

Recent Trends and Advances in Liver Transplantation

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Disclosures

- No conflicts of interest
- No financial disclosures



Final Rule: Organ Allocation

- April 1998, the Department of Health and Human Services issued the final rule on the Organ Procurement and Transplantation Network
 - Medical urgency
 - Minimize waiting time
 - Avoid futile transplantation
 - Promote efficient management of organ allocation



Organ Procurement and Transplantation Network--
HRSA. Final rule with comment period. Federal
Register 1998; 63:16296-16338.

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

PATRICK S. KAMATH,¹ 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}

- $MELD = 3.78 \times \ln[\text{serum bilirubin (mg/dL)}] + 11.2 \times \ln[INR] + 9.57 \times \ln[\text{serum creatinine (mg/dL)}] + 6.43$
- MELD-Na score was adopted by the OPTN in 2016.

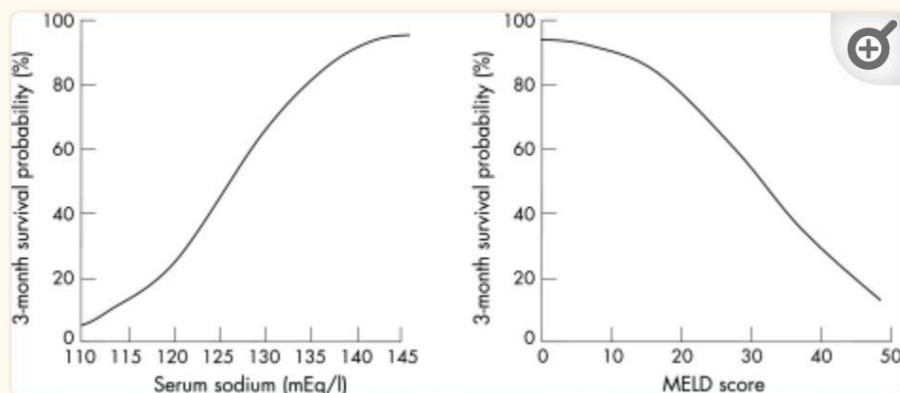
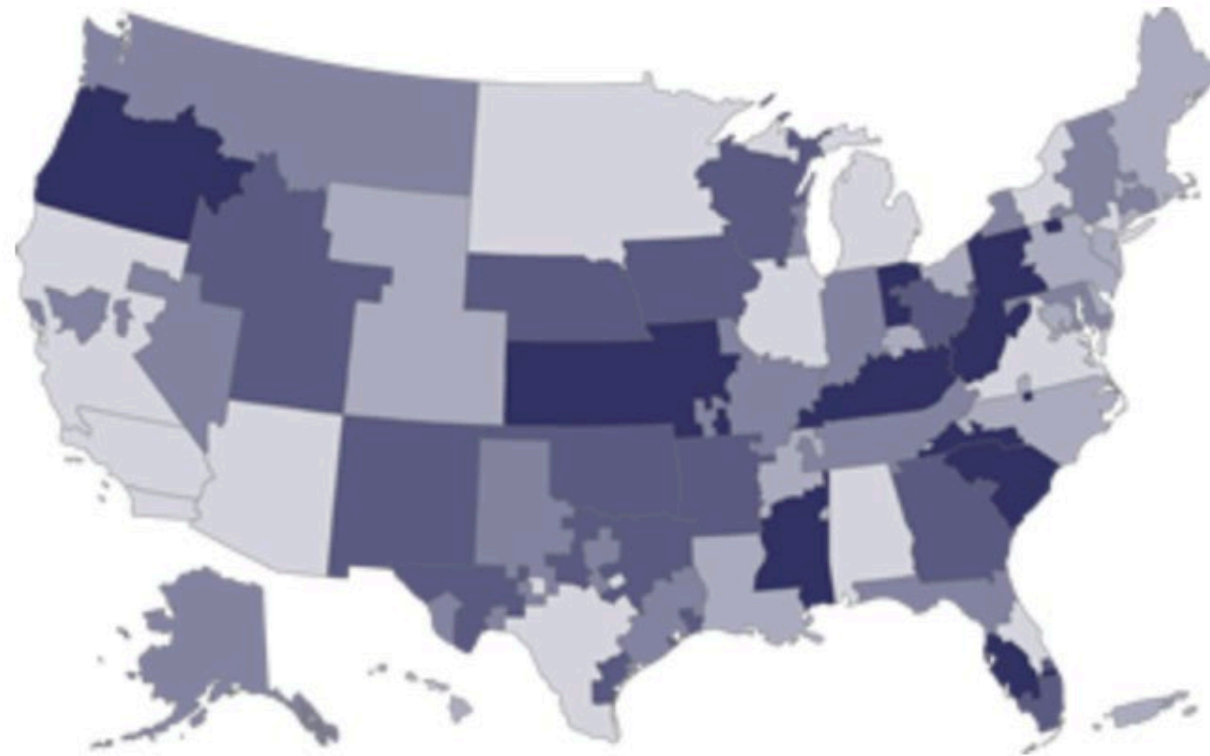


Figure 2 Relationship between serum sodium (left) and model for end-stage liver disease (MELD) score (right) and estimated 3-month probability of survival in all patients included.

Hepatology 2001; 33:464-470.

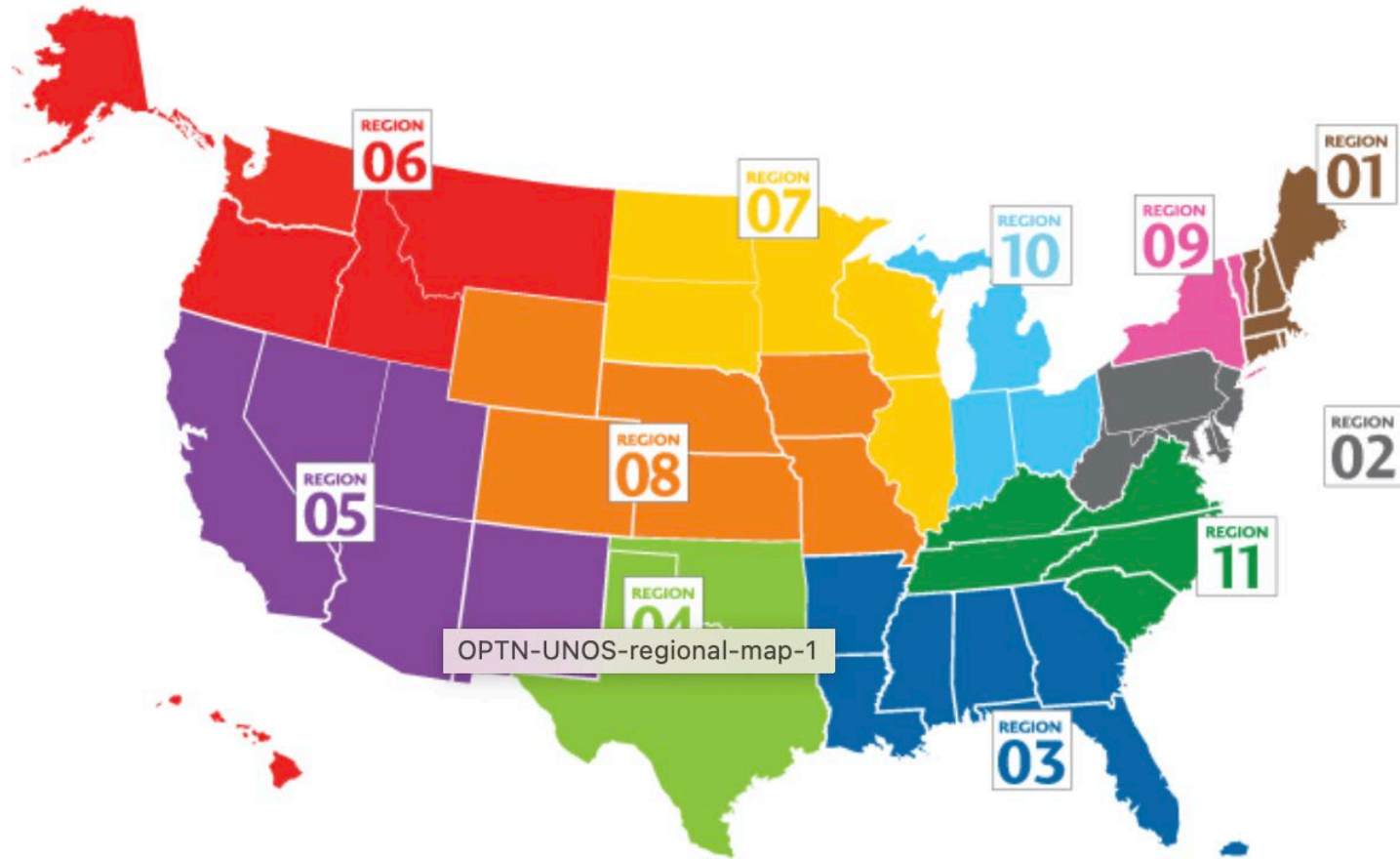
Gut. 2007 Sep; 56 (9): 1283-1290.

UNOS LIVER ALLOCATION, Prior to February 2020



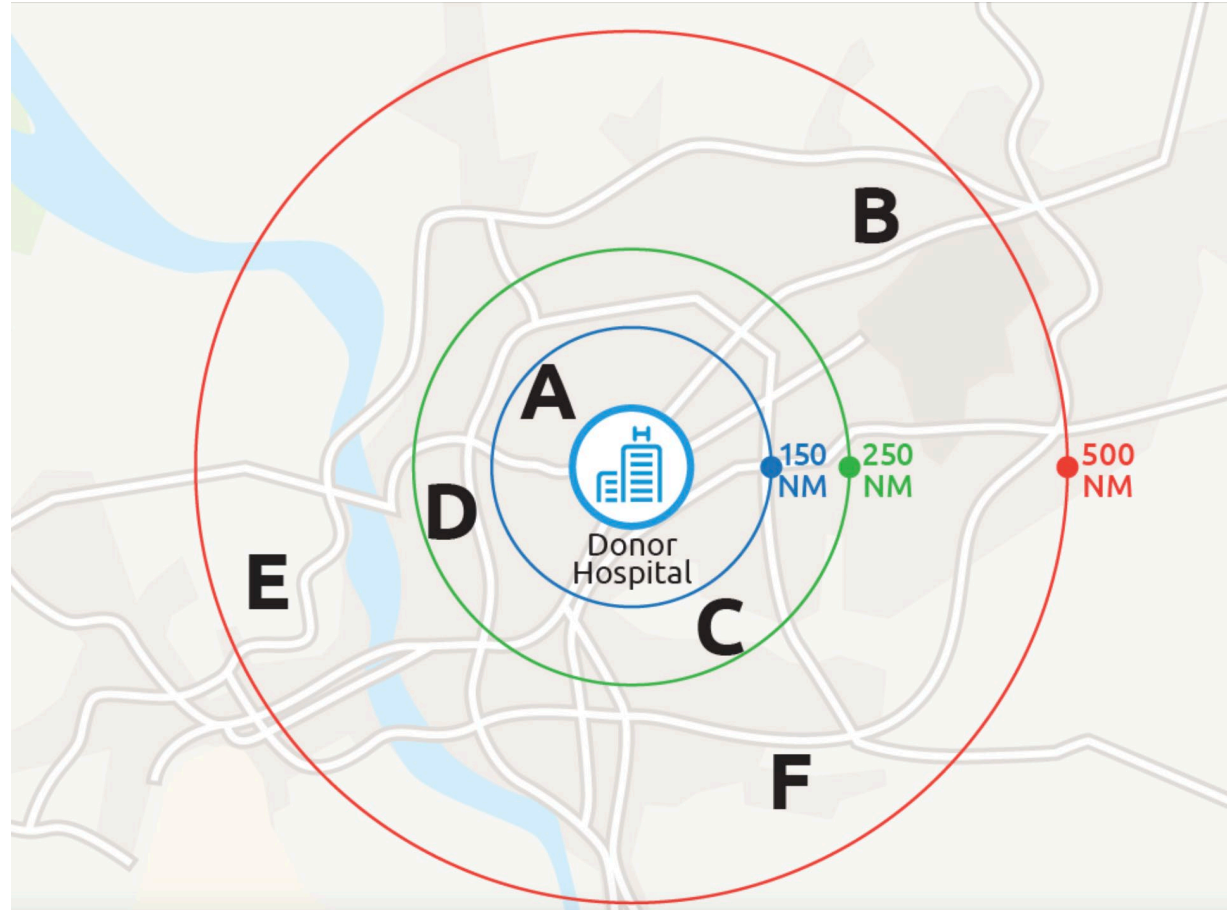
SRTR.org
Accessed 4/25/2023

UNOS LIVER ALLOCATION, Prior to February 2020



UNOS.org
Accessed 4/25/2023

UNOS LIVER ALLOCATION, Present Day



Number of Liver Transplants per Annum in US

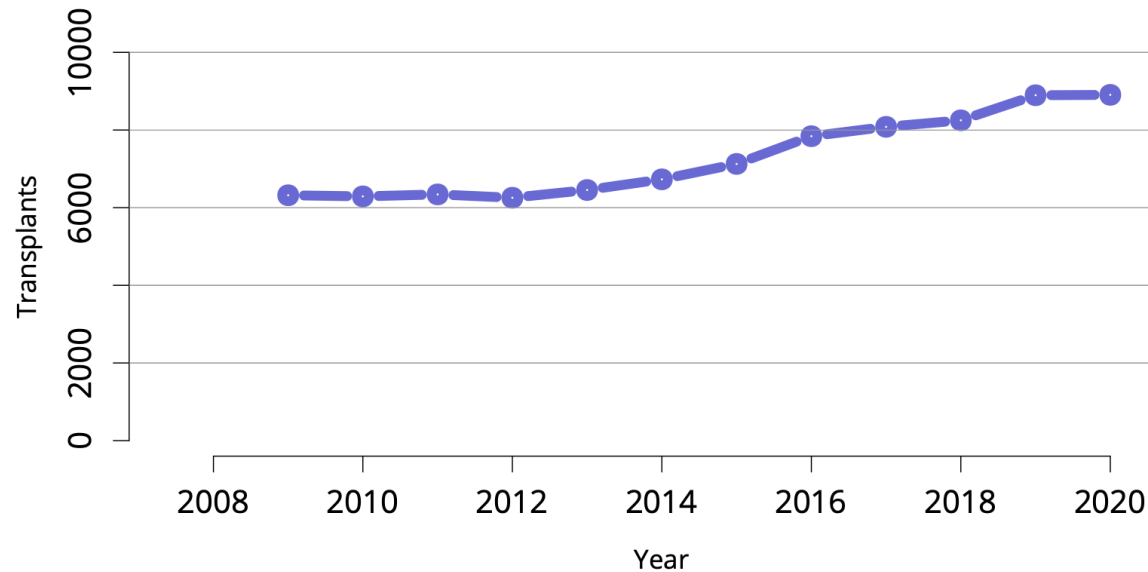


Figure LI 60. Overall liver transplants. All liver transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.

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Opioid Epidemic and Transplantation

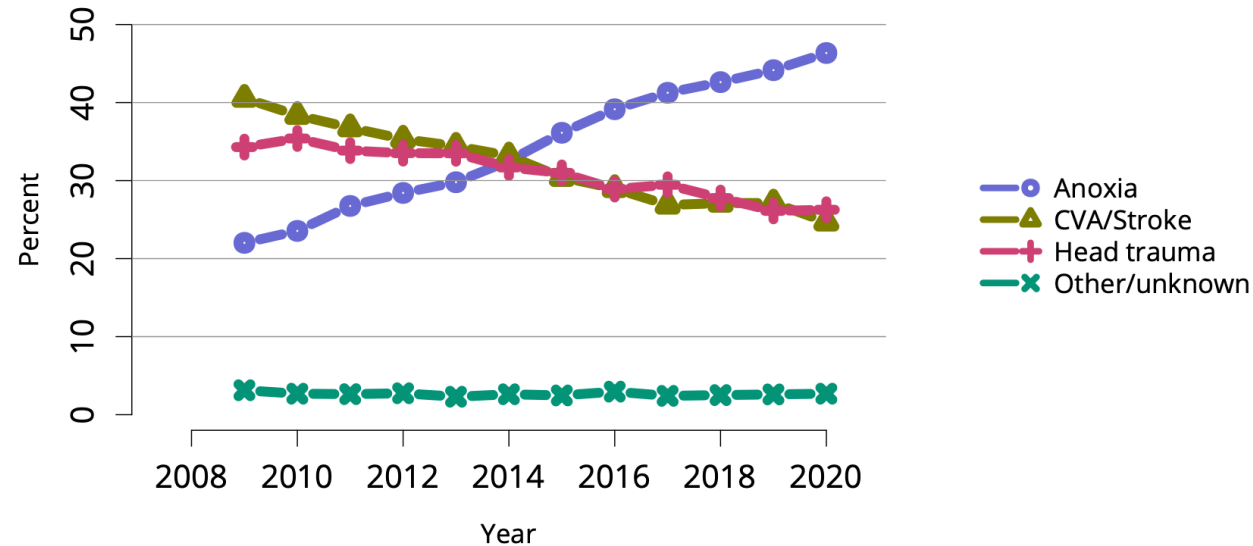


Figure LI 52. Cause of death among deceased liver donors. Deceased donors with a liver recovered for the purposes of transplant. CVA, cerebrovascular accident.

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Indications for Transplantation are Changing

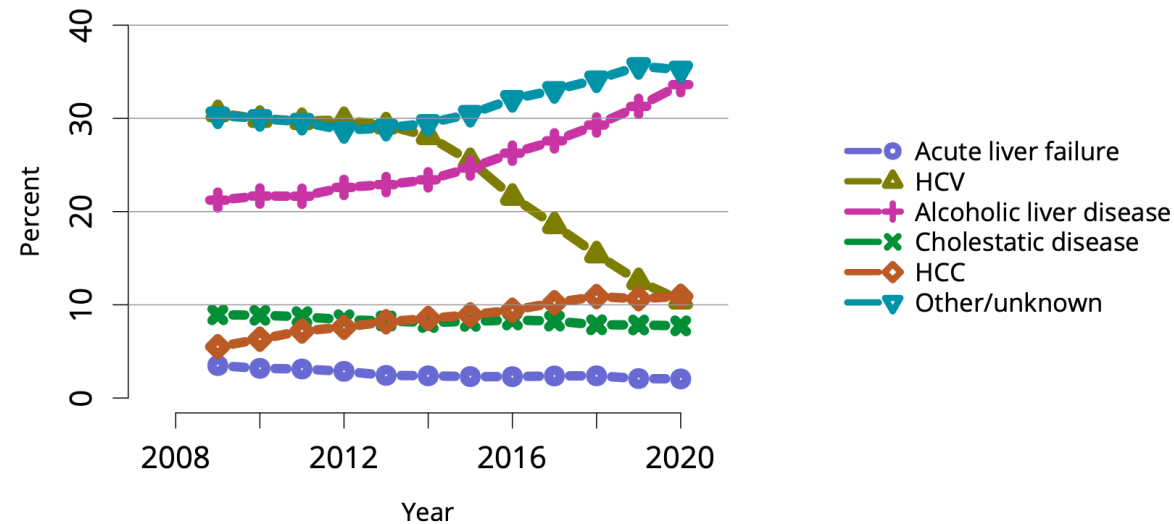


Figure LI 6. Distribution of adults waiting for liver transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

Clinical Infectious Diseases® 2016;62(10):1287–8

[BMC Health Serv Res.](#) 2019; 19: 521.

Published online 2019 Jul 25. doi: [10.1186/s12913-019-4349-x](https://doi.org/10.1186/s12913-019-4349-x)

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[Open Archive](#) • DOI: <https://doi.org/10.1111/ajt.16978>

Utilization of Hepatitis C + Donor Livers

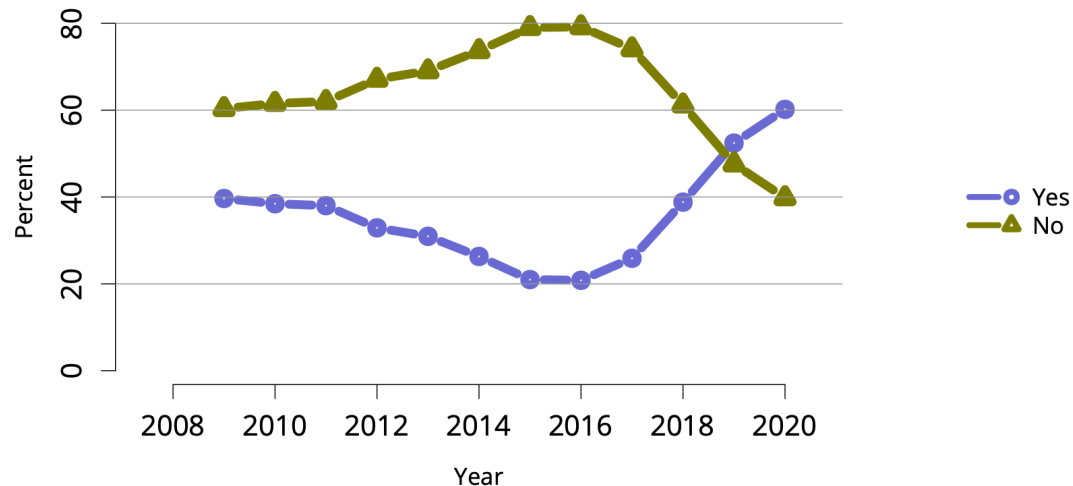


Figure LI 11. Adults willing to accept liver from HCV+ donor. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Willingness to accept HCV+ organ at time of listing. HCV, hepatitis C virus.

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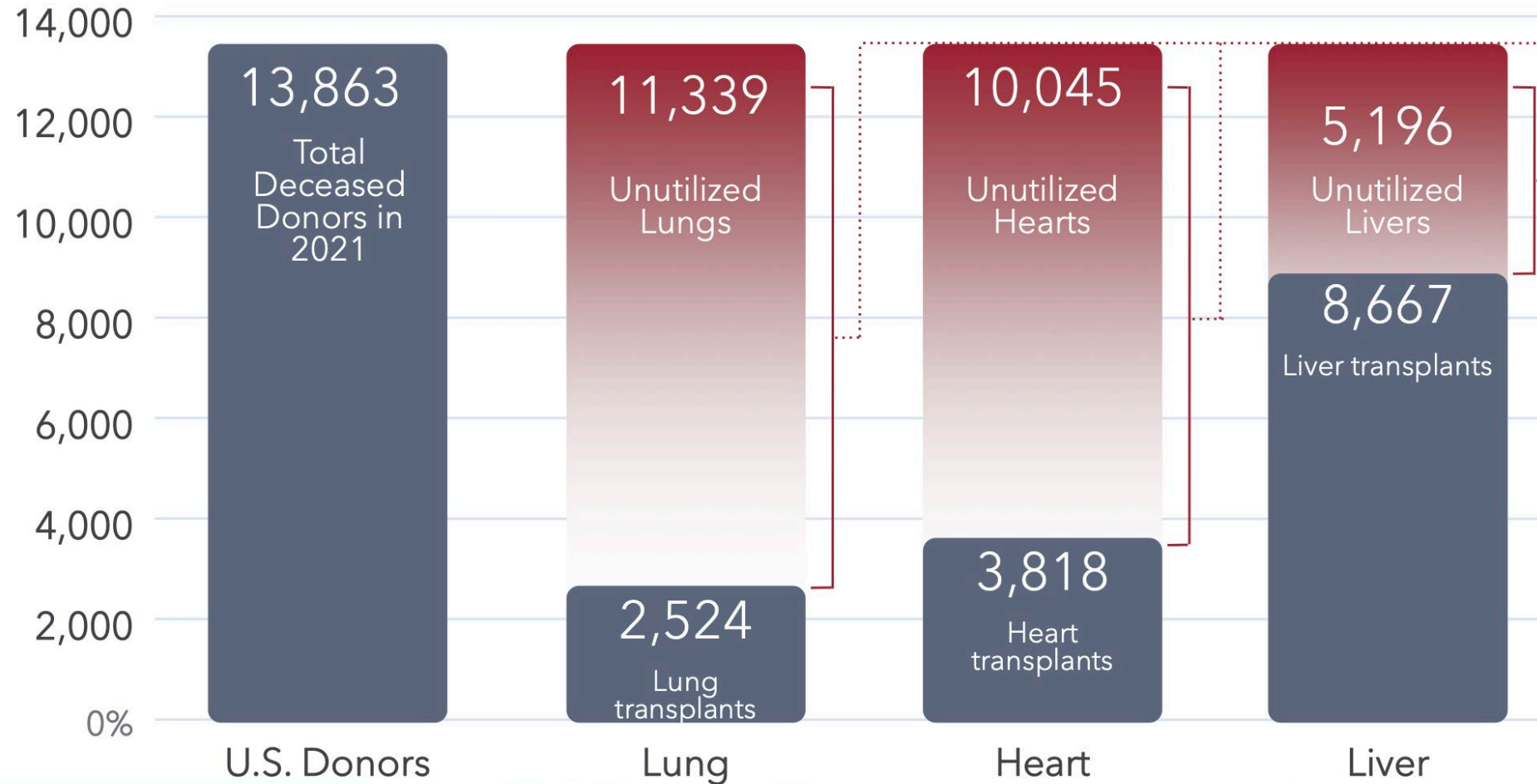
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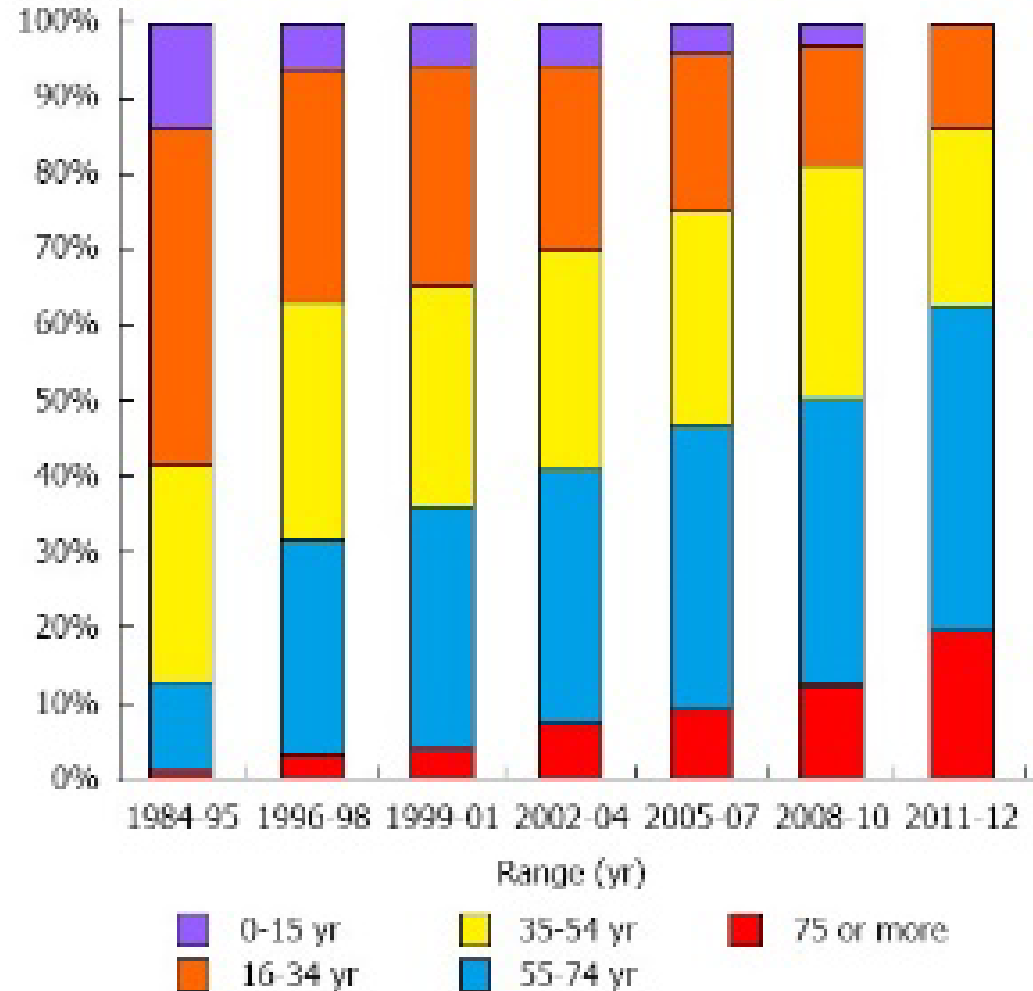
[Open Archive](#) • DOI: <https://doi.org/10.1111/ajt.16978>

ORGAN UTILIZATION



Source - 2021 Organ Procurement & Transplant Network (OPTN) Data

Liver Donor Age is Changing



Lue A et al, World J Gastro, 2016 Jun 7; 22(21): 4966-4976.

Deceased by Cardiac Death Liver Donors

BELGIAN MODIFIED CLASSIFICATION OF MAASTRICHT FOR DCD

3139

Table 1. Maastricht Categories for Donors After Circulatory Death (Kootstra, 1995)

Uncontrolled DCD	
I Dead on arrival	Includes victims of a sudden death, whether traumatic or not, occurring out of the hospital and who, for obvious reasons, have not been resuscitated.
II Unsuccessful resuscitation	Includes patients who have a CA and in whom CPR has been applied and was unsuccessful. CA occurs within the hospital, being attended by healthcare personnel with immediate initiation of CPR.
Controlled DCD	
III Awaiting cardiac arrest	Includes patients in whom withdrawal of life-sustaining therapies is applied, as agreed on within the healthcare team and with the relatives or representatives of the patient.
IV Cardiac arrest while brain-dead	Includes patients who have a CA in the process of the determination of death by neurologic criteria or after such determination has been performed but before the transfer to the operating theater. It is likely that restoration of cardiac activity is first attempted, with a switch to the protocol of donation after circulatory death, if this fails.

Abbreviations: CA, cardiac arrest; CPR, cardiopulmonary resuscitation.

Normothermic Ex Vivo Liver Perfusion

JAMA Surgery | **Original Investigation**

Impact of Portable Normothermic Blood-Based Machine Perfusion on Outcomes of Liver Transplant The OCS Liver PROTECT Randomized Clinical Trial

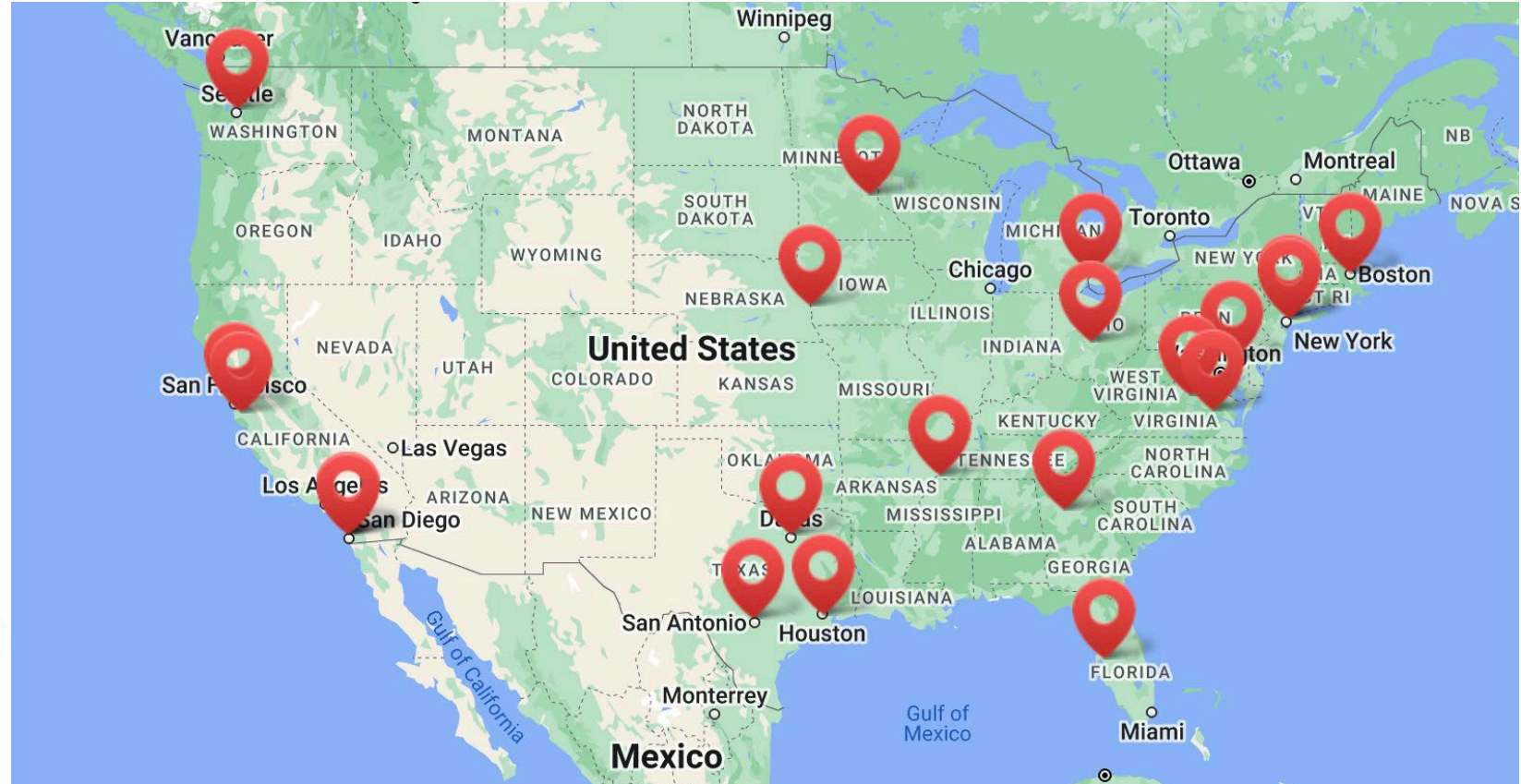
James F. Markmann, MD, PhD; Marwan S. Abouljoud, MD, PhD; R. Mark Ghobrial, MD, PhD; Chandra S. Bhati, MD; Shawn J. Pelletier, MD; Amy D. Lu, MD; Shane Ottmann, MD; Tarunjeet Klair, MD; Corey Eymard, MD; Garrett R. Roll, MD; Joseph Magliocca, MD; Timothy L. Pruett, MD; Jorge Reyes, MD; Sylvester M. Black, MD; Christopher L. Marsh, MD; Gabriel Schnickel, MD; Milan Kinkhabwala, MD; Sander S. Florman, MD; Shaheed Merani, MD; Anthony J. Demetris, MD; Shoko Kimura, MD, PhD; Michael Rizzari, MD; Ashish Saharia, MD; Marlon Levy, MD; Avinash Agarwal, MD; Francisco G. Cigarroa, MD; James D. Eason, MD; Shareef Syed, MD; W. Kenneth Washburn, MD; Justin Parekh, MD; Jang Moon, MD; Alexander Maskin, MD; Heidi Yeh, MD; Parsia A. Vagefi, MD; Malcolm P. MacConmara, MD

JAMA Surg. 2022;157(3):189-198. doi:[10.1001/jamasurg.2021.6781](https://doi.org/10.1001/jamasurg.2021.6781)
Published online January 5, 2022.

Normothermic Ex Vivo Liver Perfusion



OCS™ Liver



Hypothermic Oxygenated Perfusion (HOPE)

Hypothermic Oxygenated Machine Perfusion Reduces Early Allograft Injury and Improves Post-transplant Outcomes in Extended Criteria Donation Liver Transplantation From Donation After Brain Death

Results From a Multicenter Randomized Controlled Trial (HOPE ECD-DBD)

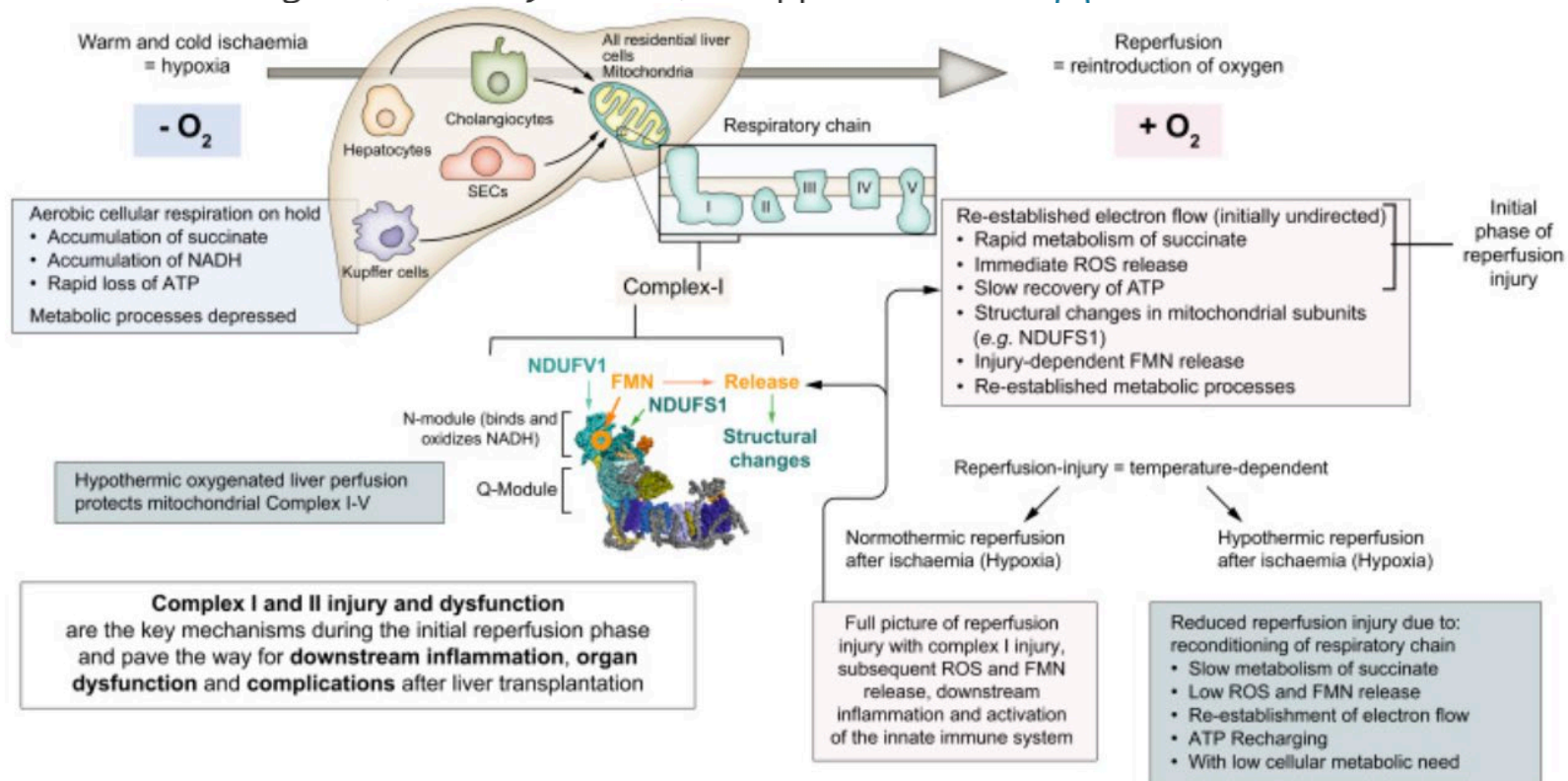


Annals of Surgery 274(5):p 705-712, November 2021. | DOI: 10.1097/SLA.0000000000005110

**ANNALS
OF
SURGERY**

Protective mechanisms and current clinical evidence of hypothermic oxygenated machine perfusion (HOPE) in preventing post-transplant cholangiopathy

Andrea Schlegel^{1,3}, Robert J. Porte², Philipp Dutkowski¹  



US Experience: Bridge to HOPE Liver Clinical Trial

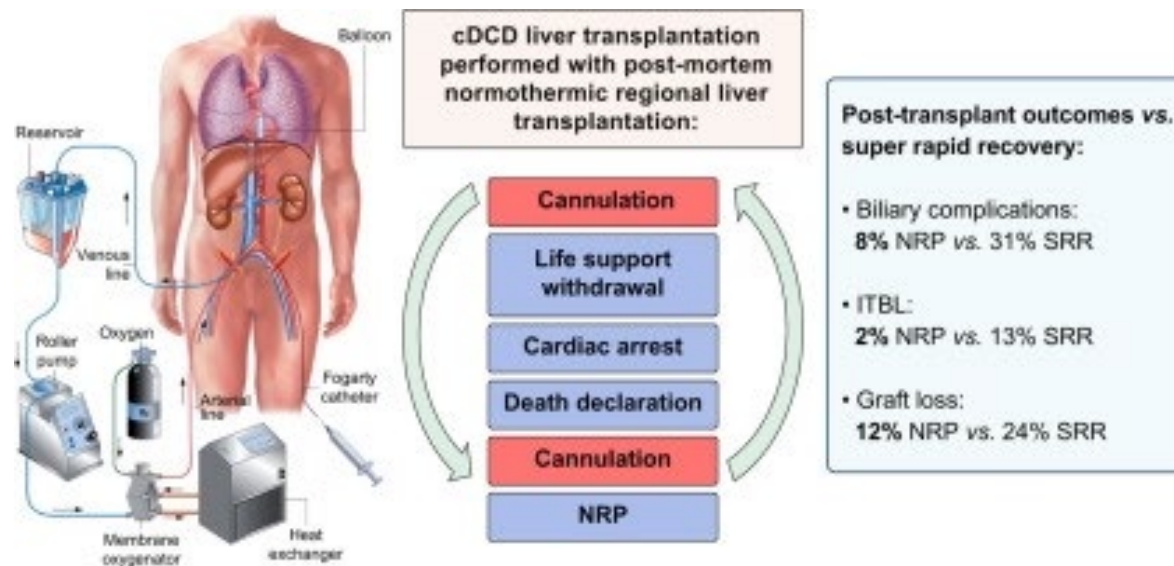
- Cold storage vs. cold storage followed by hypothermic oxygenated perfusion (HOPE)
 - Prospective, multicenter, randomized controlled study of both deceased by brain death and cardiac death donors
 - Early allograft dysfunction: HOPE 22% vs. Static Cold Storage 34%
 - Median Hospital LOS post transplant: HOPE 9.5 days vs. SCS 11.4 days

Am J Transplant. 2022; 22 (suppl 3)



Normothermic regional perfusion vs. super-rapid recovery in controlled donation after circulatory death liver transplantation

Amelia J. Hessheimer¹, Elisabeth Coll², Ferrán Torres³, Patricia Ruíz⁴, Mikel Gastaca⁴, José Ignacio Rivas⁵, Manuel Gómez⁵, Belinda Sánchez⁶, Julio Santoyo⁶, Pablo Ramírez⁷, Pascual Parrilla⁷, Luis Miguel Marín⁸, Miguel Ángel Gómez-Bravo⁸, Juan Carlos García-Valdecasas¹, Javier López-Monclús⁹, Andrea Boscá¹⁰, Rafael López-Andújar¹⁰, Jiliam Fundora-Suárez¹¹, Jesús Villar¹¹, Álvaro García-Sesma¹², Carlos Jiménez¹², Gonzalo Rodríguez-Laíz¹³, Laura Lladó¹⁴, Juan Carlos Rodríguez¹⁵, Manuel Barrera¹⁶, Ramón Charco¹⁷, Jose Ángel López-Baena¹⁸, Javier Briceño¹⁹, Fernando Pardo²⁰, Gerardo Blanco²¹, David Pacheco²², Beatriz Domínguez-Gil², Víctor Sánchez Turrión⁹, Constantino Fondevila^{1,*†}



Similar Results in Liver Transplantation From Controlled Donation After Circulatory Death Donors With Normothermic Regional Perfusion and Donation After Brain Death Donors: A Case-Matched Single-Center Study

Patricia Ruiz ¹, Andres Valdivieso ¹, Ibone Palomares,¹ Mikel Prieto ¹, Alberto Ventoso,¹ Patricia Salvador,² Maria Senosiain,² Jose Ramon Fernandez,² Milagros Testillano,² Francisco Javier Bustamante,² and Mikel Gastaca ¹

Liver Transplantation 27 1747–1757 2021 AASLD.

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Historical Threshold: Liver Transplantation Survival Benefit

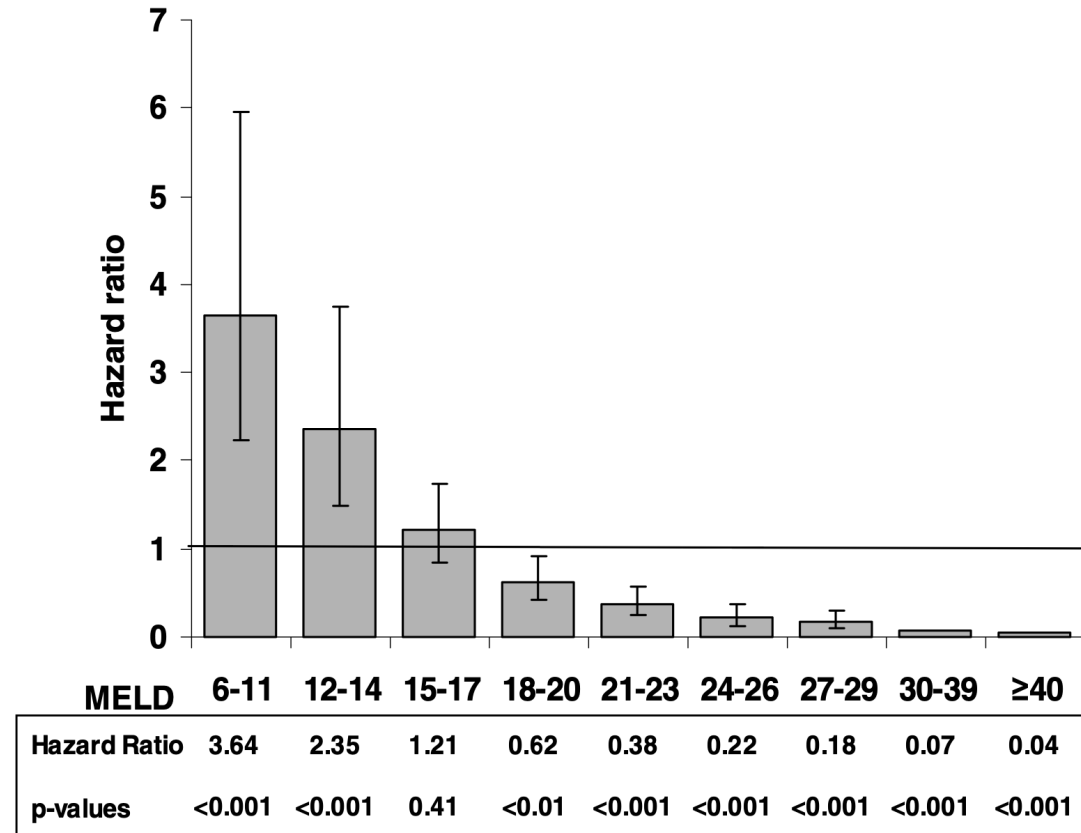
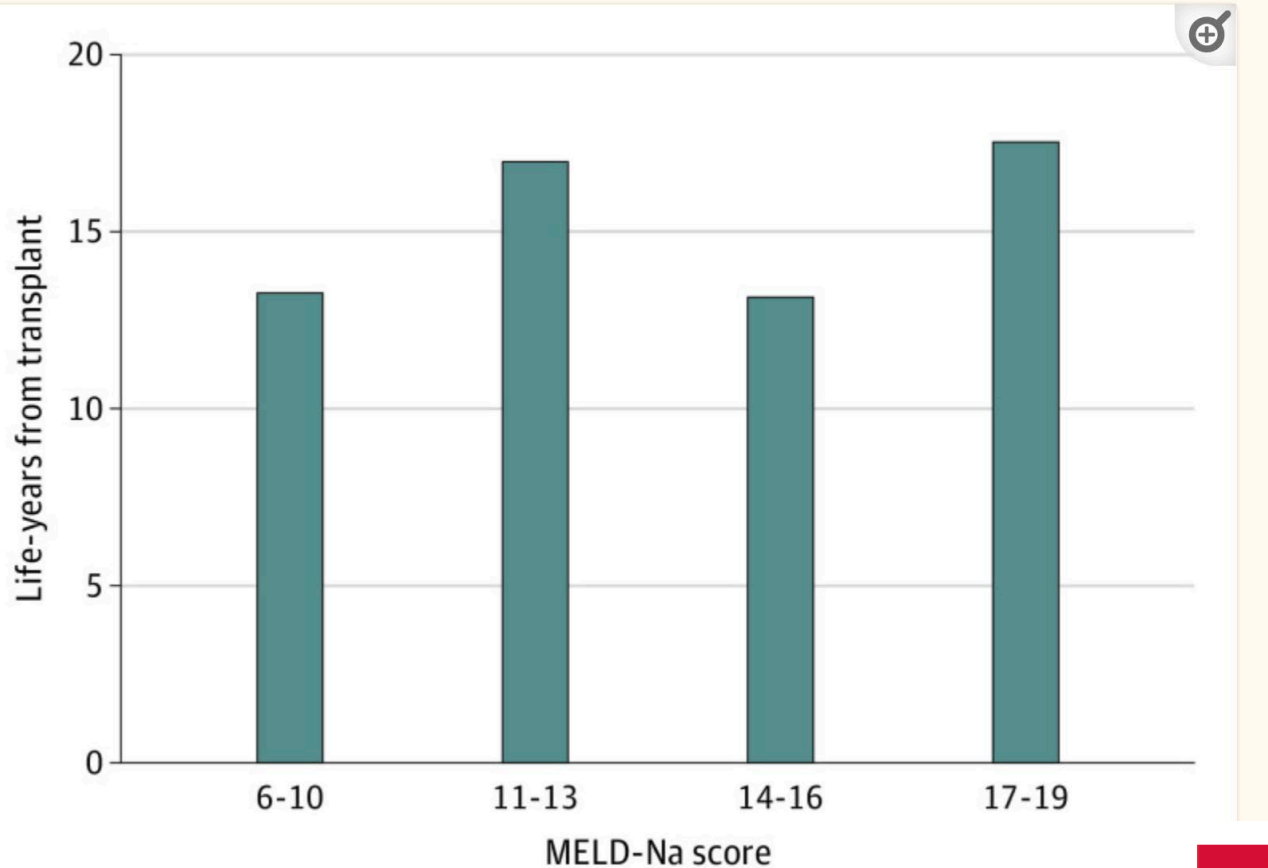


Figure 3: Comparison of mortality risk expressed as hazard ratio by MELD score for recipients of liver transplants compared to candidates on the liver transplant waiting list.

*American Journal of Transplantation 2005; 5: 307-313
Blackwell Munksgaard*

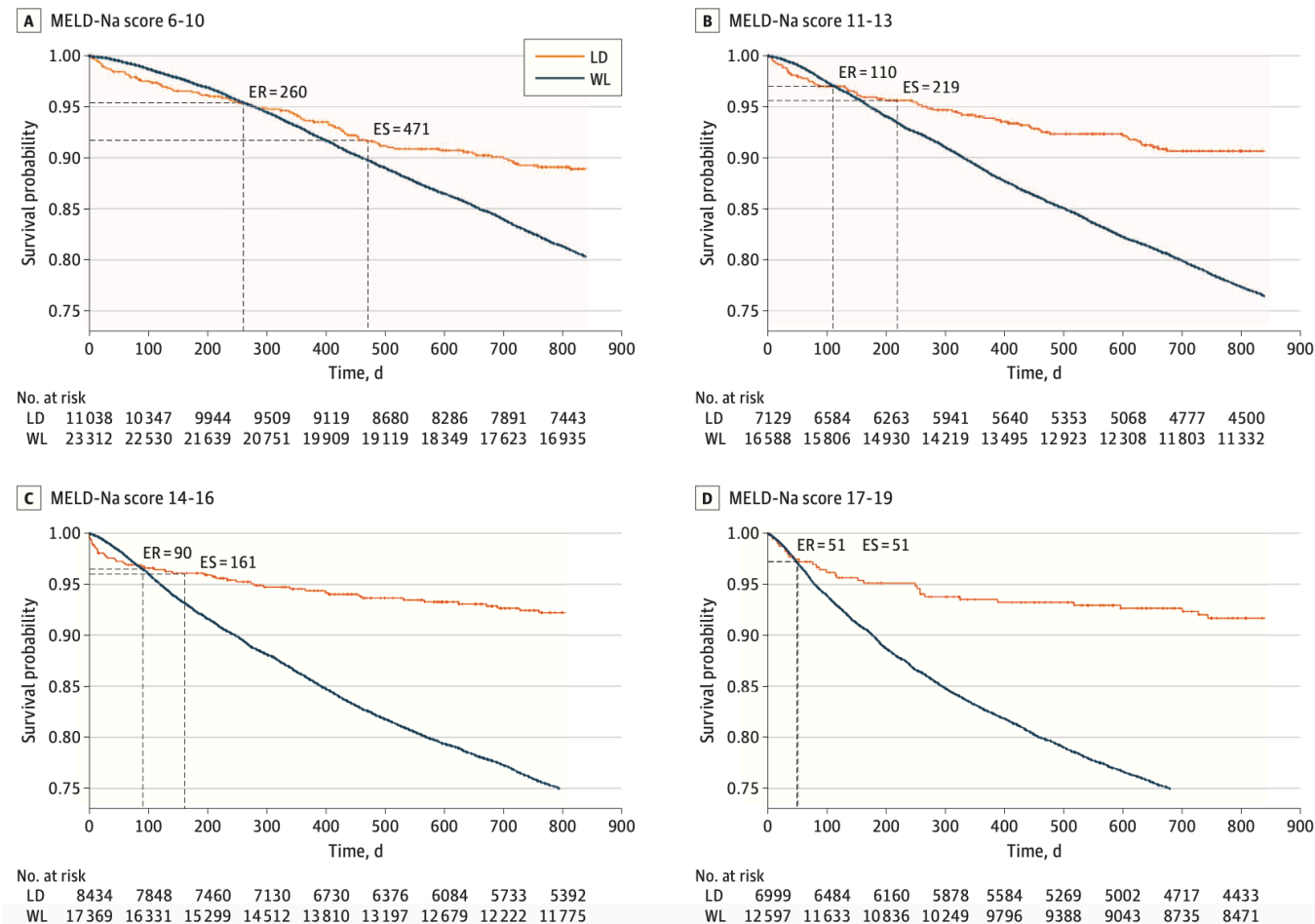
*Copyright © Blackwell Munksgaard 2004
doi: 10.1111/j.1600-6143.2004.00703.x*

Living Donor transplant for low MELD patients



Living donor transplant for low MELD patients

Figure 2. Survival Advantage of Living-Donor Liver Transplant (LDLT) vs Remaining on the Wait List Across 5 Model for End-stage Liver Disease Incorporating Sodium Levels (MELD-Na) Score Categories



Conclusion: Change, Change, Change

- UNOS adopted rolling allocation of deceased donor livers in 2020
- Indications for liver transplantation in US are changing
- Perfusion techniques may expand/rehabilitate deceased donor organ pool
- In current era, LDLT affords survival advantage to low MELD patients



Thank You



Early Allograft Dysfunction Criteria

- Bilirubin >10mg/dl on day 7
- INR >1.6 on day 7
- ALT or AST >2000 within the first 7 days