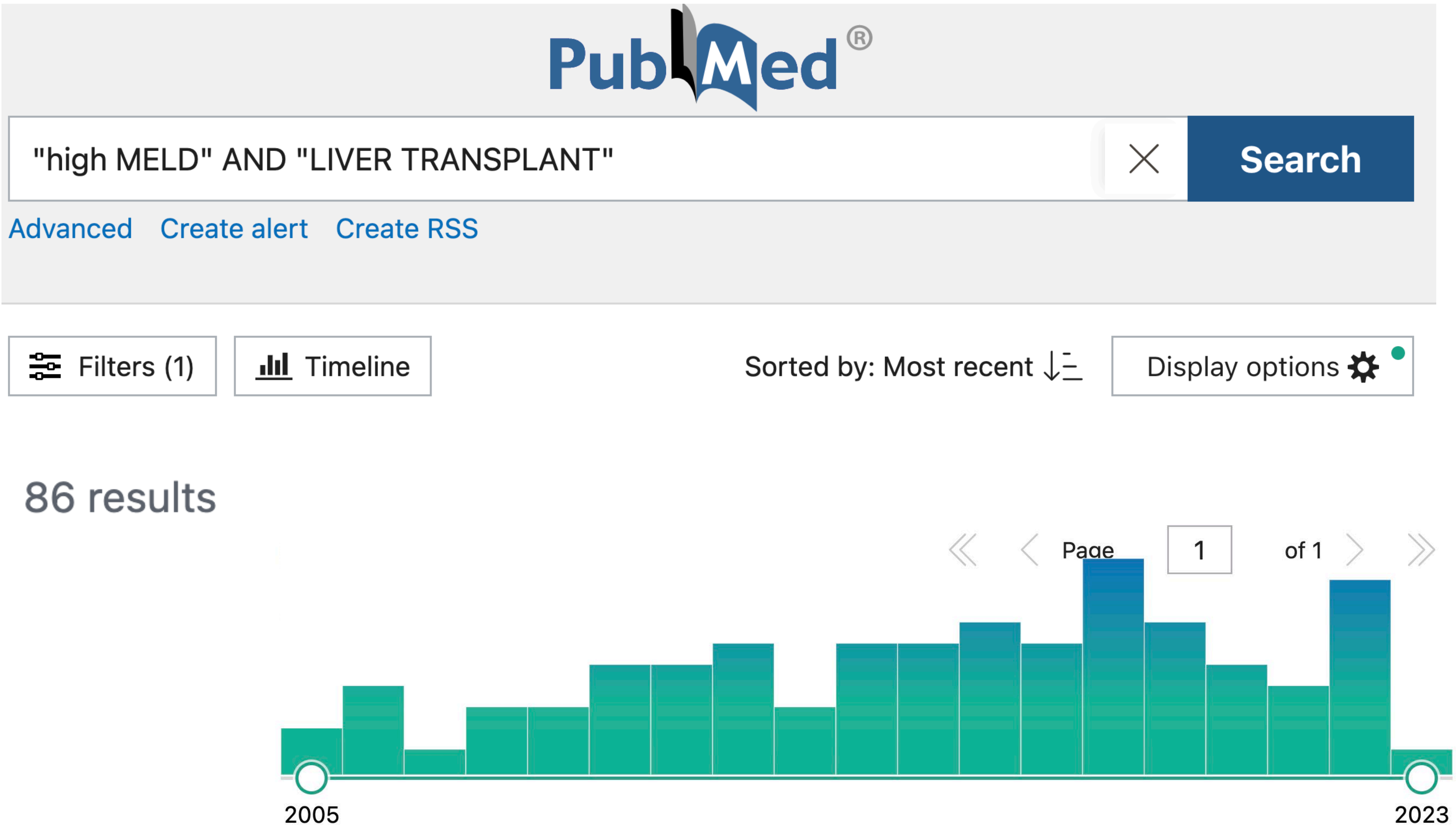
MELD

6,704 results



high MELD

1,885 results



"high MELD" AND "LIVER TRANSPLANT"

86 results

# A Model to Predict Survival in Patients With End-Stage Liver Disease

Patrick S. Kamath, Russell H. Wiesner,[1] Michael Malinchoc,[2] Walter Kremers,[2] Terry M. Therneau,[2] Catherine L. Kosberg,[1] Gennaro D'Amico,[3] E. Rolland Dickson,[1] and W. Ray Kim[1,2]

HEPATOLOGY Vol. 33, No. 2, 2001

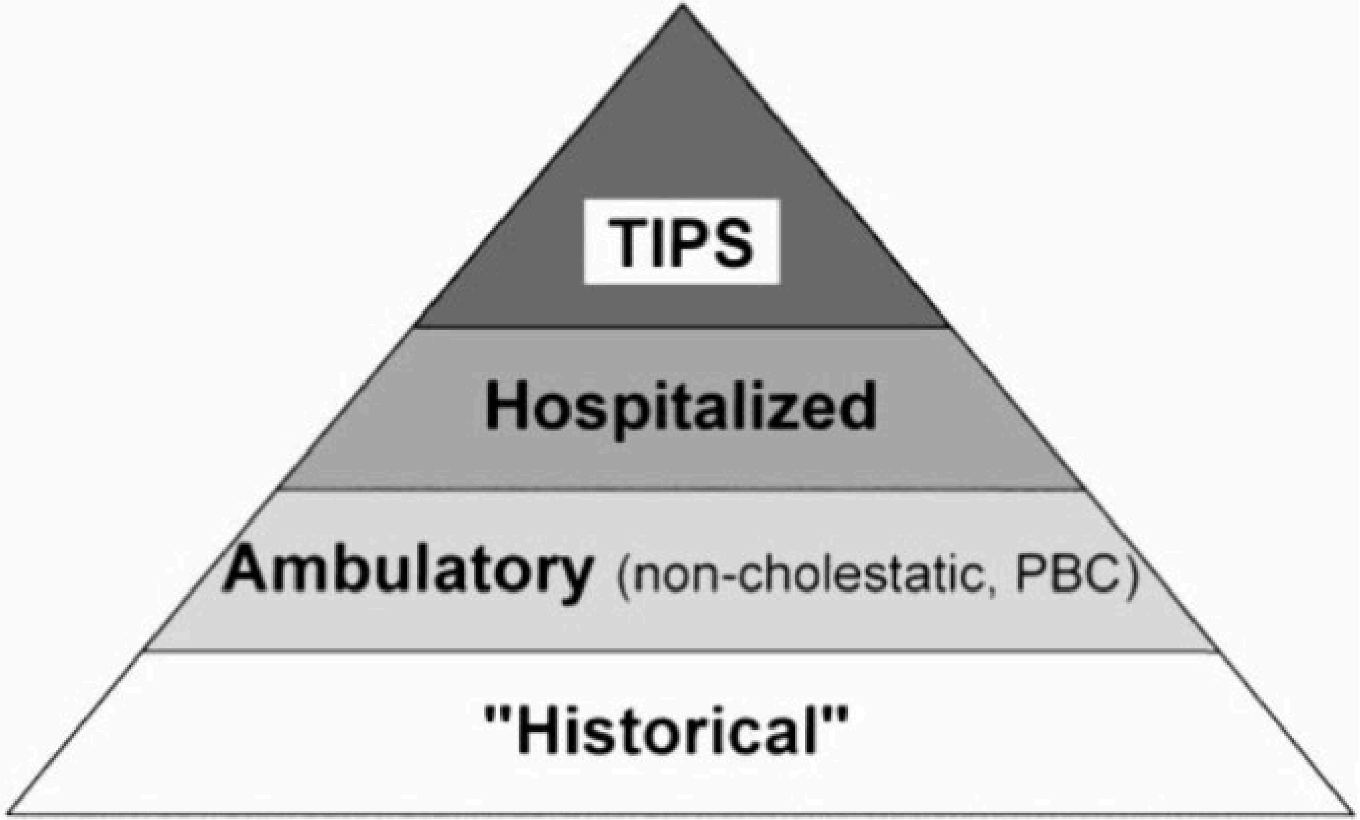


Fig. 1. Data sets used in the validation (total n = 2,278). While the model was developed in patients with end-stage liver disease undergoing the TIPS procedure, the model was validated in a large number of patients with a progressively wider spectrum of severity and etiology of liver disease.

# A Model to Predict Survival in Patients With End-Stage Liver Disease

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HEPATOLOGY Vol. 33, No. 2, 2001

Table 2. Validity of MELD in Predicting Mortality

| | Hospitalized<br>N = 282 | Ambulatory Noncholestatic<br>N = 491 | Ambulatory PBC<br>N = 326 | Historical<br>N = 1179 |
|---|---|---|---|---|
| 1-Week mortality | 0.95 (0.88-1.00) | 0.80 (0.67-0.94) | — | 0.84 (0.78-0.89) |
| 3-Month mortality | 0.87 (0.82-0.92) | 0.80 (0.69-0.90) | 0.87 (0.71-1.00) | 0.78 (0.74-0.81) |
| 1-Year mortality | 0.85 (0.80-0.90)* | 0.78 (0.70-0.85) | 0.87 (0.80-0.93) | 0.73 (0.69-0.76)† |

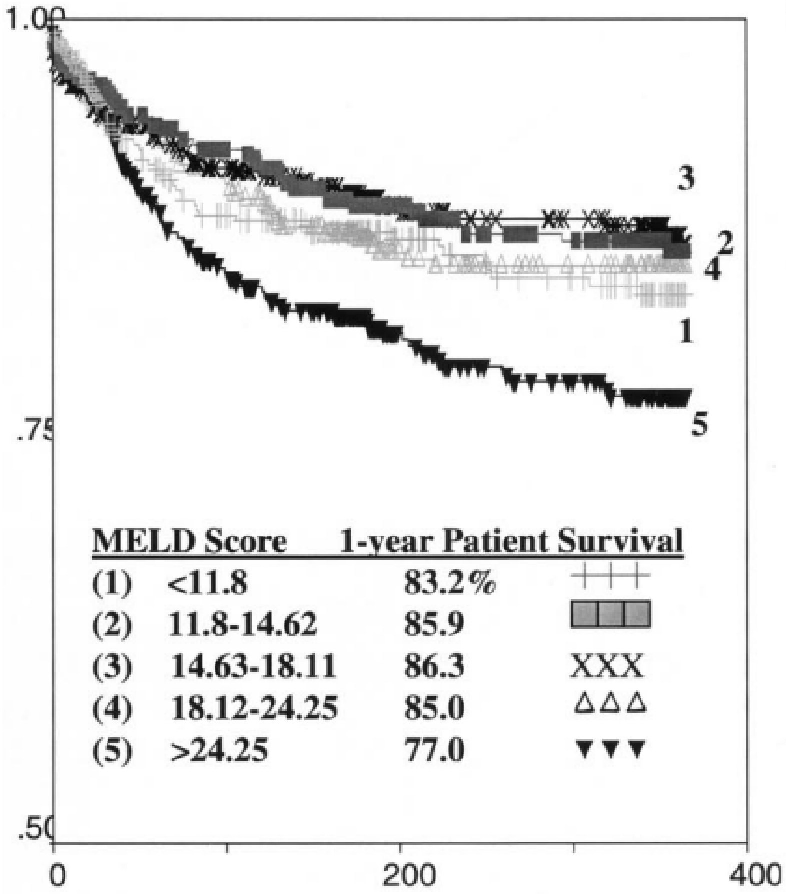
Table 3. Three-Month Death Rates

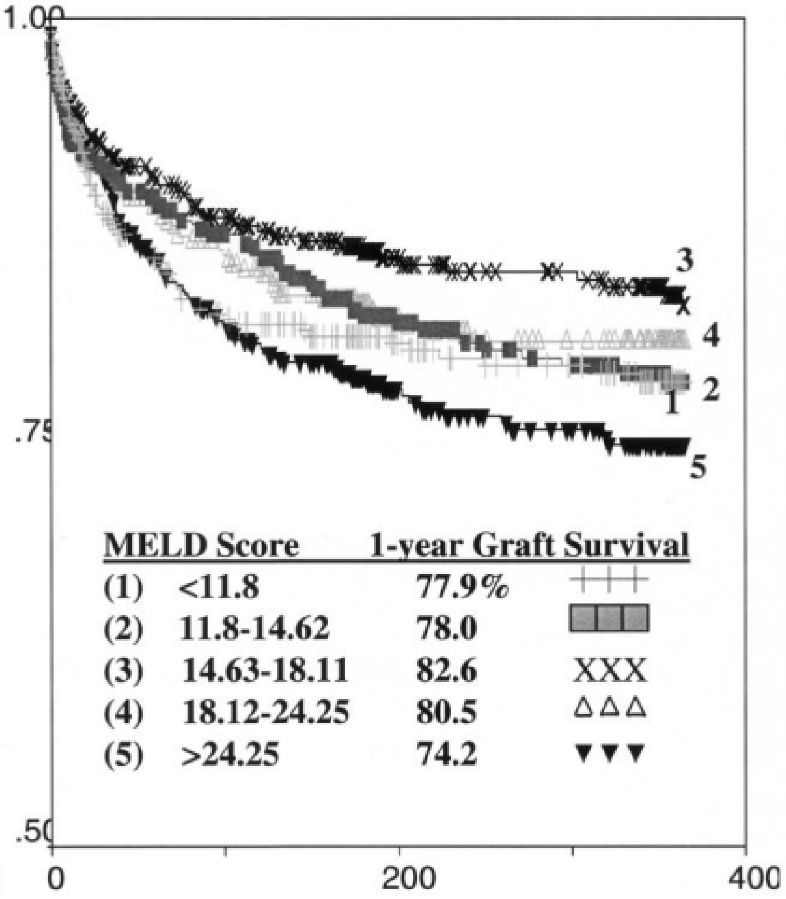
| MELD | ≤9 | 10-19 | 20-29 | 30-39 | ≥40 |
|---|---|---|---|---|---|
| Hospitalized | 4% (6/148) | 27% (28/103) | 76% (16/21) | 83% (5/6) | 100% (4/4) |
| Ambulatory noncholestatic | 2% (5/213) | 5.6% (14/248) | 50% (15/30) | — | — |
| Ambulatory PBC | 1% (3/308) | 13% (2/16) | 0% (0/2) | — | — |
| Historical | 8% (55/711) | 26% (90/344) | 56% (47/84) | 66% (23/35) | 100% (5/5) |

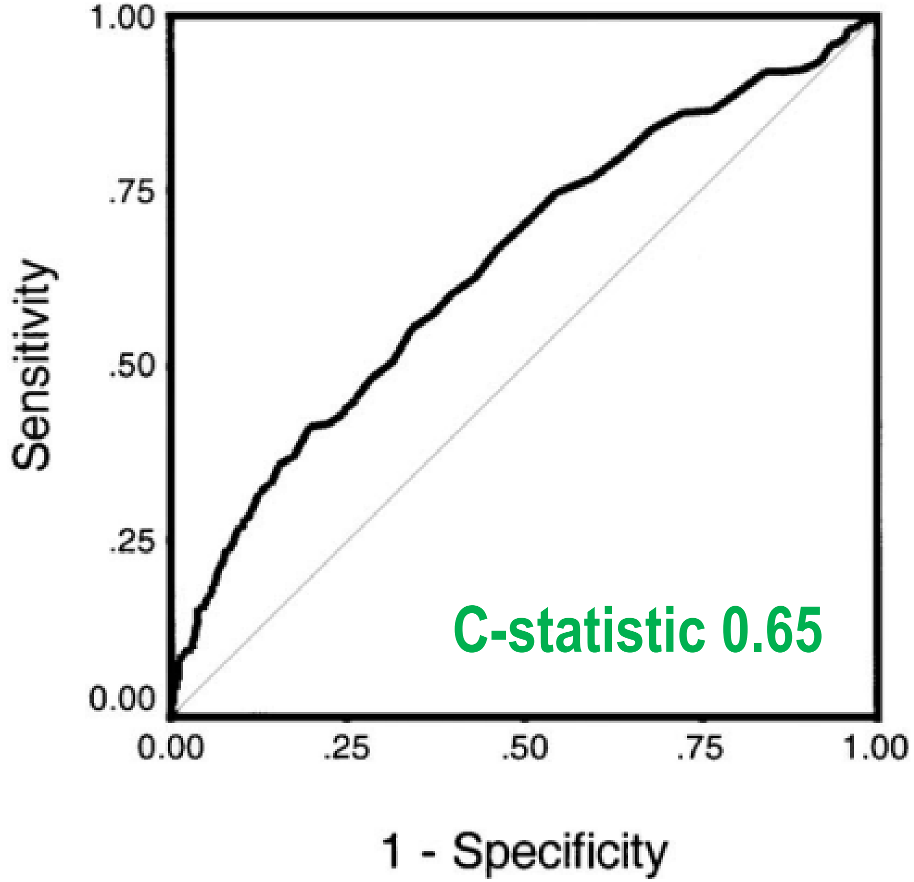
# PREDICTING OUTCOME AFTER LIVER TRANSPLANTATION: UTILITY OF THE MODEL FOR END-STAGE LIVER DISEASE AND A NEWLY DERIVED DISCRIMINATION FUNCTION[1]

Niraj M. Desai, Kevin C. Mange,[3,4] Michael D. Crawford,[5] Peter L. Abt,[5] Adam M. Frank,[5]
Joseph W. Markmann,[5] Ergun Velidedeoglu,[5] William C. Chapman,[2] and James F. Markmann[5,6]

Transplantation Vol. 77, 99–106, No. 1, January 15, 2004





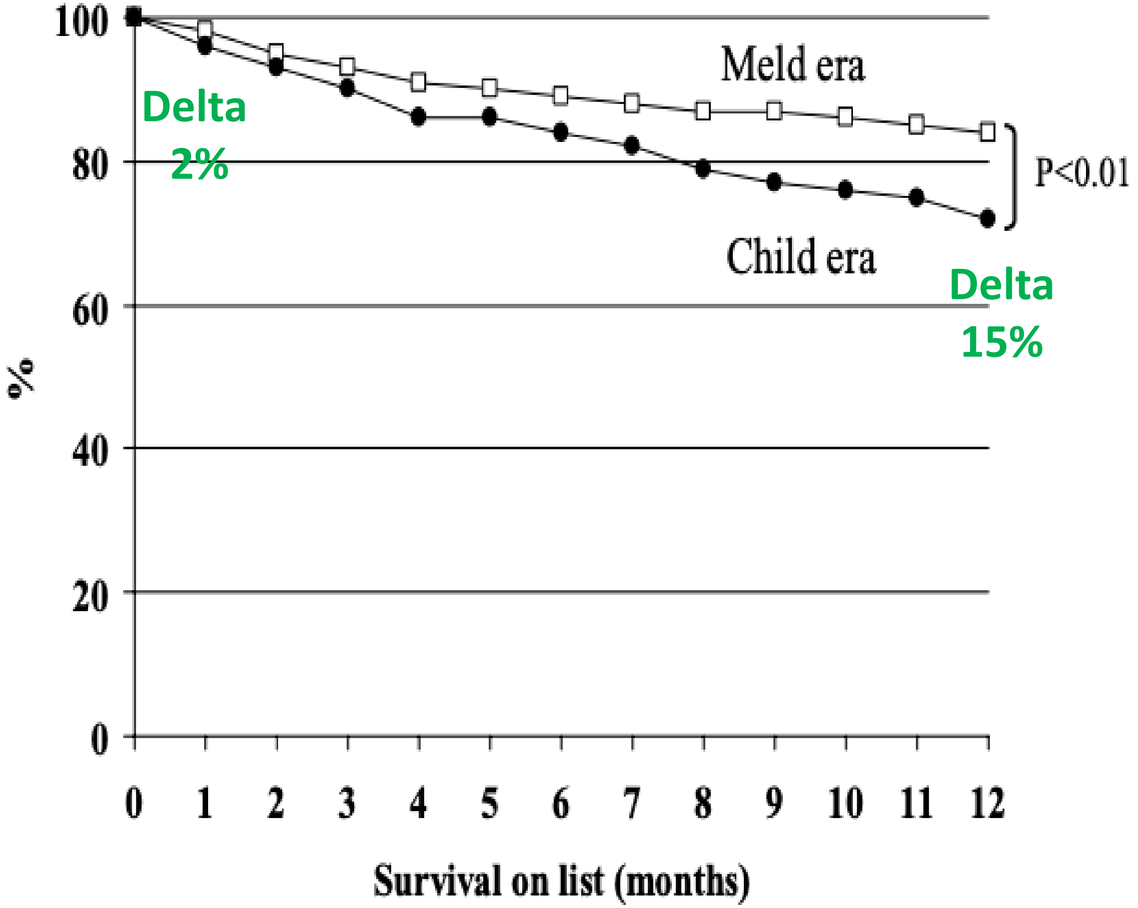


C-statistic 0.65

# Liver Transplantation with the Meld System: A Prospective Study from a Single European Center

M. Ravaioli, G. L. Grazi,∗, G. Ballardini, G. Cavrini, G. Ercolani, M. Cescon, M. Zanello, A. Cucchetti, F. Tuci, M. Del Gaudio, G. Varotti, G. Vetrone, F. Trevisani, L. Bolondi and A. D. Pinna

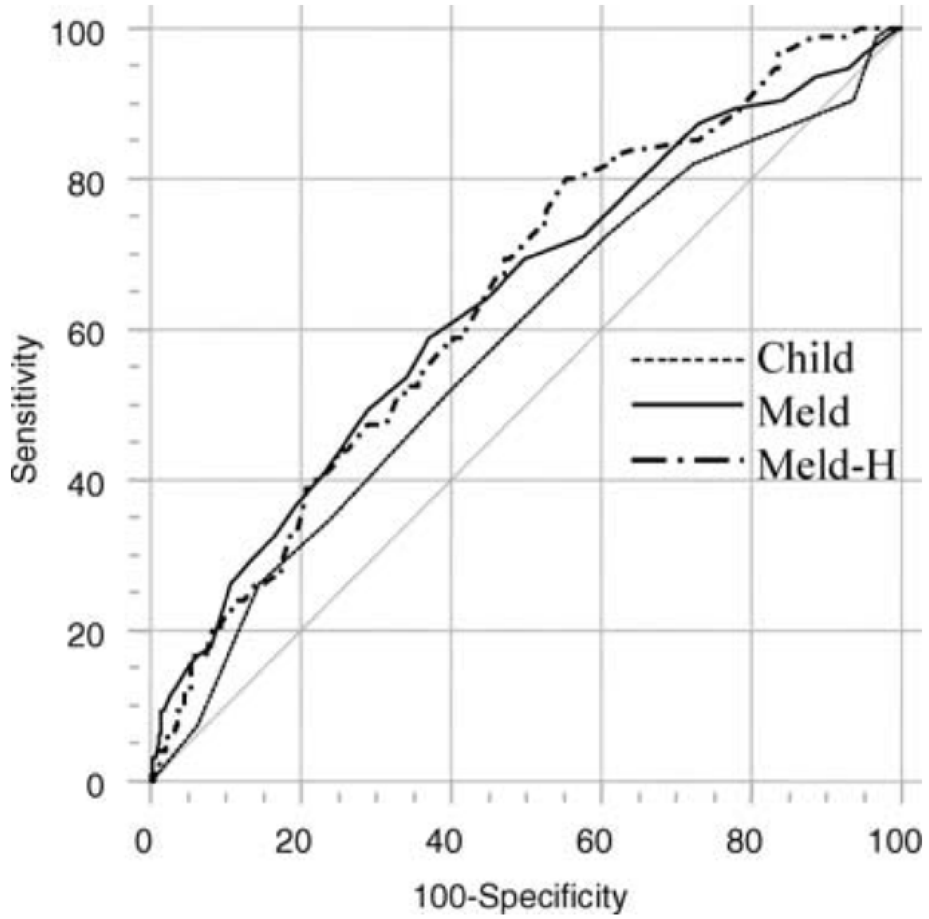
*American Journal of Transplantation 2006; 6: 1572–1577*
*Blackwell Munksgaard*



**Delta 2%**

**Delta 15%**

**MELD and MELD-H are stronger predictors of dropout**



C-statistics

**0.579 for Child,**
**0.637 for Meld**
**0.644 for Meld-H**

# Evolution of risk prediction models for post-operative mortality in patients with cirrhosis

Hepatology International
https://doi.org/10.1007/s1

CONSENSUS

**Eric Kalo**[1] · **Jacob George**[3] · **Scott Read**[1,2,3] · **Avik Majumdar**[4,5] · **Golo Ahlenstiel**[1,2,3]

Hepatol Int . 2023
Mar 27

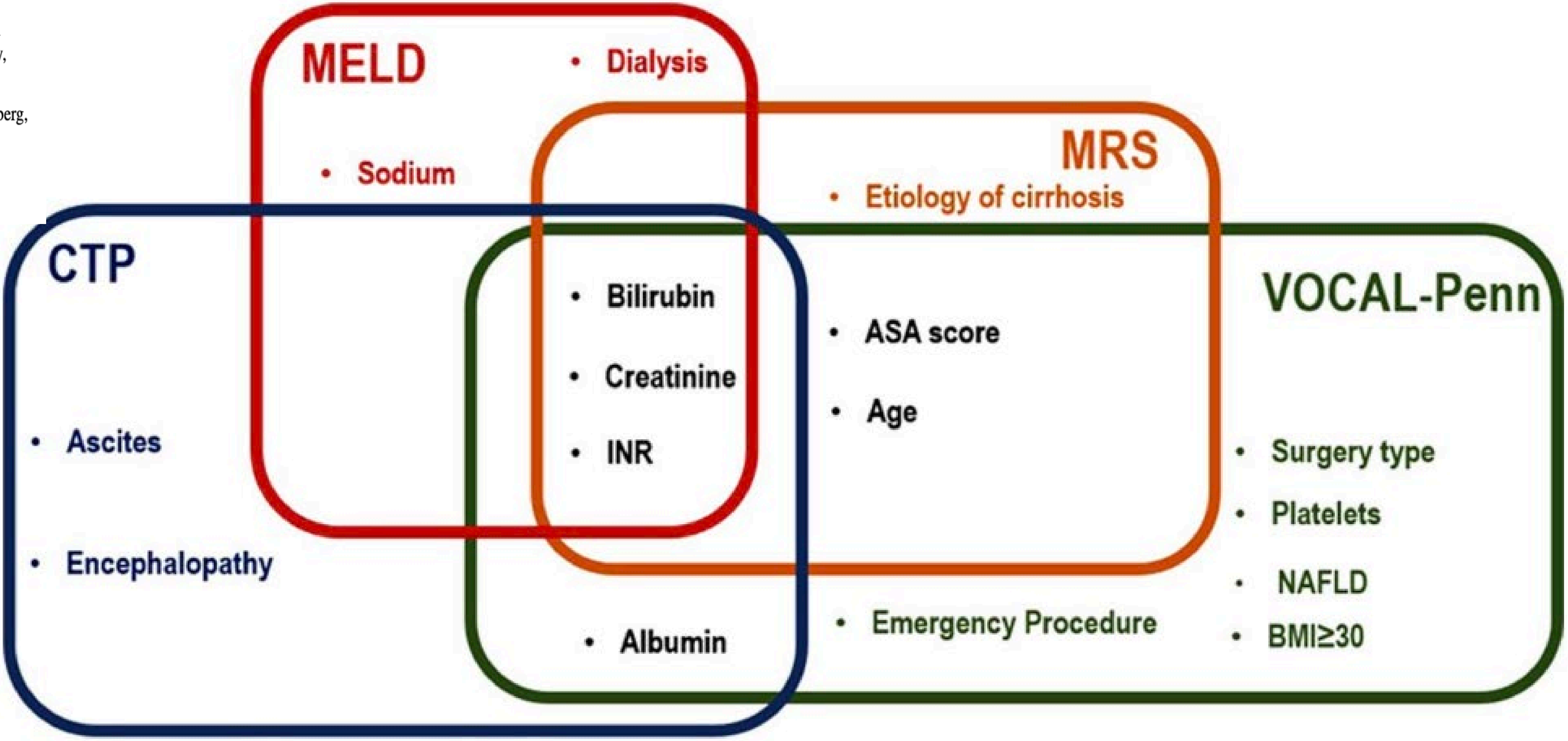
[1] Blacktown Clinical School, School of Medicine, Western Sydney University, Blacktown, NSW 2148, Australia

[2] Blacktown Hospital, Western Sydney Local Health District, Blacktown, NSW 2148, Australia

[3] Storr Liver Centre, The Westmead Institute for Medical Research, Westmead Hospital and University of Sydney, Westmead, NSW 2145, Australia

[4] Victorian Liver Transplant Unit, Austin Health, Heidelberg, VIC 3181, Australia

[5] The University of Melbourne, Melbourne, VIC 3010, Australia



MELD
- Dialysis
- Sodium

MRS
- Etiology of cirrhosis

CTP

- Bilirubin
- Creatinine
- INR

- ASA score
- Age

VOCAL-Penn

- Ascites
- Encephalopathy

- Surgery type
- Platelets
- NAFLD
- BMI≥30

- Albumin
- Emergency Procedure

**Fig. 1** Parameters of risk prediction models utilized for assessment of post-operative mortality in patients with cirrhosis. *ASA* The American Society of Anesthesiologists physical status classification, *BMI* body mass index, *CTP* Child–Turcotte–Pugh, *INR* international normalized ratio, *MELD* Model for End-Stage Liver Disease, *MRS* post-operative Mayo Risk Score, *NAFLD* non-alcoholic fatty liver disease, *VOCAL-Penn* Veterans Outcomes and Costs Associated with the Liver

# National Outcomes of Liver Transplantation for Model for End-Stage Liver Disease Score ≥40: The Impact of Share 35

V. Nekrasov, L. Matsuoka , M. Rauf1 , N. Kaur , S. Cao , S.Groshen and S. P. Alexopoulos

Transplantation. 2017 Oct;101(10):2360-2367 **(N=207)**

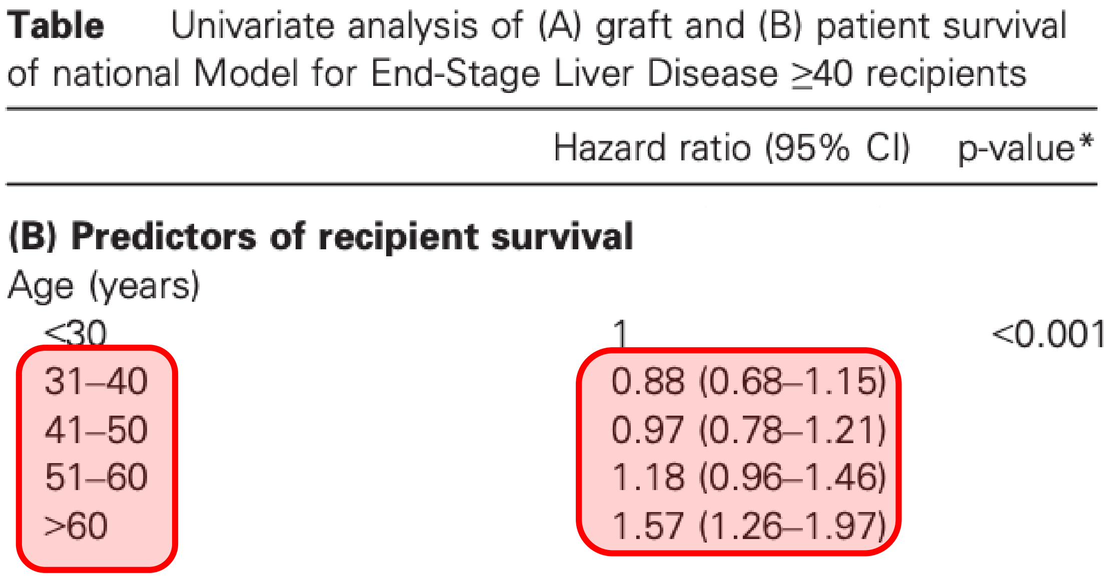


**Table** Univariate analysis of (A) graft and (B) patient survival of national Model for End-Stage Liver Disease ≥40 recipients

| | Hazard ratio (95% CI) | p-value* |
|---|---|---|
| **(B) Predictors of recipient survival** | | |
| Age (years) | | |
| ≤30 | 1 | <0.001 |
| 31–40 | 0.88 (0.68–1.15) | |
| 41–50 | 0.97 (0.78–1.21) | |
| 51–60 | 1.18 (0.96–1.46) | |
| >60 | 1.57 (1.26–1.97) | |

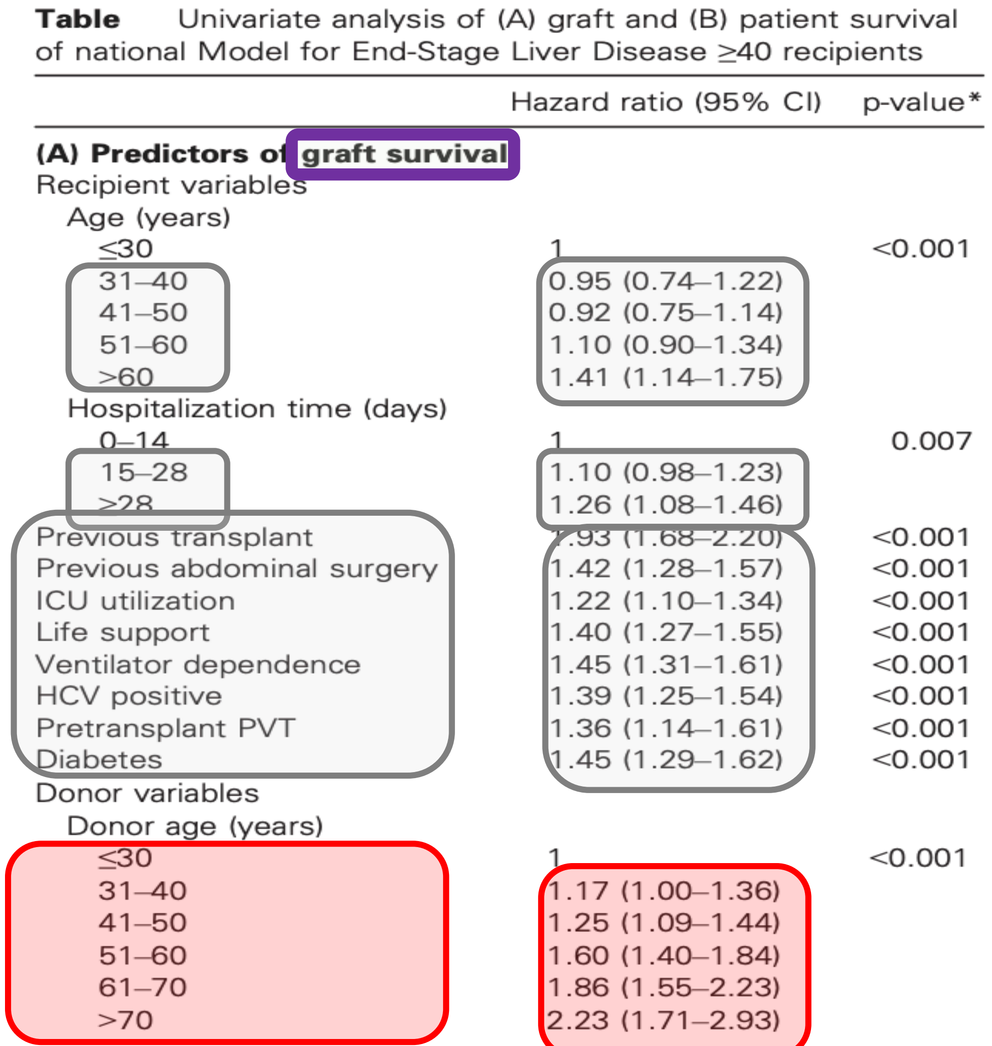


**Table** Univariate analysis of (A) graft and (B) patient survival of national Model for End-Stage Liver Disease ≥40 recipients

| | Hazard ratio (95% CI) | p-value* |
|---|---|---|
| **(A) Predictors of graft survival** | | |
| Recipient variables | | |
| Age (years) | | |
| ≤30 | 1 | <0.001 |
| 31–40 | 0.95 (0.74–1.22) | |
| 41–50 | 0.92 (0.75–1.14) | |
| 51–60 | 1.10 (0.90–1.34) | |
| >60 | 1.41 (1.14–1.75) | |
| Hospitalization time (days) | | |
| 0–14 | 1 | 0.007 |
| 15–28 | 1.10 (0.98–1.23) | |
| >28 | 1.26 (1.08–1.46) | |
| Previous transplant | 1.93 (1.68–2.20) | <0.001 |
| Previous abdominal surgery | 1.42 (1.28–1.57) | <0.001 |
| ICU utilization | 1.22 (1.10–1.34) | <0.001 |
| Life support | 1.40 (1.27–1.55) | <0.001 |
| Ventilator dependence | 1.45 (1.31–1.61) | <0.001 |
| HCV positive | 1.39 (1.25–1.54) | <0.001 |
| Pretransplant PVT | 1.36 (1.14–1.61) | <0.001 |
| Diabetes | 1.45 (1.29–1.62) | <0.001 |
| Donor variables | | |
| Donor age (years) | | |
| ≤30 | 1 | <0.001 |
| 31–40 | 1.17 (1.00–1.36) | |
| 41–50 | 1.25 (1.09–1.44) | |
| 51–60 | 1.60 (1.40–1.84) | |
| 61–70 | 1.86 (1.55–2.23) | |
| >70 | 2.23 (1.71–2.93) | |

# Is the MELD score EFFECTIVE for GRAFT ALLOCATION and SHARING ?

- in HCV patients / in HBV patients / in HCC patients
- in DCD patients
-

# Balancing Donor and Recipient Risk Factors in Liver Transplantation: The Value of D-MELD With Particular Reference to HCV Recipients

A. W. Avolio,*, U. Cillo,*, M. Salizzoni, L. De Carlis, M. Colledan, G. E. Gerunda, V. Mazzaferro, G. Tisone, R. Romagnoli, L. Caccamo, M. Rossi, A. Vitale, A. Cucchetti, L. Lupo, S. Gruttadauriam, N. Nicolotti, P. Burra, A. Gasbarrini, and S. Agnes; On behalf of the Donor-to-Recipient Italian Liver Transplant (D2R-ILTx) Study Group

*American Journal of Transplantation 2011; 11: 2724–2736*

D-MELD=Donor age x biochemical MELD

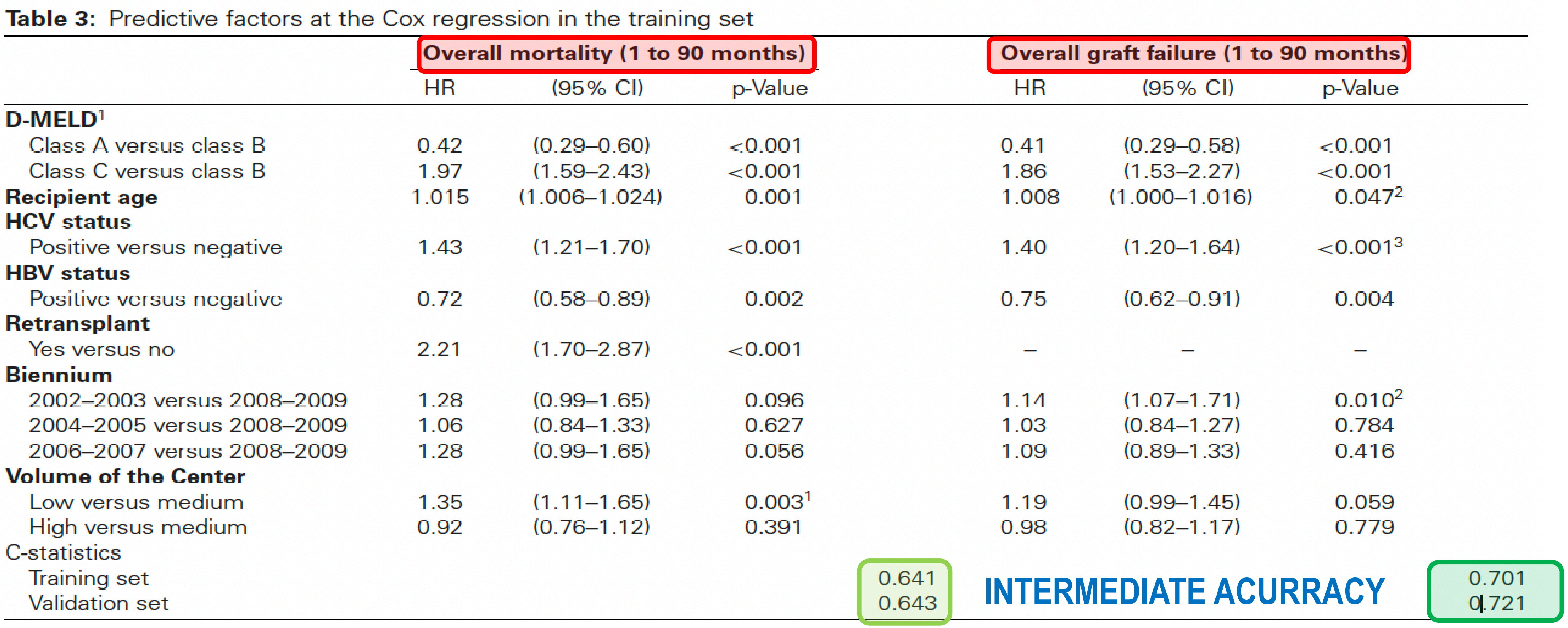


**Table 3:** Predictive factors at the Cox regression in the training set

| | **Overall mortality (1 to 90 months)** | | | **Overall graft failure (1 to 90 months)** | | |
|---|---|---|---|---|---|---|
| | HR | (95% CI) | p-Value | HR | (95% CI) | p-Value |
| **D-MELD**[1] | | | | | | |
| Class A versus class B | 0.42 | (0.29–0.60) | <0.001 | 0.41 | (0.29–0.58) | <0.001 |
| Class C versus class B | 1.97 | (1.59–2.43) | <0.001 | 1.86 | (1.53–2.27) | <0.001 |
| **Recipient age** | 1.015 | (1.006–1.024) | 0.001 | 1.008 | (1.000–1.016) | 0.047[2] |
| **HCV status** | | | | | | |
| Positive versus negative | 1.43 | (1.21–1.70) | <0.001 | 1.40 | (1.20–1.64) | <0.001[3] |
| **HBV status** | | | | | | |
| Positive versus negative | 0.72 | (0.58–0.89) | 0.002 | 0.75 | (0.62–0.91) | 0.004 |
| **Retransplant** | | | | | | |
| Yes versus no | 2.21 | (1.70–2.87) | <0.001 | – | – | – |
| **Biennium** | | | | | | |
| 2002–2003 versus 2008–2009 | 1.28 | (0.99–1.65) | 0.096 | 1.14 | (1.07–1.71) | 0.010[2] |
| 2004–2005 versus 2008–2009 | 1.06 | (0.84–1.33) | 0.627 | 1.03 | (0.84–1.27) | 0.784 |
| 2006–2007 versus 2008–2009 | 1.28 | (0.99–1.65) | 0.056 | 1.09 | (0.89–1.33) | 0.416 |
| **Volume of the Center** | | | | | | |
| Low versus medium | 1.35 | (1.11–1.65) | 0.003[1] | 1.19 | (0.99–1.45) | 0.059 |
| High versus medium | 0.92 | (0.76–1.12) | 0.391 | 0.98 | (0.82–1.17) | 0.779 |
| C-statistics | | | | | | |
| Training set | | | 0.641 | | | 0.701 |
| Validation set | | | 0.643 | | | 0.721 |

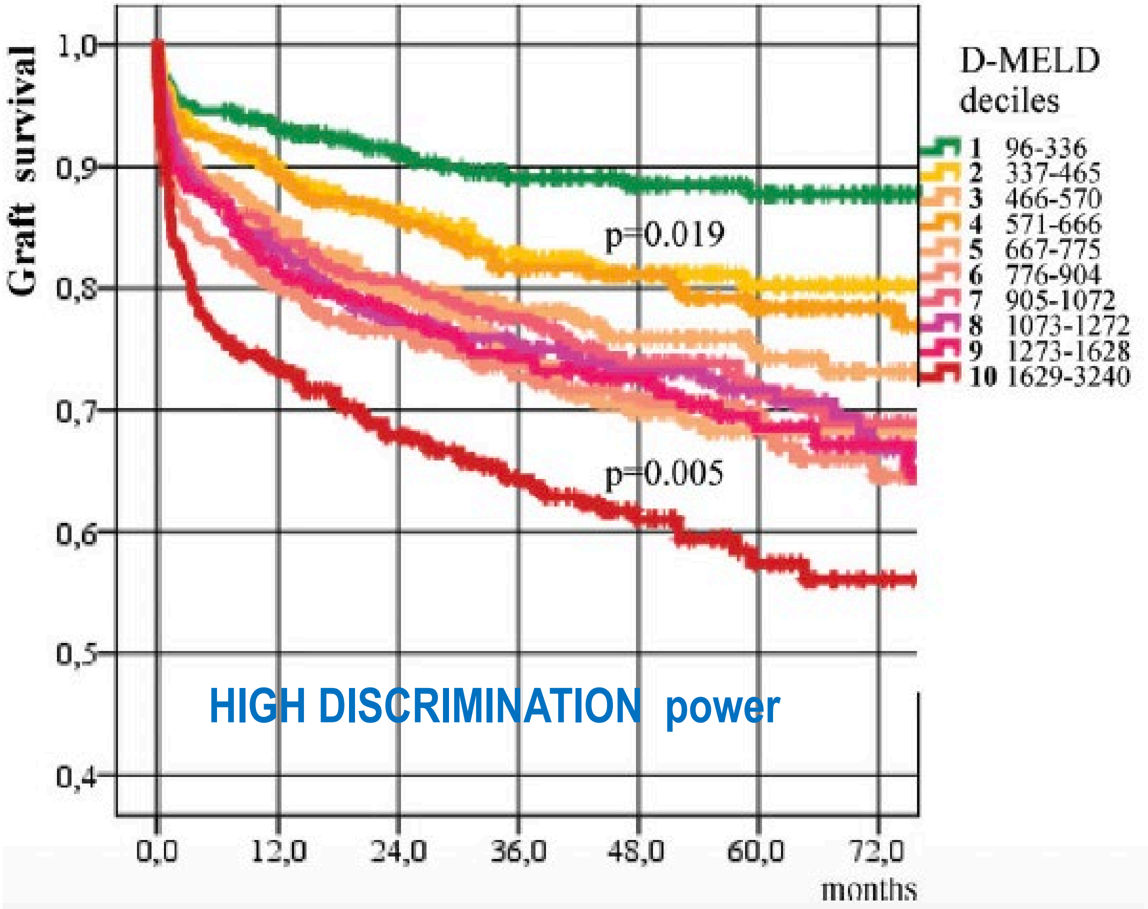
INTERMEDIATE ACURRACY

# Balancing Donor and Recipient Risk Factors in Liver Transplantation: The Value of D-MELD With Particular Reference to HCV Recipients

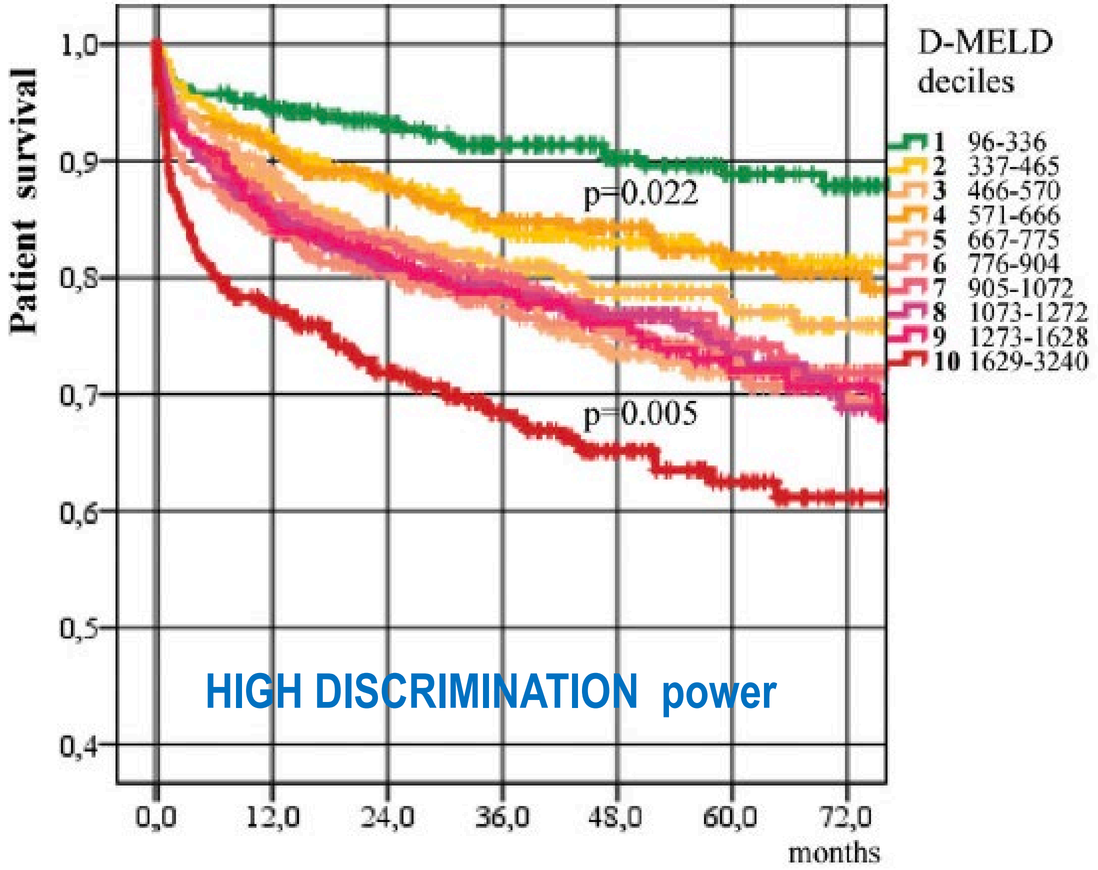
A. W. Avolio,*, U. Cillo,*, M. Salizzoni, L. De Carlis, M. Colledan, G. E. Gerunda, V. Mazzaferro, G. Tisone, R. Romagnoli, L. Caccamo, M. Rossi, A. Vitale, A. Cucchetti, L. Lupo, S. Gruttadauriam, N. Nicolotti, P. Burra, A. Gasbarrini, and S. Agnes; On behalf of the Donor-to-Recipient Italian Liver Transplant (D2R-ILTx) Study Group

*American Journal of Transplantation 2011; 11: 2724–2736*

D-MELD=Donor age x biochemical MELD



HIGH DISCRIMINATION power



HIGH DISCRIMINATION power

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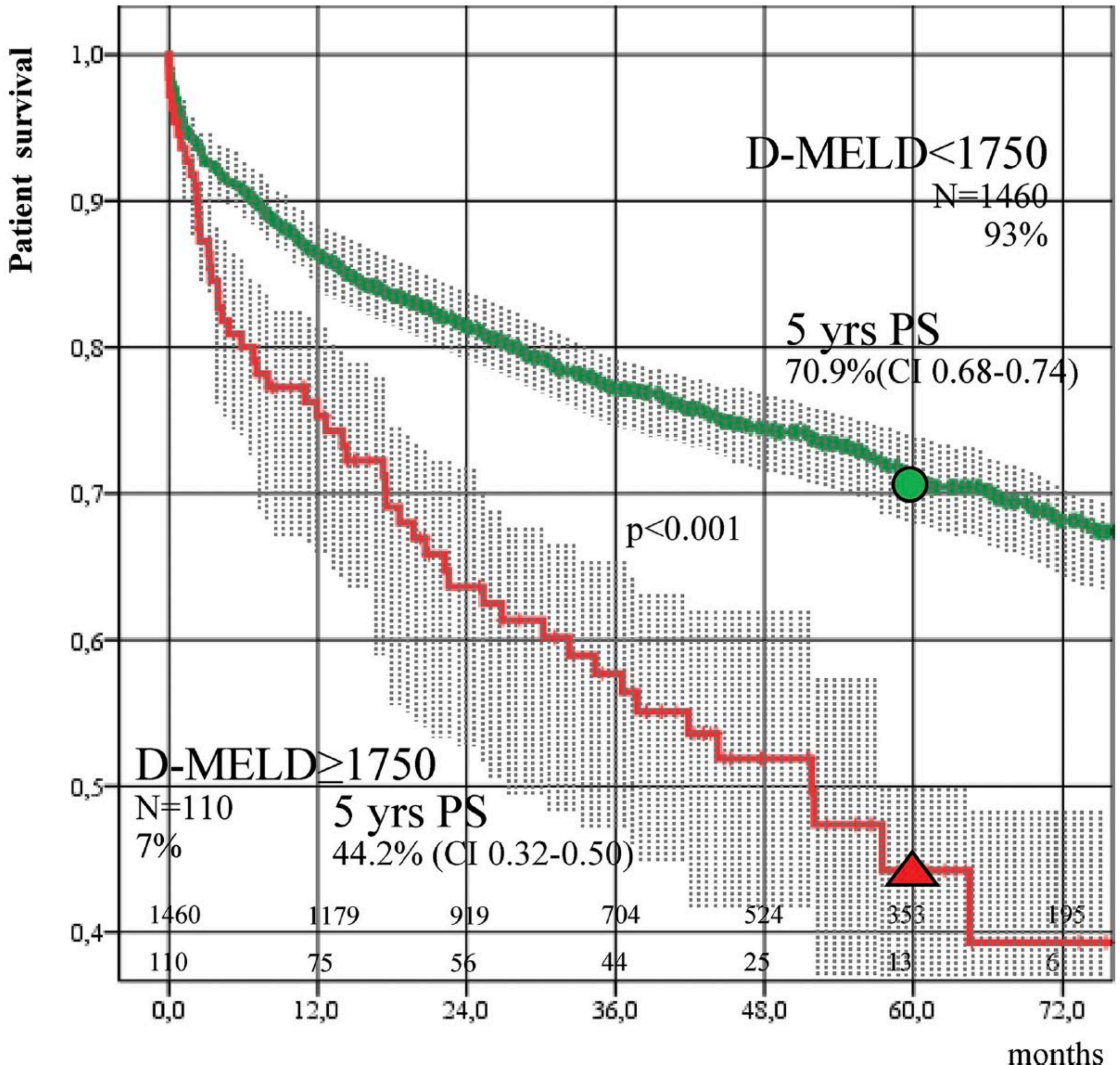


**HIGH ACCURACY**

**HIGH DISCRIMINATION**

**GOOD VALIDATION**

Transplant International

# http://www.D-MELD.com, the Italian survival calculator to optimize donor to recipient matching and to identify the unsustainable matches in liver transplantation

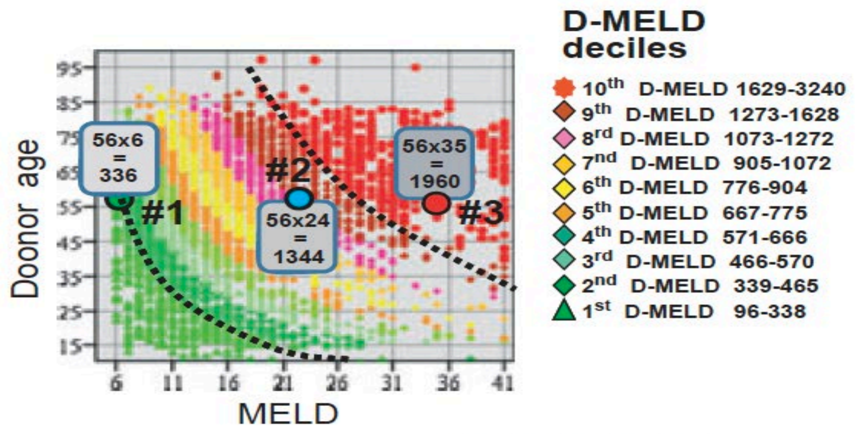
Alfonso W. Avolio,[1] Salvatore Agnes,[1] Umberto Cillo,[2] Maria C. Lirosi,[1] Renato Romagnoli,[3] Umberto Baccarani,[4] Fausto Zamboni,[5] Daniele Nicolini,[6] Matteo Donataccio,[7] Alessandro Perrella,[8] Giuseppe M. Ettorre,[9] Marina Romano,[10] Nicola Morelli,[11] Giovanni Vennarecci,[9] Chiara de Waure,[12] Stefano Fagiuoli,[13] Patrizia Burra[14] and Alessandro Cucchetti[15]

## Calculator of survival –www.D-MELD.com

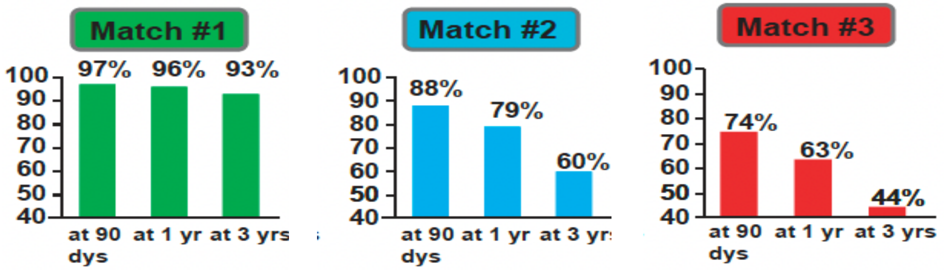
Donor age **56**

| | Possible recipient # 1 | Possible recipient # 2 | Possible recipient # 3 |
|---|---|---|---|
| Bilirubin (mg/dl) | 1.0 | 7.0 | 19.0 |
| Creatinine (mg/dl) | 1.0 | 1,4 | 2.8 |
| INR | 1,0 | 1,9 | 1.9 |
| MELD | 6 | 24 | 35 |
| D-MELD | 336 | 1344 | 1960 |

| | | | |
|---|---|---|---|
| Recipient age | 55 | 64 | 59 |
| HCV status | NEG | POS | POS |
| HBV status | POS | NEG | NEG |
| Portal vein | Patent | Thrombo | Thrombo |
| Previous re-tx | No | No | No |



Patient SURVIVAL



# Characteristics Associated with Liver Graft Failure: The Concept of a Donor Risk Index

**S. Feng**[a,*], **N.P. Goodrich**[b,c], **J.L. Bragg-Gresham**[b,c], **D.M. Dykstra**[b,c], **J.D. Punch**[d], **M.A. DebRoy**[e], **S.M. Greenstein**[f] **and R.M. Merion**[c,d]

[a] *Department of Surgery, Division of Transplantation, University of California San Francisco, San Francisco, California, USA*

*American Journal of Transplantation 2006; 6: 783–790*

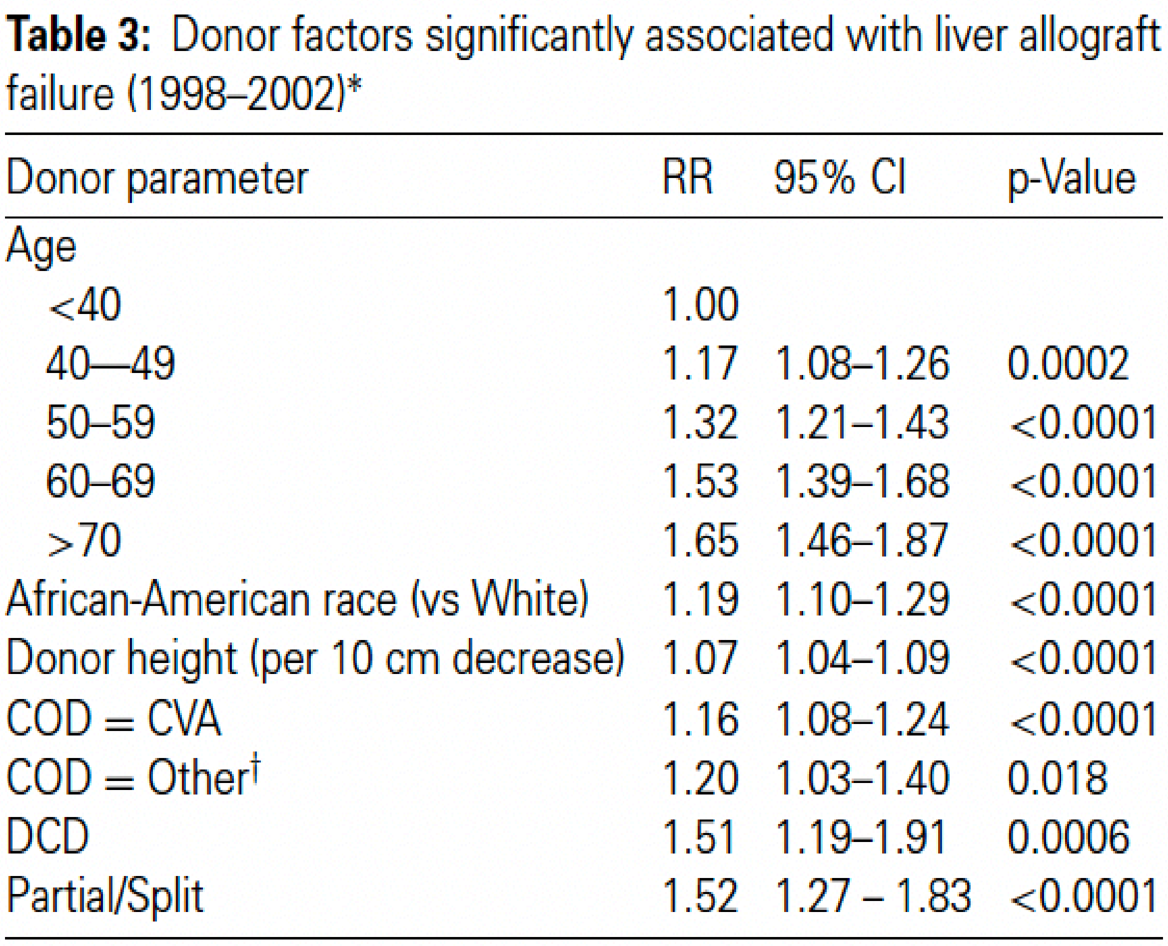
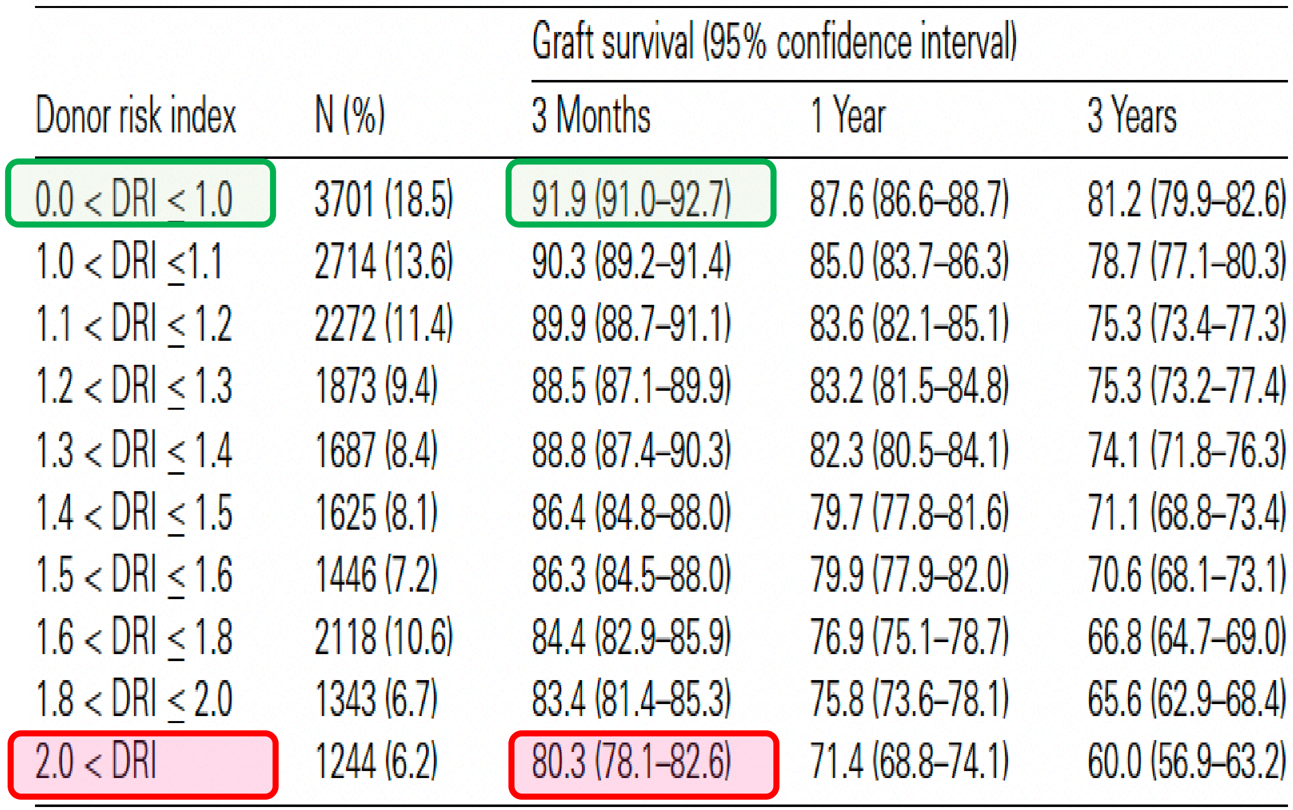


**Table 3:** Donor factors significantly associated with liver allograft failure (1998–2002)*

| Donor parameter | RR | 95% CI | p-Value |
|---|---|---|---|
| Age | | | |
| <40 | 1.00 | | |
| 40—49 | 1.17 | 1.08–1.26 | 0.0002 |
| 50–59 | 1.32 | 1.21–1.43 | <0.0001 |
| 60–69 | 1.53 | 1.39–1.68 | <0.0001 |
| >70 | 1.65 | 1.46–1.87 | <0.0001 |
| African-American race (vs White) | 1.19 | 1.10–1.29 | <0.0001 |
| Donor height (per 10 cm decrease) | 1.07 | 1.04–1.09 | <0.0001 |
| COD = CVA | 1.16 | 1.08–1.24 | <0.0001 |
| COD = Other[†] | 1.20 | 1.03–1.40 | 0.018 |
| DCD | 1.51 | 1.19–1.91 | 0.0006 |
| Partial/Split | 1.52 | 1.27 – 1.83 | <0.0001 |



| | | Graft survival (95% confidence interval) | | |
|---|---|---|---|---|
| Donor risk index | N (%) | 3 Months | 1 Year | 3 Years |
| 0.0 < DRI < 1.0 | 3701 (18.5) | 91.9 (91.0–92.7) | 87.6 (86.6–88.7) | 81.2 (79.9–82.6) |
| 1.0 < DRI ≤1.1 | 2714 (13.6) | 90.3 (89.2–91.4) | 85.0 (83.7–86.3) | 78.7 (77.1–80.3) |
| 1.1 < DRI ≤ 1.2 | 2272 (11.4) | 89.9 (88.7–91.1) | 83.6 (82.1–85.1) | 75.3 (73.4–77.3) |
| 1.2 < DRI ≤ 1.3 | 1873 (9.4) | 88.5 (87.1–89.9) | 83.2 (81.5–84.8) | 75.3 (73.2–77.4) |
| 1.3 < DRI ≤ 1.4 | 1687 (8.4) | 88.8 (87.4–90.3) | 82.3 (80.5–84.1) | 74.1 (71.8–76.3) |
| 1.4 < DRI ≤ 1.5 | 1625 (8.1) | 86.4 (84.8–88.0) | 79.7 (77.8–81.6) | 71.1 (68.8–73.4) |
| 1.5 < DRI ≤ 1.6 | 1446 (7.2) | 86.3 (84.5–88.0) | 79.9 (77.9–82.0) | 70.6 (68.1–73.1) |
| 1.6 < DRI ≤ 1.8 | 2118 (10.6) | 84.4 (82.9–85.9) | 76.9 (75.1–78.7) | 66.8 (64.7–69.0) |
| 1.8 < DRI ≤ 2.0 | 1343 (6.7) | 83.4 (81.4–85.3) | 75.8 (73.6–78.1) | 65.6 (62.9–68.4) |
| 2.0 < DRI | 1244 (6.2) | 80.3 (78.1–82.6) | 71.4 (68.8–74.1) | 60.0 (56.9–63.2) |

# Share 35 Changes Center Level Liver Acceptance Practices

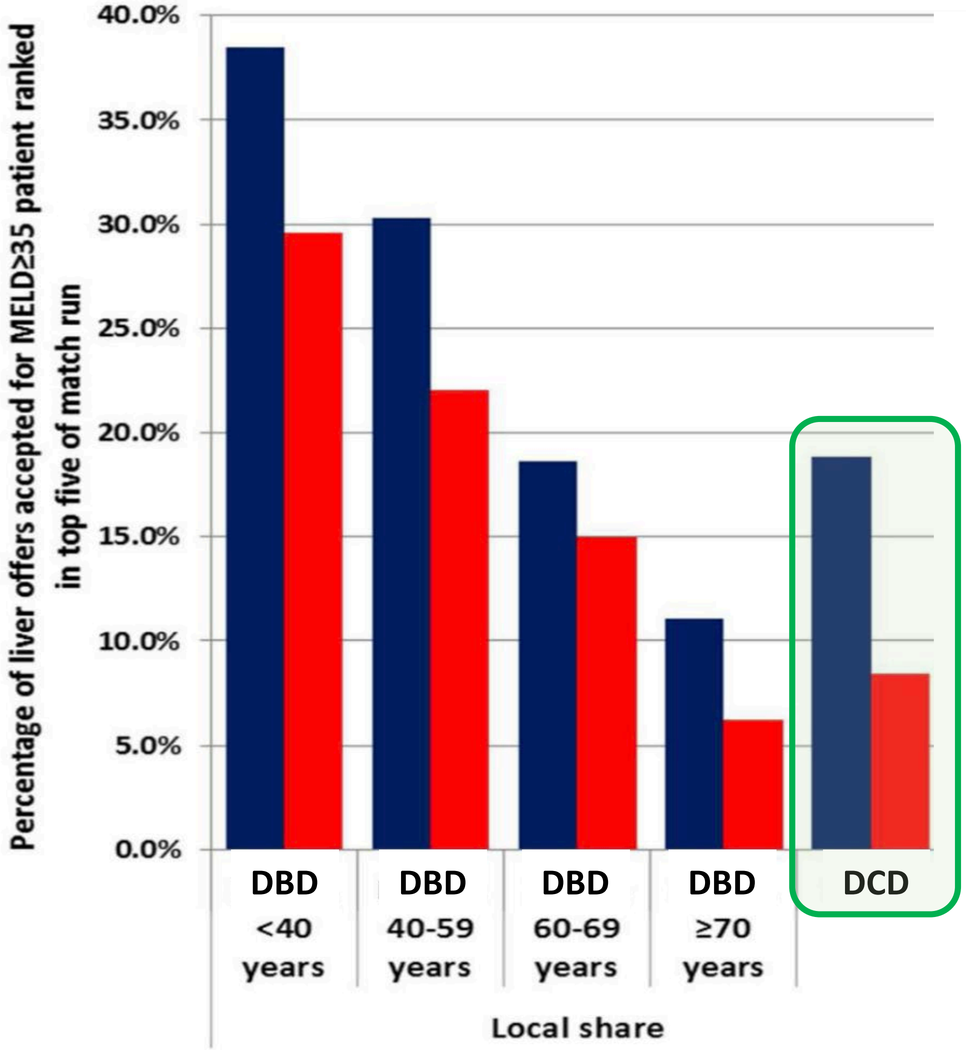
David S. Goldberg, Matthew Levine, Seth Karp, Richard Gilroy, and L Peter

Liver Transpl. 2017 May;23(5):604-613

🟦 Δ acceptance rates for allocation MELD<35

🟥 Δ acceptance rates for allocation MELD≥35

**% of LIVER ACCEPTED for patients with MELD 35 & over**



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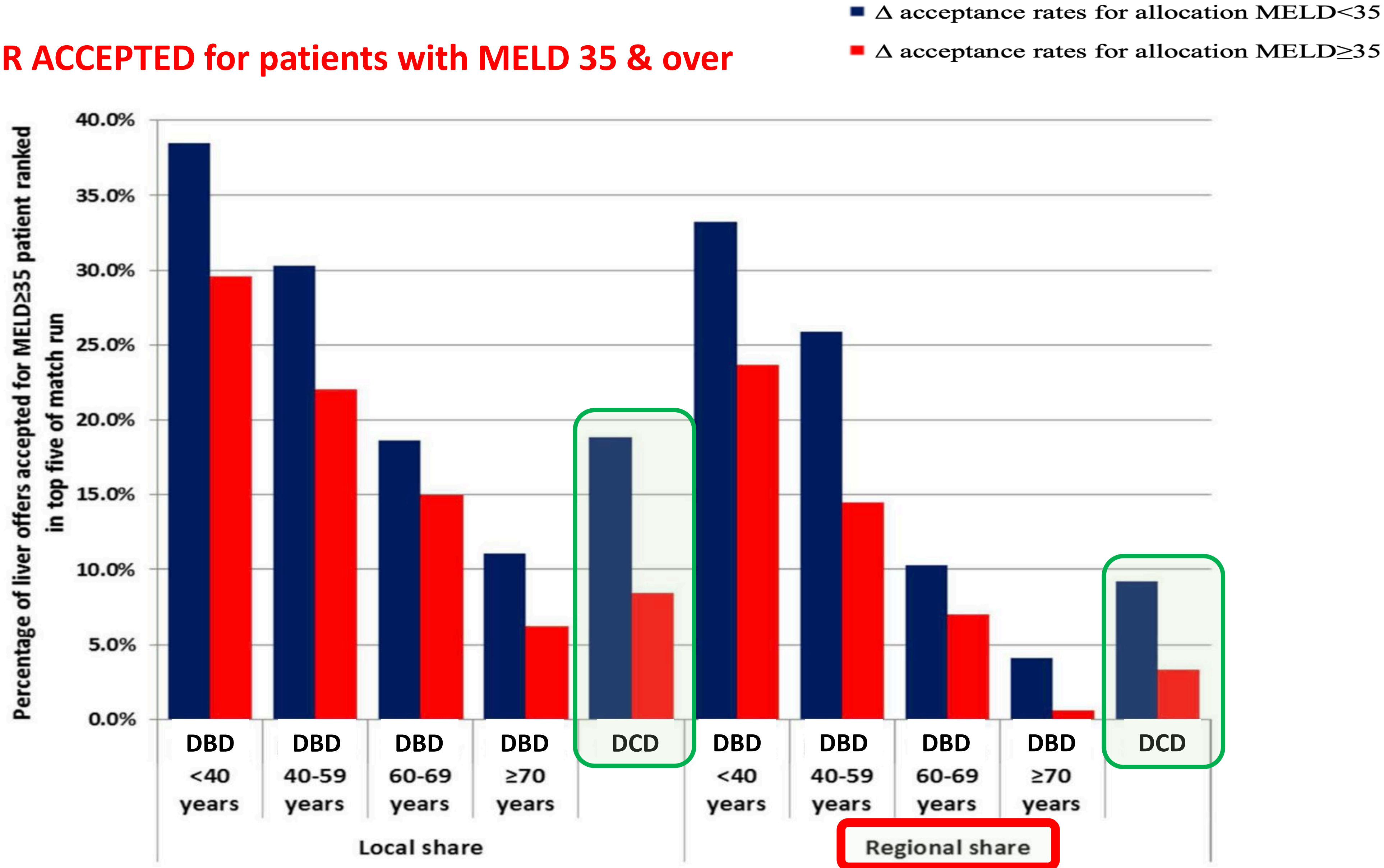
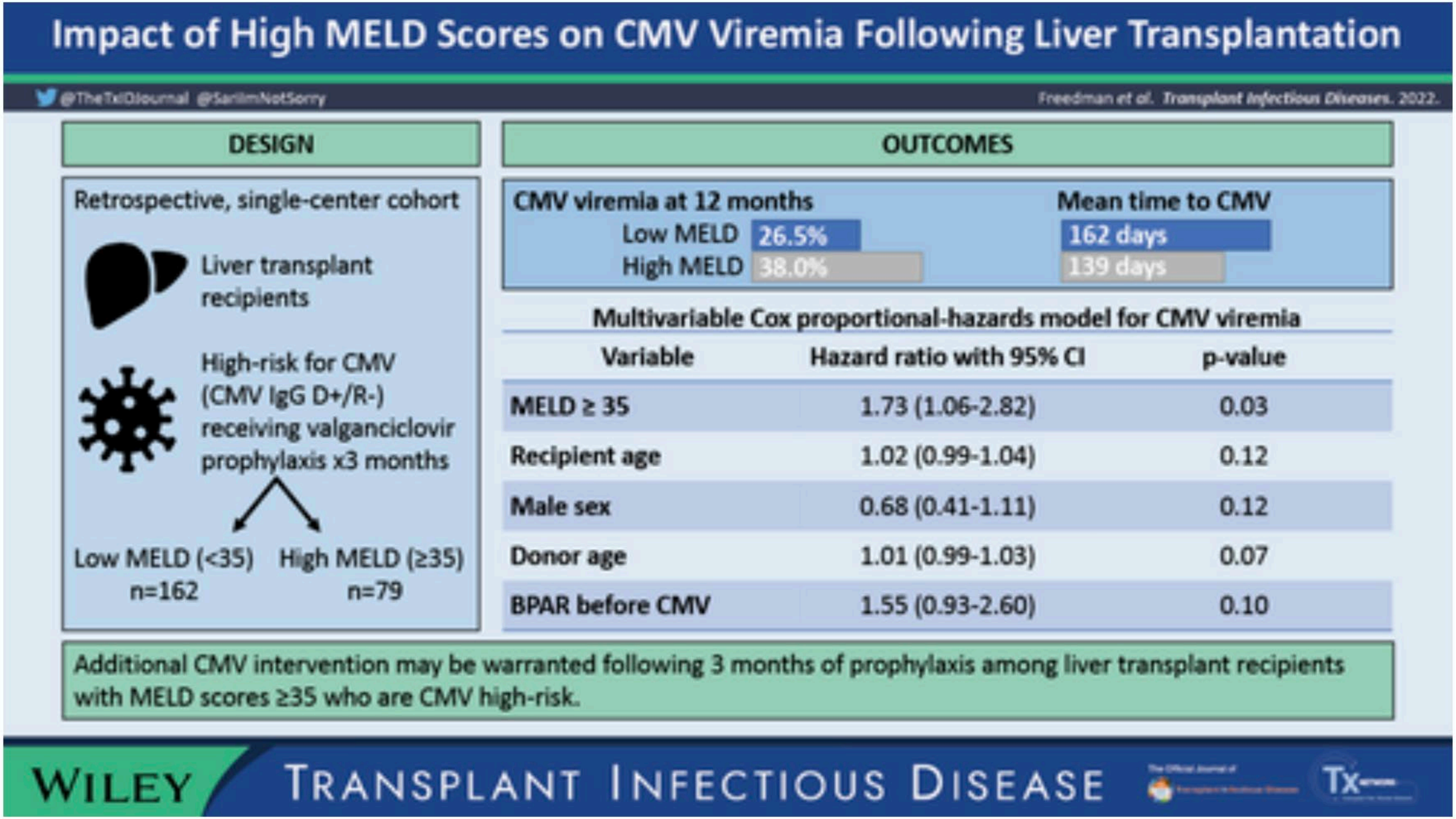


Transplant Infectious Dis, Volume: 25, Issue: 1, 12: 2022



# Impact of High MELD Scores on CMV Viremia Following Liver Transplantation

@TheTxIDJournal @SarIimNotSorry

Freedman *et al. Transplant Infectious Diseases.* 2022.

## DESIGN

Retrospective, single-center cohort

Liver transplant recipients

High-risk for CMV (CMV IgG D+/R-) receiving valganciclovir prophylaxis x3 months

Low MELD (<35)
n=162

High MELD (≥35)
n=79

## OUTCOMES

| | CMV viremia at 12 months | Mean time to CMV |
|---|---|---|
| Low MELD | 26.5% | 162 days |
| High MELD | 38.0% | 139 days |

**Multivariable Cox proportional-hazards model for CMV viremia**

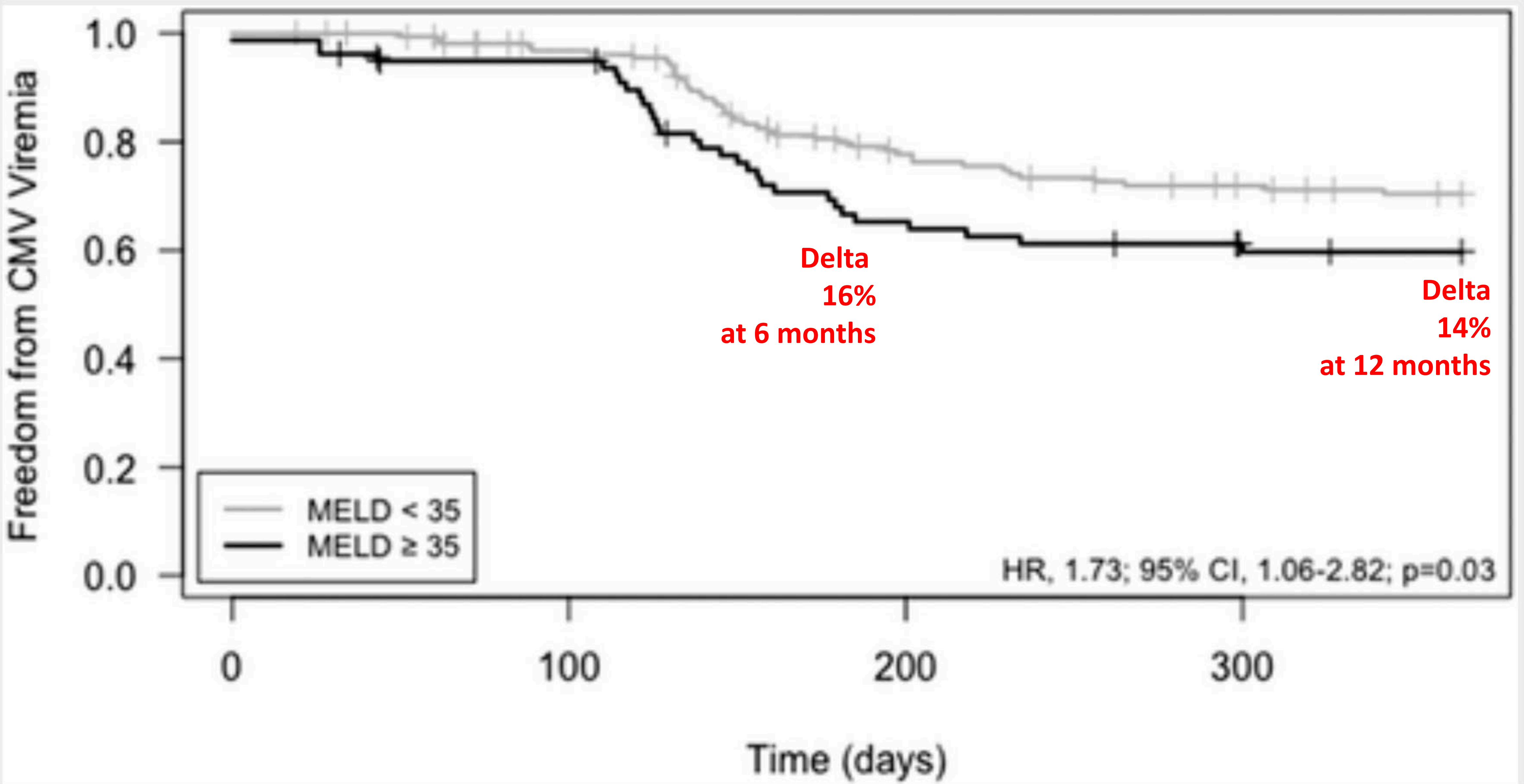
| Variable | Hazard ratio with 95% CI | p-value |
|---|---|---|
| **MELD ≥ 35** | 1.73 (1.06-2.82) | 0.03 |
| **Recipient age** | 1.02 (0.99-1.04) | 0.12 |
| **Male sex** | 0.68 (0.41-1.11) | 0.12 |
| **Donor age** | 1.01 (0.99-1.03) | 0.07 |
| **BPAR before CMV** | 1.55 (0.93-2.60) | 0.10 |

Additional CMV intervention may be warranted following 3 months of prophylaxis among liver transplant recipients with MELD scores ≥35 who are CMV high-risk.

WILEY TRANSPLANT INFECTIOUS DISEASE

# Impact of high MELD scores on CMV viremia following liver transplantation

Transplant Infectious Dis, Volume: 25, Issue: 1, 12: 2022



Delta 16% at 6 months

Delta 14% at 12 months

# Survival Outcomes Following Liver Transplantation (SOFT) Score: A Novel Method to Predict Patient Survival Following Liver Transplantation

**A. Rana***, **M. A. Hardy, K. J. Halazun, D. C. Woodland, L. E. Ratner, B. Samstein, J. V. Guarrera, R. S. Brown Jr. and J. C. Emond**

*Division of Abdominal Organ Transplantation, Columbia University College of Physicians and Surgeons, New York*

*American Journal of Transplantation 2008; 8: 2537–2546*

PATIENT POPULATION 21.673 patients from DBD (2002-2006) and 41.504 years-at-risk

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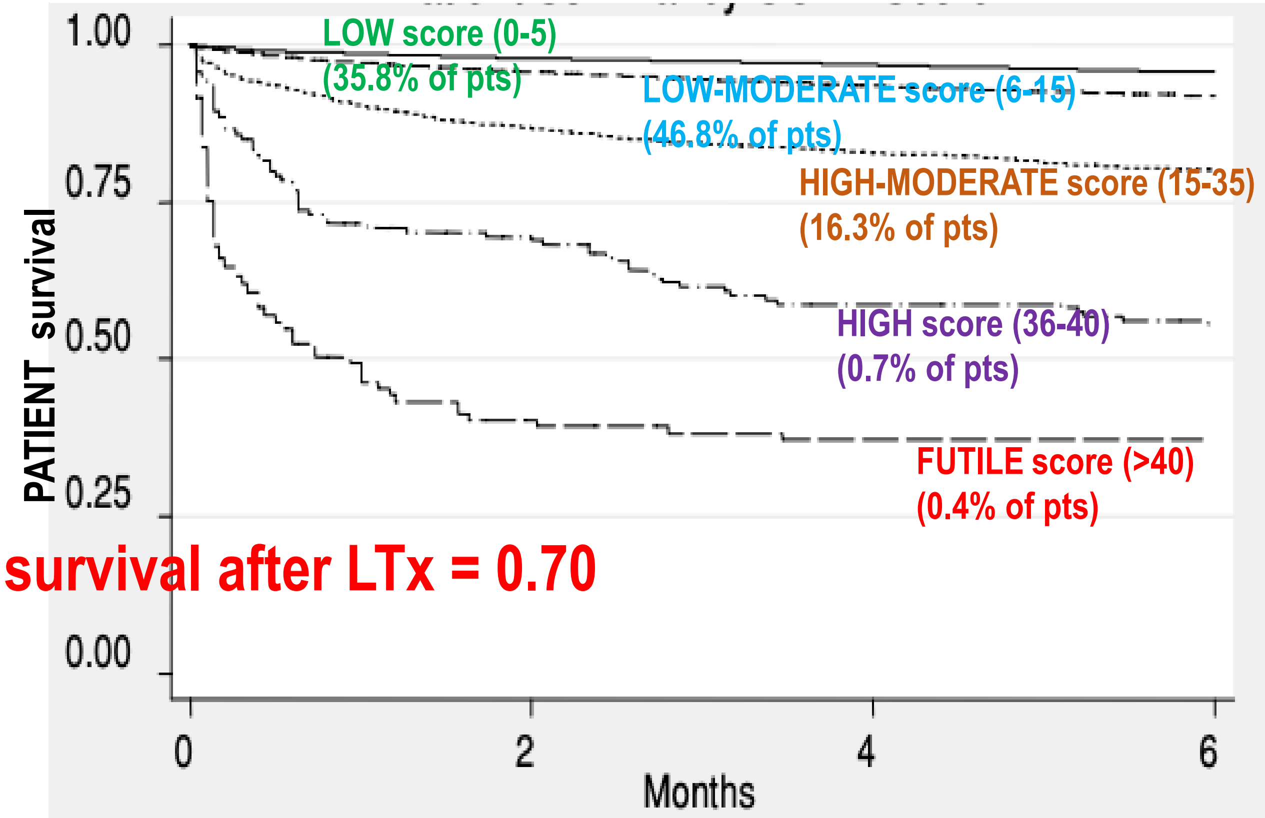
**Table 4:** P-SOFT and SOFT scores

| Risk factor | Points allotted |
|---|---|
| **Score to predict survival outcomes following liver transplantation (SOFT)** | |
| • P-SOFT score | Total from above |
| • Portal bleed 48 h pretransplant | 6 |
| • Donor age 10–20 years | –2 |
| • Donor age > 60 years | 3 |
| • Donor cause of death from cerebral vascular accident | 2 |
| • Donor creatinine > 1.5 mg/dL | 2 |
| • National allocation | 2 |
| • Cold ischemia time 0–6 h | –3 |

BMI = body mass index; MELD = model for end-stage liver disease.

**SOFT score**



c-statistic for 3-month survival after LTx = 0.70

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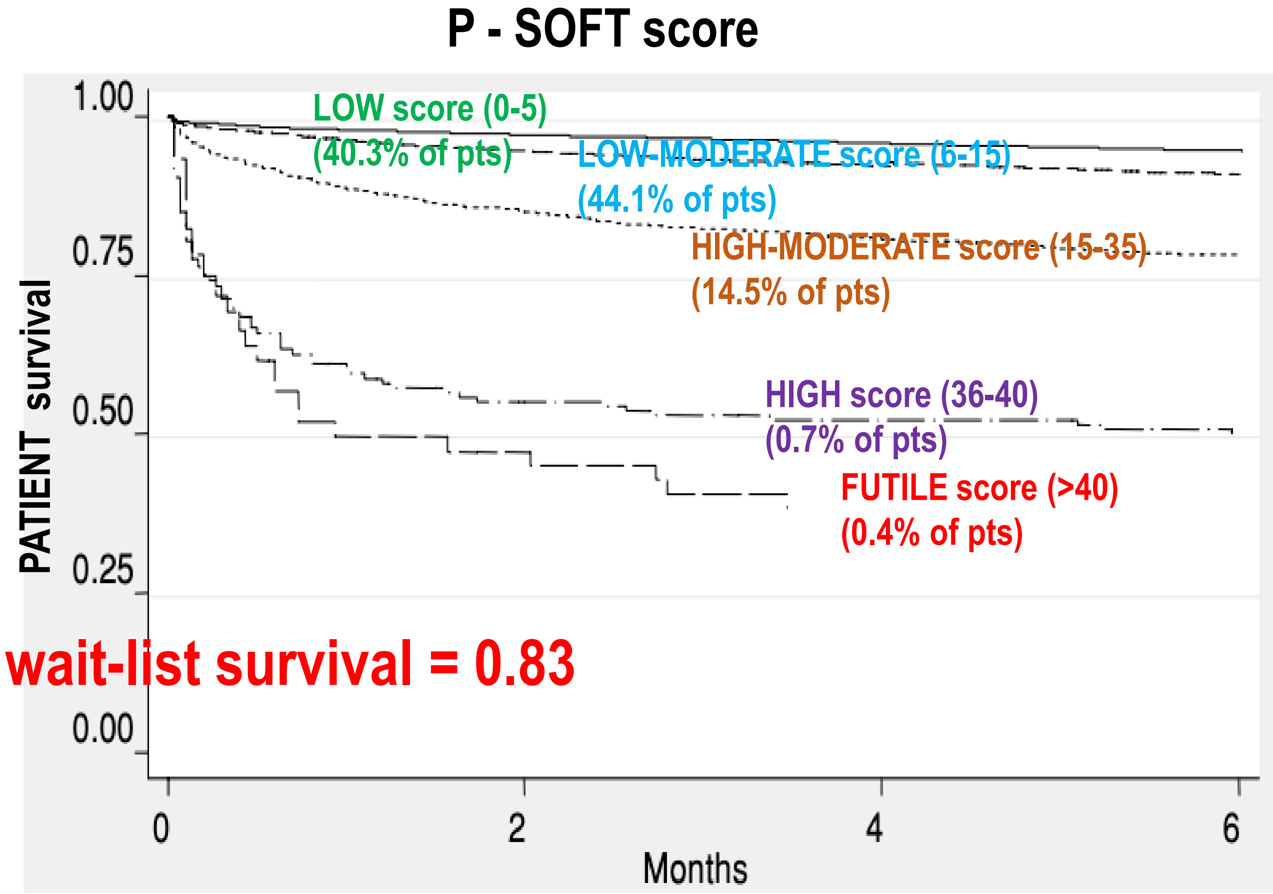
| Risk factor | Points allotted |
|---|---|
| **Preallocation score to predict survival outcomes following live transplantation (P-SOFT)** | |
| • Age > 60 | 4 |
| • BMI > 35 | 2 |
| • One previous transplant | 9 |
| • Two previous transplants | 14 |
| • Previous abdominal surgery | 2 |
| • Albumin < 2.0 g/dL | 2 |
| • Dialysis prior to transplantation | 3 |
| • Intensive care unit pretransplant | 6 |
| • Admitted to hospital pretransplant | 3 |
| • MELD score >30 | 4 |
| • Life support pretransplant | 9 |
| • Encephalopathy | 2 |
| • Portal vein thrombosis | 5 |
| • Ascites pretransplant | 3 |



**c-statistic for 3-month wait-list survival = 0.83**

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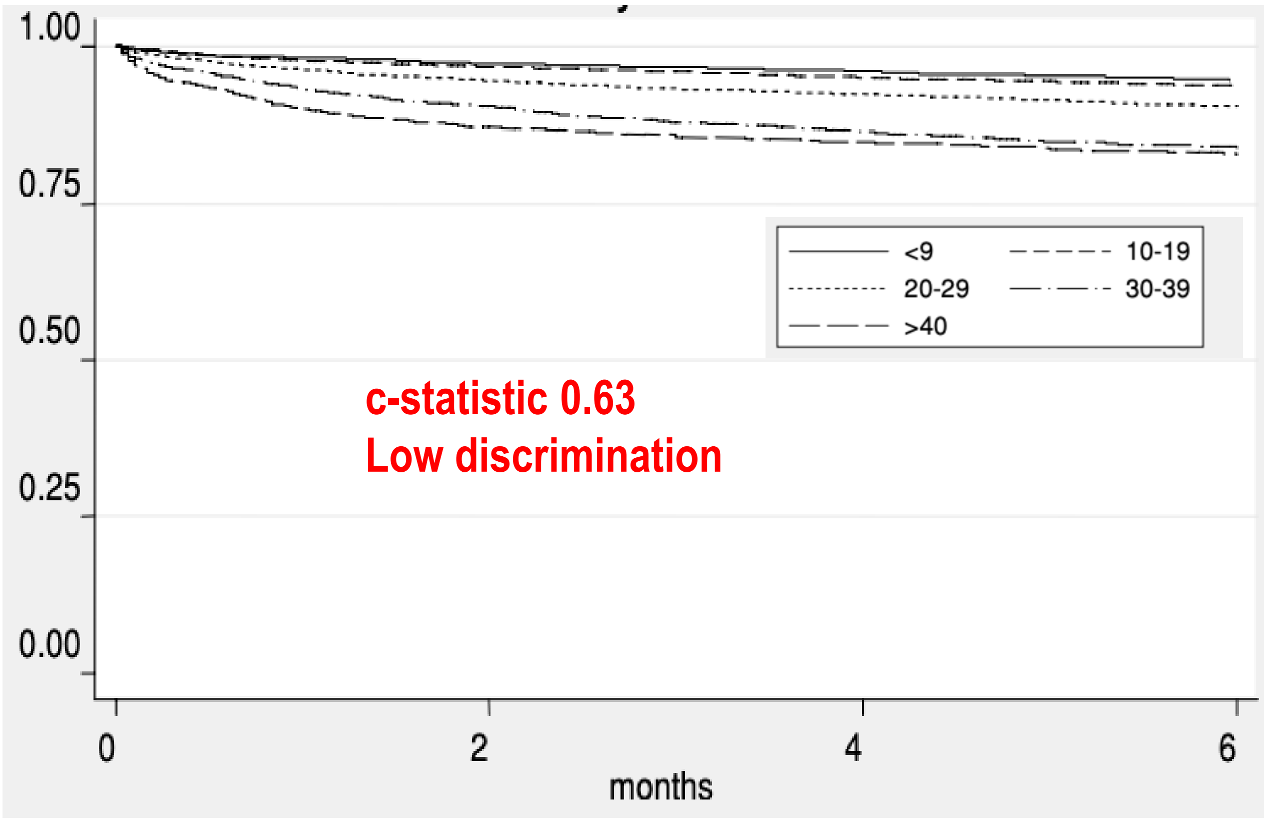
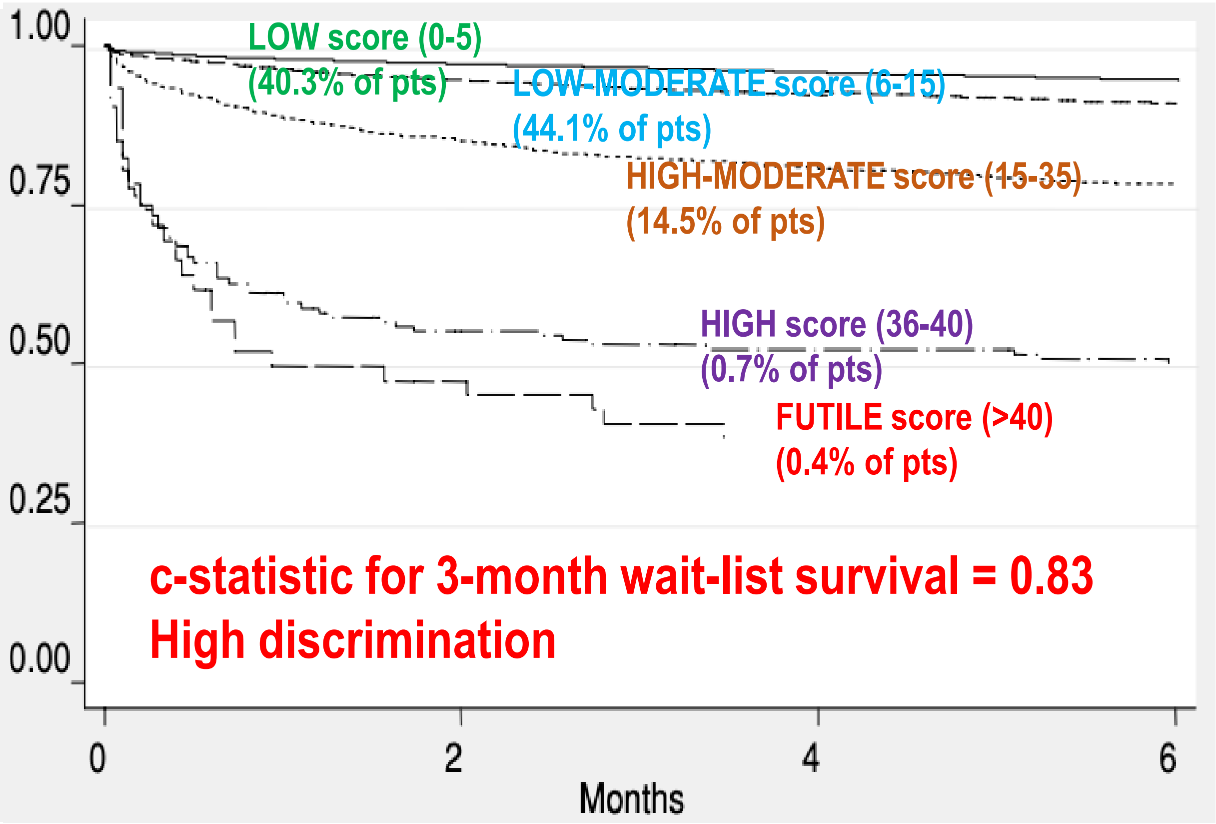
**MELD score**



c-statistic 0.63
Low discrimination

**P - SOFT score**



c-statistic for 3-month wait-list survival = 0.83
High discrimination

# The Economic Implications of Broader Sharing of Liver Allografts

**D. A. Axelrod[a]*, A. Gheorghian[b], M. A. Schnitzler[b], N. Dzebisashvili[b], P. R. Salvalaggio[b], J. Tuttle-Newhall[c], D. L. Segev[d], S. Gentry[e], S. Hohmann[f], R. M. Merion[g] and K. L. Lentine[b]**

[a] *Department of Surgery, Dartmouth-Hitchcock Medical Center, Hanover, NH*
[b] *Center for Outcomes Research, Saint Louis University School of Medicine, St. Louis, MO*

**Table 2:** Regression model for prediction of transplant hospitalization costs based on illness severity at transplant and other clinical and demographic factors

| Characteristic | Parameter estimate, (Standard error) $ | p-Value |
|---|---|---|
| Regression intercept | 129 519 (6338) | <0.0001 |
| Donor risk index | | |
| <1.17 | Reference | |
| 1.17–1.36 | 2883 (2351) | 0.22 |
| 1.37–1.61 | 7735 (2356) | 0.001 |
| 1.62–1.92 | 5241 (2392) | 0.03 |
| >1.93 | 11 013 (2516) | <0.0001 |
| Missing | 11 306 (2598) | <0.0001 |
| Recipient age | | |
| 12–17 | –6999 (6552) | 0.28 |
| 18–29 | –5642 (4346) | 0.19 |
| 30–45 | Reference | |
| 45–59 | 3560 (2308) | 0.12 |
| 60+ | 8547 (2588) | 0.001 |

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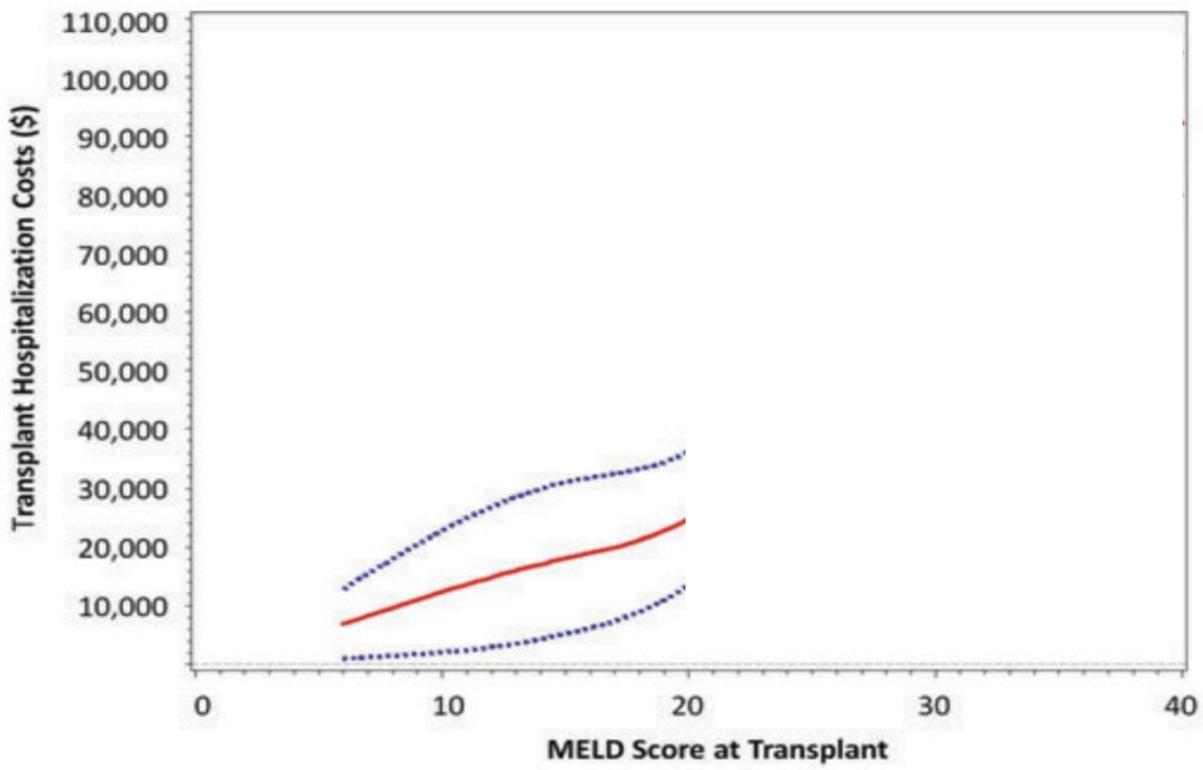
| Illness severity at transplant | | |
| MELD score at transplant | | |
| <10 | Reference | |
| 10–14 | 6876 (2853) | 0.02 |
| 15–19 | 7876 (2826) | 0.005 |
| 20–24 | 21 782 (2939) | <0.0001 |
| 25–29 | 42 171 (3214) | <0.0001 |
| 30–34 | 79 136 (3507) | <0.0001 |
| ≥35 | 87 625 (3402) | <0.0001 |
| Status 1 | 60 012 (4758) | <0.0001 |



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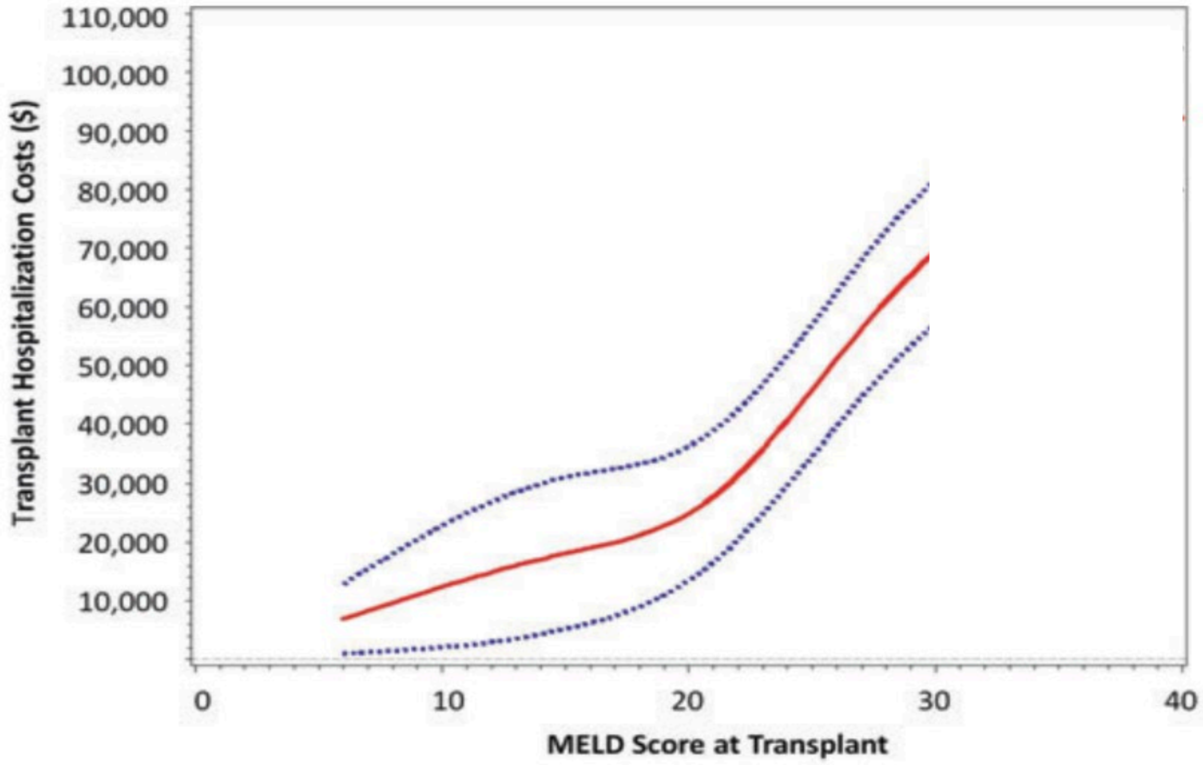

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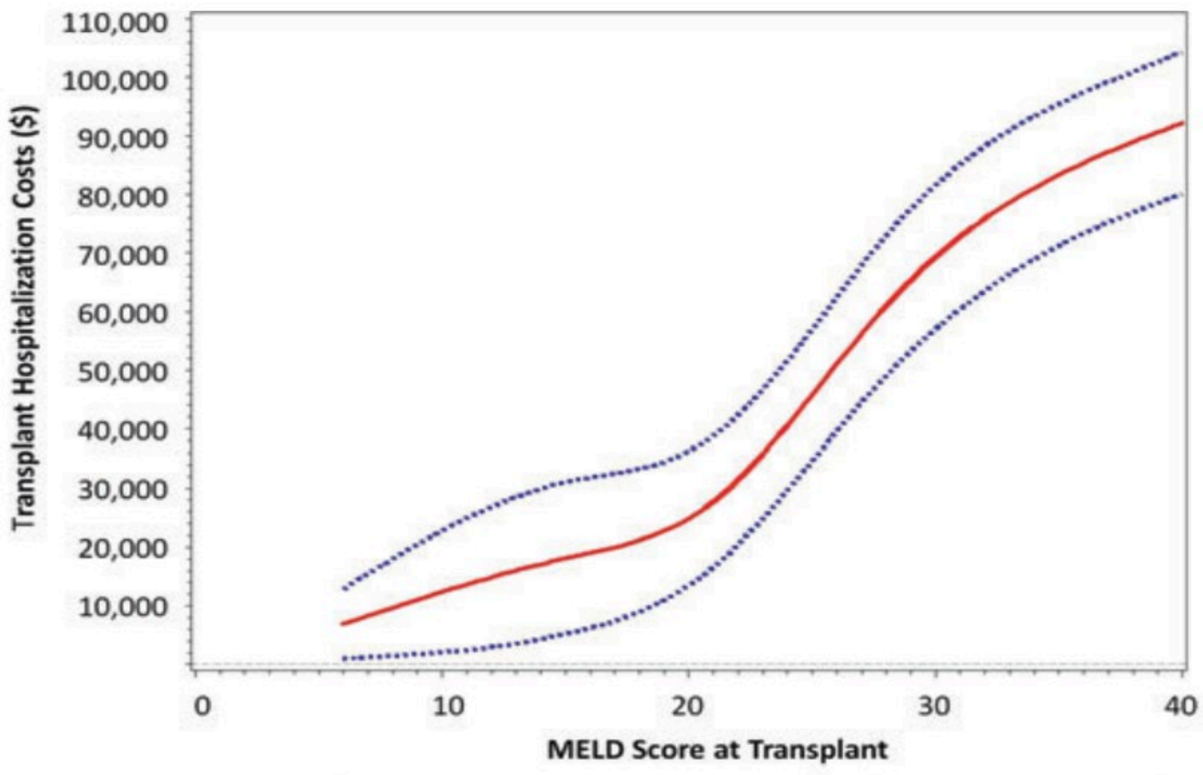

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# Hyponatremia and Mortality among Patients on the Liver-Transplant Waiting List

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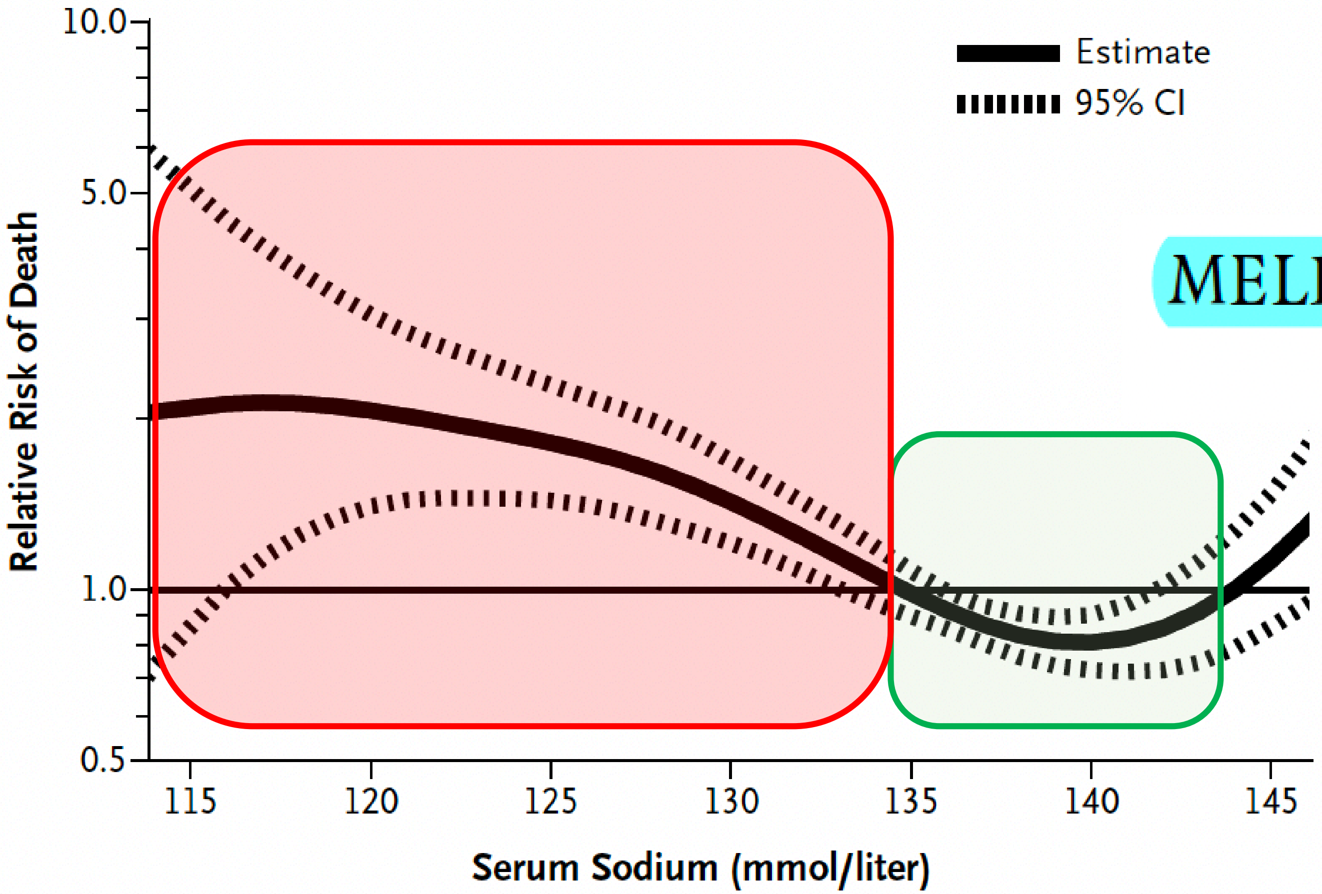
*The* NEW ENGLAND JOURNAL *of* MEDICINE



$$\mathrm{MELDNa} = \mathrm{MELD} - \mathrm{Na} - [0.025 \times \mathrm{MELD} \times (140 - \mathrm{Na})] + 140,$$

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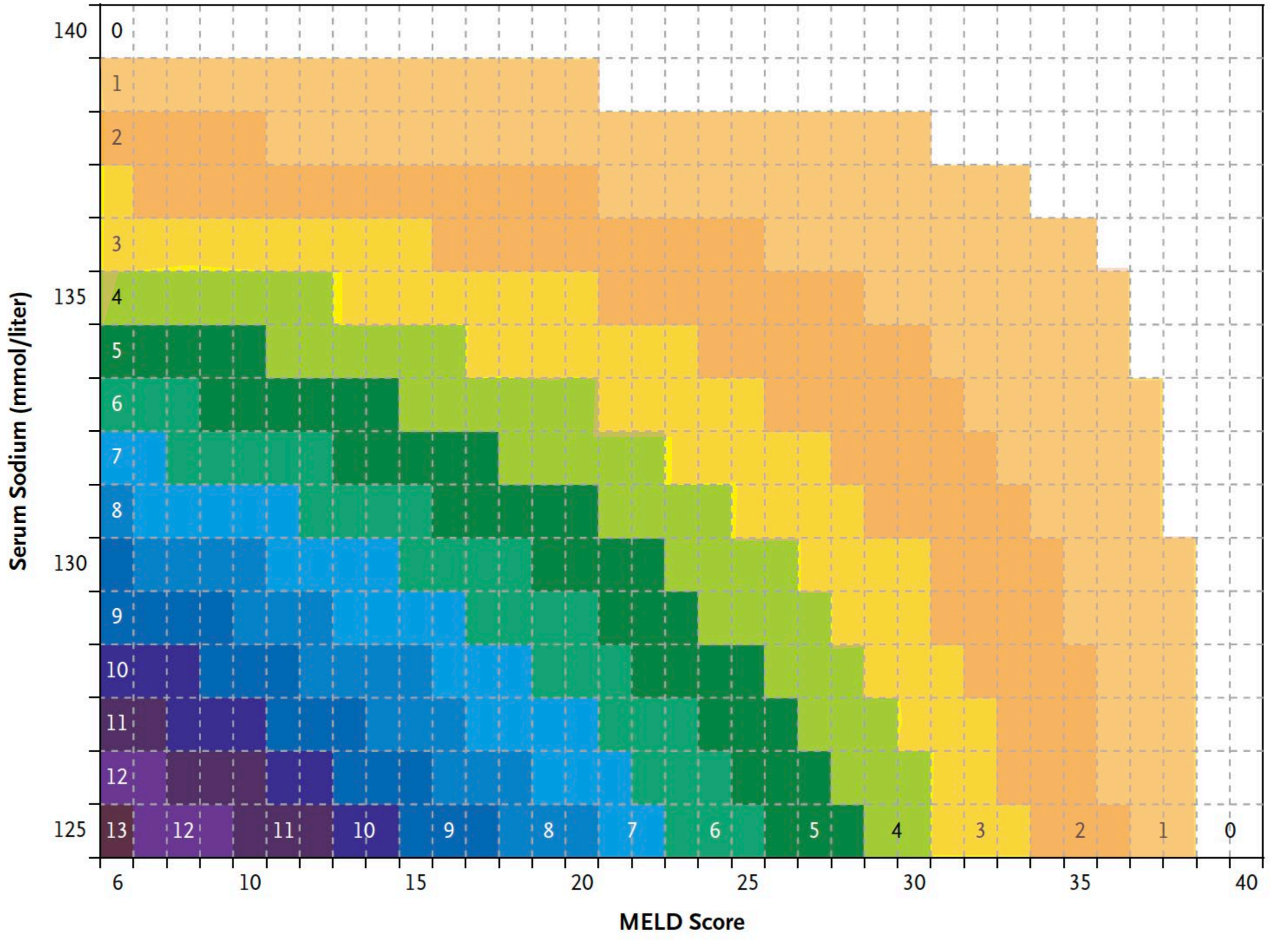

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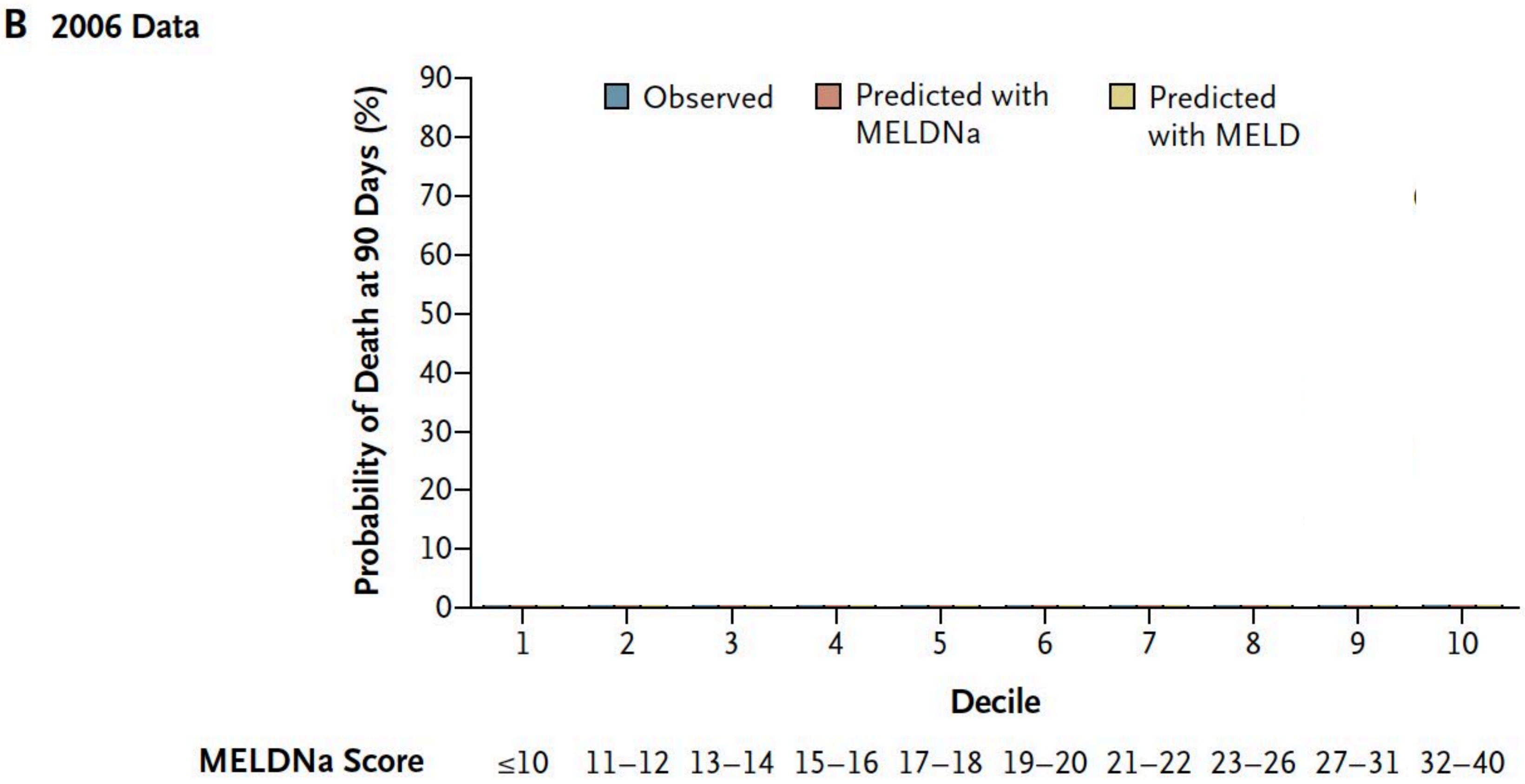

**Figure 3.** Observed and Predicted Probability of Death at 90 Days.

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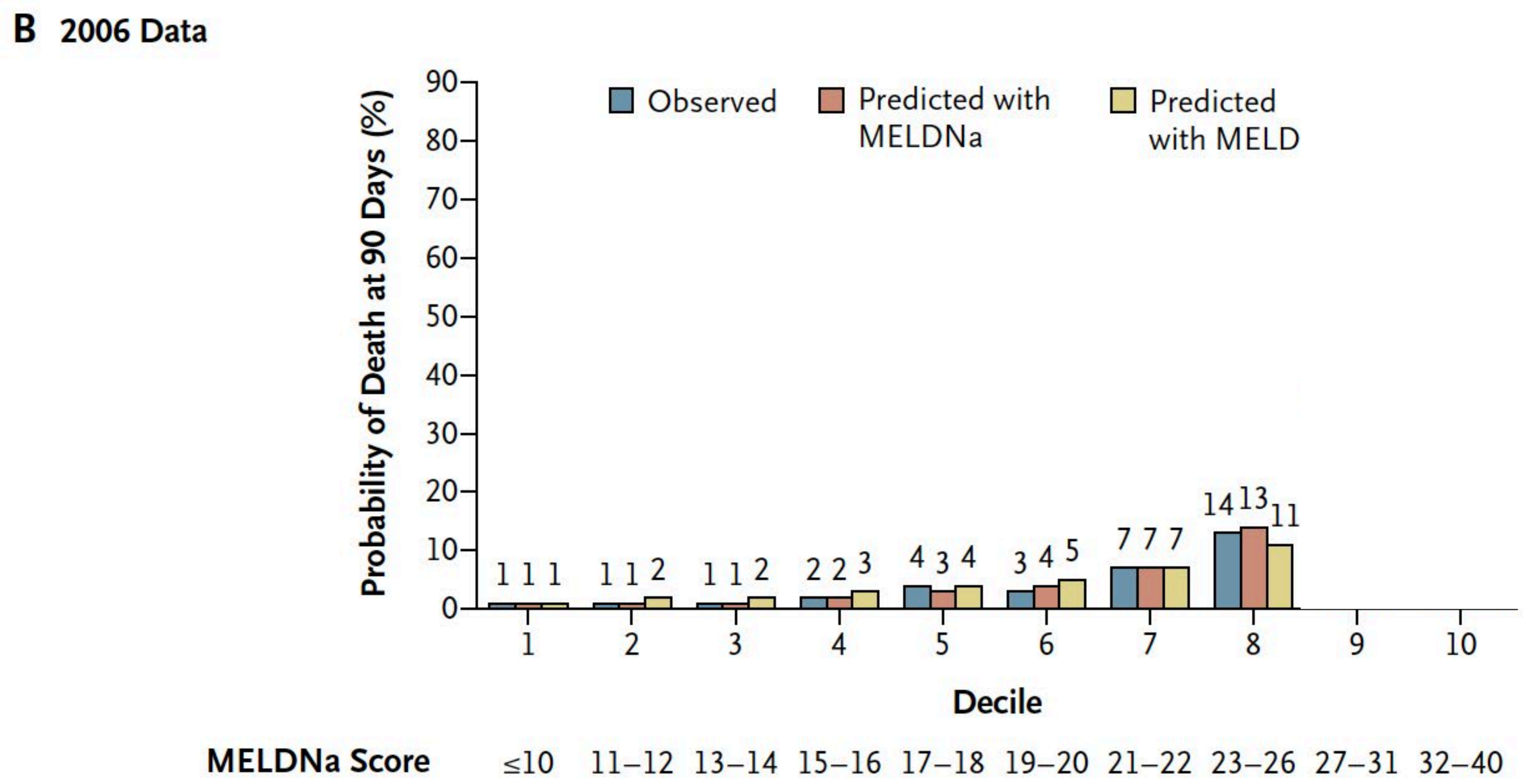

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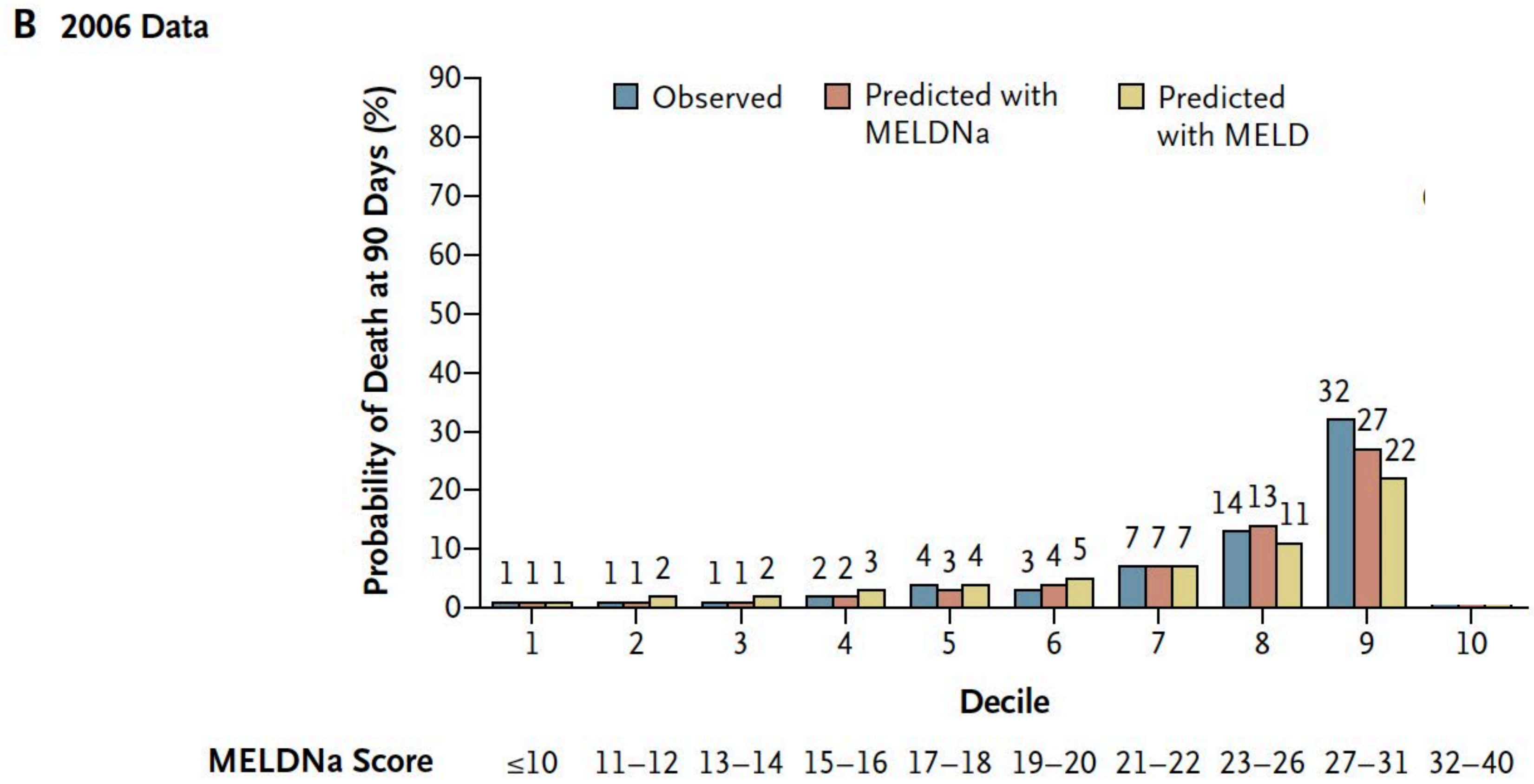

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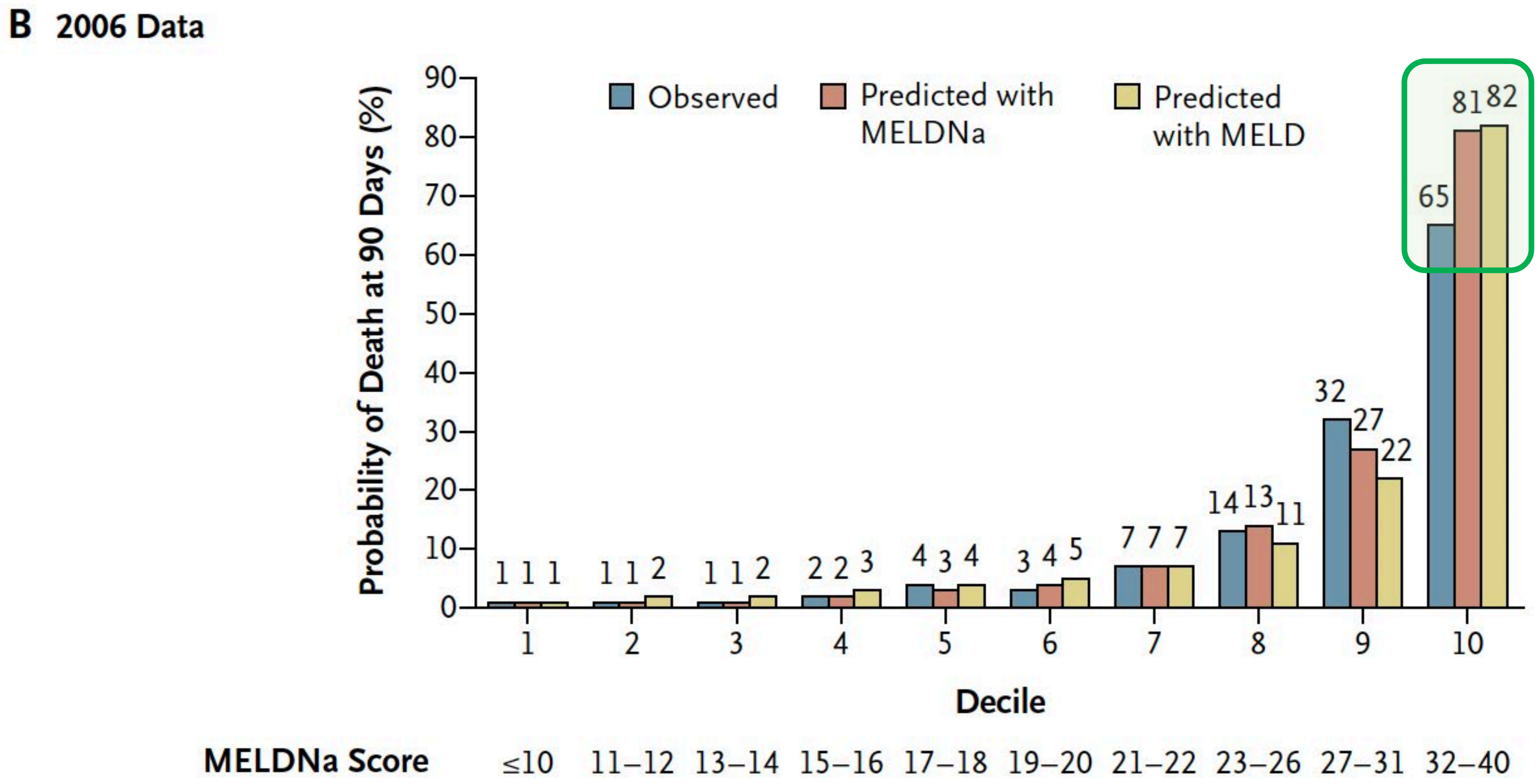

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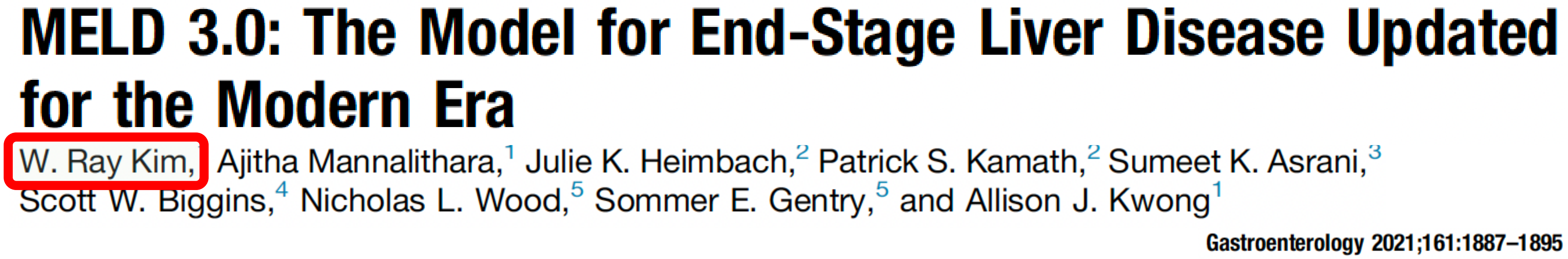


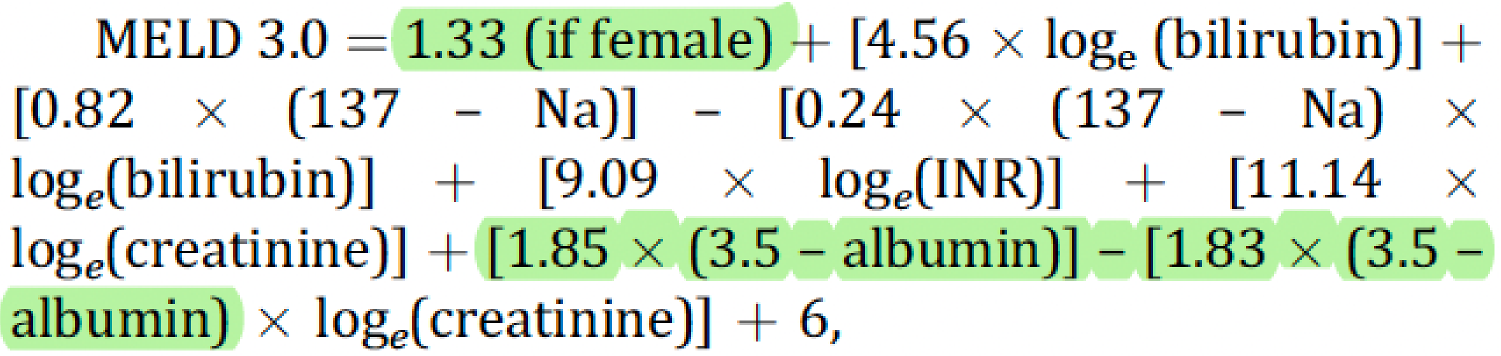
# MELD 3.0: The Model for End-Stage Liver Disease Updated for the Modern Era

W. Ray Kim,[1] Ajitha Mannalithara,[1] Julie K. Heimbach,[2] Patrick S. Kamath,[2] Sumeet K. Asrani,[3] Scott W. Biggins,[4] Nicholas L. Wood,[5] Sommer E. Gentry,[5] and Allison J. Kwong[1]

Gastroenterology 2021;161:1887–1895

- female sex was associated with a significantly higher risk of death

- Godfrey et al suggested that the predictive accuracy of the MELD score has declined over time, attributed to the changing demographics of liver disease,  with a C-statistic of 0.80 in 2003 and 0.70 in 2015.



$$\text{MELD 3.0} = 1.33\ (\text{if female}) + [4.56 \times \log_e(\text{bilirubin})] + [0.82 \times (137 - \text{Na})] - [0.24 \times (137 - \text{Na}) \times \log_e(\text{bilirubin})] + [9.09 \times \log_e(\text{INR})] + [11.14 \times \log_e(\text{creatinine})] + [1.85 \times (3.5 - \text{albumin})] - [1.83 \times (3.5 - \text{albumin}) \times \log_e(\text{creatinine})] + 6,$$

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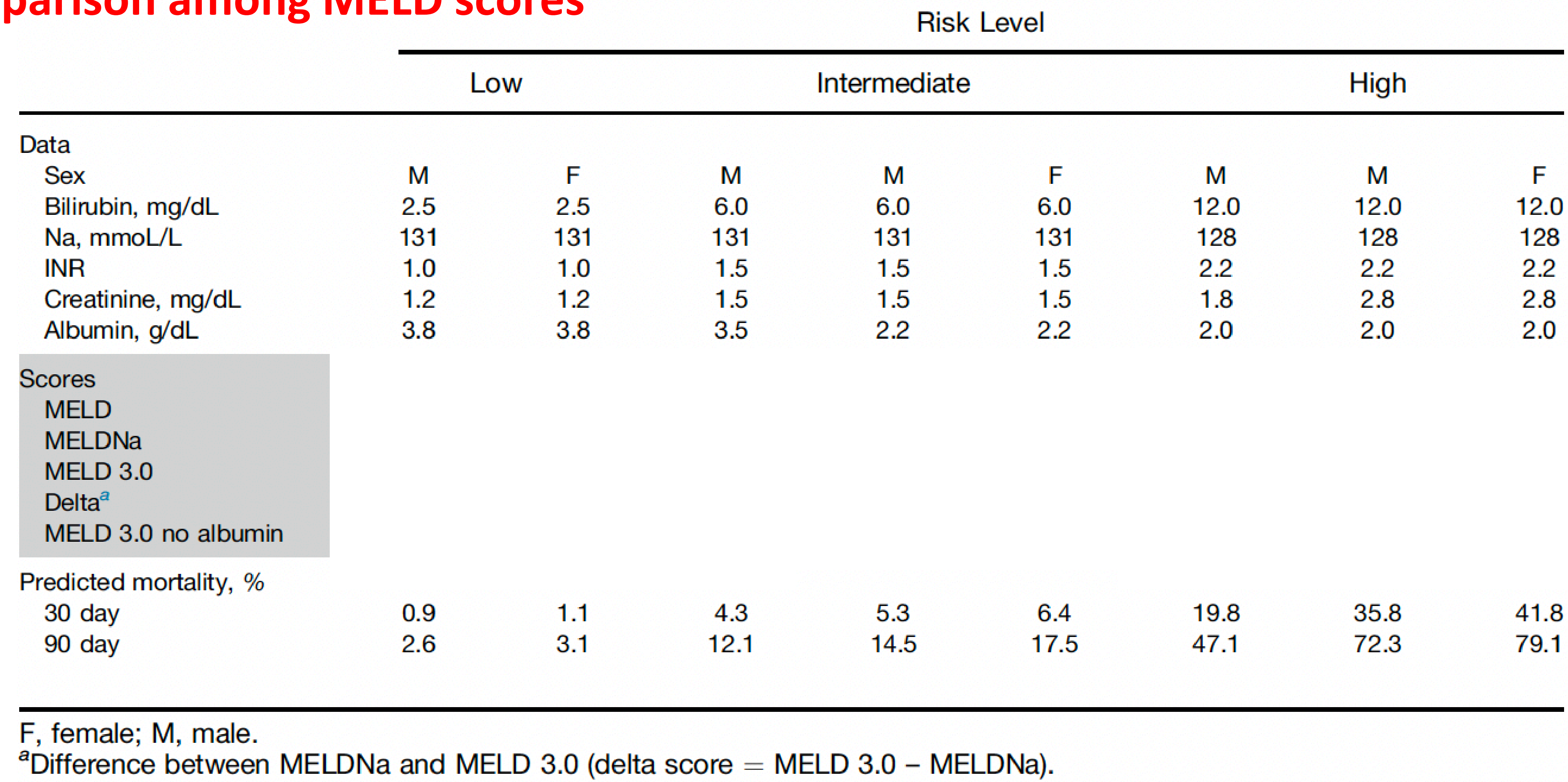
## Comparison among MELD scores



| | Risk Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low | | Intermediate | | | High | | |
| Data | | | | | | | | |
| Sex | M | F | M | M | F | M | M | F |
| Bilirubin, mg/dL | 2.5 | 2.5 | 6.0 | 6.0 | 6.0 | 12.0 | 12.0 | 12.0 |
| Na, mmoL/L | 131 | 131 | 131 | 131 | 131 | 128 | 128 | 128 |
| INR | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 | 2.2 | 2.2 | 2.2 |
| Creatinine, mg/dL | 1.2 | 1.2 | 1.5 | 1.5 | 1.5 | 1.8 | 2.8 | 2.8 |
| Albumin, g/dL | 3.8 | 3.8 | 3.5 | 2.2 | 2.2 | 2.0 | 2.0 | 2.0 |
| Scores | | | | | | | | |
| MELD | | | | | | | | |
| MELDNa | | | | | | | | |
| MELD 3.0 | | | | | | | | |
| Delta[a] | | | | | | | | |
| MELD 3.0 no albumin | | | | | | | | |
| Predicted mortality, % | | | | | | | | |
| 30 day | 0.9 | 1.1 | 4.3 | 5.3 | 6.4 | 19.8 | 35.8 | 41.8 |
| 90 day | 2.6 | 3.1 | 12.1 | 14.5 | 17.5 | 47.1 | 72.3 | 79.1 |

F, female; M, male.

[a] Difference between MELDNa and MELD 3.0 (delta score = MELD 3.0 – MELDNa).

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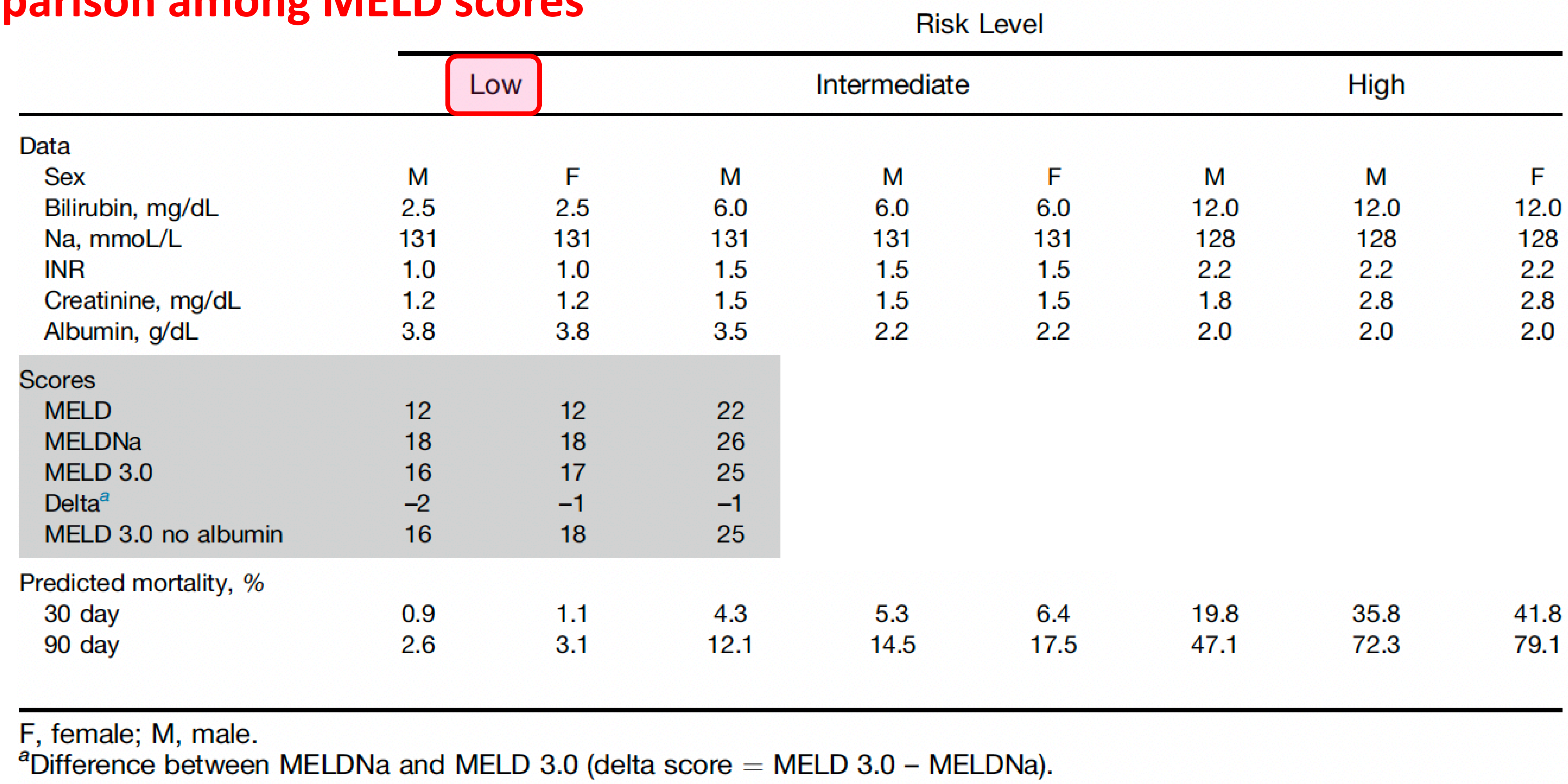


| | Risk Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low | | Intermediate | | | High | | |
| Data | | | | | | | | |
| Sex | M | F | M | M | F | M | M | F |
| Bilirubin, mg/dL | 2.5 | 2.5 | 6.0 | 6.0 | 6.0 | 12.0 | 12.0 | 12.0 |
| Na, mmoL/L | 131 | 131 | 131 | 131 | 131 | 128 | 128 | 128 |
| INR | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 | 2.2 | 2.2 | 2.2 |
| Creatinine, mg/dL | 1.2 | 1.2 | 1.5 | 1.5 | 1.5 | 1.8 | 2.8 | 2.8 |
| Albumin, g/dL | 3.8 | 3.8 | 3.5 | 2.2 | 2.2 | 2.0 | 2.0 | 2.0 |
| Scores | | | | | | | | |
| MELD | 12 | 12 | 22 | | | | | |
| MELDNa | 18 | 18 | 26 | | | | | |
| MELD 3.0 | 16 | 17 | 25 | | | | | |
| Delta[a] | –2 | –1 | –1 | | | | | |
| MELD 3.0 no albumin | 16 | 18 | 25 | | | | | |
| Predicted mortality, % | | | | | | | | |
| 30 day | 0.9 | 1.1 | 4.3 | 5.3 | 6.4 | 19.8 | 35.8 | 41.8 |
| 90 day | 2.6 | 3.1 | 12.1 | 14.5 | 17.5 | 47.1 | 72.3 | 79.1 |

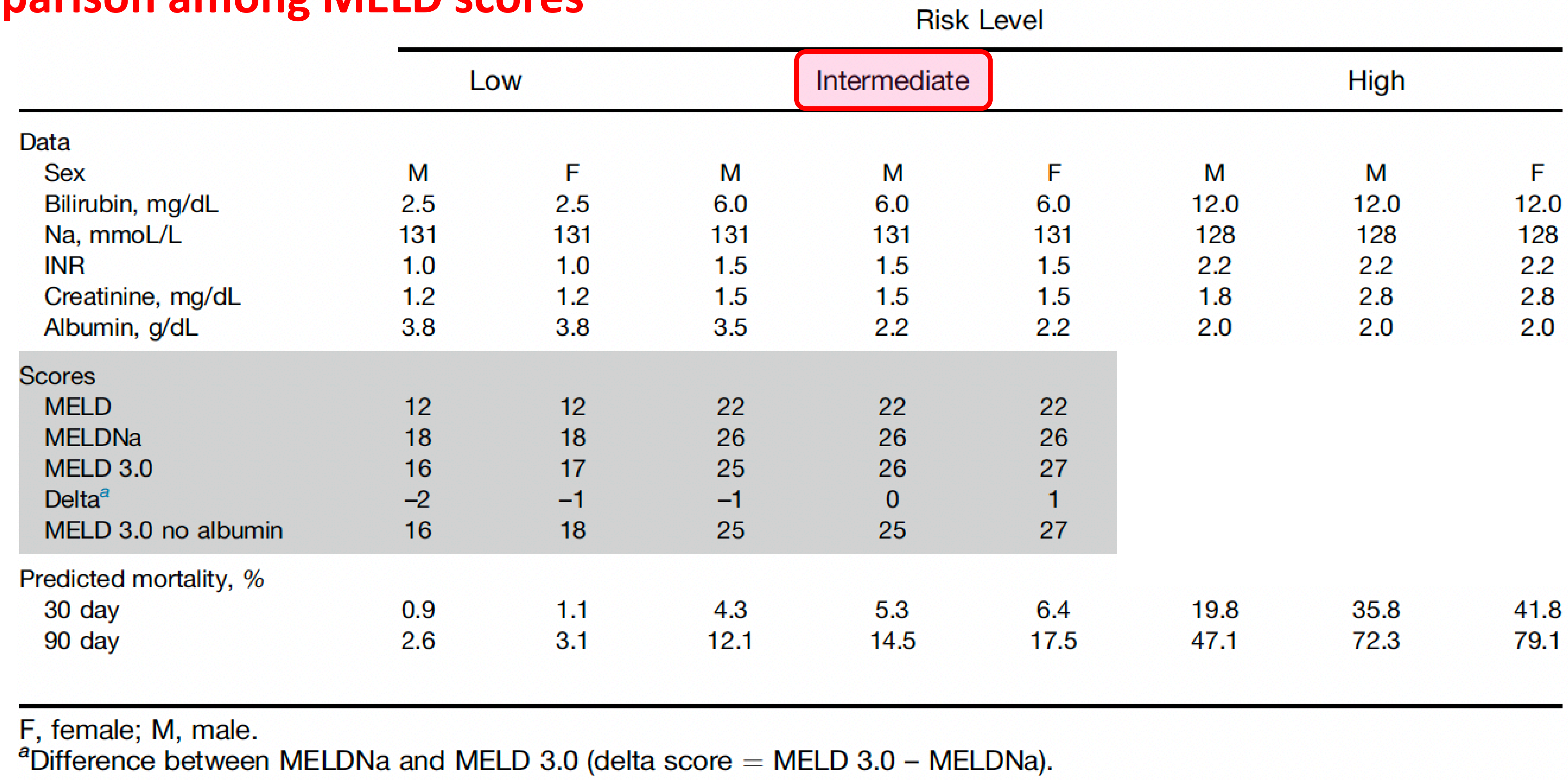
F, female; M, male.
[a] Difference between MELDNa and MELD 3.0 (delta score = MELD 3.0 – MELDNa).

# MELD 3.0: The Model for End-Stage Liver Disease Updated for the Modern Era

W. Ray Kim, Ajitha Mannalithara,[1] Julie K. Heimbach,[2] Patrick S. Kamath,[2] Sumeet K. Asrani,[3]
Scott W. Biggins,[4] Nicholas L. Wood,[5] Sommer E. Gentry,[5] and Allison J. Kwong[1]

Gastroenterology 2021;161:1887–1895

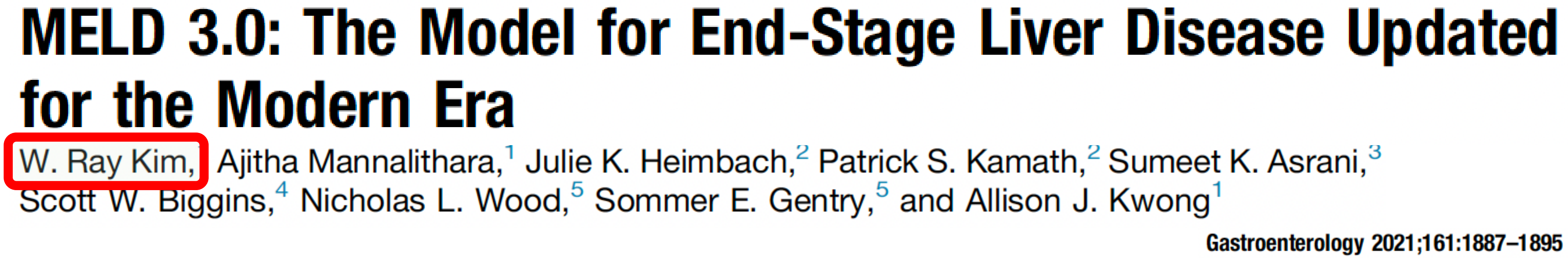
## Comparison among MELD scores



| | Risk Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low | | Intermediate | | | High | | |
| Data | | | | | | | | |
| Sex | M | F | M | M | F | M | M | F |
| Bilirubin, mg/dL | 2.5 | 2.5 | 6.0 | 6.0 | 6.0 | 12.0 | 12.0 | 12.0 |
| Na, mmoL/L | 131 | 131 | 131 | 131 | 131 | 128 | 128 | 128 |
| INR | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 | 2.2 | 2.2 | 2.2 |
| Creatinine, mg/dL | 1.2 | 1.2 | 1.5 | 1.5 | 1.5 | 1.8 | 2.8 | 2.8 |
| Albumin, g/dL | 3.8 | 3.8 | 3.5 | 2.2 | 2.2 | 2.0 | 2.0 | 2.0 |
| Scores | | | | | | | | |
| MELD | 12 | 12 | 22 | 22 | 22 | | | |
| MELDNa | 18 | 18 | 26 | 26 | 26 | | | |
| MELD 3.0 | 16 | 17 | 25 | 26 | 27 | | | |
| Delta[a] | –2 | –1 | –1 | 0 | 1 | | | |
| MELD 3.0 no albumin | 16 | 18 | 25 | 25 | 27 | | | |
| Predicted mortality, % | | | | | | | | |
| 30 day | 0.9 | 1.1 | 4.3 | 5.3 | 6.4 | 19.8 | 35.8 | 41.8 |
| 90 day | 2.6 | 3.1 | 12.1 | 14.5 | 17.5 | 47.1 | 72.3 | 79.1 |

F, female; M, male.

[a] Difference between MELDNa and MELD 3.0 (delta score = MELD 3.0 – MELDNa).



# MELD 3.0: The Model for End-Stage Liver Disease Updated for the Modern Era

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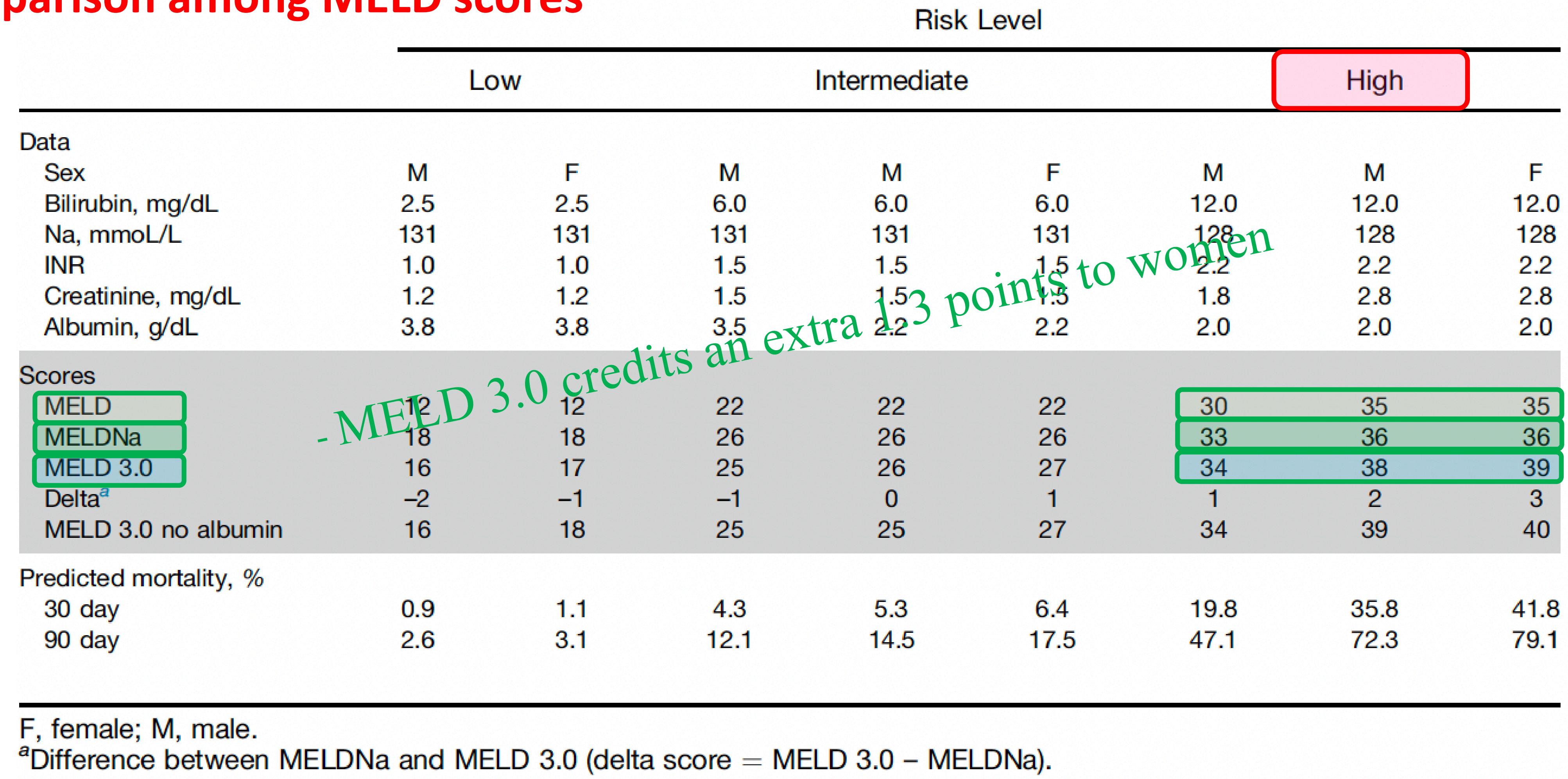
Gastroenterology 2021;161:1887–1895

## Comparison among MELD scores



| | Risk Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low | | Intermediate | | | High | | |
| Data | | | | | | | | |
| Sex | M | F | M | M | F | M | M | F |
| Bilirubin, mg/dL | 2.5 | 2.5 | 6.0 | 6.0 | 6.0 | 12.0 | 12.0 | 12.0 |
| Na, mmoL/L | 131 | 131 | 131 | 131 | 131 | 128 | 128 | 128 |
| INR | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 | 2.2 | 2.2 | 2.2 |
| Creatinine, mg/dL | 1.2 | 1.2 | 1.5 | 1.5 | 1.5 | 1.8 | 2.8 | 2.8 |
| Albumin, g/dL | 3.8 | 3.8 | 3.5 | 2.2 | 2.2 | 2.0 | 2.0 | 2.0 |
| Scores | | | | | | | | |
| MELD | 12 | 12 | 22 | 22 | 22 | 30 | 35 | 35 |
| MELDNa | 18 | 18 | 26 | 26 | 26 | 33 | 36 | 36 |
| MELD 3.0 | 16 | 17 | 25 | 26 | 27 | 34 | 38 | 39 |
| Delta[a] | −2 | −1 | −1 | 0 | 1 | 1 | 2 | 3 |
| MELD 3.0 no albumin | 16 | 18 | 25 | 25 | 27 | 34 | 39 | 40 |
| Predicted mortality, % | | | | | | | | |
| 30 day | 0.9 | 1.1 | 4.3 | 5.3 | 6.4 | 19.8 | 35.8 | 41.8 |
| 90 day | 2.6 | 3.1 | 12.1 | 14.5 | 17.5 | 47.1 | 72.3 | 79.1 |

F, female; M, male.

[a] Difference between MELDNa and MELD 3.0 (delta score = MELD 3.0 − MELDNa).

- MELD 3.0 credits an extra 1-3 points to women

# Sarco-Model: A score to predict the dropout risk in the perspective of organ allocation in patients awaiting liver transplantation

Liver International

*Liver International*. 2021;00:1–12.

Q.Lai, P.Magistri, R.Lionetti, A.W. Avolio, I. Lenci, V. Giannelli, A.R. Pecchi, F. Ferri, G. Marrone, M. Angelico, M. Milana, V. Schinniná, R. Menozzi, M. Di Martino, A. T.M. Manzia, G. Tisone, S. Agnes, M. Rossi, F. Di Benedetto, G.M. Ettorre

## Total Psoas Area (TPA)

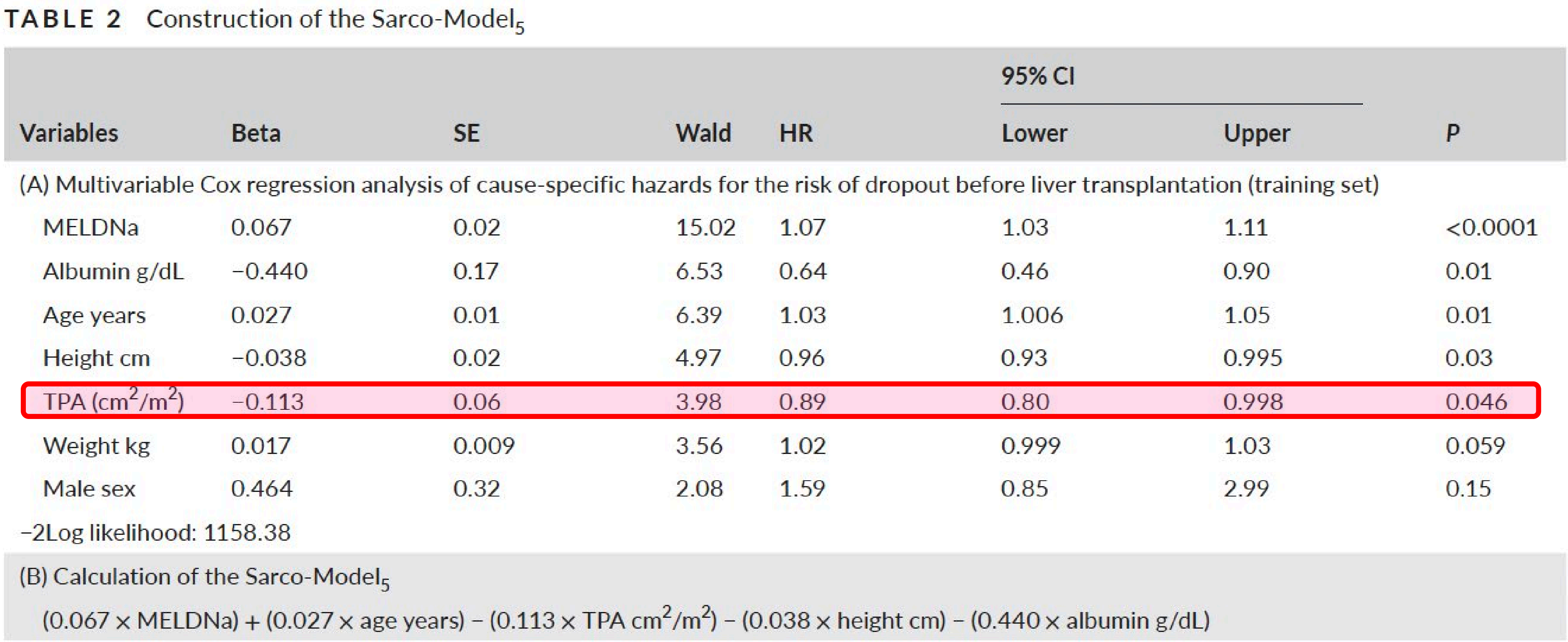


**TABLE 2** Construction of the Sarco-Model$_5$

| | | | | | 95% CI | | |
|---|---|---|---|---|---|---|---|
| Variables | Beta | SE | Wald | HR | Lower | Upper | P |
| (A) Multivariable Cox regression analysis of cause-specific hazards for the risk of dropout before liver transplantation (training set) | | | | | | | |
| MELDNa | 0.067 | 0.02 | 15.02 | 1.07 | 1.03 | 1.11 | <0.0001 |
| Albumin g/dL | −0.440 | 0.17 | 6.53 | 0.64 | 0.46 | 0.90 | 0.01 |
| Age years | 0.027 | 0.01 | 6.39 | 1.03 | 1.006 | 1.05 | 0.01 |
| Height cm | −0.038 | 0.02 | 4.97 | 0.96 | 0.93 | 0.995 | 0.03 |
| TPA (cm$^2$/m$^2$) | −0.113 | 0.06 | 3.98 | 0.89 | 0.80 | 0.998 | 0.046 |
| Weight kg | 0.017 | 0.009 | 3.56 | 1.02 | 0.999 | 1.03 | 0.059 |
| Male sex | 0.464 | 0.32 | 2.08 | 1.59 | 0.85 | 2.99 | 0.15 |
| −2Log likelihood: 1158.38 | | | | | | | |
| (B) Calculation of the Sarco-Model$_5$ | | | | | | | |
| (0.067 × MELDNa) + (0.027 × age years) − (0.113 × TPA cm$^2$/m$^2$) − (0.038 × height cm) − (0.440 × albumin g/dL) | | | | | | | |

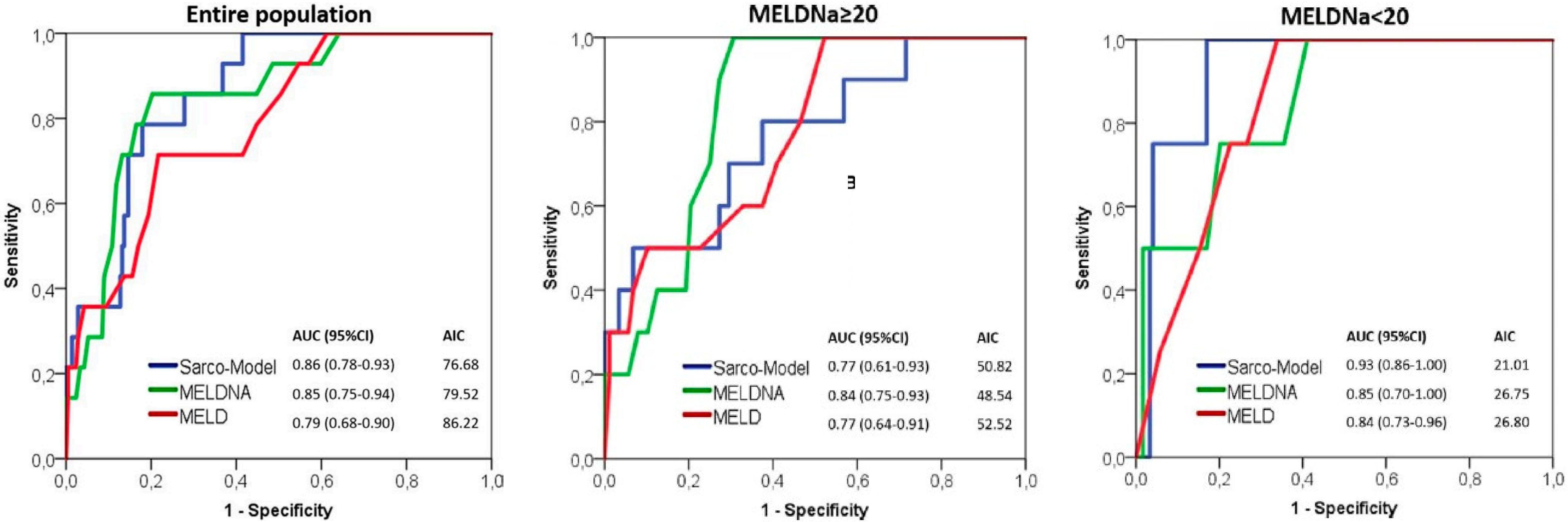
# Sarco-Model: A score to predict the dropout risk in the perspective of organ allocation in patients awaiting liver transplantation

Liver INTERNATIONAL

*Liver International*. 2021;00:1–12.

Q.Lai, P.Magistri, R.Lionetti, A.W. Avolio, I. Lenci, V. Giannelli, A.R. Pecchi, F. Ferri, G. Marrone, M. Angelico, M. Milana, V. Schinniná, R. Menozzi, M. Di Martino, A. T.M. Manzia, G. Tisone, S. Agnes, M. Rossi, F. Di Benedetto, G.M. Ettorre

**Sarco-Model** $(0.067 \times \text{MELDNa}) + (0.027 \times \text{age years}) - (0.113 \times \text{TPA cm}^2/\text{m}^2) - (0.038 \times \text{height cm}) - (0.440 \times \text{albumin g/dL})$



# Sarco-Model: A score to predict the dropout risk in the perspective of organ allocation in patients awaiting liver transplantation

Liver INTERNATIONAL

*Liver International.* 2021;00:1–12.

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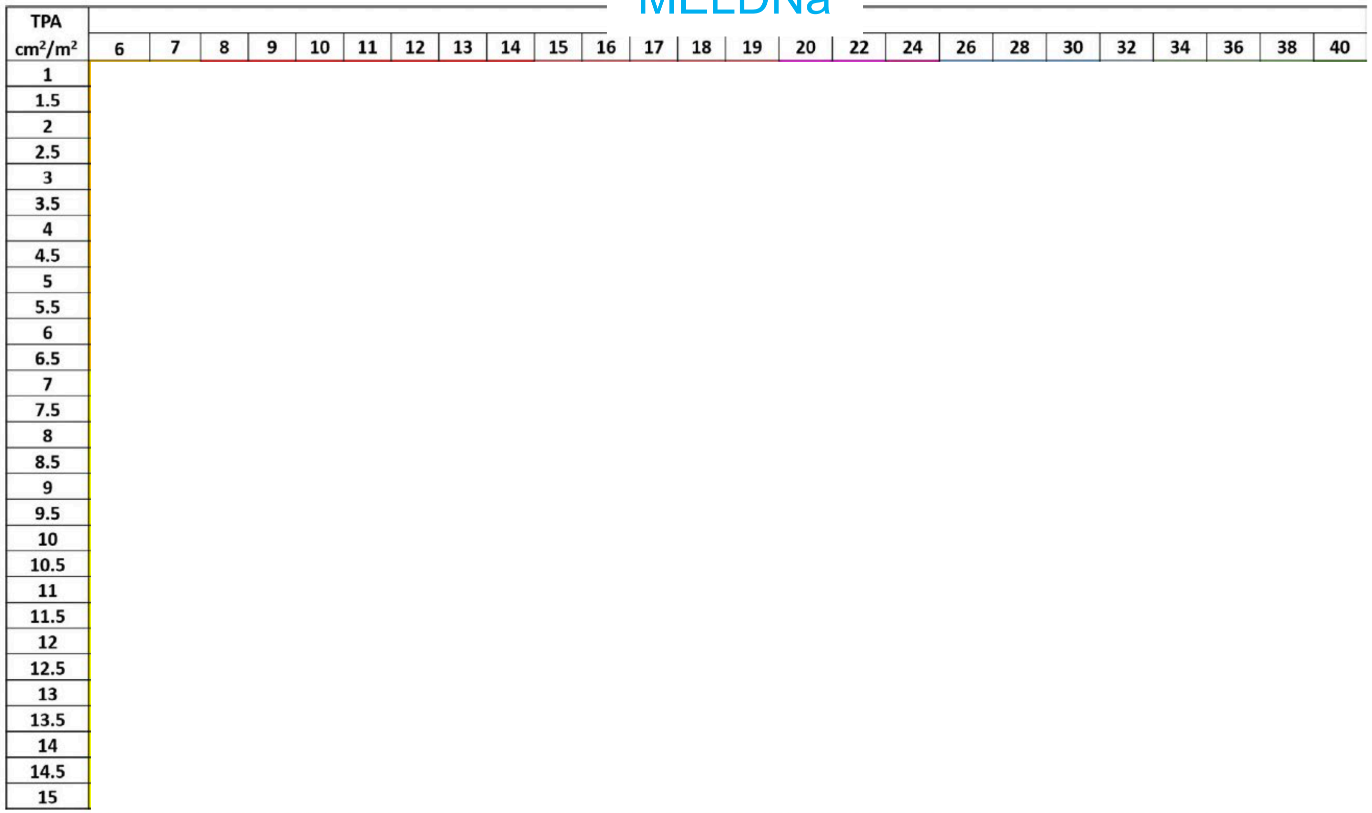
**One extra point** of MELDNa was added for each 0.5 cm2/m2 reduction of Total Psoas Area (TPA) < 6.0 cm2/m2

MELDNa

Total Psoas Area



| TPA cm²/m² | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14.5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | | | | | | | |

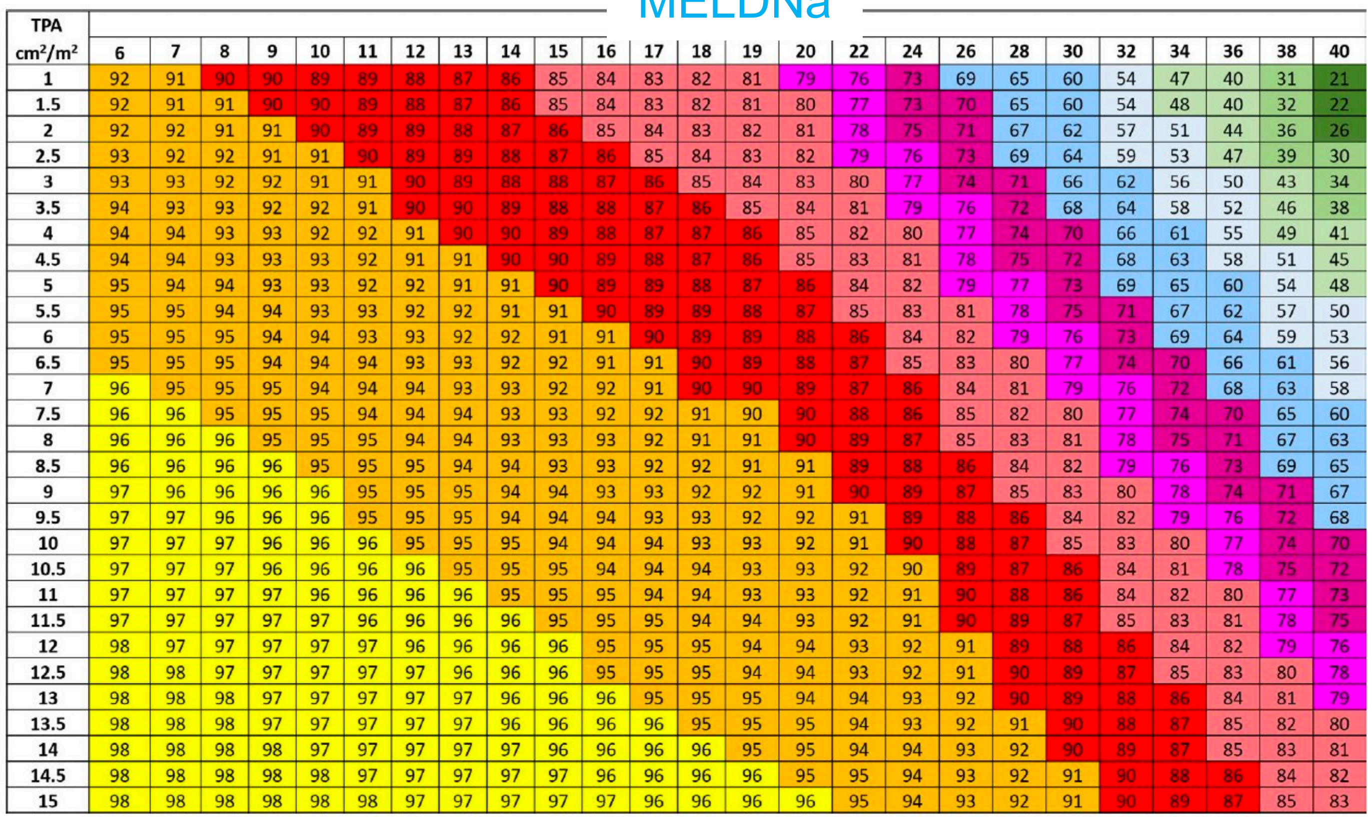
# Sarco-Model: A score to predict the dropout risk in the perspective of organ allocation in patients awaiting liver transplantation

Liver INTERNATIONAL

*Liver International*. 2021;00:1–12.

Q.Lai, P.Magistri, R.Lionetti, A.W. Avolio, I. Lenci, V. Giannelli, A.R. Pecchi, F. Ferri, G. Marrone, M. Angelico, M. Milana, V. Schinniná, R. Menozzi, M. Di Martino, A. T.M. Manzia, G. Tisone, S. Agnes, M. Rossi, F. Di Benedetto, G.M. Ettorre

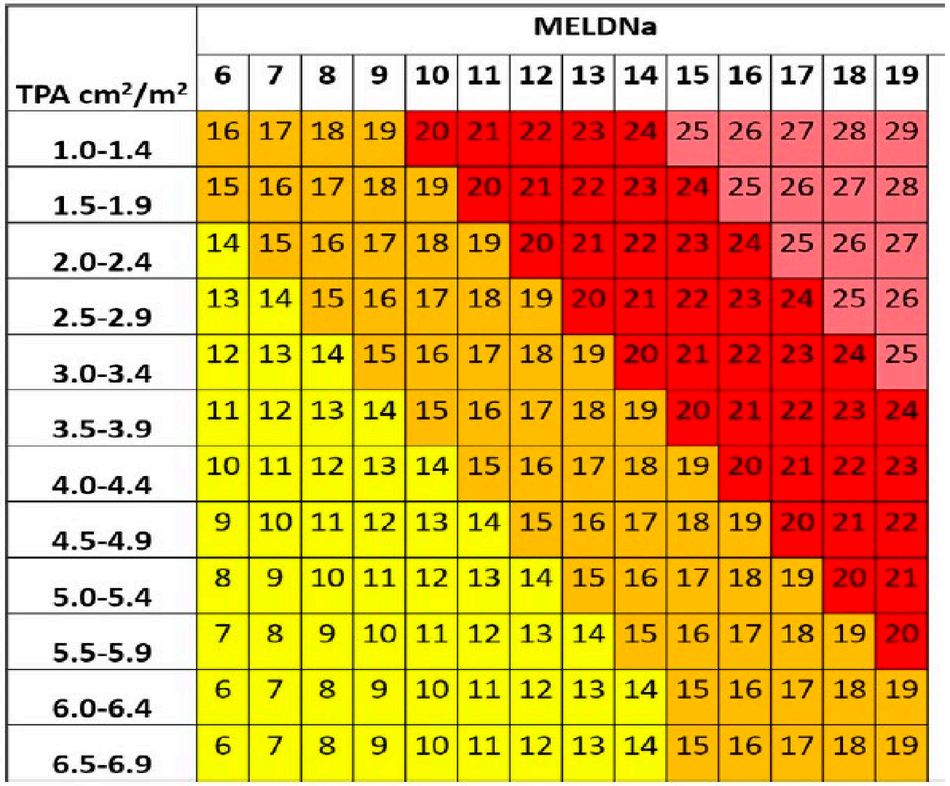
**One extra point** of MELDNa was added for each 0.5 cm2/m2 reduction of Total Psoas Area (TPA) < 6.0 cm2/m2



MELDNa

Total Psoas Area

| TPA cm²/m² | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 92 | 91 | 90 | 90 | 89 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 79 | 76 | 73 | 69 | 65 | 60 | 54 | 47 | 40 | 31 | 21 |
| 1.5 | 92 | 91 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 80 | 77 | 73 | 70 | 65 | 60 | 54 | 48 | 40 | 32 | 22 |
| 2 | 92 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 78 | 75 | 71 | 67 | 62 | 57 | 51 | 44 | 36 | 26 |
| 2.5 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 79 | 76 | 73 | 69 | 64 | 59 | 53 | 47 | 39 | 30 |
| 3 | 93 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 88 | 88 | 87 | 86 | 85 | 84 | 83 | 80 | 77 | 74 | 71 | 66 | 62 | 56 | 50 | 43 | 34 |
| 3.5 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 90 | 89 | 88 | 88 | 87 | 86 | 85 | 84 | 81 | 79 | 76 | 72 | 68 | 64 | 58 | 52 | 46 | 38 |
| 4 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 90 | 89 | 88 | 87 | 87 | 86 | 85 | 82 | 80 | 77 | 74 | 70 | 66 | 61 | 55 | 49 | 41 |
| 4.5 | 94 | 94 | 93 | 93 | 93 | 92 | 91 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 85 | 83 | 81 | 78 | 75 | 72 | 68 | 63 | 58 | 51 | 45 |
| 5 | 95 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 87 | 86 | 84 | 82 | 79 | 77 | 73 | 69 | 65 | 60 | 54 | 48 |
| 5.5 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 87 | 85 | 83 | 81 | 78 | 75 | 71 | 67 | 62 | 57 | 50 |
| 6 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 86 | 84 | 82 | 79 | 76 | 73 | 69 | 64 | 59 | 53 |
| 6.5 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 91 | 90 | 89 | 88 | 87 | 85 | 83 | 80 | 77 | 74 | 70 | 66 | 61 | 56 |
| 7 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 90 | 89 | 87 | 86 | 84 | 81 | 79 | 76 | 72 | 68 | 63 | 58 |
| 7.5 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 90 | 88 | 86 | 85 | 82 | 80 | 77 | 74 | 70 | 65 | 60 |
| 8 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 93 | 92 | 91 | 91 | 90 | 89 | 87 | 85 | 83 | 81 | 78 | 75 | 71 | 67 | 63 |
| 8.5 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 91 | 89 | 88 | 86 | 84 | 82 | 79 | 76 | 73 | 69 | 65 |
| 9 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 89 | 87 | 85 | 83 | 80 | 78 | 74 | 71 | 67 |
| 9.5 | 97 | 97 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 89 | 88 | 86 | 84 | 82 | 79 | 76 | 72 | 68 |
| 10 | 97 | 97 | 97 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 91 | 90 | 88 | 87 | 85 | 83 | 80 | 77 | 74 | 70 |
| 10.5 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 92 | 90 | 89 | 87 | 86 | 84 | 81 | 78 | 75 | 72 |
| 11 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 91 | 90 | 88 | 86 | 84 | 82 | 80 | 77 | 73 |
| 11.5 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 85 | 83 | 81 | 78 | 75 |
| 12 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 89 | 88 | 86 | 84 | 82 | 79 | 76 |
| 12.5 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 85 | 83 | 80 | 78 |
| 13 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 90 | 89 | 88 | 86 | 84 | 81 | 79 |
| 13.5 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 87 | 85 | 82 | 80 |
| 14 | 98 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 94 | 94 | 93 | 92 | 90 | 89 | 87 | 85 | 83 | 81 |
| 14.5 | 98 | 98 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 86 | 84 | 82 |
| 15 | 98 | 98 | 98 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 85 | 83 |

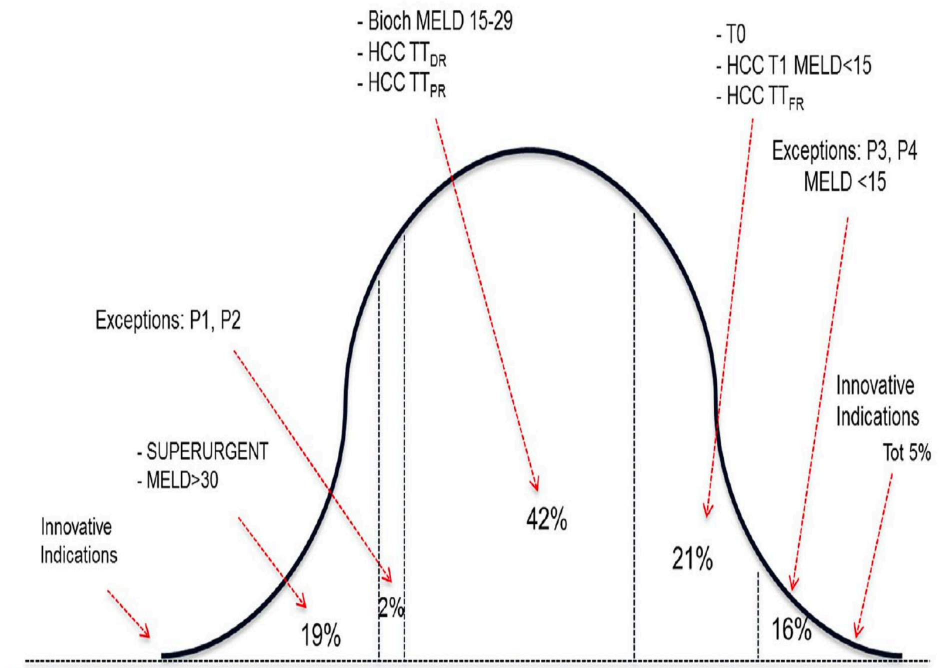


| TPA cm²/m² | MELDNa | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 1.0-1.4 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 1.5-1.9 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 2.0-2.4 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 2.5-2.9 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 3.0-3.4 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 3.5-3.9 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 4.0-4.4 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 4.5-4.9 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 5.0-5.4 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 5.5-5.9 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 6.0-6.4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 6.5-6.9 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

# A Multistep, Consensus-Based Approach to Organ Allocation in Liver Transplantation: Toward a "Blended Principle Model"

## I-BELT (Italian Board of Experts in the Field of Liver Transplantation)

American Journal of Transplantation 2015; 15: 2552–2561



| | | | | | |
|---|---|---|---|---|---|
| PRINCIPLE | 🟦 FUTURE BENEFIT 🟦 | 🟥 Pure URGENCY HIGH BENEFIT 🟥 | 🟨 Low ALTERNATIVES HIGH BENEFIT 🟨 | 🟩 Post OLT UTILITY LOW BENEFIT 🟩 | 🟦 FUTURE BENEFIT 🟦 |
| PRIORITY | Multidisc | Sickest first | Greater benefit | Waitlist time | Multidisc |
| PREDICTOR | ----- | MELD/time bonus | MELD, HCC-MELD | MELD + time bonus | ----- |
| PREVAL 2014 | ----- | 21% | 42% | 37% | ------ |
| FUTURE AIM | Up to2.5% | To be reduced | To be increased | Not greater than 40% | Up to2.5% |

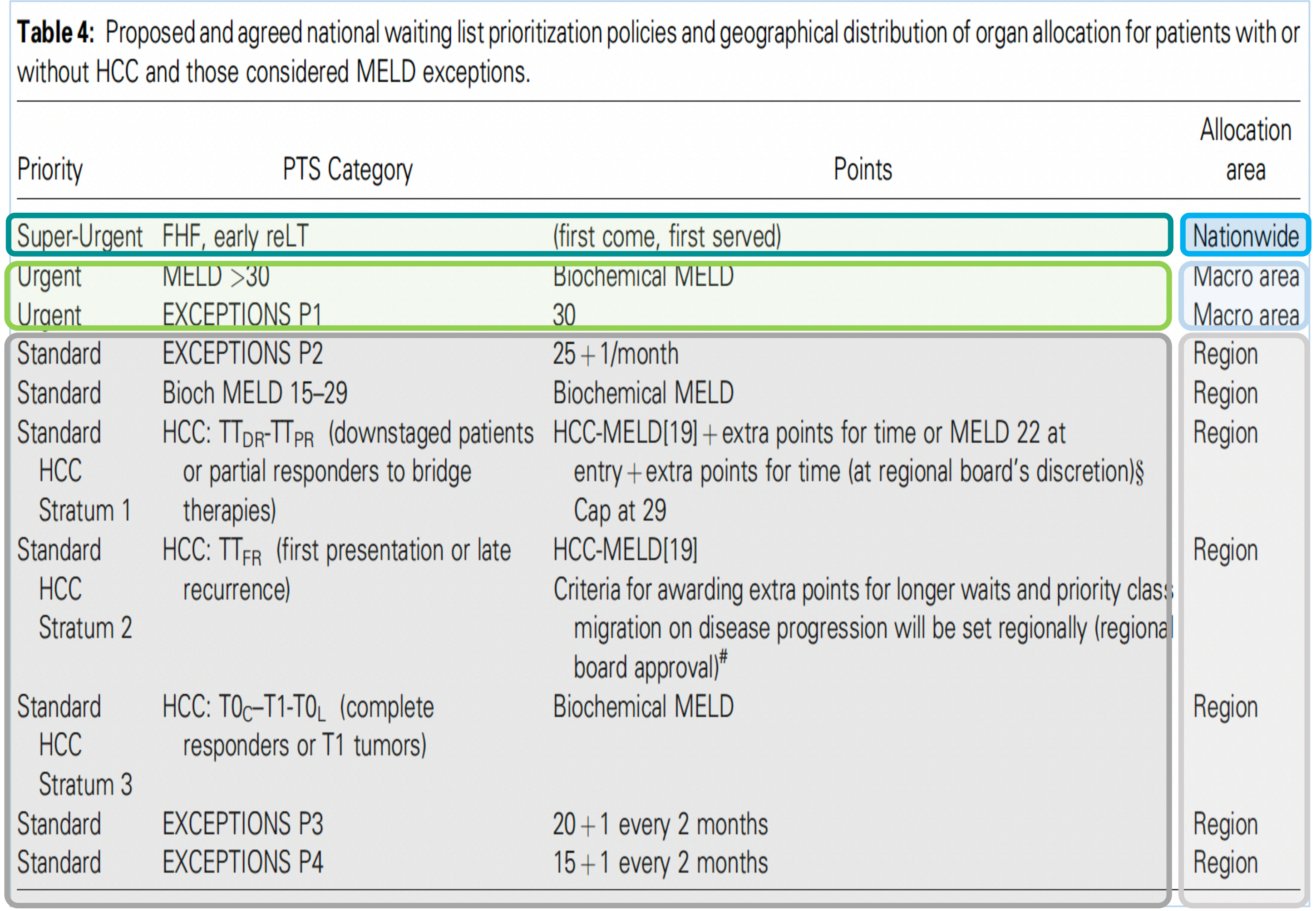


**Table 4:** Proposed and agreed national waiting list prioritization policies and geographical distribution of organ allocation for patients with or without HCC and those considered MELD exceptions.

| Priority | PTS Category | Points | Allocation area |
|---|---|---|---|
| Super-Urgent | FHF, early reLT | (first come, first served) | Nationwide |
| Urgent | MELD >30 | Biochemical MELD | Macro area |
| Urgent | EXCEPTIONS P1 | 30 | Macro area |
| Standard | EXCEPTIONS P2 | 25 + 1/month | Region |
| Standard | Bioch MELD 15–29 | Biochemical MELD | Region |
| Standard HCC Stratum 1 | HCC: $TT_{DR}$-$TT_{PR}$ (downstaged patients or partial responders to bridge therapies) | HCC-MELD[19] + extra points for time or MELD 22 at entry + extra points for time (at regional board's discretion)§ Cap at 29 | Region |
| Standard HCC Stratum 2 | HCC: $TT_{FR}$ (first presentation or late recurrence) | HCC-MELD[19]<br>Criteria for awarding extra points for longer waits and priority class migration on disease progression will be set regionally (regional board approval)# | Region |
| Standard HCC Stratum 3 | HCC: $T0_C$–T1-$T0_L$ (complete responders or T1 tumors) | Biochemical MELD | Region |
| Standard | EXCEPTIONS P3 | 20 + 1 every 2 months | Region |
| Standard | EXCEPTIONS P4 | 15 + 1 every 2 months | Region |

# The new **Acuity Circle**-based Liver Allocation in United States

*Saving lives together*

UNOS℠

- In July 2018, a lawsuit was filed against Health Resources and Services Administration regarding the **disparity or LT access between areas and called for the OPTN/UNOS** to implement a new liver allocation policy not based on arbitrary Donation Service Areas or Region Areas but rather as a **zone-based liver distribution policy**.

- OPTN/UNOS introduced the new liver allocation policy, called **acuity circle (AC)–based model, in February 2020**.

- The new model is based on **radially oriented zones** around potential donors and involves converting each transplant center's median Model for End-stage Liver Disease (MELD) score at transplant to reflect transplants performed within a **250 nautical mile radius**.

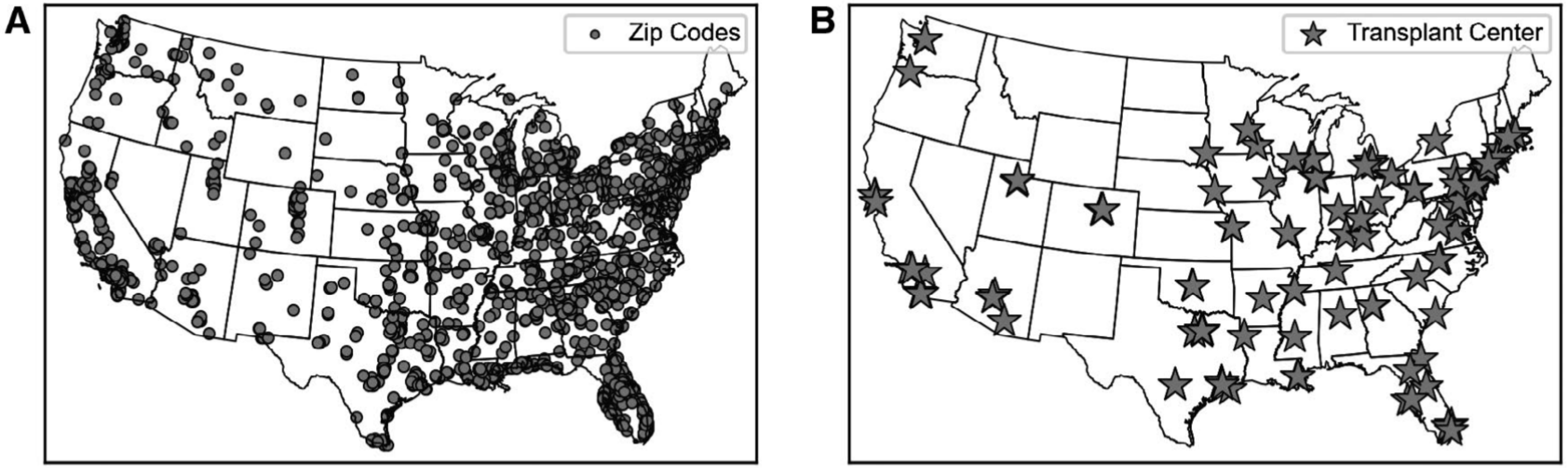
HEPATOLOGY

AASLD
AMERICAN ASSOCIATION FOR THE STUDY OF LIVER DISEASES

PUBLIC POLICY CORNER | HEPATOLOGY, VOL. 74, NO. 1, 2021

# Heterogeneous Circles for Liver Allocation

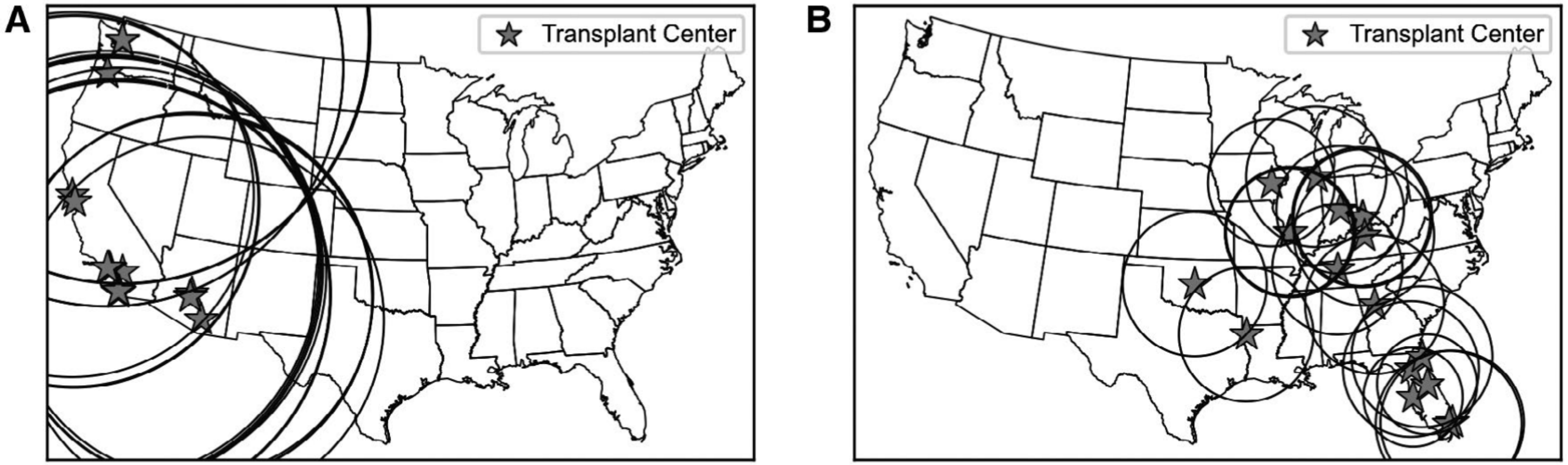
Nicholas L. Wood,[1] Amber B. Kernodle,[2] Andrew J. Hartley,[3] Dorry L. Segev,[2,4] and Sommer E. Gentry



## Geographic variation in liver supply and demand

The circles (A) indicate the location of the supply of livers at each ZIP code

The stars (B) indicate the liver transplant centers in the continental United States.



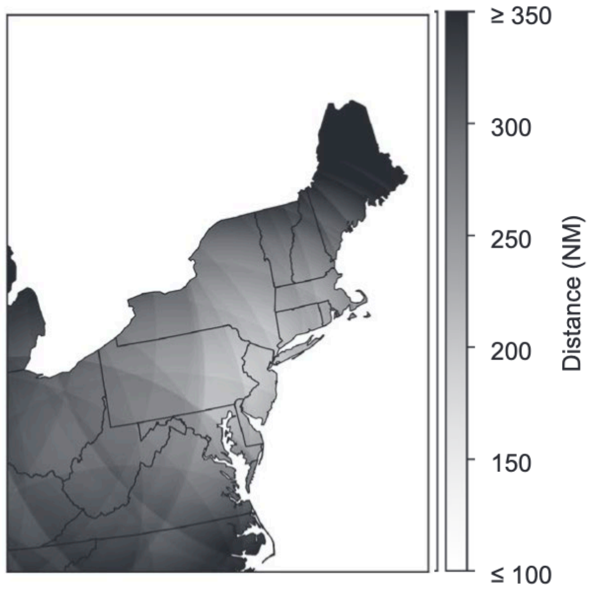
## Transplant center and circle size

The 20 LTx centers with the largest circles were in the western states (Washington, Oregon, California, and Arizona) and had circles ranging in size from 662 to 894 nm.

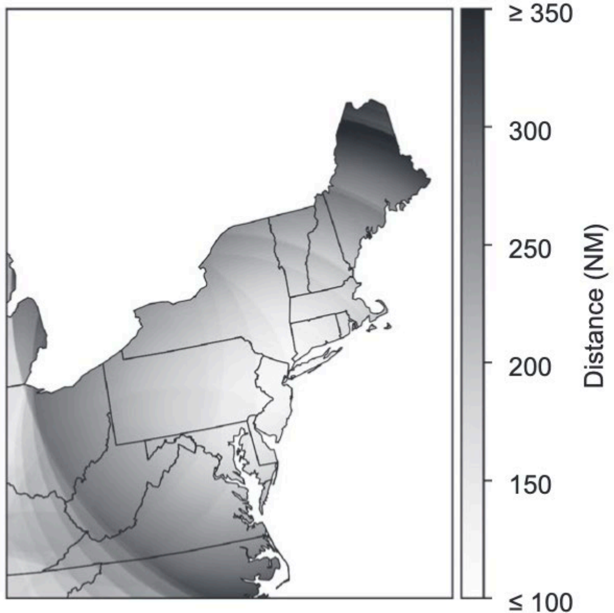
The 20 transplant cen-ters with the smallest circles were in the Midwest and the South and had circles ranging in size from 179 to 264 nm.

# Heterogeneous Circles for Liver Allocation

**A**



**B**



**Average distance livers would travel in the northeast**.

A. Using **homogeneous 500 nm circles**, each location indicates the average distance a liver would travel based on its recovery location and on the homogeneous circles.

*Livers recovered near high-demand areas such as Philadelphia and New York City will travel approximately 200-250 nautic miles on average.*

B. Using **heterogeneous 500 nm circles**, each location indicates the average distance a liver would travel based on its recovery location and on the heterogeneous circles.

*Livers recovered near high-demand areas such as Philadelphia and New York City will only travel approximately 100- 150 nautic miles on average.*

HEPATOLOGY

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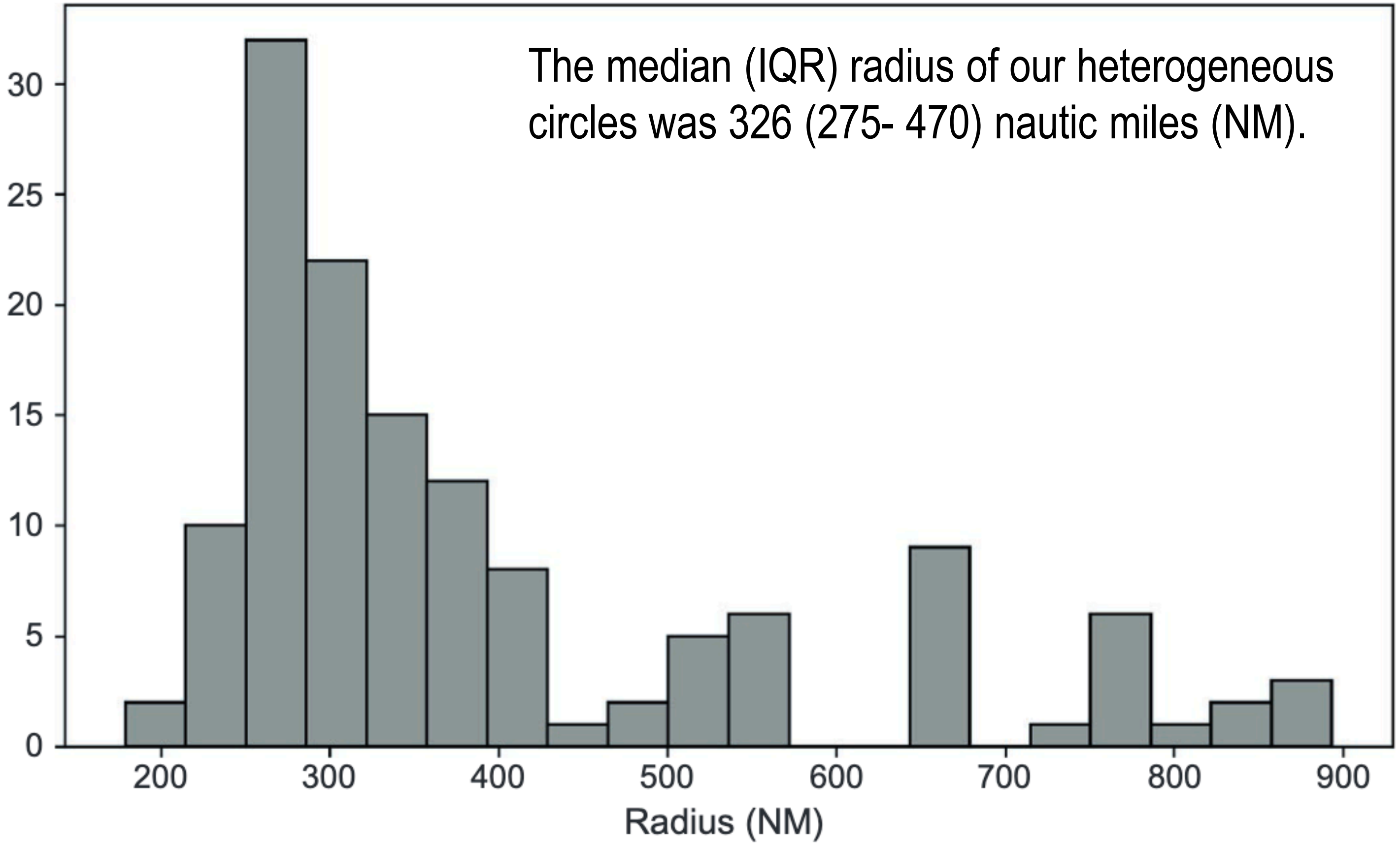
# Heterogeneous Acuity Circles for Liver Allocation

Nicholas L. Wood,[1] Amber B. Kernodle,[2] Andrew J. Hartley,[3] Dorry L. Segev,[2,4] and Sommer E. Gentry

Distribution of heterogeneous circle radii around each transplant center.



The median (IQR) radius of our heterogeneous circles was 326 (275- 470) nautic miles (NM).

## CONCLUSION

Using carefully designed **heterogeneous acuity circles can reduce geographic disparity** in liver supply/demand ratios compared with homogeneous circles of radius ranging from 150 to 1,000 nautic miles.

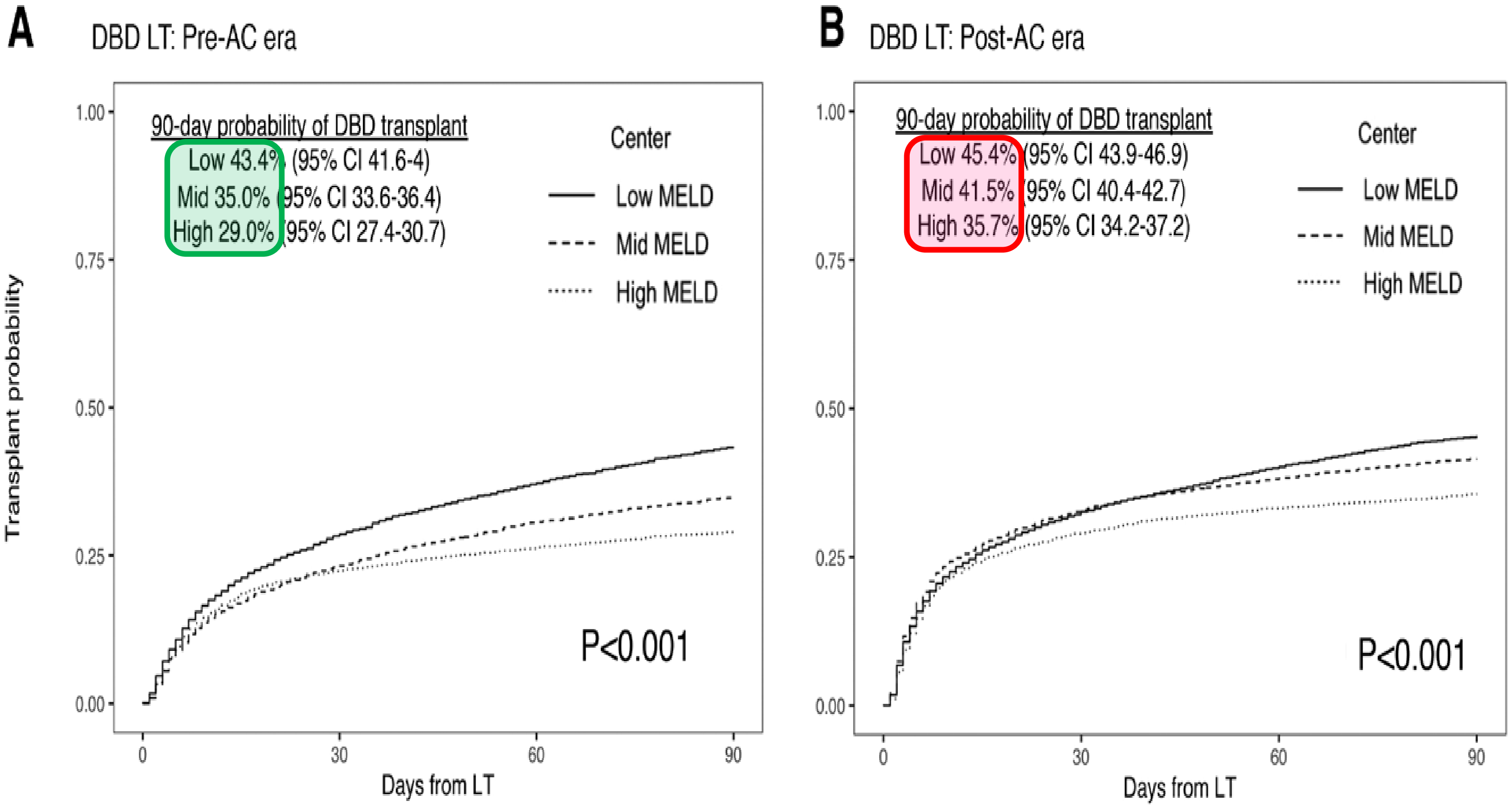
# Disparities in the Effects of Acuity Circle–based Liver Allocation on Waitlist and Transplant Practice Between Centers

Shunji Nagai, MD, PhD,[1] Tommy Ivanics, MD, MPH,[1] Toshihiro Kitajima, MD,[1] Shingo Shimada, MD, PhD,[1] Tayseer M. Shamaa, MD,[1] Kelly Collins, MD,[1] Michael Rizzari, MD,[1] Atsushi Yoshida, MD,[1] Dilip Moonka, MD,[2] and Marwan Abouljoud, MD[1]

Transplantation DIRECT

Transplant Direct 2022

## 90-d hazards of transplant and waitlist mortality: DBD



The post-Acuity Circle (AC) era was associated with higher cause specific 90-d hazards of transplant and waitlist mortality.

The latter effect was primarily driven by high-MELD centers.

# Disparities in the Effects of Acuity Circle–based Liver Allocation on Waitlist and Transplant Practice Between Centers

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Transplantation DIRECT
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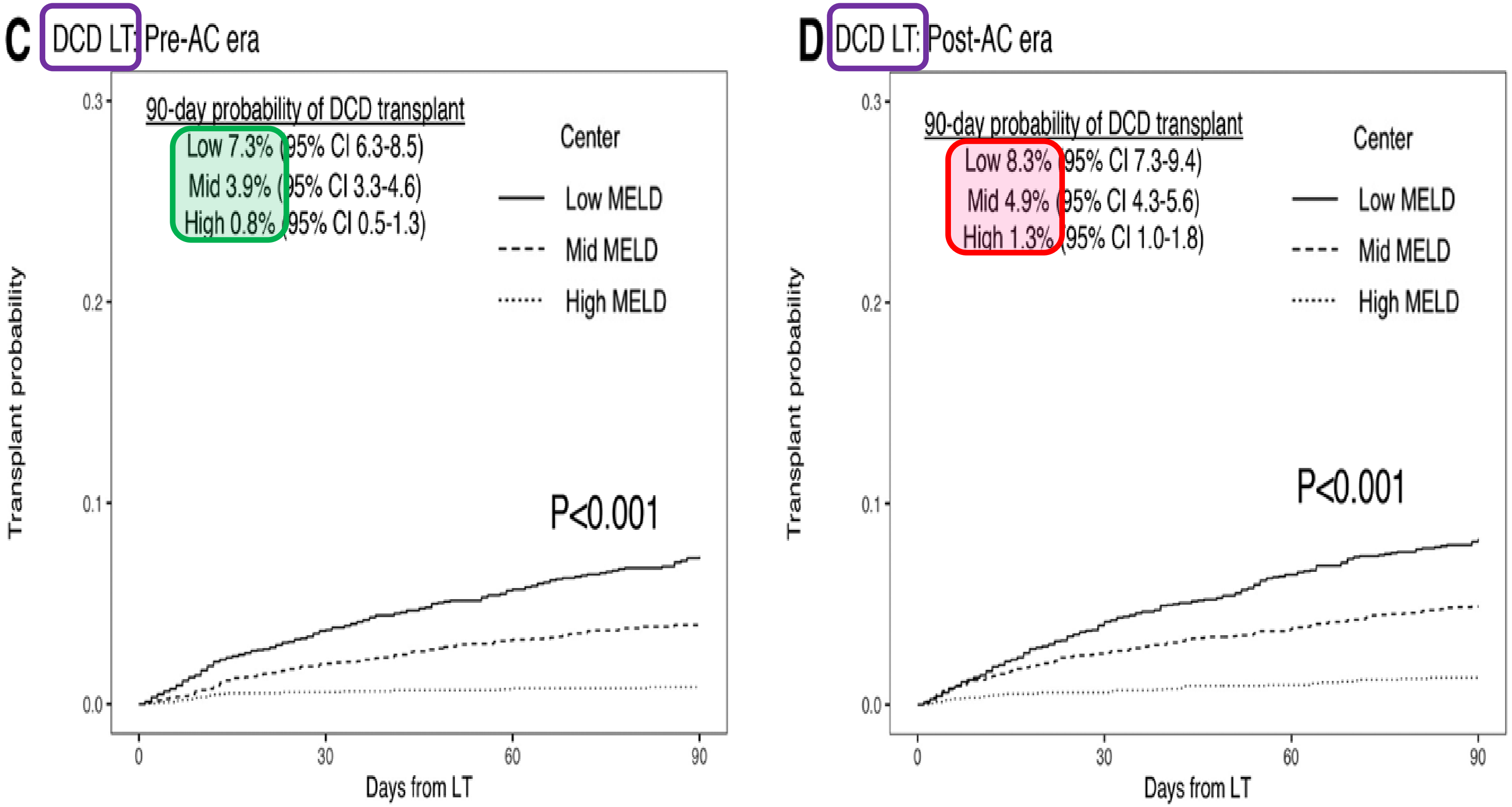


**Low-MELD** centers had a higher proportion of donations after circulatory death (DCDs) used.

Compared with low-MELD centers, **mid-MELD and high-MELD centers had significantly lower cause-specific hazards of DCD-LT in both eras.**

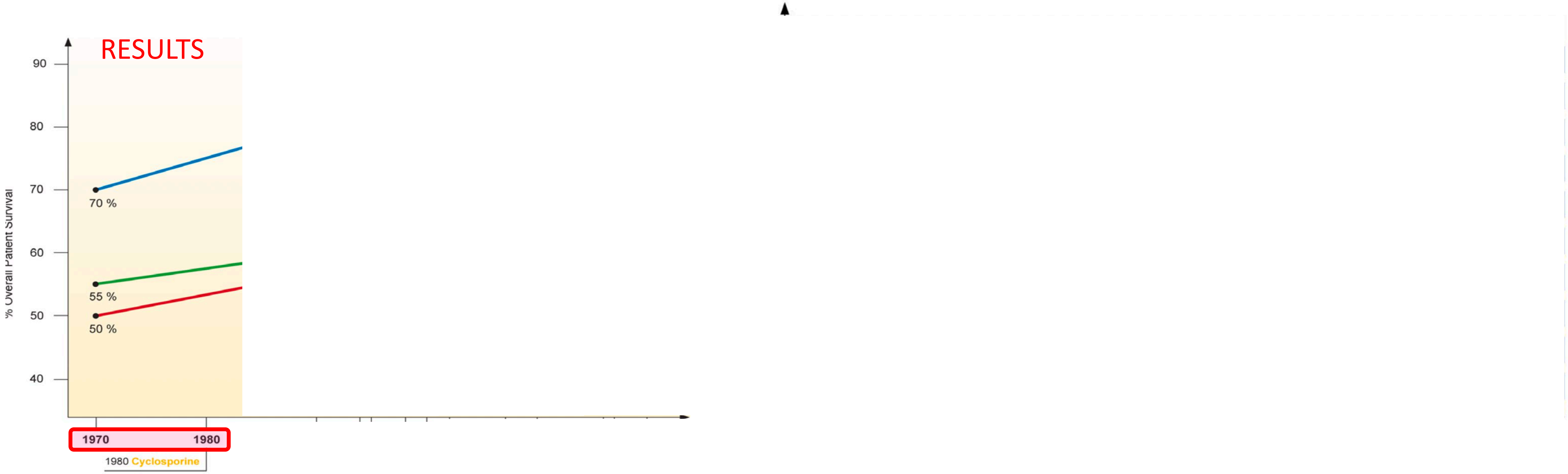
## Are MELD score(s) predictive of GRAFT SURVIVAL ?

- recovery after high-risk graft
- intrinsic prognostic power

# The Need to Update Endpoints and Outcome Analysis in the Rapidly Changing Field of Liver Transplantation

Margot Fodor, MD,[1] Heinz Zoller, MD,[2] Rupert Oberhuber, MD,[1] Robert Sucher, MD, PhD, MBA,[3] Daniel Seehofer, MD,[3] Umberto Cillo, MD,[4] Pal Dag Line, MD,[5,6] Herbert Tilg, MD,[2] and Stefan Schneeberger, MD, MBA[1]

Transplantation. 2021 Nov 9.



RESULTS

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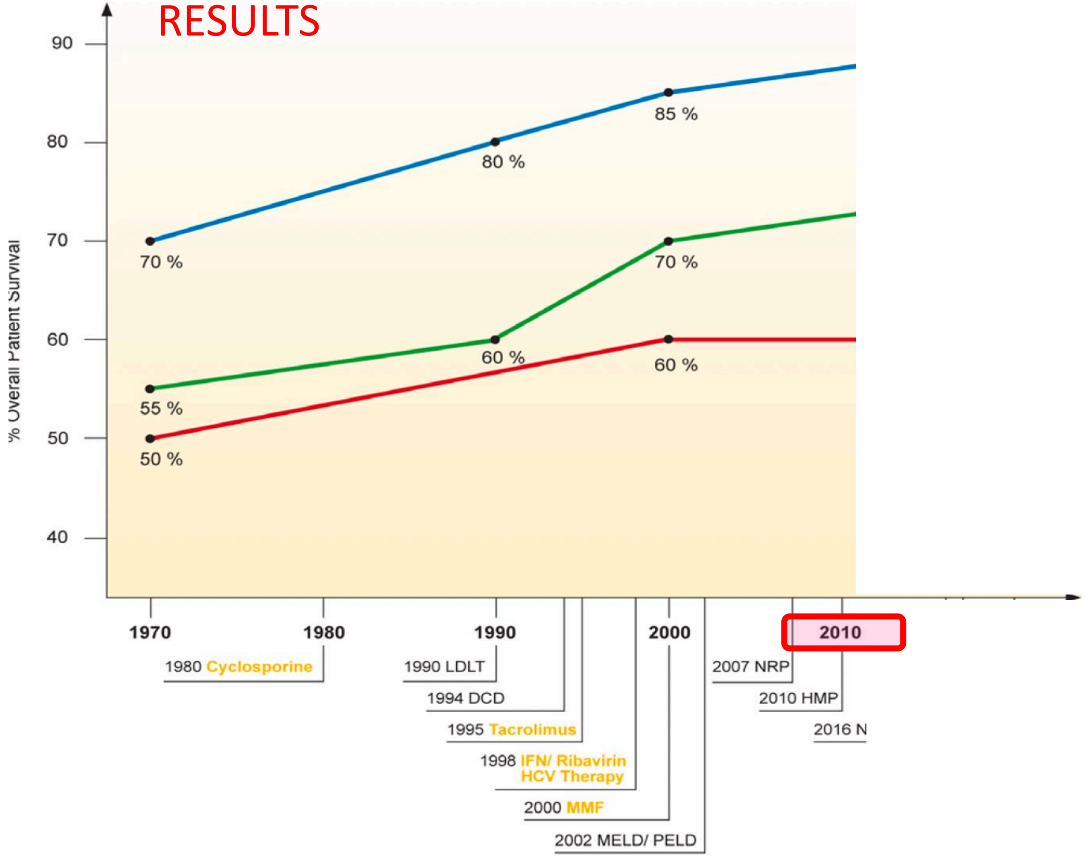

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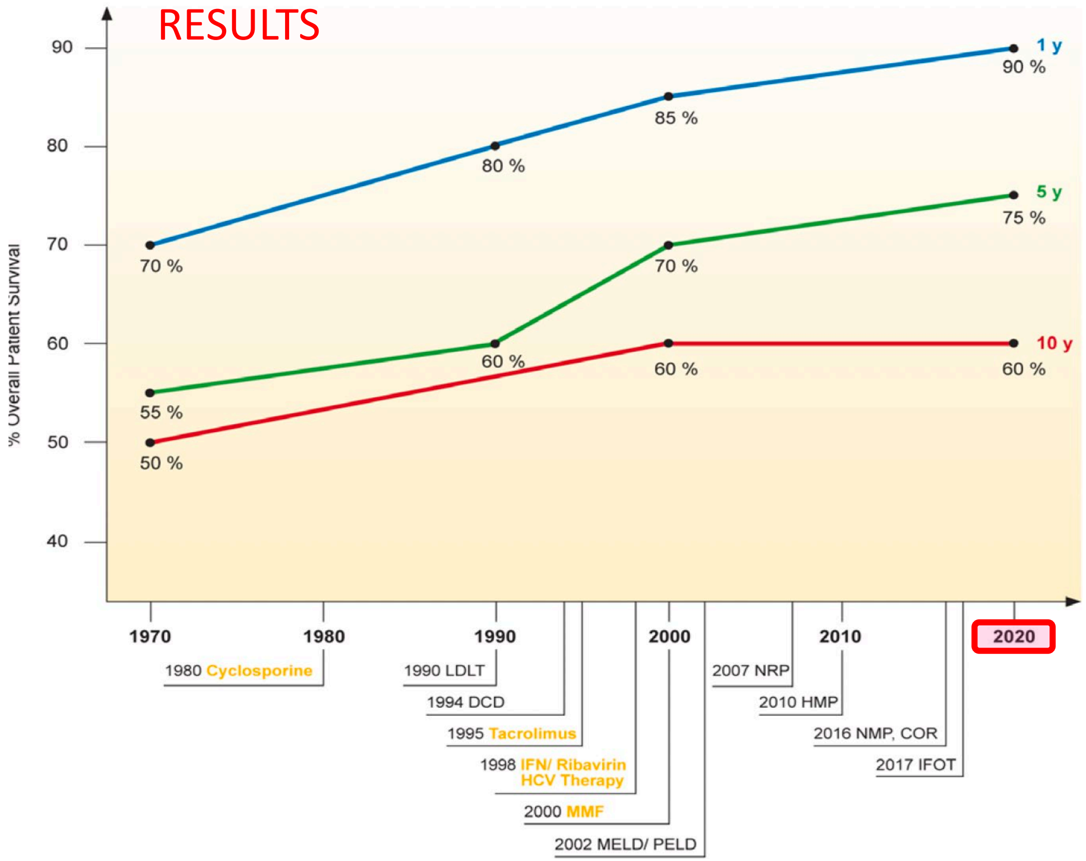

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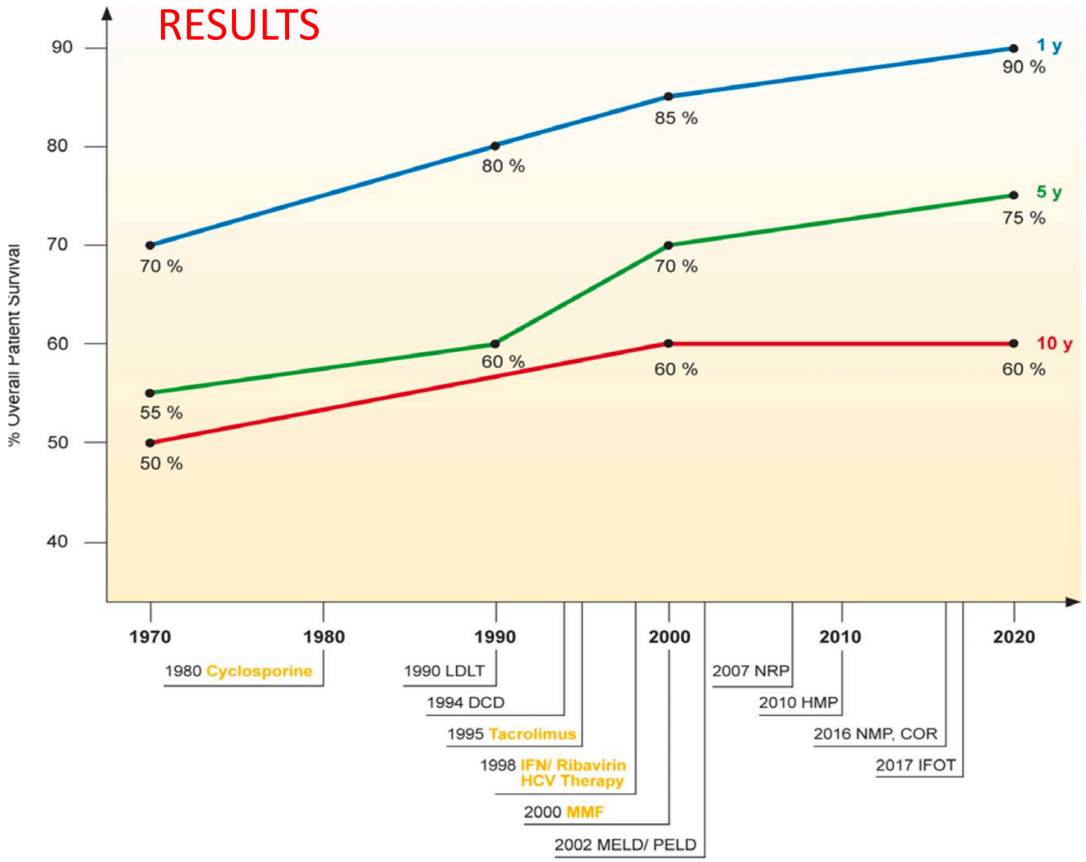
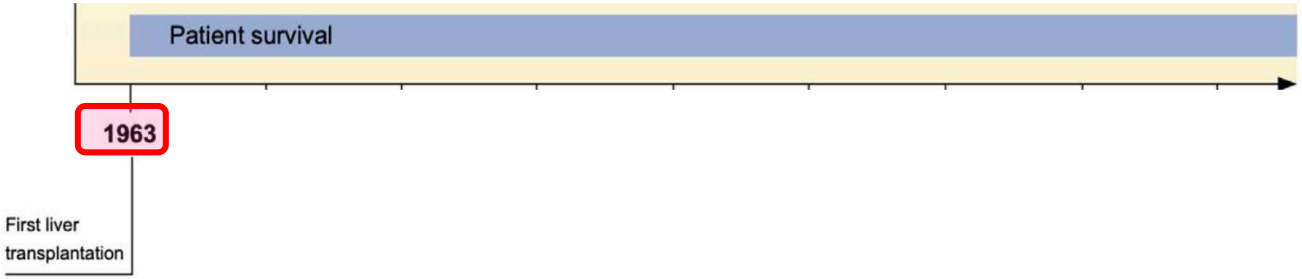


ENDPOINTS



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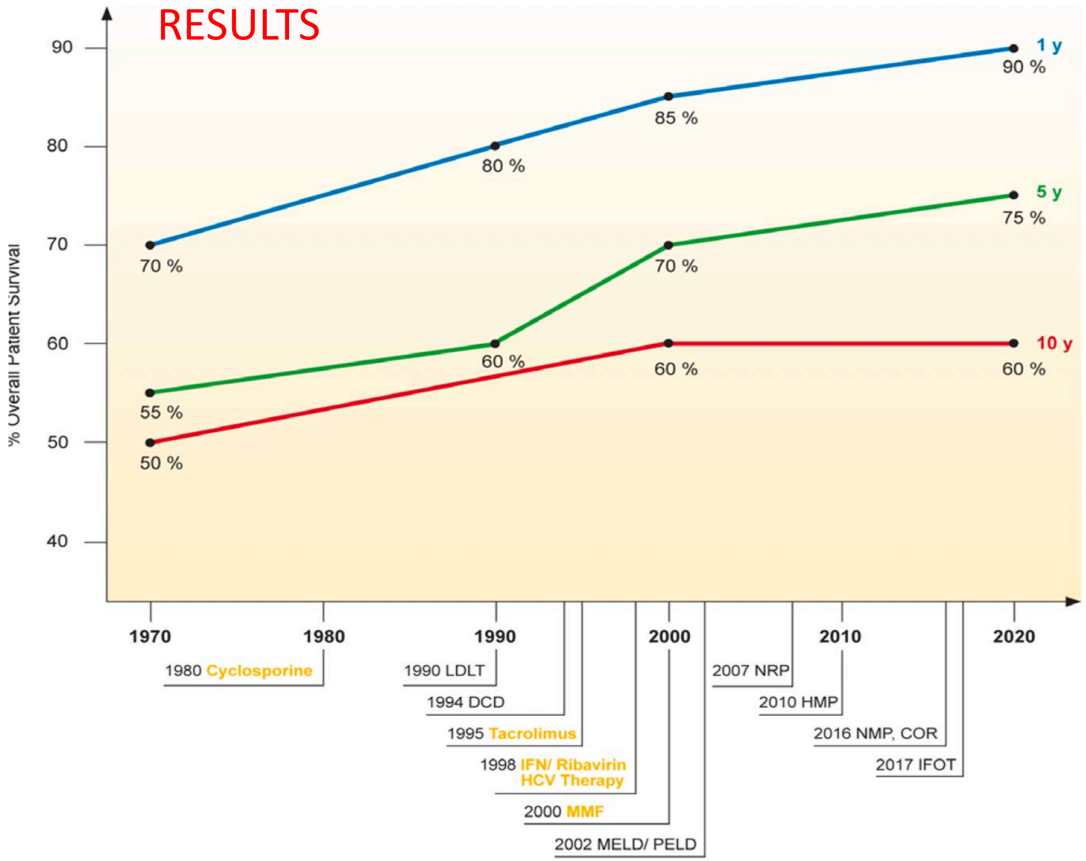

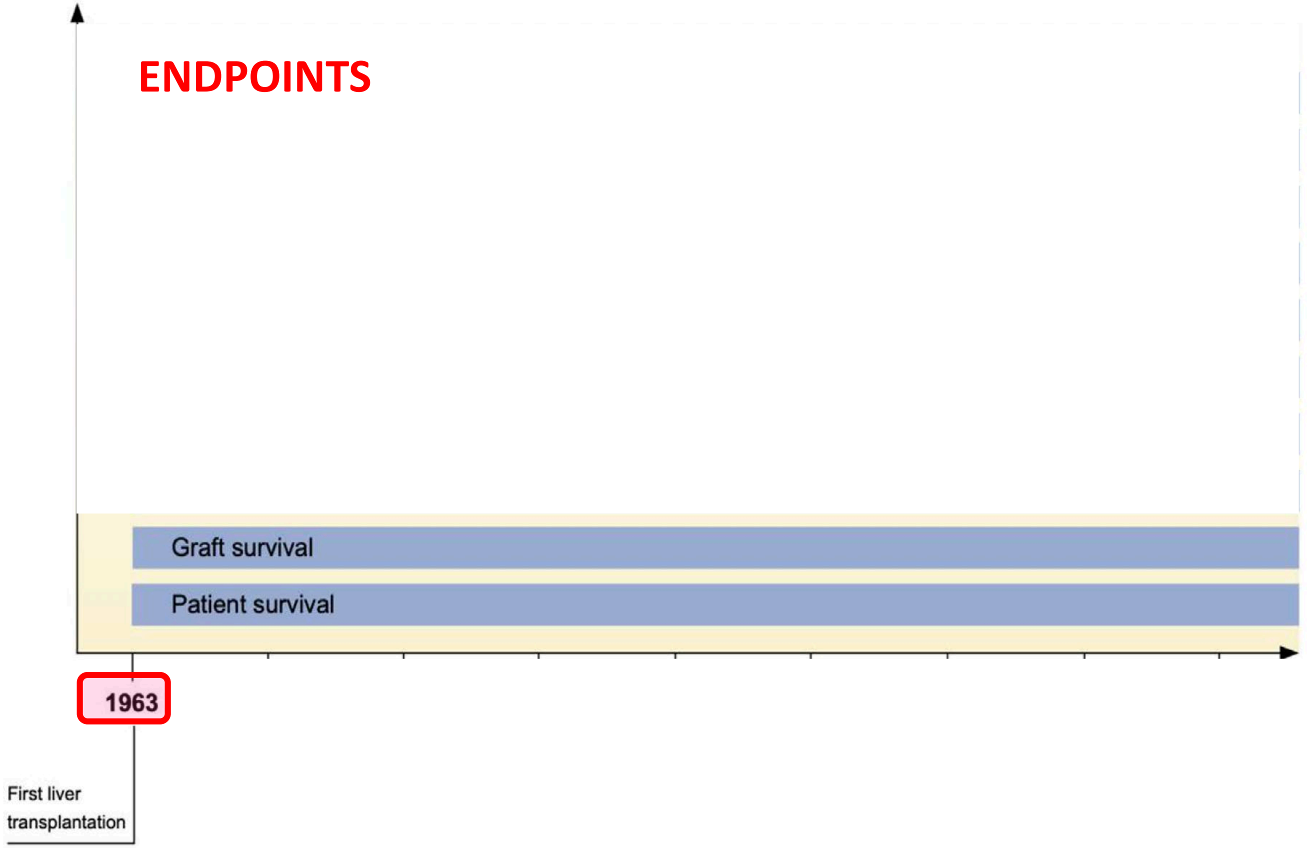

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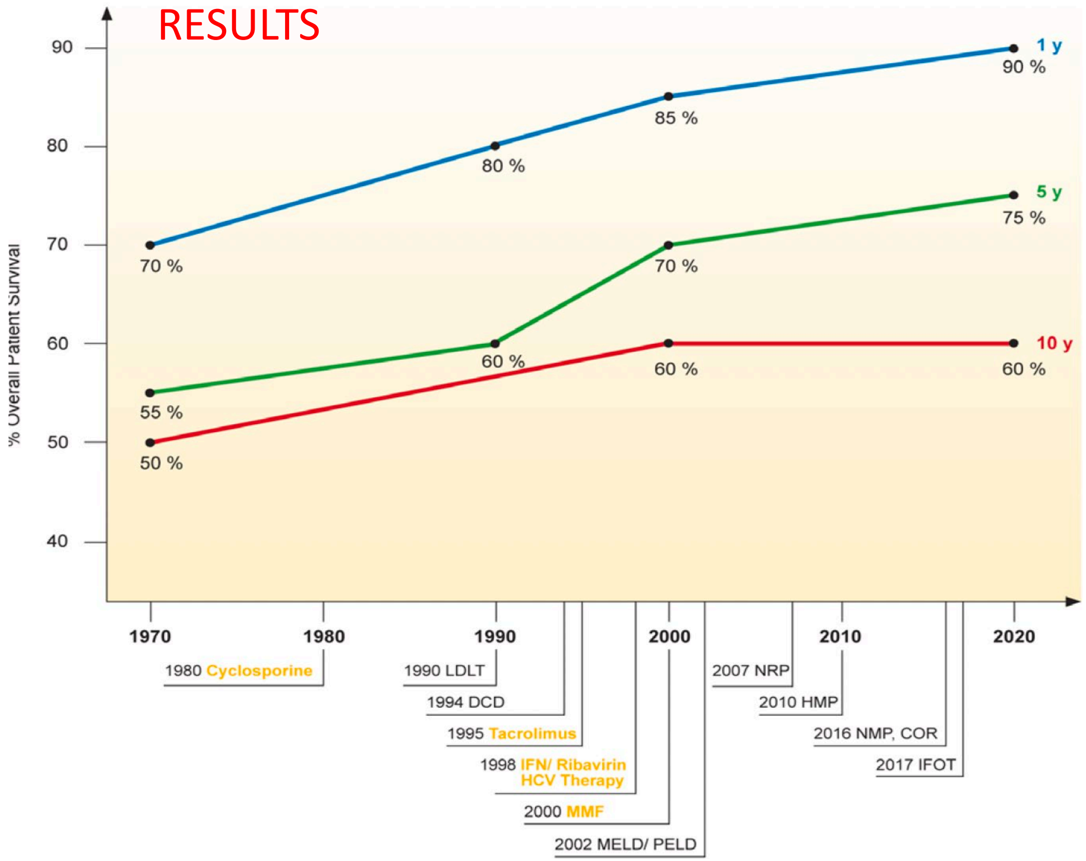

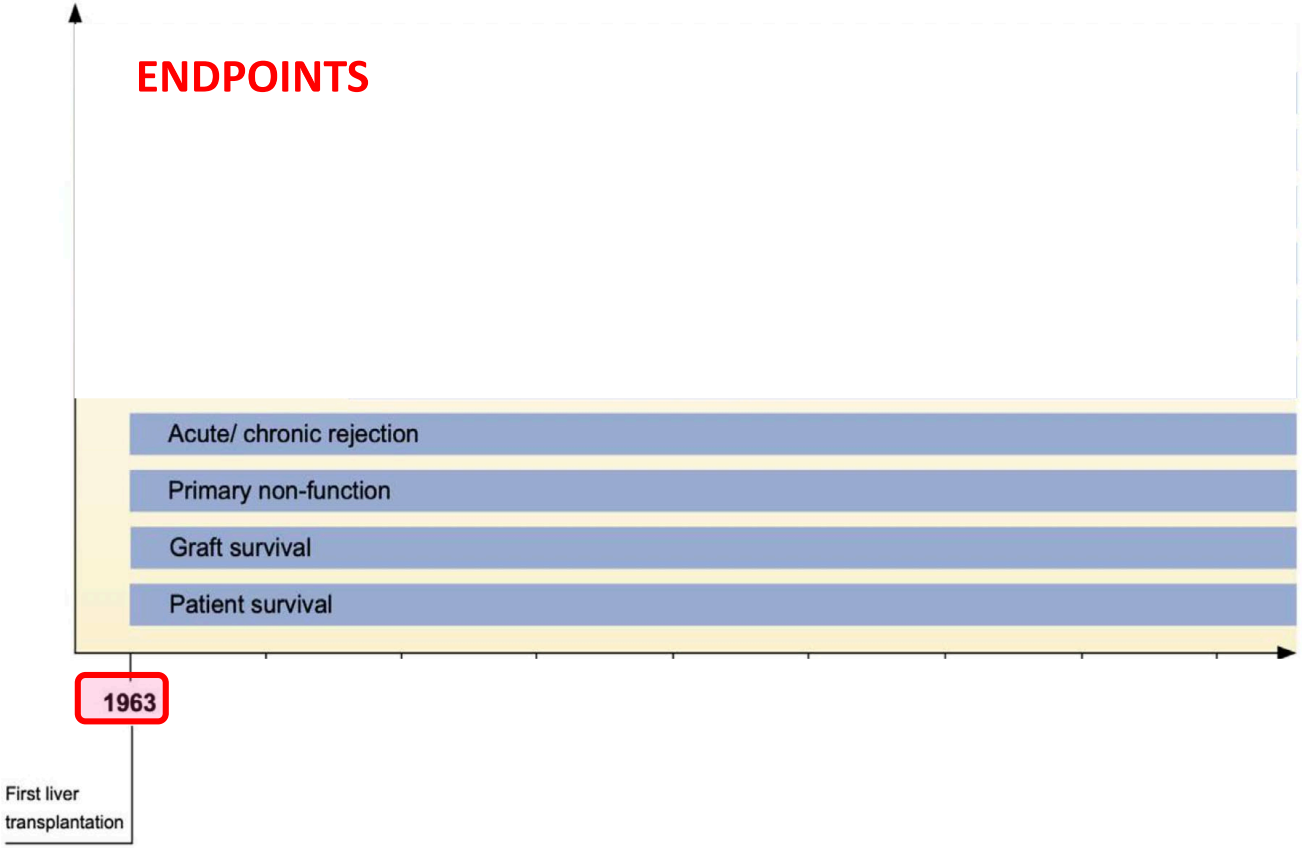

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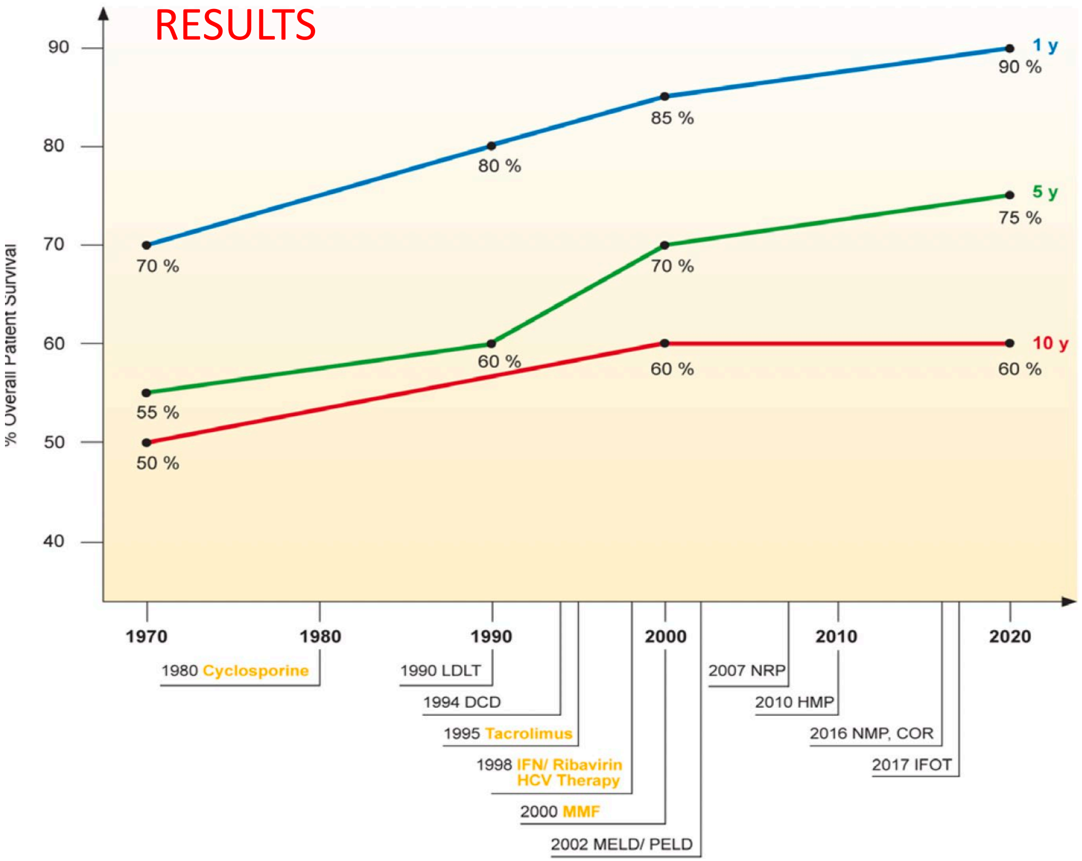

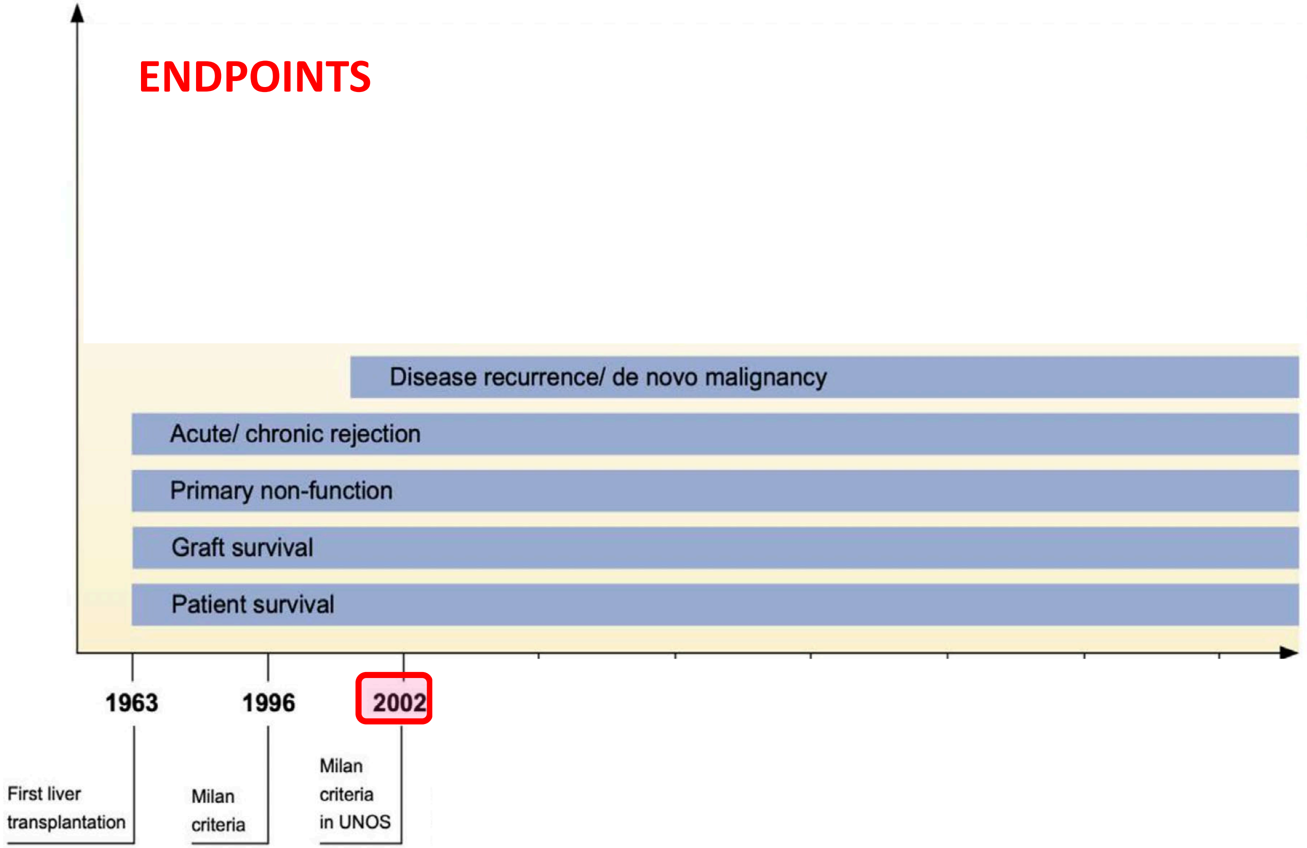

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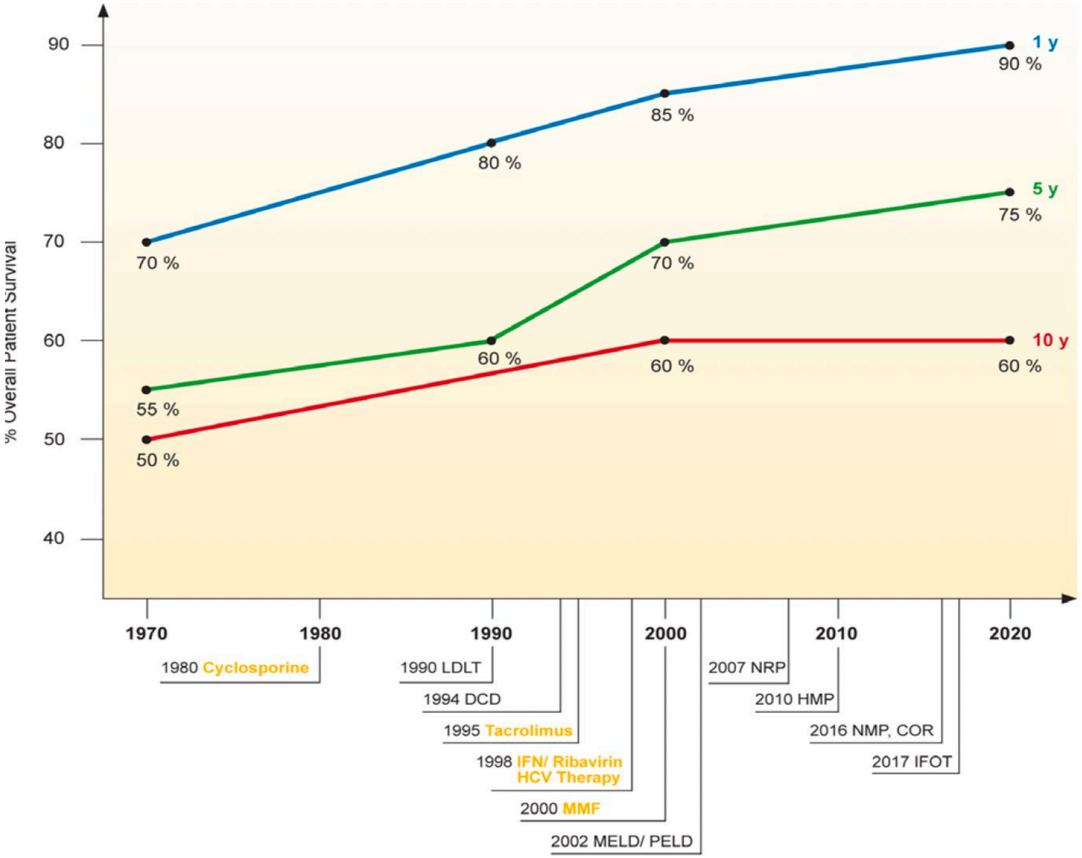

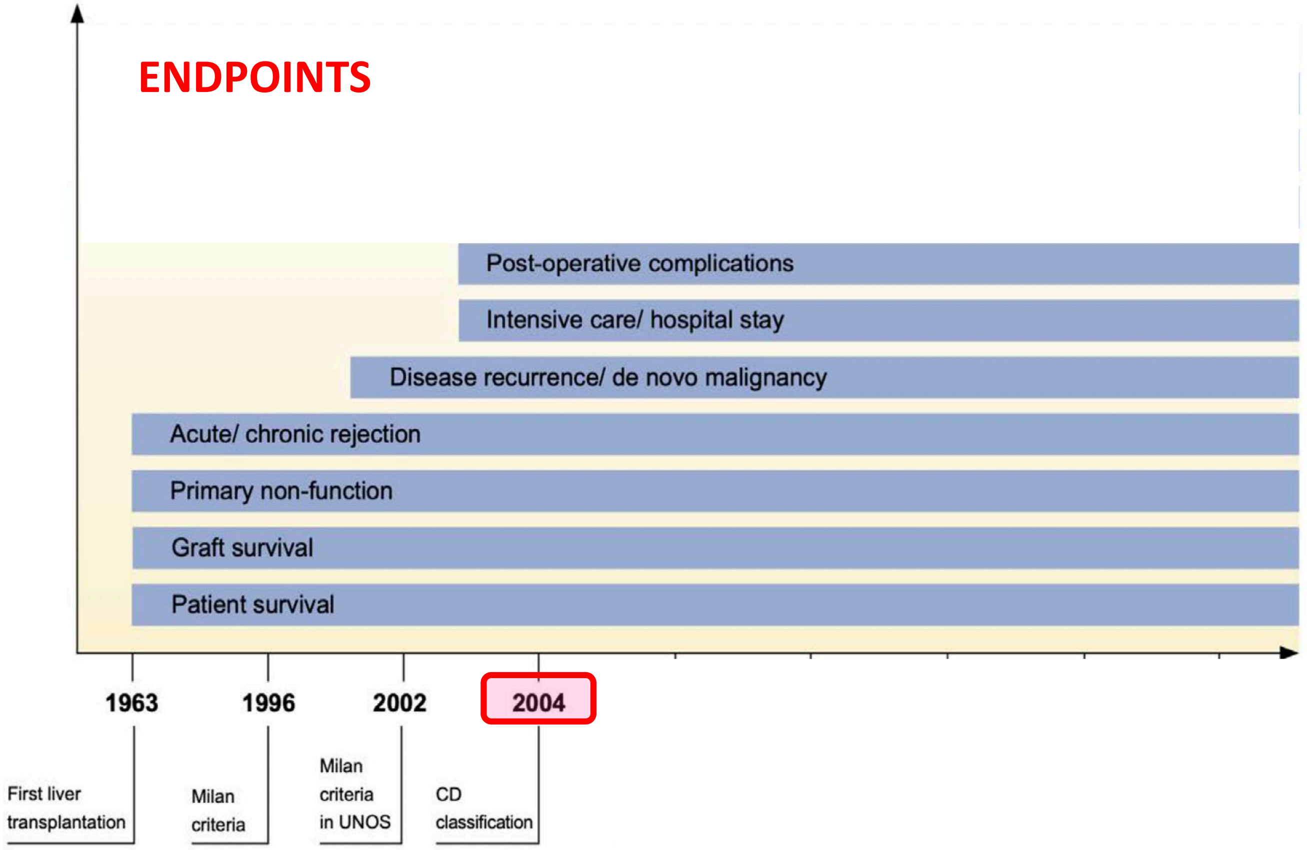

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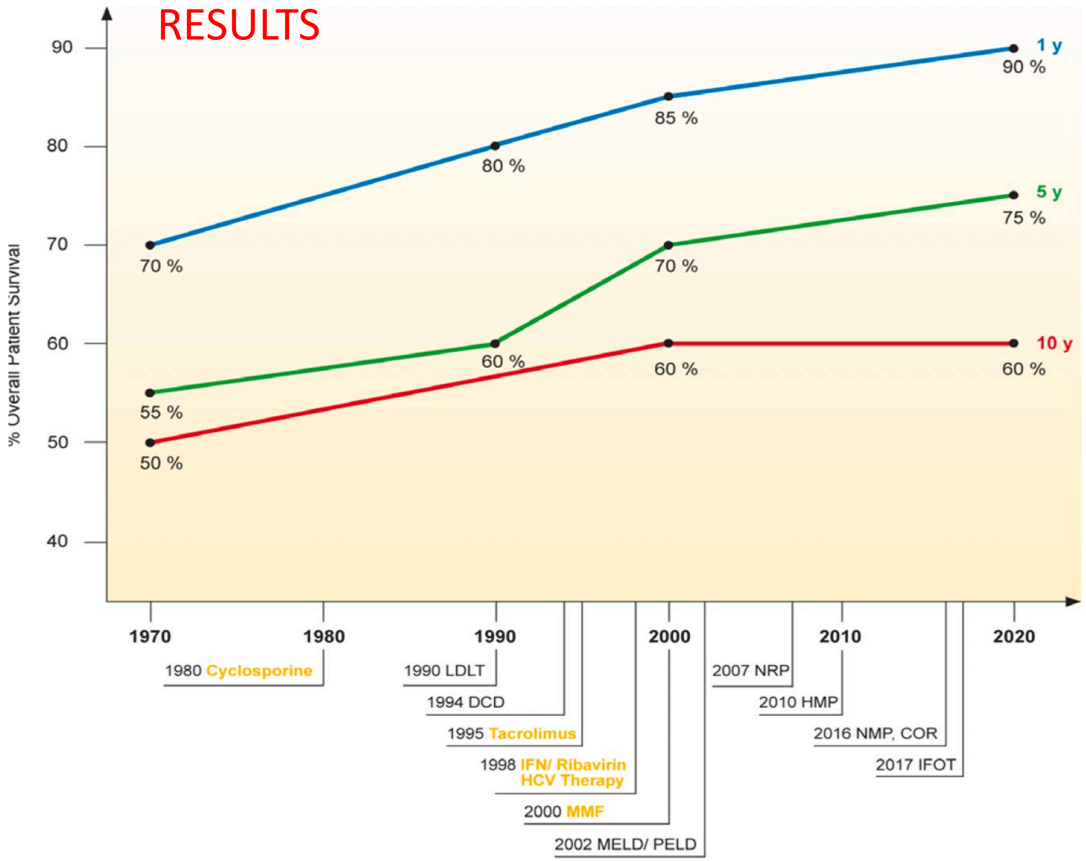

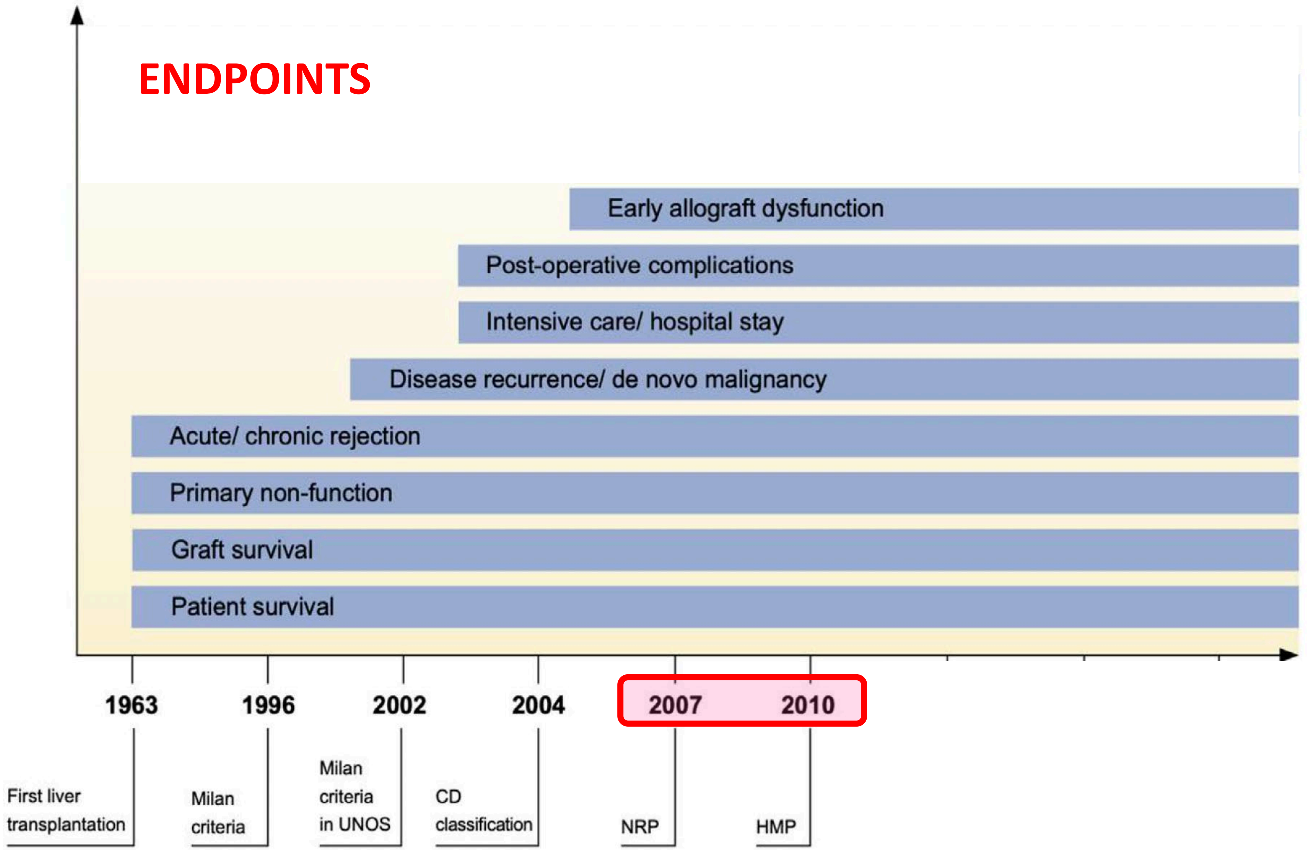

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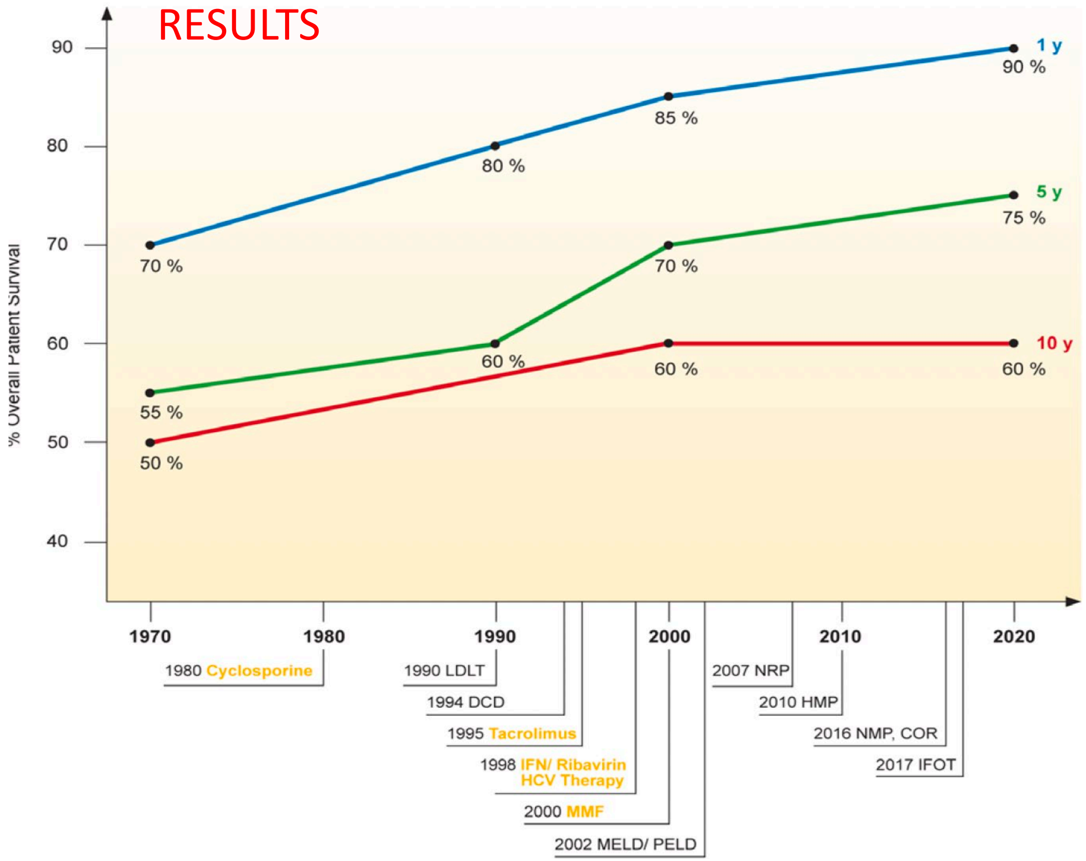

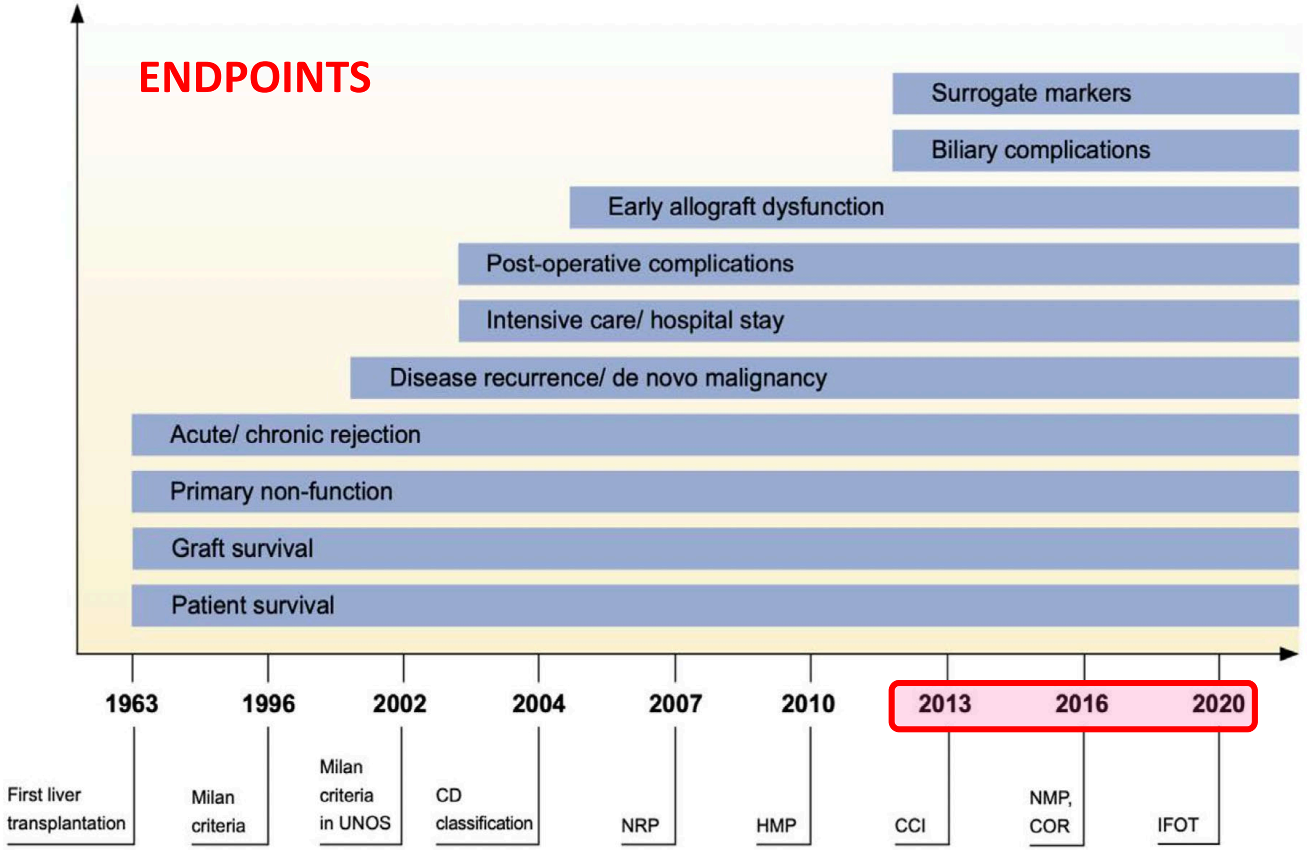

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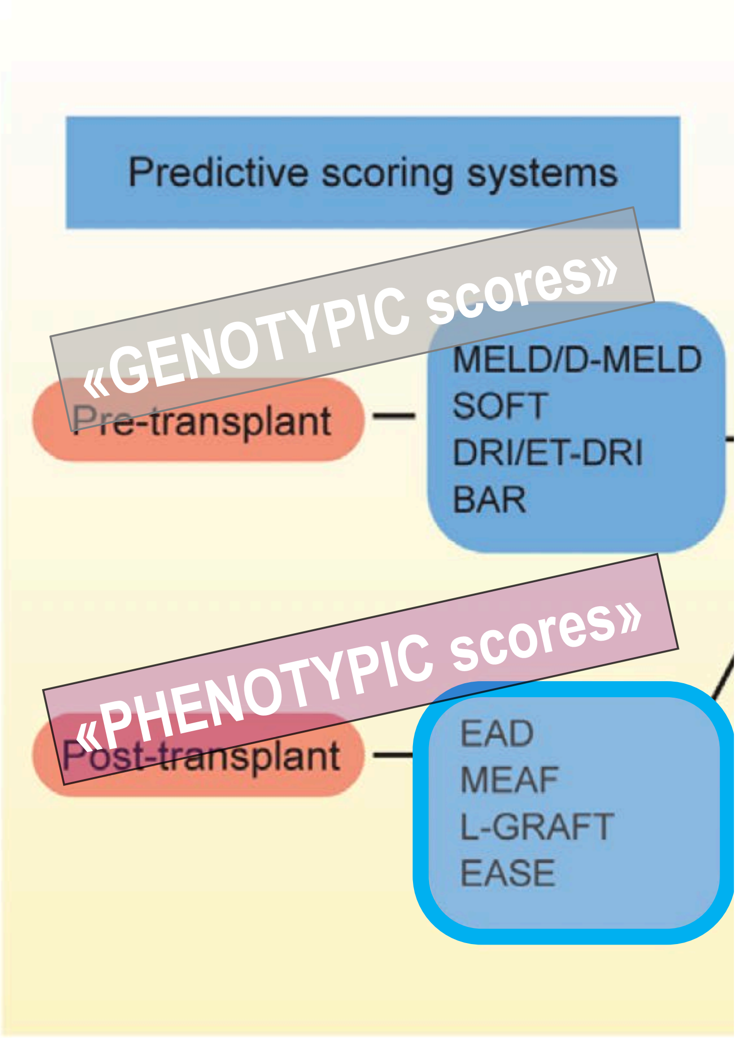


Predictive scoring systems

«GENOTYPIC scores»

Pre-transplant

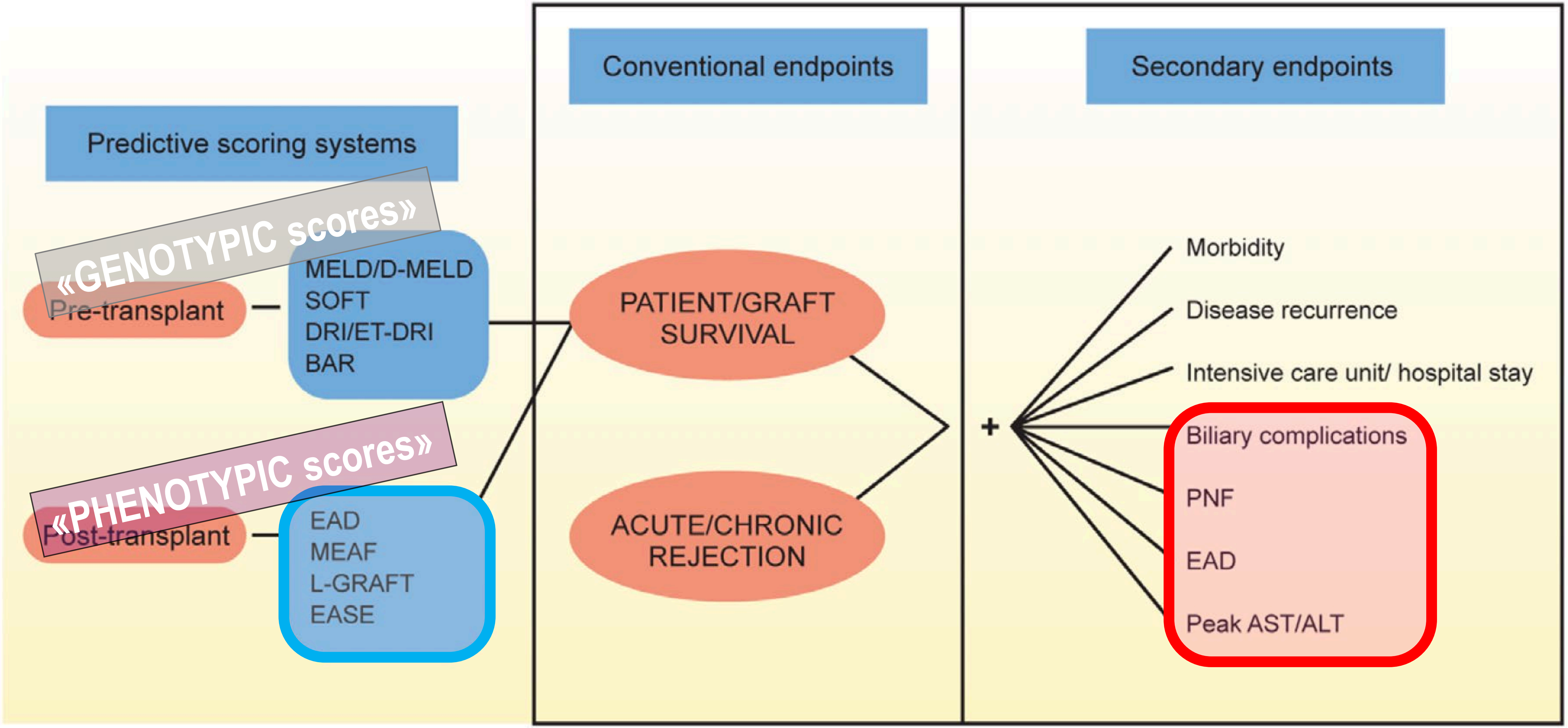
MELD/D-MELD
SOFT
DRI/ET-DRI
BAR

«PHENOTYPIC scores»

Post-transplant

EAD
MEAF
L-GRAFT
EASE

# The Need to Update Endpoints and Outcome Analysis in the Rapidly Changing Field of Liver Transplantation



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Post-transplant

EAD
MEAF
L-GRAFT
EASE

Conventional endpoints

PATIENT/GRAFT SURVIVAL

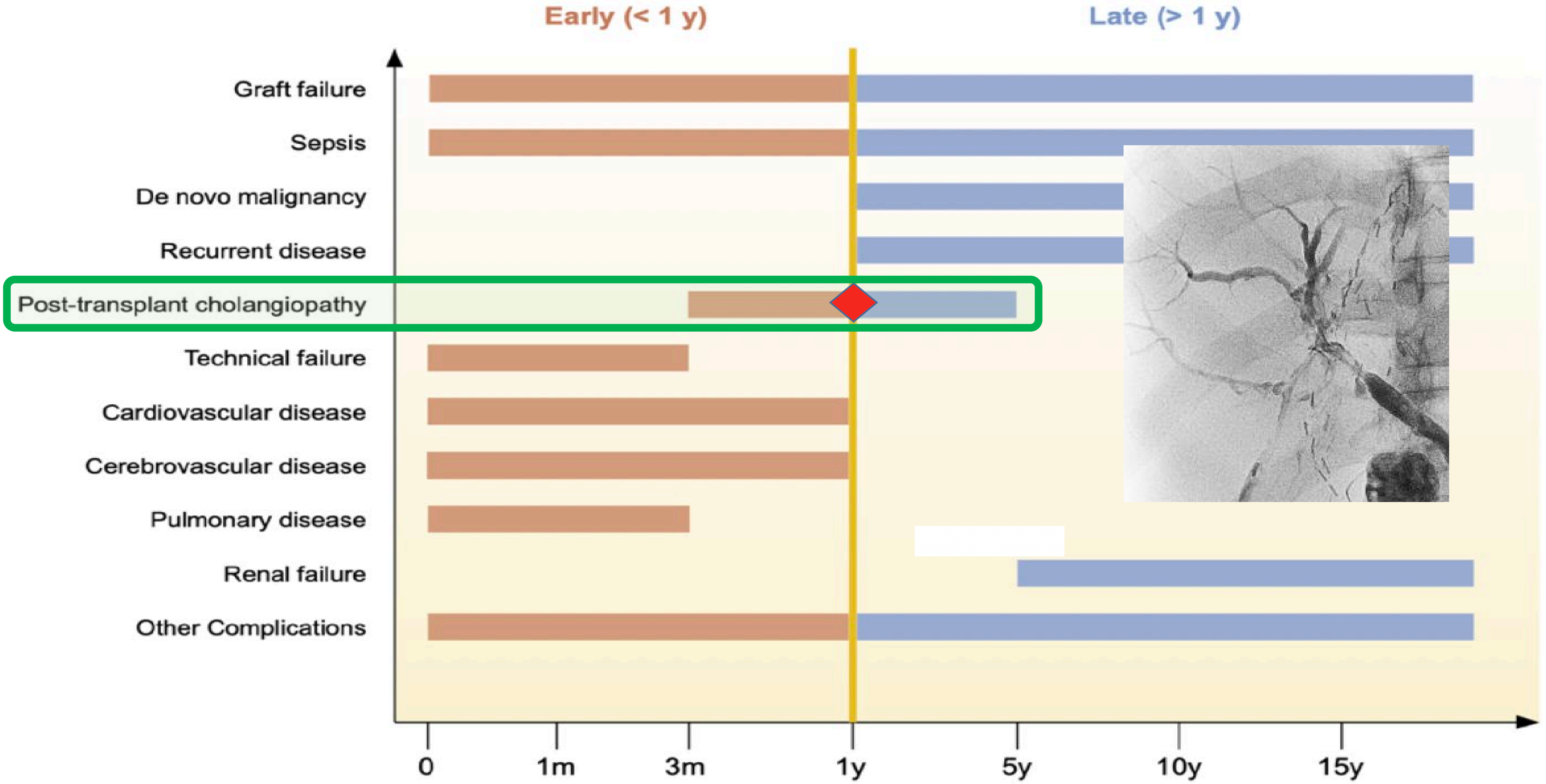
ACUTE/CHRONIC REJECTION

+

Secondary endpoints

Morbidity
Disease recurrence
Intensive care unit/ hospital stay
Biliary complications
PNF
EAD
Peak AST/ALT

# Early (<1 y) and late (>1 y) causes of death after liver transplantation.



# Are There Better Guidelines for Allocation in Liver Transplantation?

*A Novel Score Targeting Justice and Utility in the Model for End-Stage Liver Disease Era*

*Philipp Dutkowski, MD,* Christian E. Oberkofler, MD,* Ksenija Slankamenac, MC,* Milo A. Puhan, MD,‡ Erik Schadde, MD,* Beat Müllhaupt, MD,† Andreas Geier, MD,† and Pierre A. Clavien, MD, PhD**

«GENOTYPIC scores»

*Annals of Surgery* • Volume 254, Number 5, November 2011

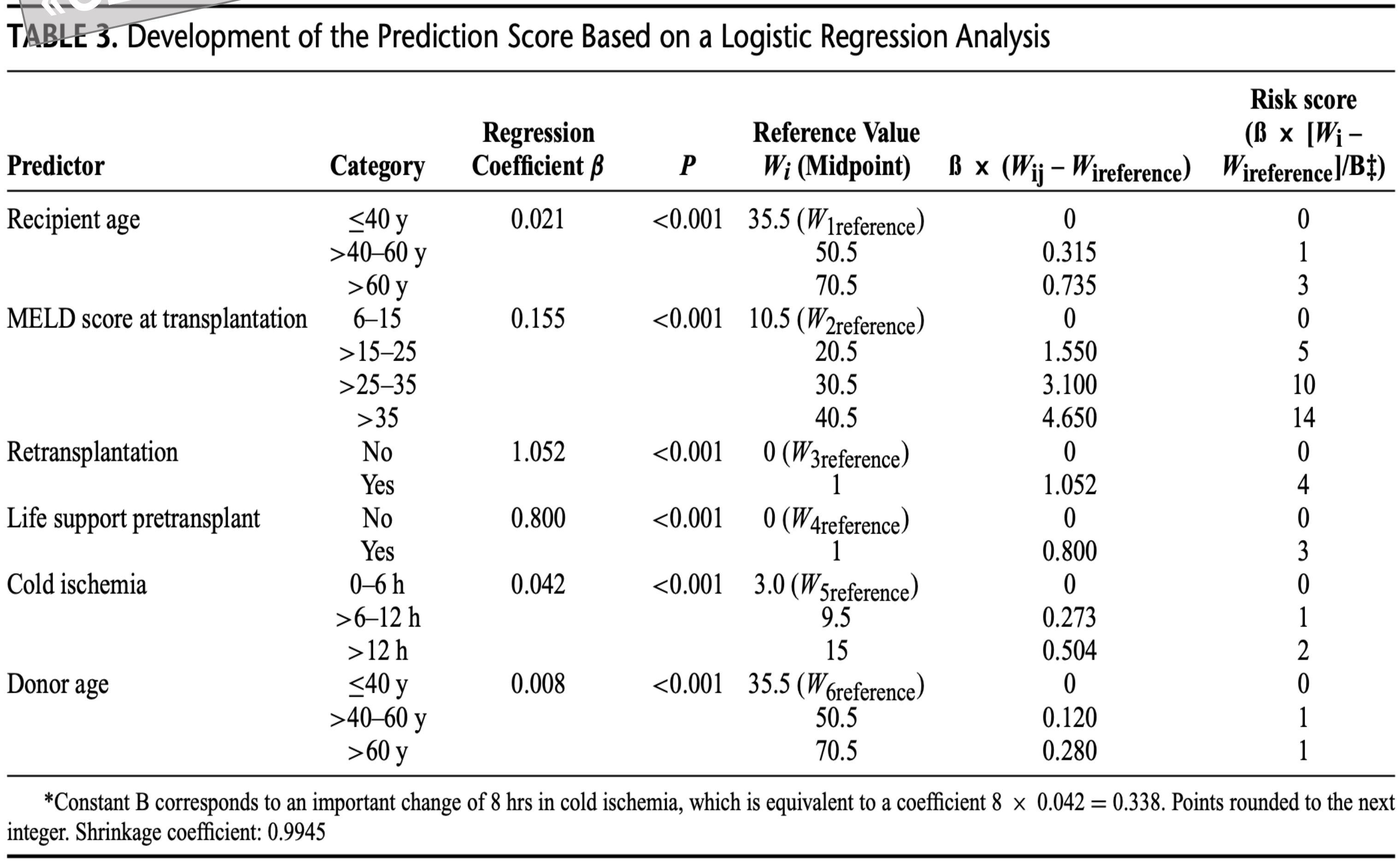
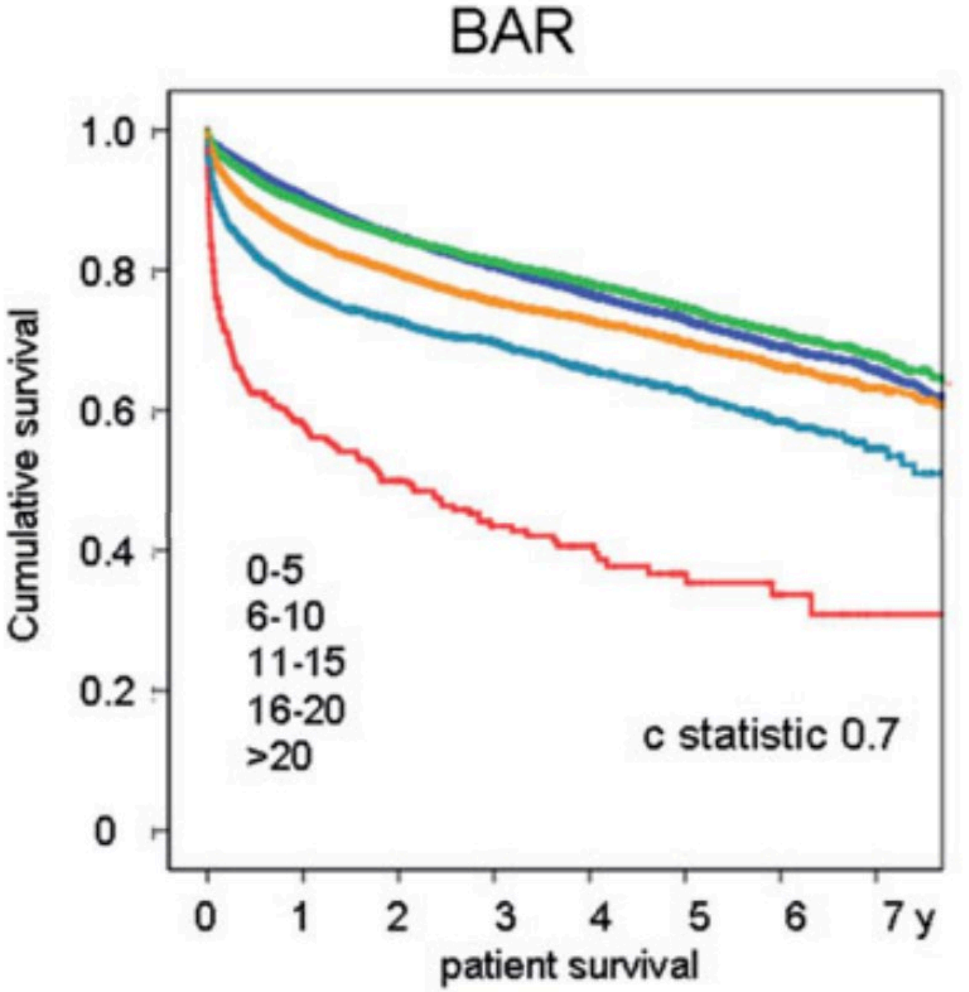


**TABLE 3.** Development of the Prediction Score Based on a Logistic Regression Analysis

| Predictor | Category | Regression Coefficient $\beta$ | $P$ | Reference Value $W_i$ (Midpoint) | $\beta \times (W_{ij} - W_{ireference})$ | Risk score ($\beta \times [W_i - W_{ireference}]/B$‡) |
|---|---|---|---|---|---|---|
| Recipient age | ≤40 y | 0.021 | <0.001 | 35.5 ($W_{1reference}$) | 0 | 0 |
| | >40–60 y | | | 50.5 | 0.315 | 1 |
| | >60 y | | | 70.5 | 0.735 | 3 |
| MELD score at transplantation | 6–15 | 0.155 | <0.001 | 10.5 ($W_{2reference}$) | 0 | 0 |
| | >15–25 | | | 20.5 | 1.550 | 5 |
| | >25–35 | | | 30.5 | 3.100 | 10 |
| | >35 | | | 40.5 | 4.650 | 14 |
| Retransplantation | No | 1.052 | <0.001 | 0 ($W_{3reference}$) | 0 | 0 |
| | Yes | | | 1 | 1.052 | 4 |
| Life support pretransplant | No | 0.800 | <0.001 | 0 ($W_{4reference}$) | 0 | 0 |
| | Yes | | | 1 | 0.800 | 3 |
| Cold ischemia | 0–6 h | 0.042 | <0.001 | 3.0 ($W_{5reference}$) | 0 | 0 |
| | >6–12 h | | | 9.5 | 0.273 | 1 |
| | >12 h | | | 15 | 0.504 | 2 |
| Donor age | ≤40 y | 0.008 | <0.001 | 35.5 ($W_{6reference}$) | 0 | 0 |
| | >40–60 y | | | 50.5 | 0.120 | 1 |
| | >60 y | | | 70.5 | 0.280 | 1 |

*Constant B corresponds to an important change of 8 hrs in cold ischemia, which is equivalent to a coefficient 8 × 0.042 = 0.338. Points rounded to the next integer. Shrinkage coefficient: 0.9945



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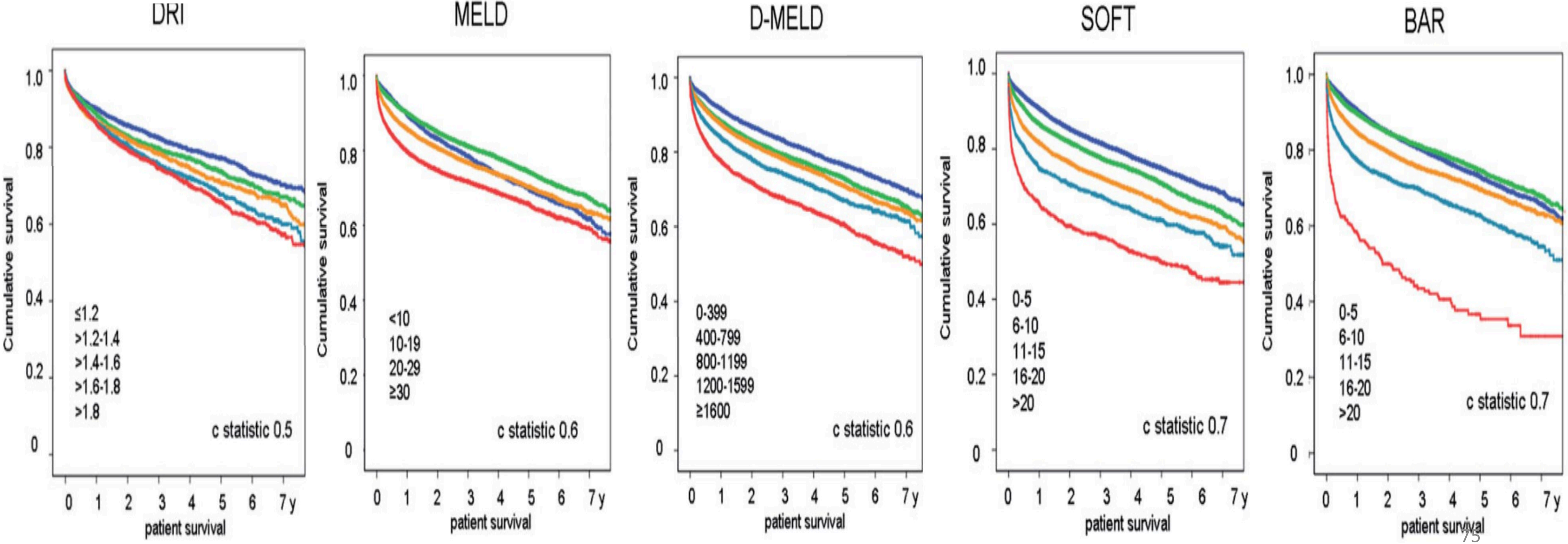
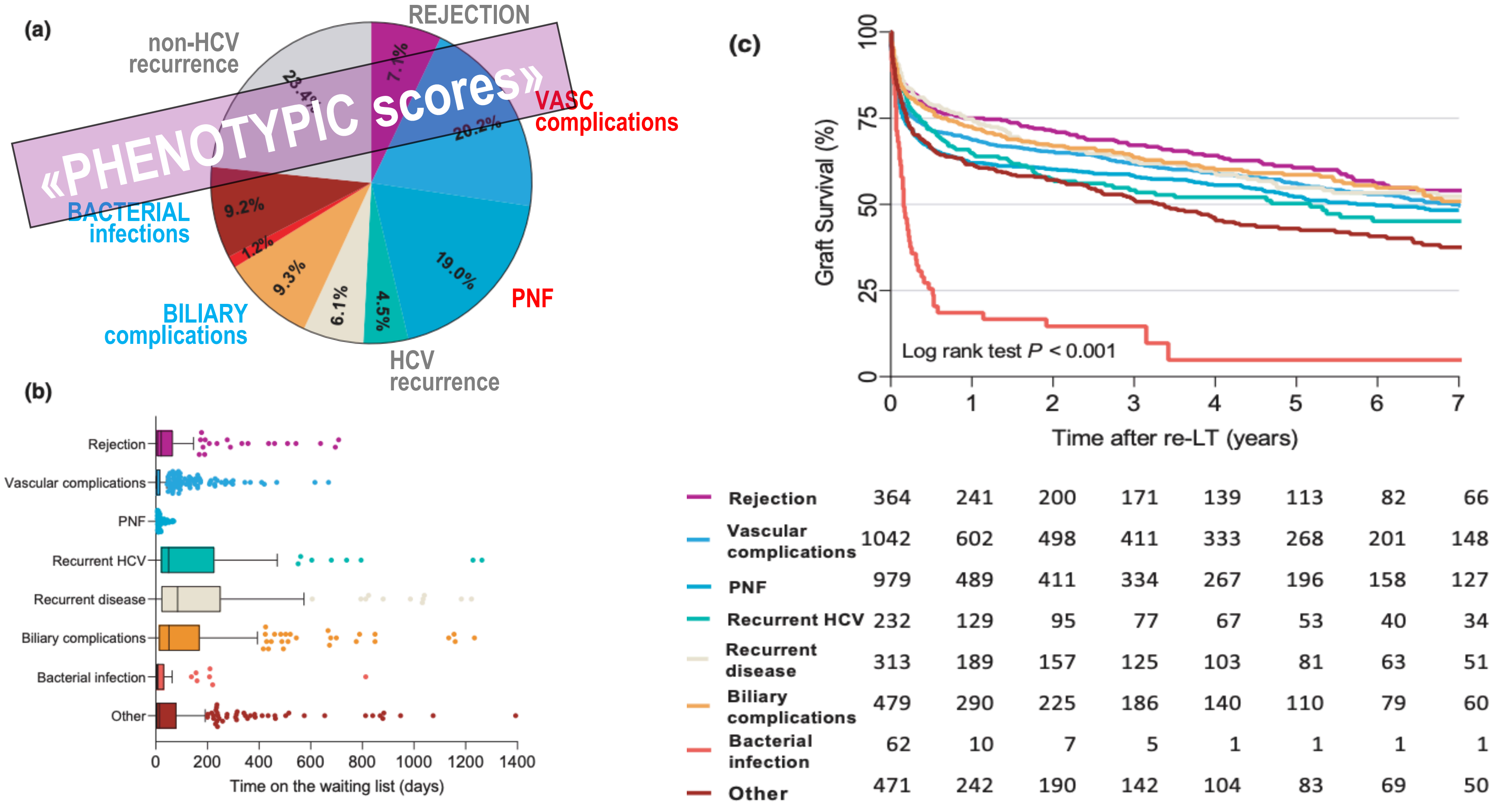


# The Liver Retransplantation Risk Score: a prognostic model for survival after adult liver retransplantation

Isabel M. A. Brüggenwirth[1], Maureen J. M. Werner[1], René Adam[2], Wojciech G. Polak[3], Vincent Karam[2], Michael A. Heneghan[4], Arianeb Mehrabi[5], Jürgen L. Klempnauer[6], Andreas Paul[7], Darius F. Mirza[8], Johann Pratschke[9], Mauro Salizzoni[10], Daniel Cherqui[11], Michael Allison[12], Olivier Soubrane[13], Steven J. Staffa[14], David Zurakowski[14], Robert J. Porte[1], Vincent E. de Meijer[1] & all the other contributing centers (www.eltr.org), the European Liver, Intestine Transplant Association (ELITA)

*Transplant International* 2021; 34: 1928–1937

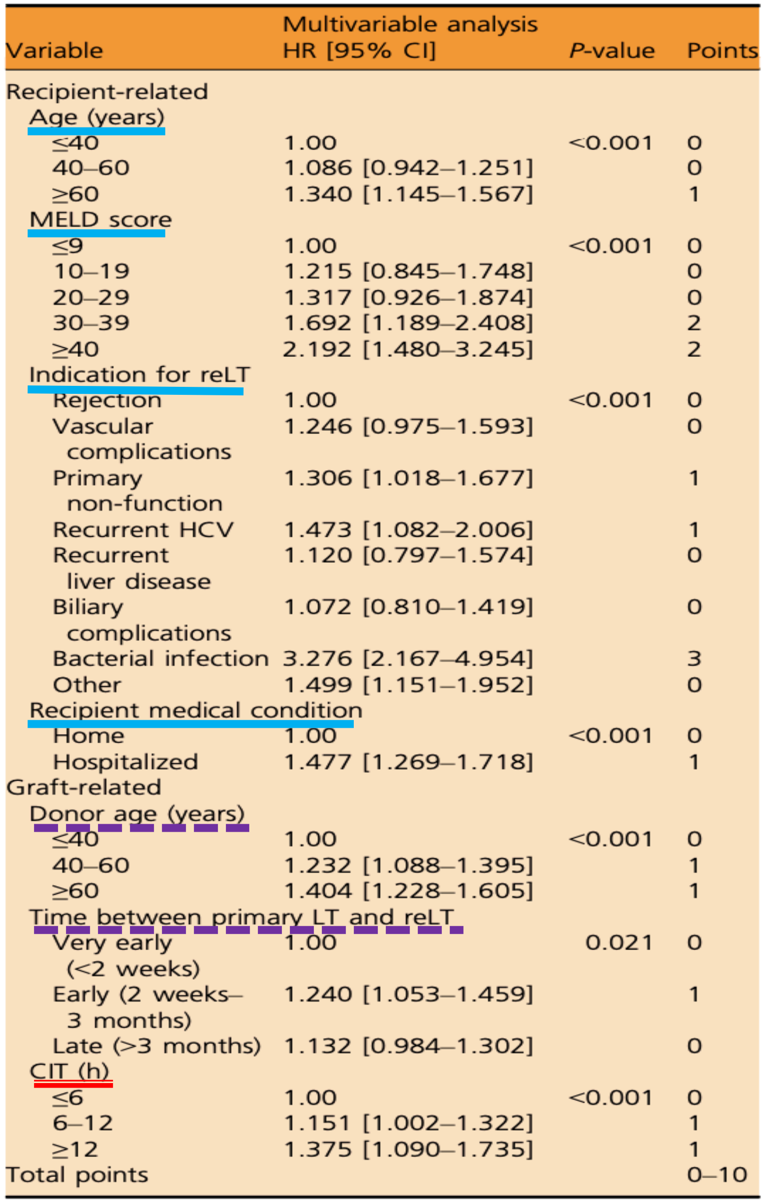


«PHENOTYPIC scores»

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rejection | 364 | 241 | 200 | 171 | 139 | 113 | 82 | 66 |
| Vascular complications | 1042 | 602 | 498 | 411 | 333 | 268 | 201 | 148 |
| PNF | 979 | 489 | 411 | 334 | 267 | 196 | 158 | 127 |
| Recurrent HCV | 232 | 129 | 95 | 77 | 67 | 53 | 40 | 34 |
| Recurrent disease | 313 | 189 | 157 | 125 | 103 | 81 | 63 | 51 |
| Biliary complications | 479 | 290 | 225 | 186 | 140 | 110 | 79 | 60 |
| Bacterial infection | 62 | 10 | 7 | 5 | 1 | 1 | 1 | 1 |
| Other | 471 | 242 | 190 | 142 | 104 | 83 | 69 | 50 |

Transplant International

7 Variables prognostic for graft failure after liver retransplantation ($N = 5150$; 2006–2016) and points according to the reLT risk score.



| Variable | Multivariable analysis HR [95% CI] | *P*-value | Points |
|---|---|---|---|
| Recipient-related | | | |
| Age (years) | | | |
| ≤40 | 1.00 | <0.001 | 0 |
| 40–60 | 1.086 [0.942–1.251] | | 0 |
| ≥60 | 1.340 [1.145–1.567] | | 1 |
| MELD score | | | |
| ≤9 | 1.00 | <0.001 | 0 |
| 10–19 | 1.215 [0.845–1.748] | | 0 |
| 20–29 | 1.317 [0.926–1.874] | | 0 |
| 30–39 | 1.692 [1.189–2.408] | | 2 |
| ≥40 | 2.192 [1.480–3.245] | | 2 |
| Indication for reLT | | | |
| Rejection | 1.00 | <0.001 | 0 |
| Vascular complications | 1.246 [0.975–1.593] | | 0 |
| Primary non-function | 1.306 [1.018–1.677] | | 1 |
| Recurrent HCV | 1.473 [1.082–2.006] | | 1 |
| Recurrent liver disease | 1.120 [0.797–1.574] | | 0 |
| Biliary complications | 1.072 [0.810–1.419] | | 0 |
| Bacterial infection | 3.276 [2.167–4.954] | | 3 |
| Other | 1.499 [1.151–1.952] | | 0 |
| Recipient medical condition | | | |
| Home | 1.00 | <0.001 | 0 |
| Hospitalized | 1.477 [1.269–1.718] | | 1 |
| Graft-related | | | |
| Donor age (years) | | | |
| ≤40 | 1.00 | <0.001 | 0 |
| 40–60 | 1.232 [1.088–1.395] | | 1 |
| ≥60 | 1.404 [1.228–1.605] | | 1 |
| Time between primary LT and reLT | | | |
| Very early (<2 weeks) | 1.00 | 0.021 | 0 |
| Early (2 weeks–3 months) | 1.240 [1.053–1.459] | | 1 |
| Late (>3 months) | 1.132 [0.984–1.302] | | 0 |
| CIT (h) | | | |
| ≤6 | 1.00 | <0.001 | 0 |
| 6–12 | 1.151 [1.002–1.322] | | 1 |
| ≥12 | 1.375 [1.090–1.735] | | 1 |
| Total points | | | 0–10 |

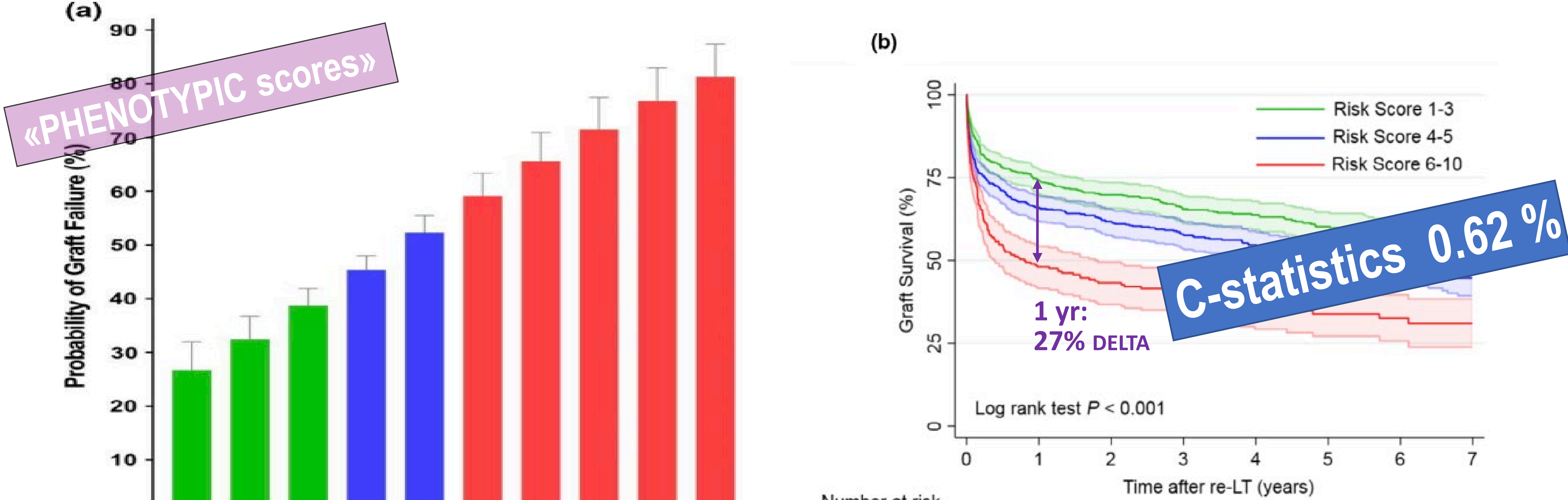
# The Liver Retransplantation Risk Score: a prognostic model for survival after adult liver retransplantation

**Transplant International**

*Transplant International* 2021; 34: 1928–1937

Isabel M. A. Brüggenwirth[1], Maureen J. M. Werner[1], René Adam[2], Wojciech G. Polak[3], Vincent Karam[2], Michael A. Heneghan[4], Arianeb Mehrabi[5], Jürgen L. Klempnauer[6], Andreas Paul[7], Darius F. Mirza[8], Johann Pratschke[9], Mauro Salizzoni[10], Daniel Cherqui[11], Michael Allison[12], Olivier Soubrane[13], Steven J. Staffa[14], David Zurakowski[14], Robert J. Porte[1], Vincent E. de Meijer[1] & all the other contributing centers (www.eltr.org), the European Liver, Intestine Transplant Association (ELITA)

*Transplant International* 2021; 34: 1928–1937



«PHENOTYPIC scores»

**1 yr: 27% DELTA**

**C-statistics 0.62 %**

| Number at risk | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Risk Score 1-3 | 568 | 370 | 312 | 247 | 198 | 154 | 117 | 85 |
| Risk Score 4-5 | 593 | 342 | 281 | 221 | 169 | 118 | 85 | 58 |
| Risk Score 6-10 | 243 | 105 | 81 | 63 | 45 | 32 | 21 | 15 |

**JAMA Surgery** | **Original Investigation**

Gemelli
Fondazione Policlinico Universitario Agostino Gemelli IRCCS
Università Cattolica del Sacro Cuore
Azienda Ospedaliera Papa Giovanni XXIII Bergamo
Centro Nazionale Trapianti
S·I·T·O·

# Development and Validation of a Comprehensive Model to Estimate Early Allograft Failure Among Patients Requiring Early Liver Retransplant

*JAMA Surg*. 2020;155(12):e204095. doi:10.1001/jamasurg.2020.4095

Alfonso W. Avolio, MD; Antonio Franco, MD; Andrea Schlegel, MD, PhD; Quirino Lai, MD, PhD; Sonia Meli, MD; Patrizia Burra, MD, PhD; Damiano Patrono, MD; Matteo Ravaioli, MD; Domenico Bassi, MD; Fabio Ferla, MD; Duilio Pagano, MD; Paola Violi, MD, PhD; Stefania Camagni, MD; Daniele Dondossola, MD; Roberto Montalti, MD; Wasfi Alrawashdeh, MD; Alessandro Vitale, MD, PhD; Luciana Teofili, MD; Gabriele Spoletini, MD, PhD; Paolo Magistri, MD; Marco Bongini, MD; Massimo Rossi, MD; Vincenzo Mazzaferro, MD, PhD; Fabrizio Di Benedetto, MD; John Hammond, MD, PhD; Marco Vivarelli, MD; Salvatore Agnes, MD; Michele Colledan, MD; Amedeo Carraro, MD, PhD; Matteo Cescon, MD, PhD; Luciano De Carlis, MD; Lucio Caccamo, MD, PhD; Salvatore Gruttadauria, MD, PhD; Paolo Muiesan, MD; Umberto Cillo, MD; Renato Romagnoli, MD; Paolo De Simone, MD, PhD

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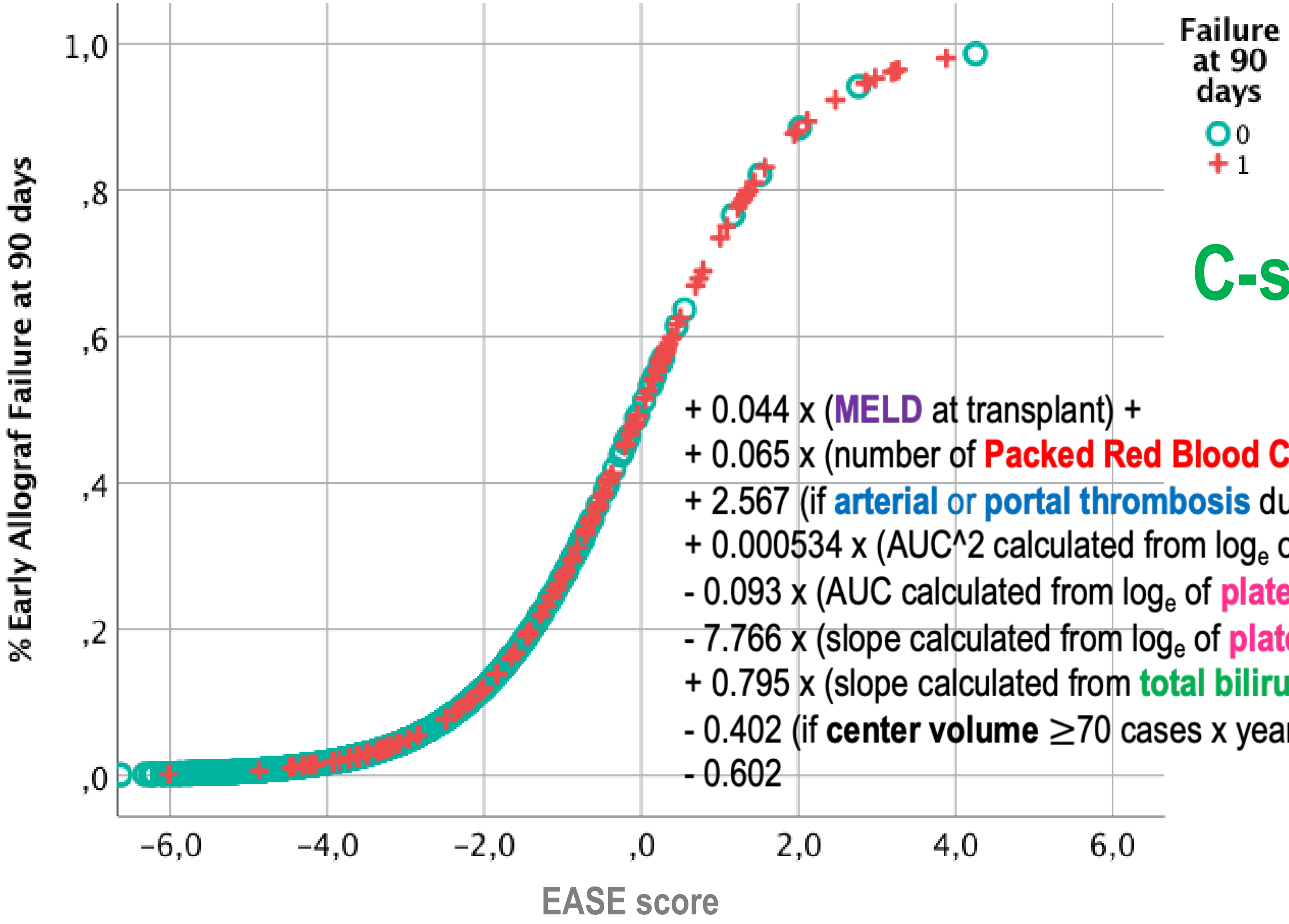
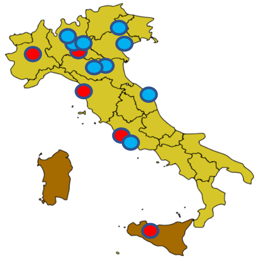
# EASE score





**C-statistic 0.87**

+ 0.044 x (**MELD** at transplant) +
+ 0.065 x (number of **Packed Red Blood Cell** transfused units during surgery) +
+ 2.567 (if **arterial** or **portal thrombosis** during days 1-10) +
+ 0.000534 x (AUC^2 calculated from $\log_e$ of **AST** in 1, 2, 3, 7, 10 POD) +
- 0.093 x (AUC calculated from $\log_e$ of **platelet count** in 1, 3, 7, 10 POD) +
- 7.766 x (slope calculated from $\log_e$ of **platelet count** in 1, 3, 7, 10 POD) +
+ 0.795 x (slope calculated from **total bilirubin** in 1, 3, 7, 10 POD) +
- 0.402 (if **center volume** ≥70 cases x year) +
- 0.602

# Availability of a Web and Smartphone Application to Stratify the Risk of of Early Allograft Failure Requiring Liver Retransplantation

HEPATOLOGY COMMUNICATIONS
Open Access

Impact factor: 5.073

September 2021

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Andrea Contegiacomo, M.D. [3]
Salvatore Agnes, M.D. [1,2]
Giuseppe Marrone, M.D., Ph.D. [1]
Giovanni Moschetta, M.D. [1]
Luca Miele, M.D., Ph.D. [1,2]
Marc L. Melcher, M.D., Ph.D. [4]

The early allograft failure (EAF) definition allows
a quantification of the overall risk of failure at 90 days
after hen
Moos
W ultiv
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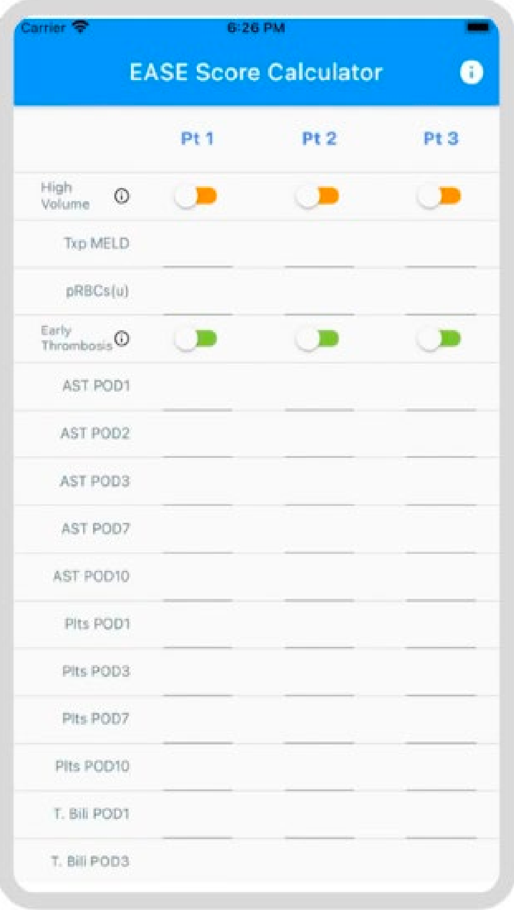
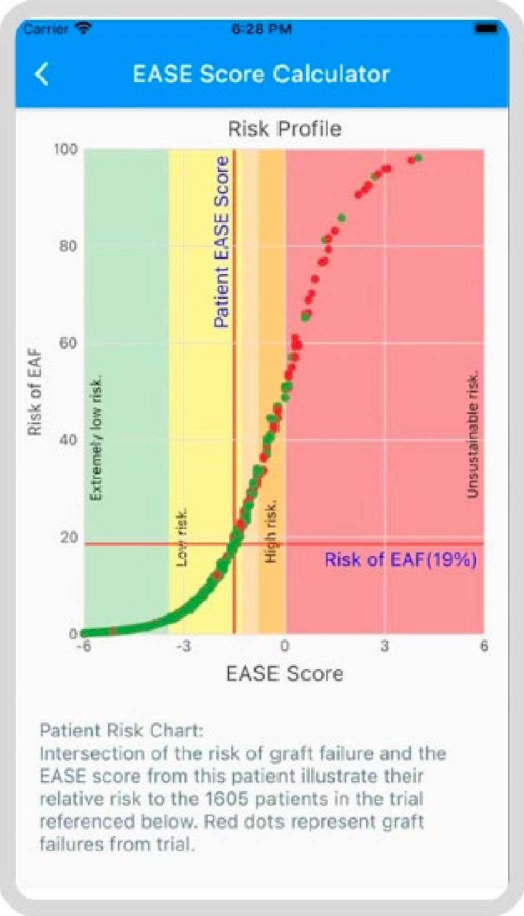
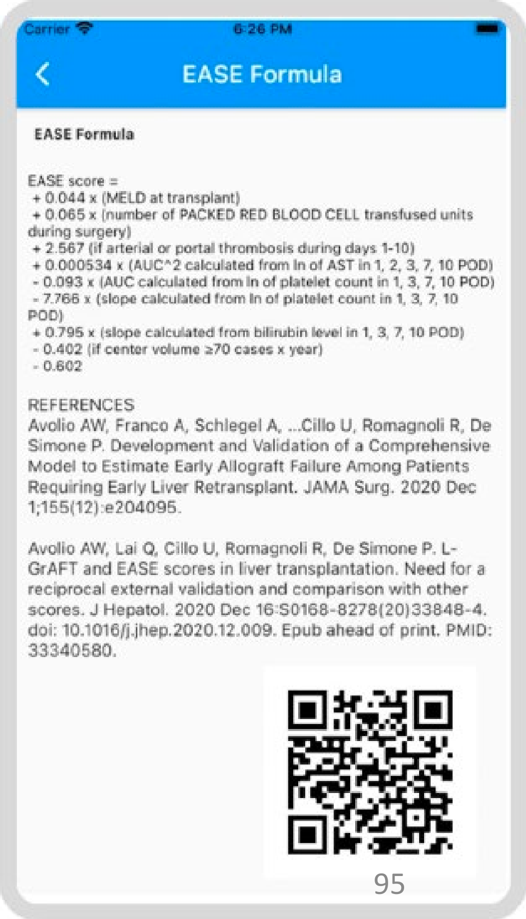


EASE Score Calculator

| | Pt 1 | Pt 2 | Pt 3 |
|---|---|---|---|
| High Volume | | | |
| Txp MELD | | | |
| pRBCs(u) | | | |
| Early Thrombosis | | | |
| AST POD1 | | | |
| AST POD2 | | | |
| AST POD3 | | | |
| AST POD7 | | | |
| AST POD10 | | | |
| Plts POD1 | | | |
| Plts POD3 | | | |
| Plts POD7 | | | |
| Plts POD10 | | | |
| T. Bili POD1 | | | |
| T. Bili POD3 | | | |



Patient Risk Chart:
Intersection of the risk of graft failure and the EASE score from this patient illustrate their relative risk to the 1605 patients in the trial referenced below. Red dots represent graft failures from trial.



EASE Formula

**EASE Formula**

EASE score =
+ 0.044 x (MELD at transplant)
+ 0.065 x (number of PACKED RED BLOOD CELL transfused units during surgery)
+ 2.567 (if arterial or portal thrombosis during days 1-10)
+ 0.000534 x (AUC^2 calculated from ln of AST in 1, 2, 3, 7, 10 POD)
- 0.093 x (AUC calculated from ln of platelet count in 1, 3, 7, 10 POD)
- 7.766 x (slope calculated from ln of platelet count in 1, 3, 7, 10 POD)
+ 0.795 x (slope calculated from bilirubin level in 1, 3, 7, 10 POD)
- 0.402 (if center volume ≥70 cases x year)
- 0.602

REFERENCES

Avolio AW, Franco A, Schlegel A, ...Cillo U, Romagnoli R, De Simone P. Development and Validation of a Comprehensive Model to Estimate Early Allograft Failure Among Patients Requiring Early Liver Retransplant. JAMA Surg. 2020 Dec 1;155(12):e204095.

Avolio AW, Lai Q, Cillo U, Romagnoli R, De Simone P. L-GrAFT and EASE scores in liver transplantation. Need for a reciprocal external validation and comparison with other scores. J Hepatol. 2020 Dec 16:S0168-8278(20)33848-4. doi: 10.1016/j.jhep.2020.12.009. Epub ahead of print. PMID: 33340580.

# International, Multicenter, Prospective, Non-competitive, Observational study to Validate and Optimize kinetic prediction models of 90-day and 1-year allograft failure after Liver Transplantation. The IMPROVEMENT study

## Promoters:

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*ClinicalTrials.gov PRS*
*Protocol Registration and Results System*
*NCT05289609*

GemelliGenerator
*Clinical research beyond tomorrow*

*https://gemelligenerator.it/projects/the-improvement-study-2/*

# International, Multicenter, Prospective, Non-competitive, Observational study to Validate and Optimize prediction models of 90-day and 1-year allograft failure after Liver Transplantation.

## The IMPROVEMENT study

**Vatche Agopian** (US)

**Alfonso Avolio** (IT)

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(hepatologist)

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Hiroto Egawa (Japan)

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Wojtek Polak (NE)

Zhiyong Guo (China)

Gabriel Oniscu (UK)

Quirino Lai (IT)

Marc Melcher (US)

Paulo Martins (US)

**North America**
6 members

**ASIA**
3 members

**EUROPE**
7 members

**South America**
2 members

## NEW STUDY (ongoing, 2790 cases enrolled)

**International Multicenter Prospective, Non-competitive, Observational study to Validate and Optimize prediction models of 90-day and 1-year allograft failure after liver transplantation.**

***The IMPROVEMENT study***

# NEW STUDY

**International Multicenter Prospective, Non-competitive, Observational study to Validate and Optimize prediction models of 90-day and 1-year allograft failure after liver transplantation**

*The **IMPROVEMENT** study*

**The RATIONALE of the study and the working hypothesis of the MODEL:**

**three graft MACRO-types**

1. **DBD (standard grafts)** **reference group**
2. **DCD** (& high-risk DBD) **grafts** ***high-risk group ?*** **perfusion machines**
   ↳ ***reference group ?***
3. **Living Donor grafts** ***low-risk group ?*** **perfusion machines**
   ***for previously excluded grafts (steatosis >30%)***

# NEW STUDY (proposal)

**International Multicenter Prospective, non-competitive, Observational study to Validate and Optimize prediction models of 90-day and 1-year allograft failure after liver transplantation.**

**The IMPROVEMENT study**

## A. Stratification according to the SEVERITY of the DISEASE in the RECIPIENT

- **MELD, MELDNa, MELD 3.0** at transplant
- Modified Charlson comorbidity index at transplant
- ASA class
- Frailty index at transplant
- Sarcopenia evaluation (area of 3° lumbar vertebra): last CT-scan during the list period
- Nutritional evaluation (Visceral Adipose Tissue): last CT-scan during the list period
- CAD-LT score, number of stents, ejection fraction %

# International Multicenter Prospective, Non-competitive, Observational study to Validate and Optimize kinetic prediction models of 90-day and 1-year allograft failure after liver transplantation

## *The **IMPROVEMENT** study*

**STEERING COMMITTEE** **(Asia 3, Europe 7, Americas 8 members)**

- Avolio A, PI, Italy
- Agopian V, co-PI, USA
- Burra P, Italy (hepatologist)
- Cillo U, Italy
- Croome K, USA
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- Fondevilla C, Spain
- Guo Z, China
- Lai Q, Italy
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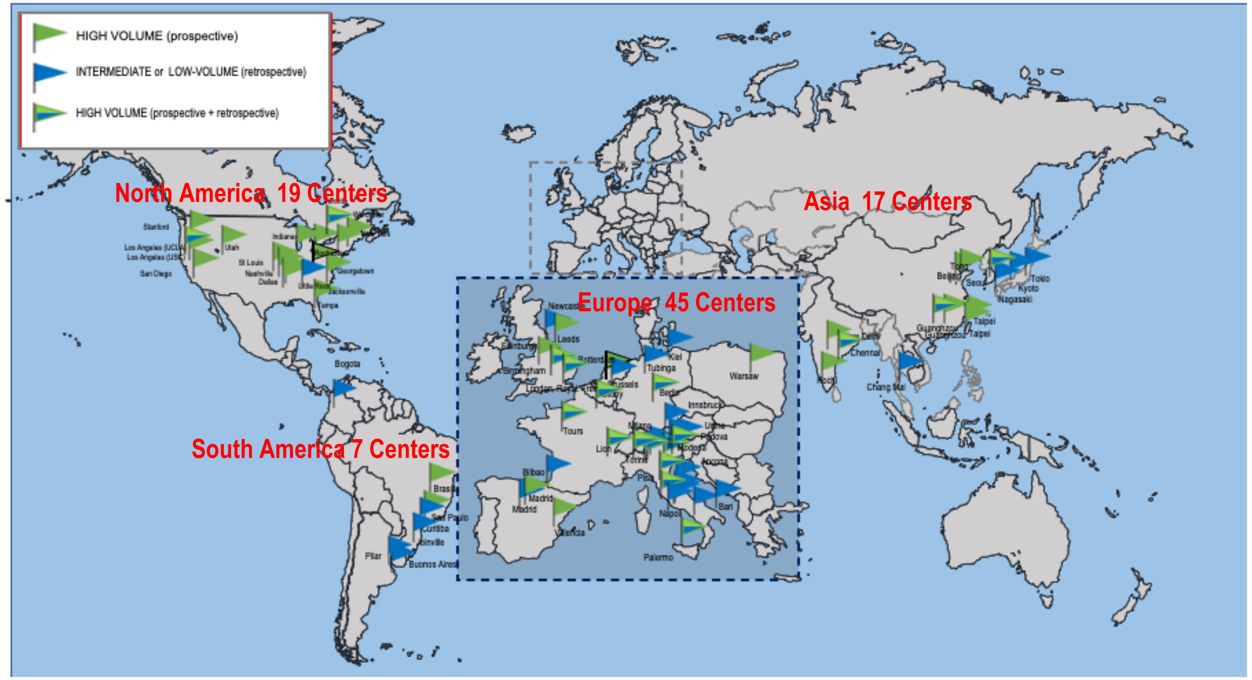
- Oniscu G, UK
- Polak W, NE
- Quintini C, USA
- Rela M, India
- Sapisochin G, Canada
- Wielderkehr J, Brazil



*ClinicalTrials.gov PRS*

*Protocol Registration and Results System*

*NCT05289609*

Alfonso Avolio, Matteo Cescon, Renato Romagnoli, Walter Santaniello, Massimo Rossi, Vittorio Corno, Paolo Caraceni, Barbara Coco, Mirella Fraquelli, Maria Rendina, Mario Angelico, Stefano Fagiuoli, Raffaele Bruno, Alessandro Nanni Costa, Lorenza Ridolfi, Renato Romagnoli, Renzo Pretagostini, Antonio Amoroso, Giandomenico Biancofiore, Andrea De Gasperi,
Sacchini, Renzo Pegoraro, Ivan Gardini, Patrizia Pipitò, Carlo Maffeo, Salvatore R

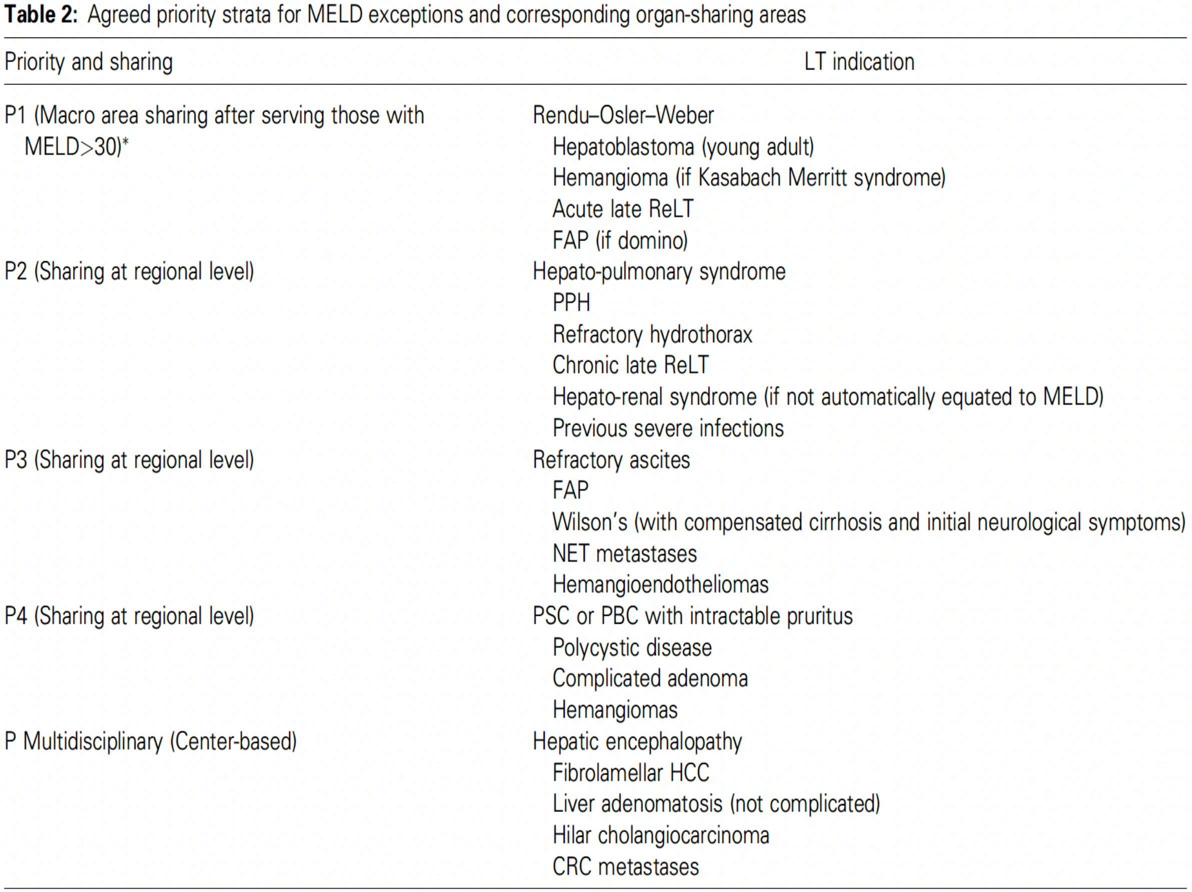


**Table 2:** Agreed priority strata for MELD exceptions and corresponding organ-sharing areas

| Priority and sharing | LT indication |
|---|---|
| P1 (Macro area sharing after serving those with MELD>30)* | Rendu–Osler–Weber<br>Hepatoblastoma (young adult)<br>Hemangioma (if Kasabach Merritt syndrome)<br>Acute late ReLT<br>FAP (if domino) |
| P2 (Sharing at regional level) | Hepato-pulmonary syndrome<br>PPH<br>Refractory hydrothorax<br>Chronic late ReLT<br>Hepato-renal syndrome (if not automatically equated to MELD)<br>Previous severe infections |
| P3 (Sharing at regional level) | Refractory ascites<br>FAP<br>Wilson's (with compensated cirrhosis and initial neurological symptoms)<br>NET metastases<br>Hemangioendotheliomas |
| P4 (Sharing at regional level) | PSC or PBC with intractable pruritus<br>Polycystic disease<br>Complicated adenoma<br>Hemangiomas |
| P Multidisciplinary (Center-based) | Hepatic encephalopathy<br>Fibrolamellar HCC<br>Liver adenomatosis (not complicated)<br>Hilar cholangiocarcinoma<br>CRC metastases |