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The Impact of Inter-Center Competition on Liver Transplant Practices and Outcomes

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Liver Allocation Proceeds by “Sickest First” Principle

Acute “Fulminant” Liver Failure (Expected Lifespan <7 days without Transplantation)

Status 1
Highest Priority

or

Chronic Liver Failure

Waitlist Mortality Priority based on MELD score

MELD and Waitlist Mortality

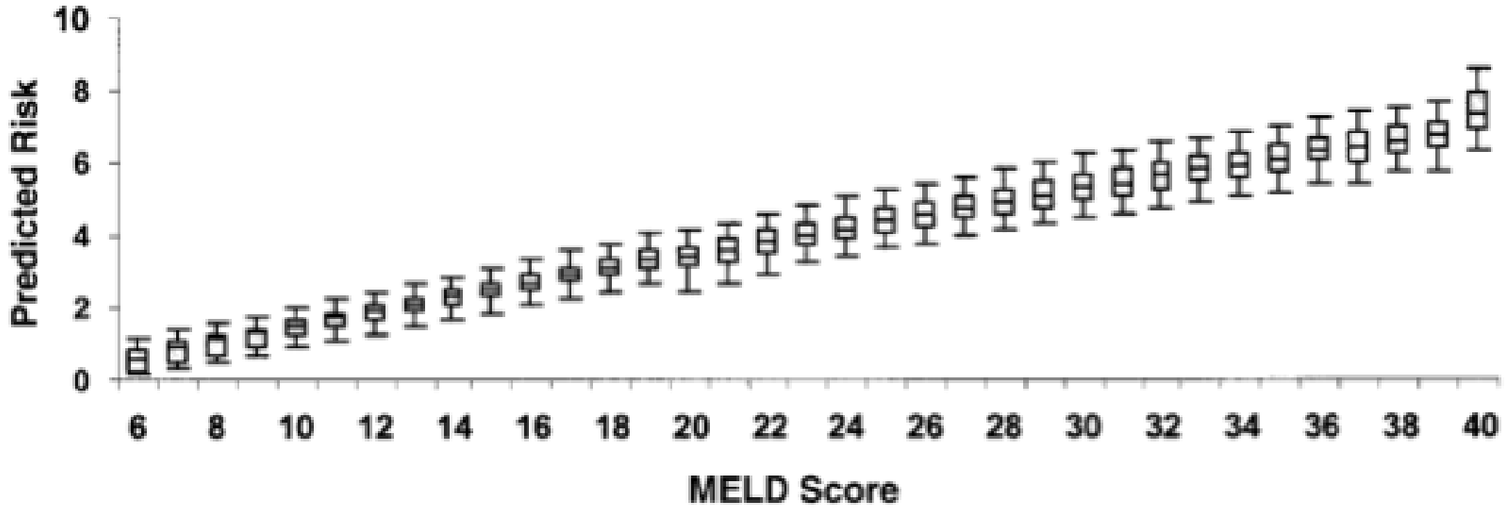
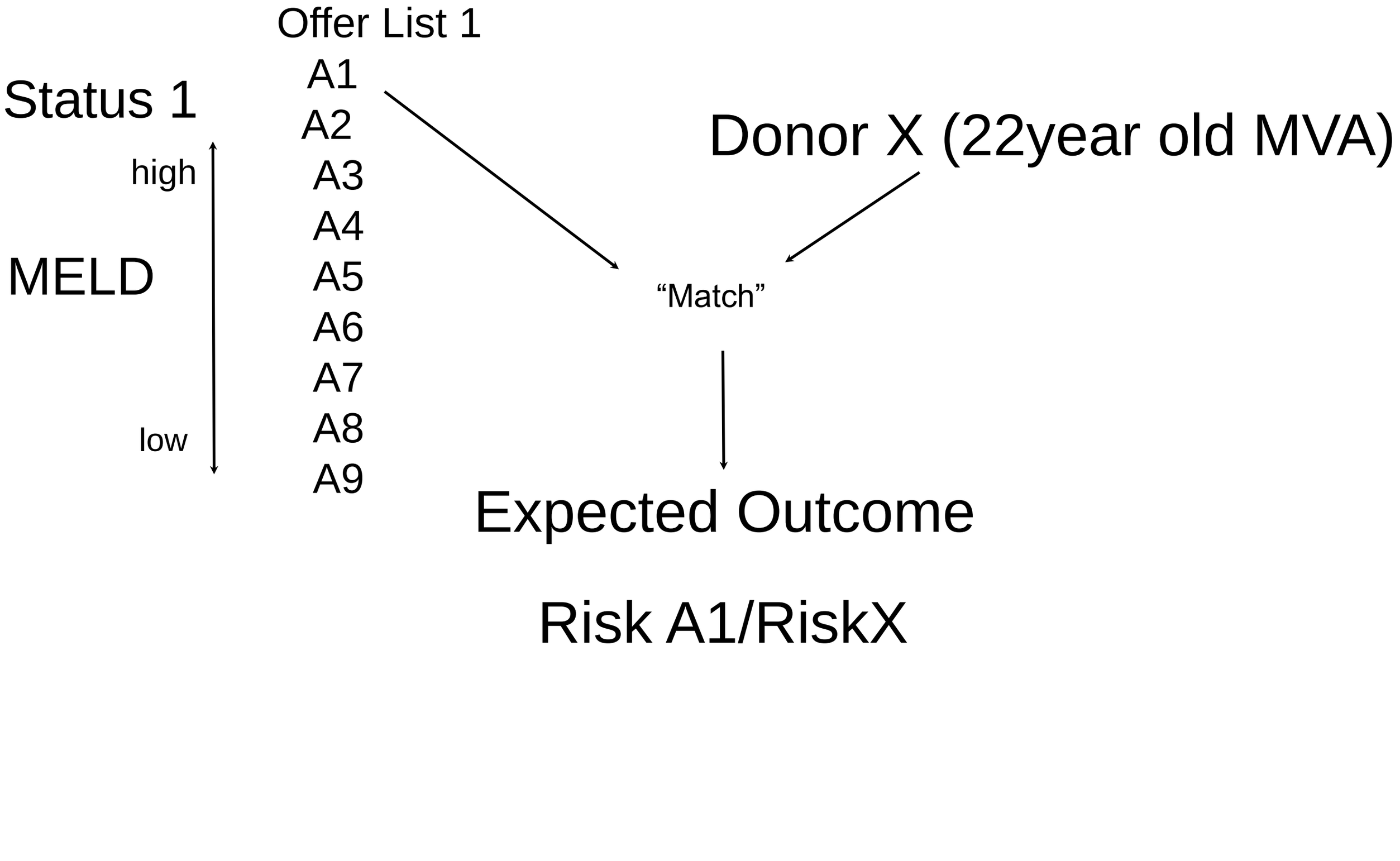


Figure 2. Box plots of mortality risk on the waiting list, by MELD score.

Merion,RM Liver Transplantation. 2004

Liver Transplant Waitlist



Transplant Center Report Card

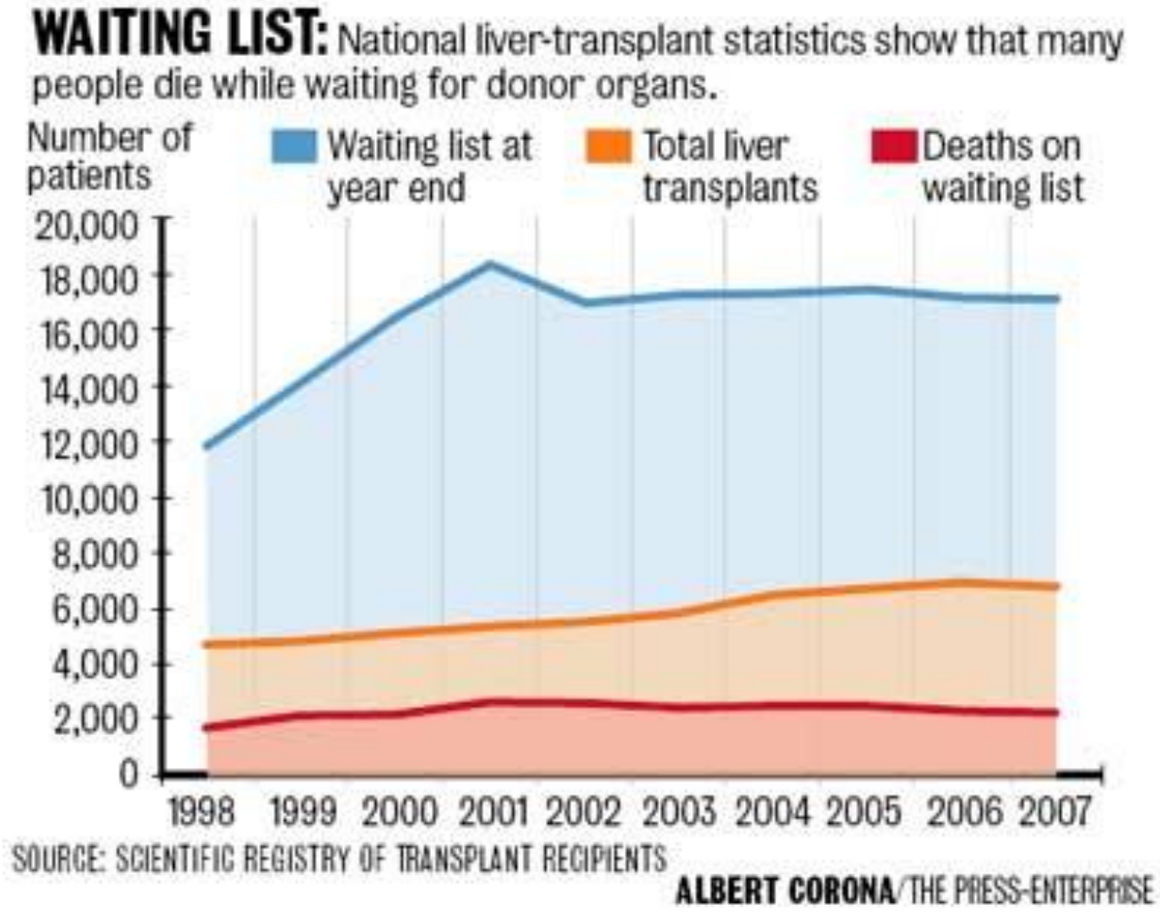
Center 1

Post-transplant Outcomes (01/01/2009-06/30/2011)	1 Year			Tal
	Observed	Expected	Statistical Significance of Difference	
Adult graft survival (based on 301 transplants) (%)	90.46	87.15	Statistically Higher (b)	
Adult patient survival (based on 295 transplants) (%)	91.36	89.83	Not Significantly Different (a)	
Pediatric graft survival (based on 35 transplants) (%)	85.71	87.37	Not Significantly Different (a)	
Pediatric patient survival (based on 31 transplants) (%)	93.55	93.43	Not Significantly Different (a)	

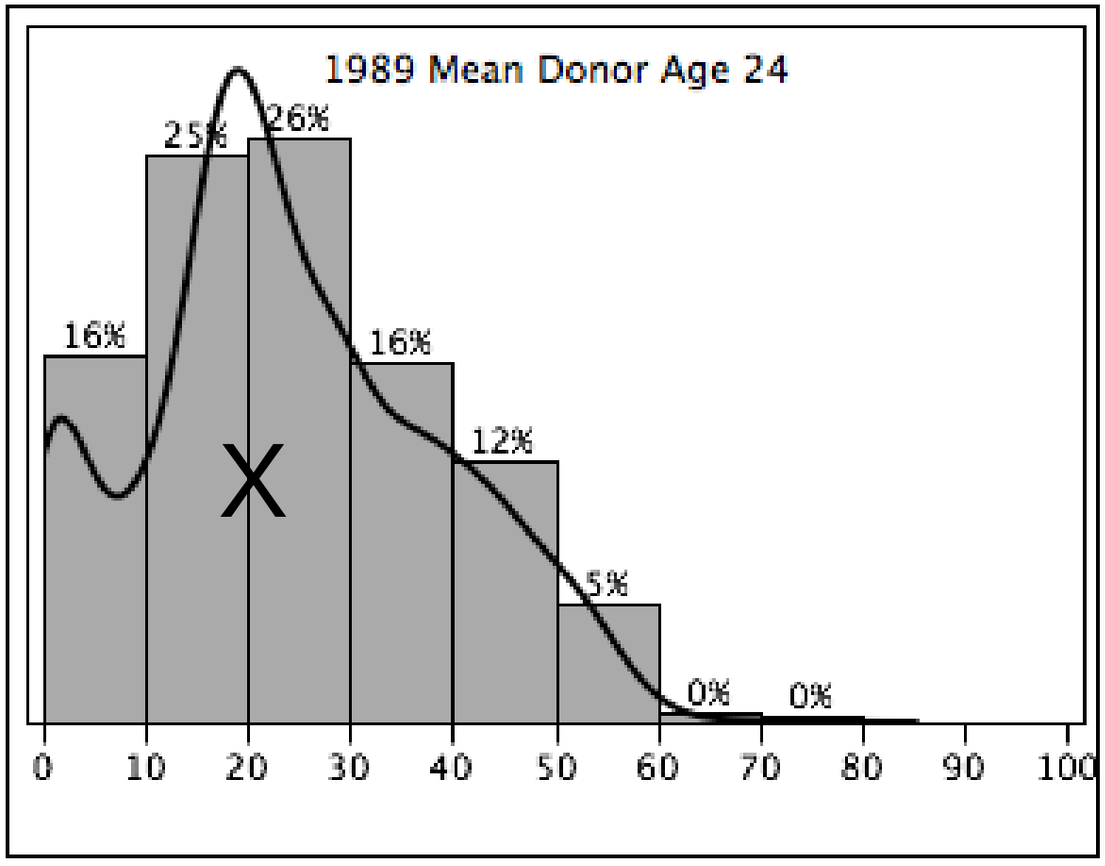
Center 2

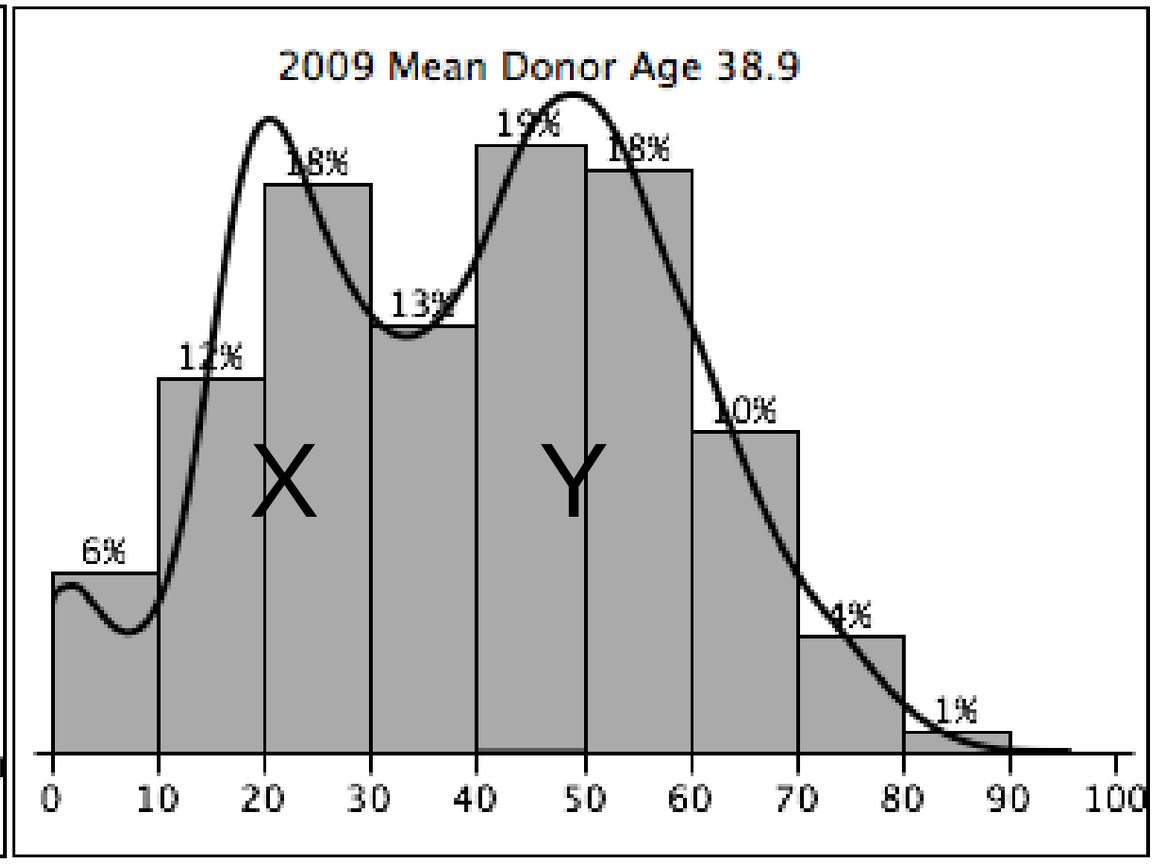
Post-transplant Outcomes (01/01/2009-06/30/2011)	1 Year		
	Observed	Expected	Statistical Significance of Difference
Adult graft survival (based on 33 transplants) (%)	75.00	89.41	Statistically Lower (b)
Adult patient survival (based on 31 transplants) (%)	79.84	92.29	Statistically Lower (b)
Pediatric graft survival (%)	NA	NA	NA
Pediatric patient survival (%)	NA	NA	NA

Waitlist/Transplants/Deaths by Year



The Changing Liver Donor Population1989-2009





1989

2009

No ECD Donors
No Matching considerations Necessary
No Special Informed Consent

The Older Donor European Challenges

Mario Angelico M.D.

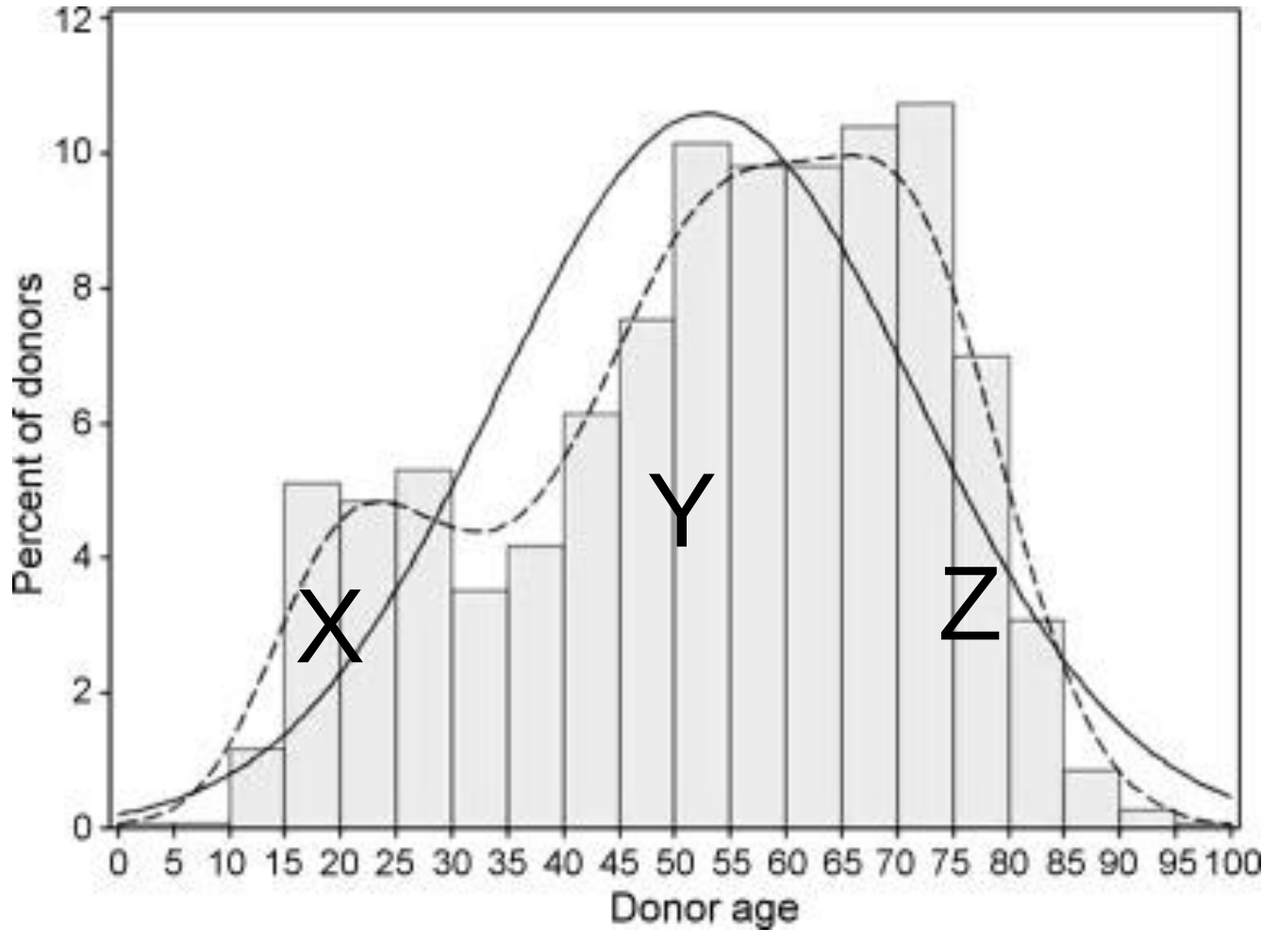


Fig. 1.

Age distribution of overall donor population. Continuous line: estimated normal density (mean = 52.9, SD = 18.9). Dashed line: empirical density (kernel estimate).

The Bad News: Donor age will continue to increase

The Good News: There is a great potential in the US to expand utilization of older donors for Liver Transplantation

Donor Risk Index

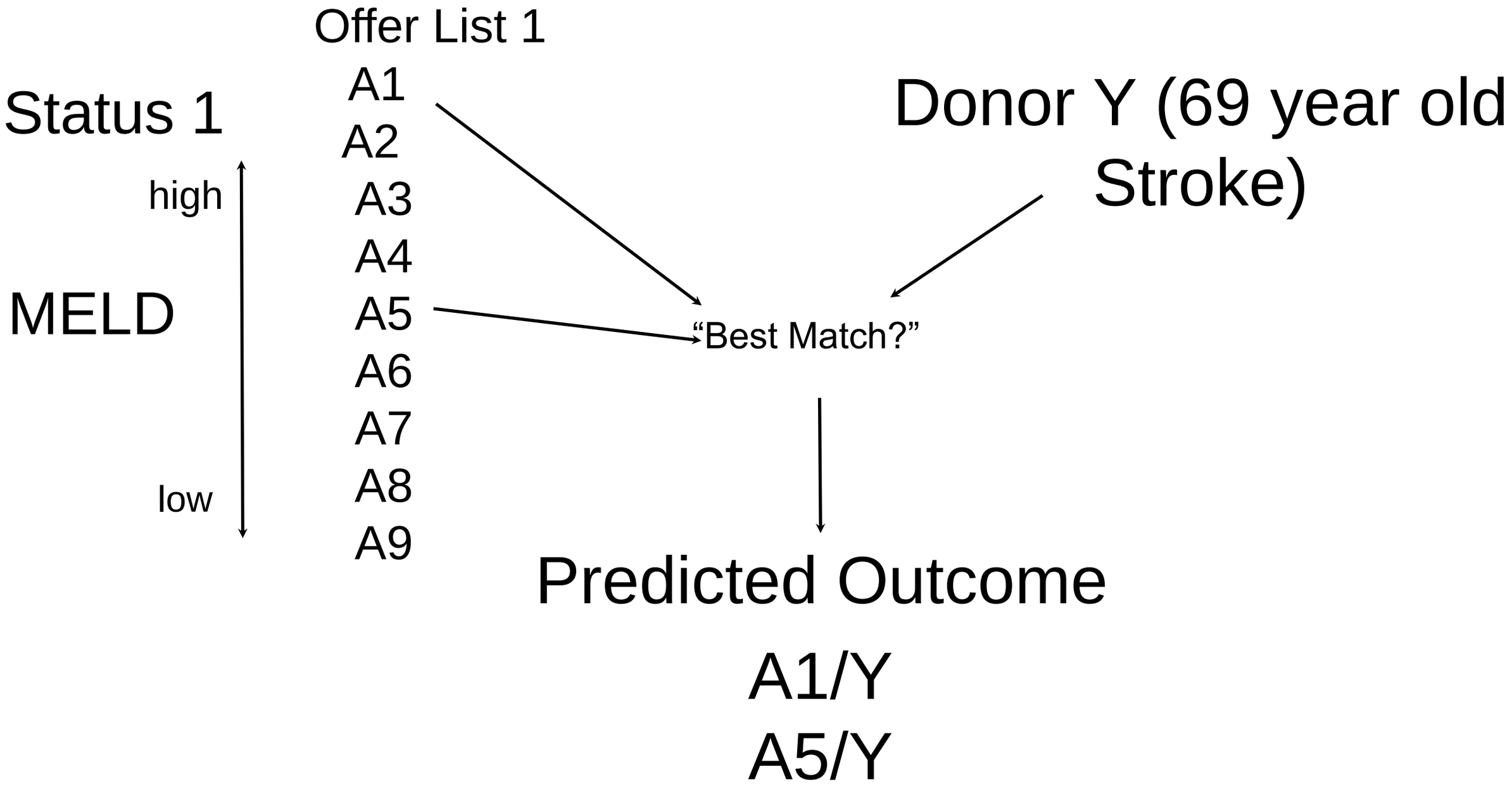
Characteristics Associated with Liver Graft Failure

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

Donor Risk Index, Feng, et. al., AJT 2006

Liver Transplant Waitlist



Organ Acceptance Decisions in Liver Transplantation: Howard Model

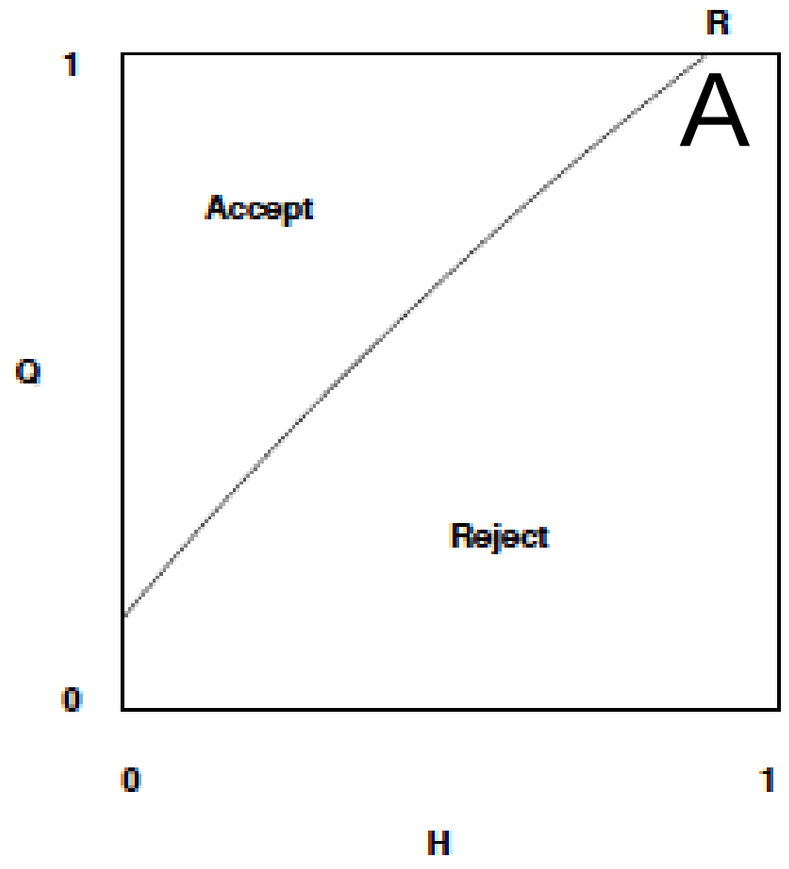
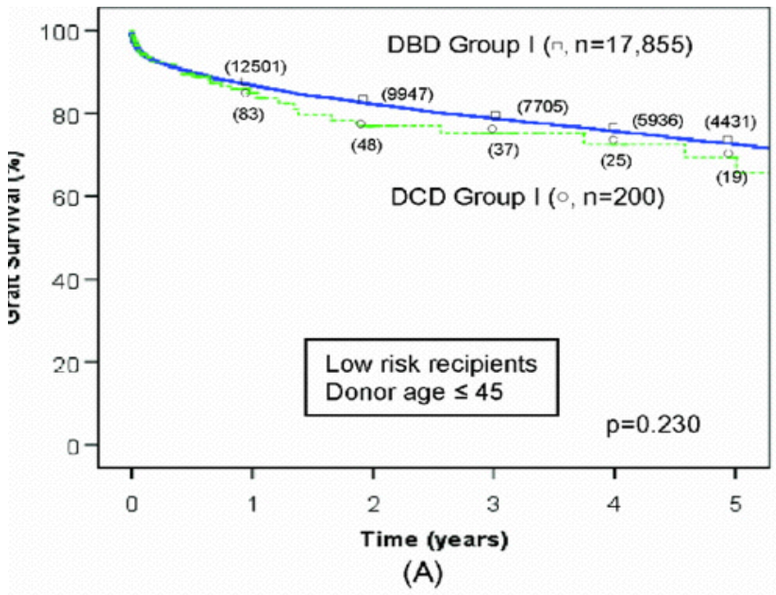
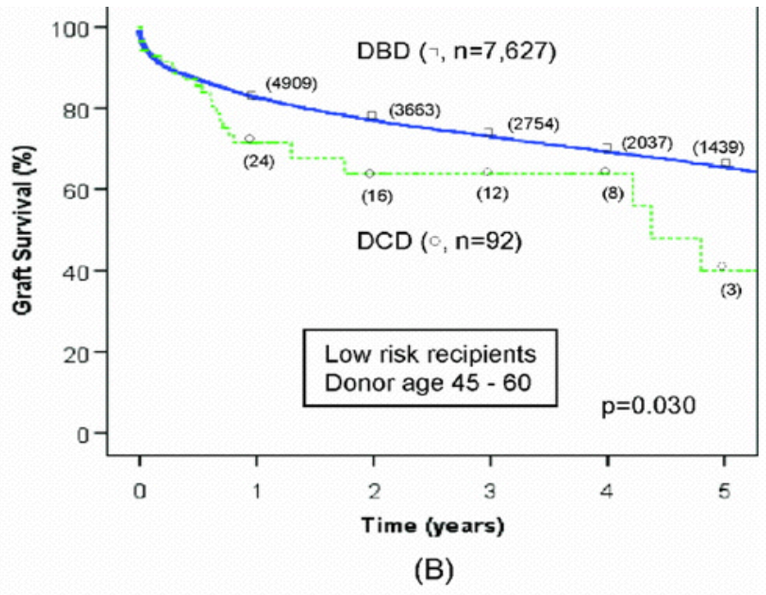
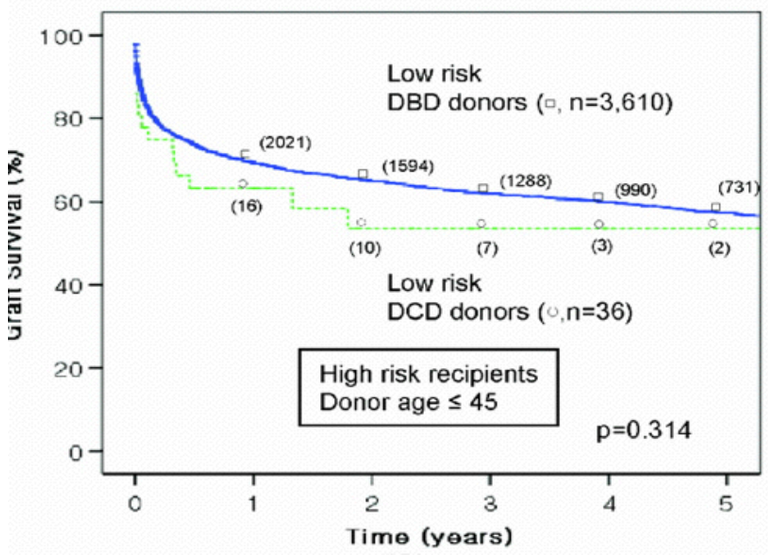


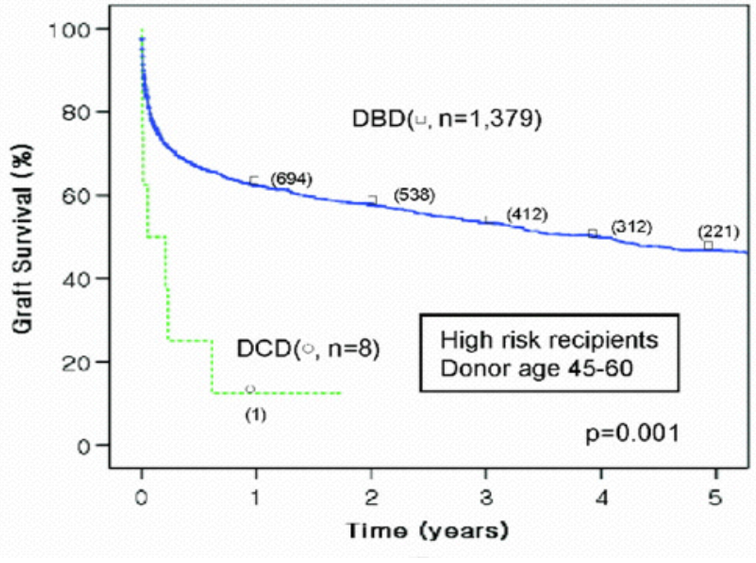
Figure 4: Accept and Reject Regions in Howard [2002] Model

Matching Donors and Recipients









Lee KW, Simpkins CE, Montgomery RA, Locke JE, Segev DL, Maley WR. Factors affecting graft survival after liver transplantation from donation after cardiac death donors. Transplantation 2006; 82: 1683-8

Organ Acceptance Decisions in Liver Transplantation: Alagosz Model

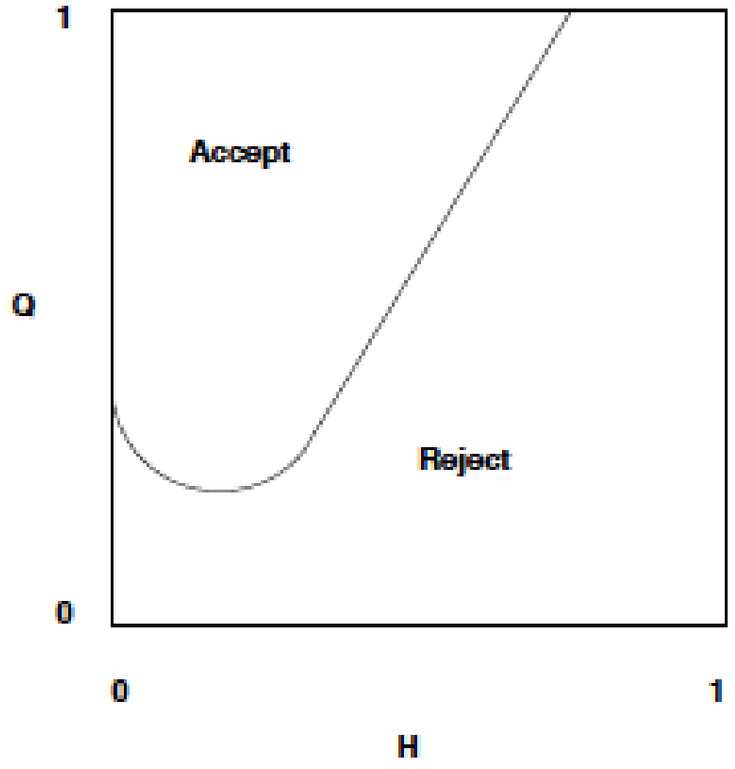
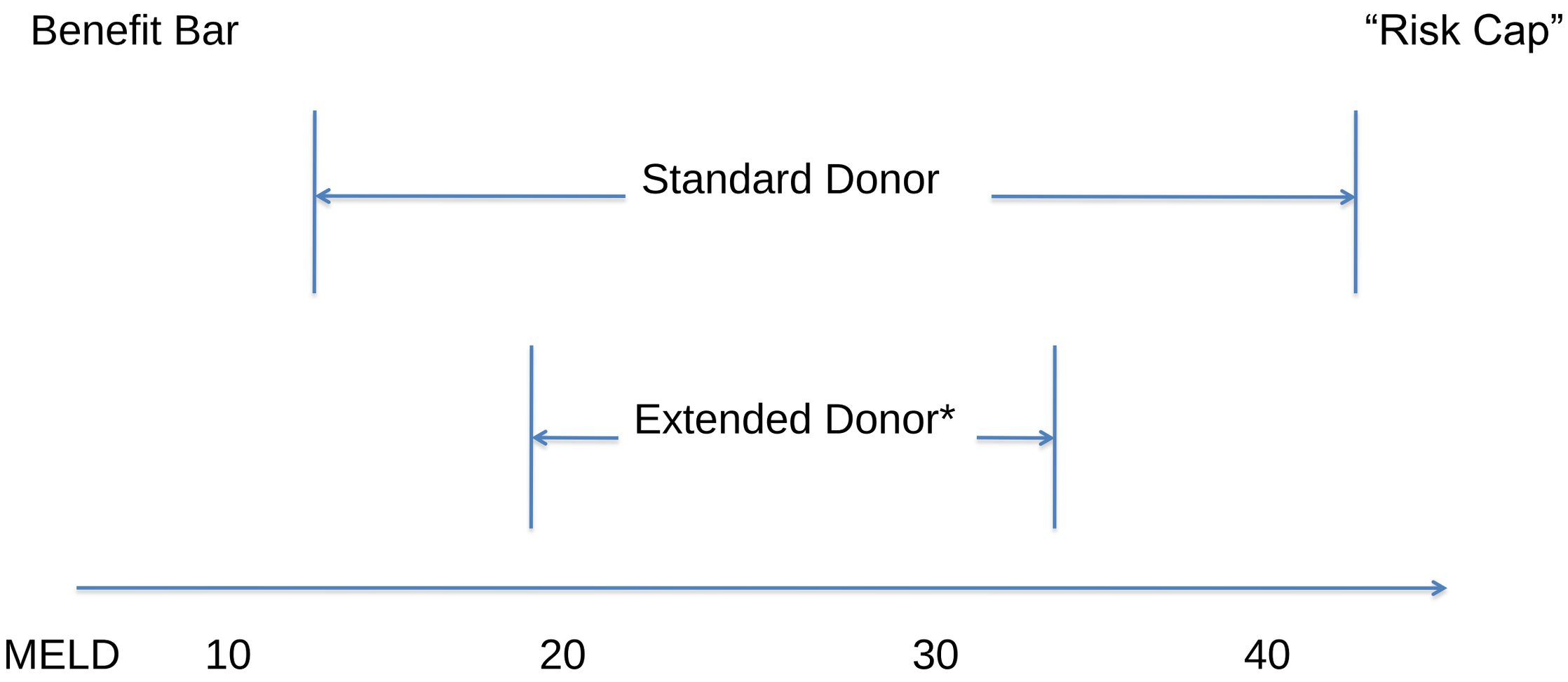


Figure 5: Alternative Accept and Reject Regions

Matching Donors and Recipients:

“Window of Appropriate Use”



*DCD, Split, Older Donor…..Steatosis

On competition…

Adam Smith

In general, if any branch of trade…….. be advantageous to the public, the freer and more general the competition, it will always be the more so.

The Wealth Of Nations, Book II, Chapter II, p.329, para. 106.

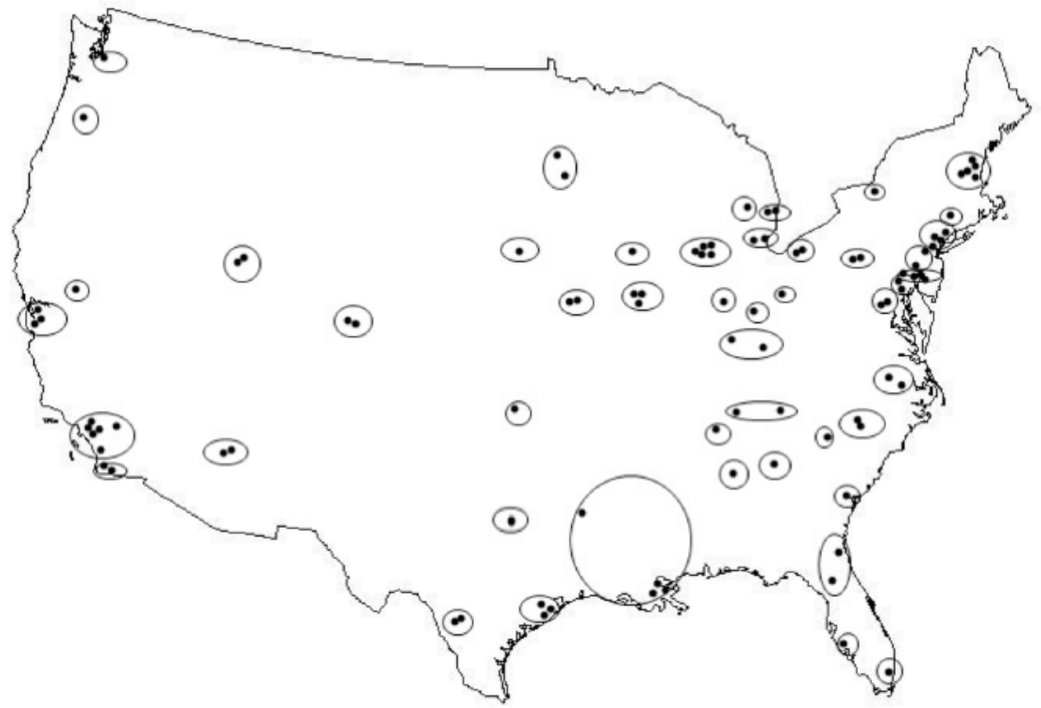
Hypothesis: "Local Competition Between Liver Transplant Centers Within a DSA should Advantage the Public"

1. Improved Outcomes
2. Greater Access/Improved Organ Utilization
3. Decreased Cost

Distribution of Liver Transplant Centers

UNOS Regions

DSAs/Centers



The competitive environment for organs varies greatly at the local level. (1-6 Liver Centers/DSA)

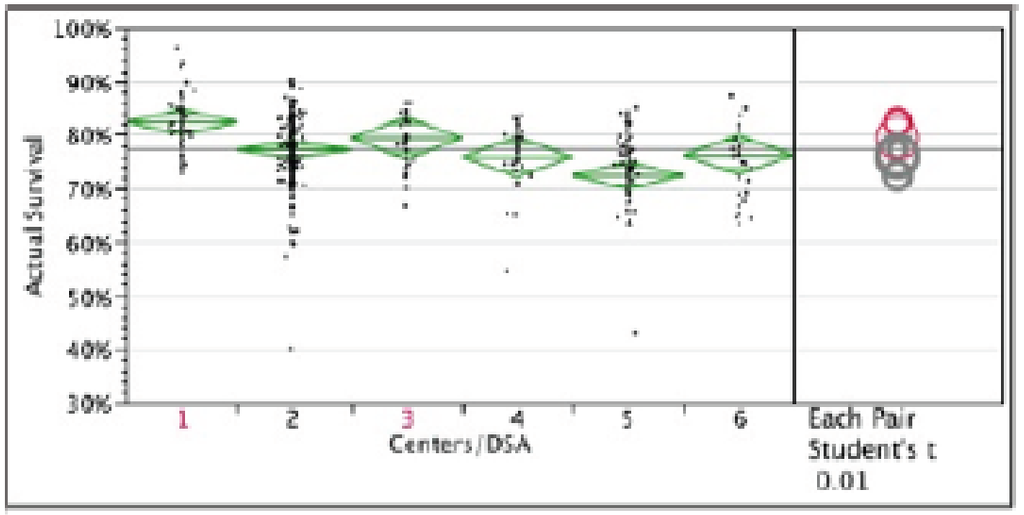
Overall Patient Survival
Non-Competitive(NC) vs. Competitive(C) Centers

	NC(22%)	**C(78%)**	p-value
1 year actual Survival	88.0%	85.3%	<0.001
1 year expected Survival	88.3%	86.4%	<0.001
3 year actual Survival	80.8%	76.5%	<0.001
3 year expected Survival	80.2%	77.4%	<0.001

2003-2010

3 Year Patient Survival MELD era (n=375 observations)

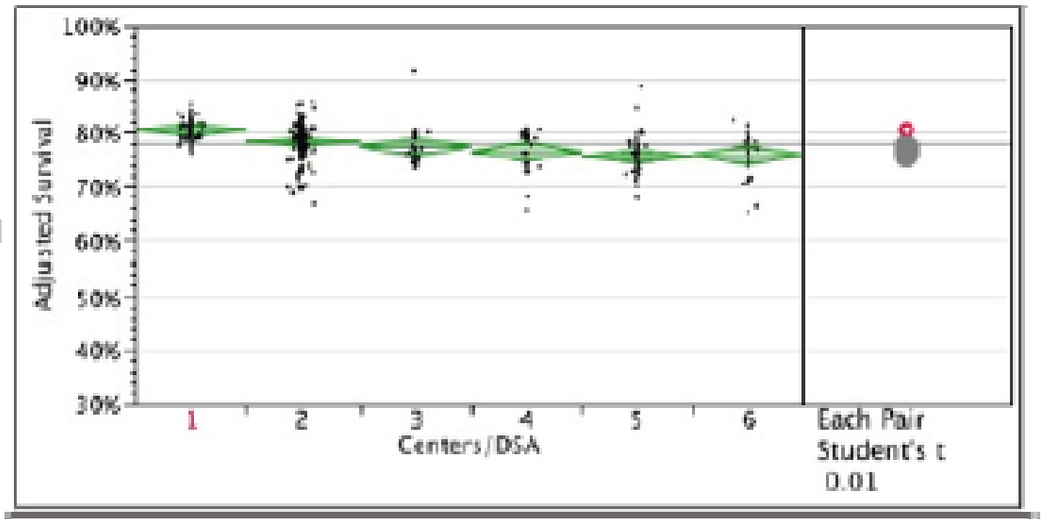
Observed



Centers/DSA	Mean			
1	82.4%	A		
3	79.3%	A	B	
2	77.2%		B	
6	76.2%		B	C
4	75.8%		B	C
5	72.3%			C

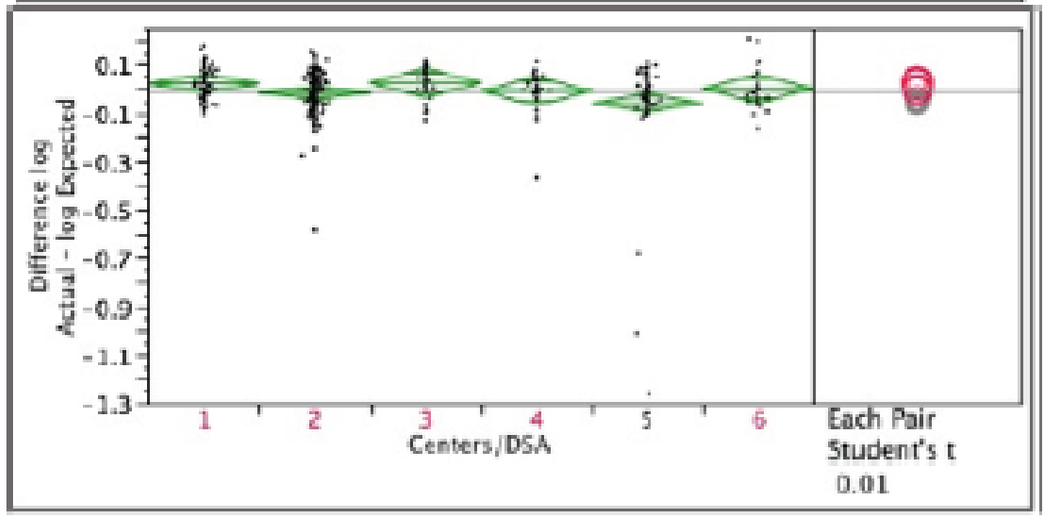
Student's t α=0.01

Expected



Centers/DSA	Mean			
1	80.5%	A		
2	78.2%		B	
3	77.3%		B	C
4	76.2%			C
6	75.8%			C
5	75.5%			C

logObs - logExp



Centers/DSA	Mean		
3	0.024	A	
1	0.021	A	
6	0.000	A	B
4	-0.010	A	B
2	-0.017	A	B
5	-0.058		B

What is the Impact of Competitive Environment on?

1. Post Transplant Outcomes?
2. Organ Utilization?
3. Disease Severity at Transplantation
4. Listing/Organ acceptance

Methods

All liver transplants from the MELD era (2003 and 2009) were studied using the UNOS database (n=38,385). Competitive environment for a local market was stratified into tertiles using the **Herfindahl–Hirschman Index* (HHI).**

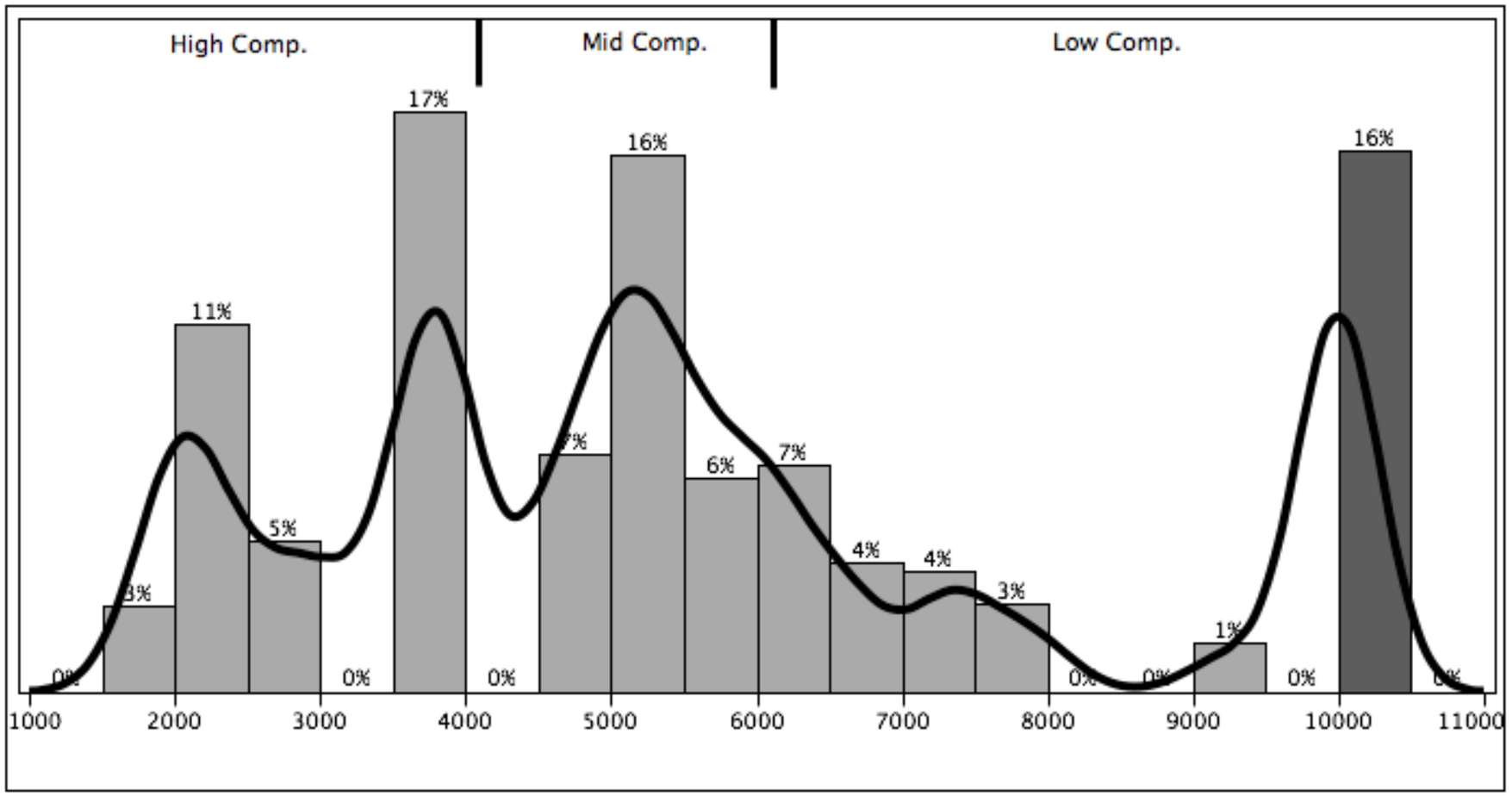
Herfindahl–Hirschman Index (HHI) a commonly accepted measure of market concentration. The HHI is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

Example 1: A market consisting of four centers with shares of 30%, 30%, 20% and 20%, the HHI = 2,600 ($30^2 + 30^2 + 20^2 + 20^2$).

Example 2: A market consisting of three centers with shares of 90%, 7% and 3%, the HHI = 8158 ($90^2 + 7^2 + 3^2$).

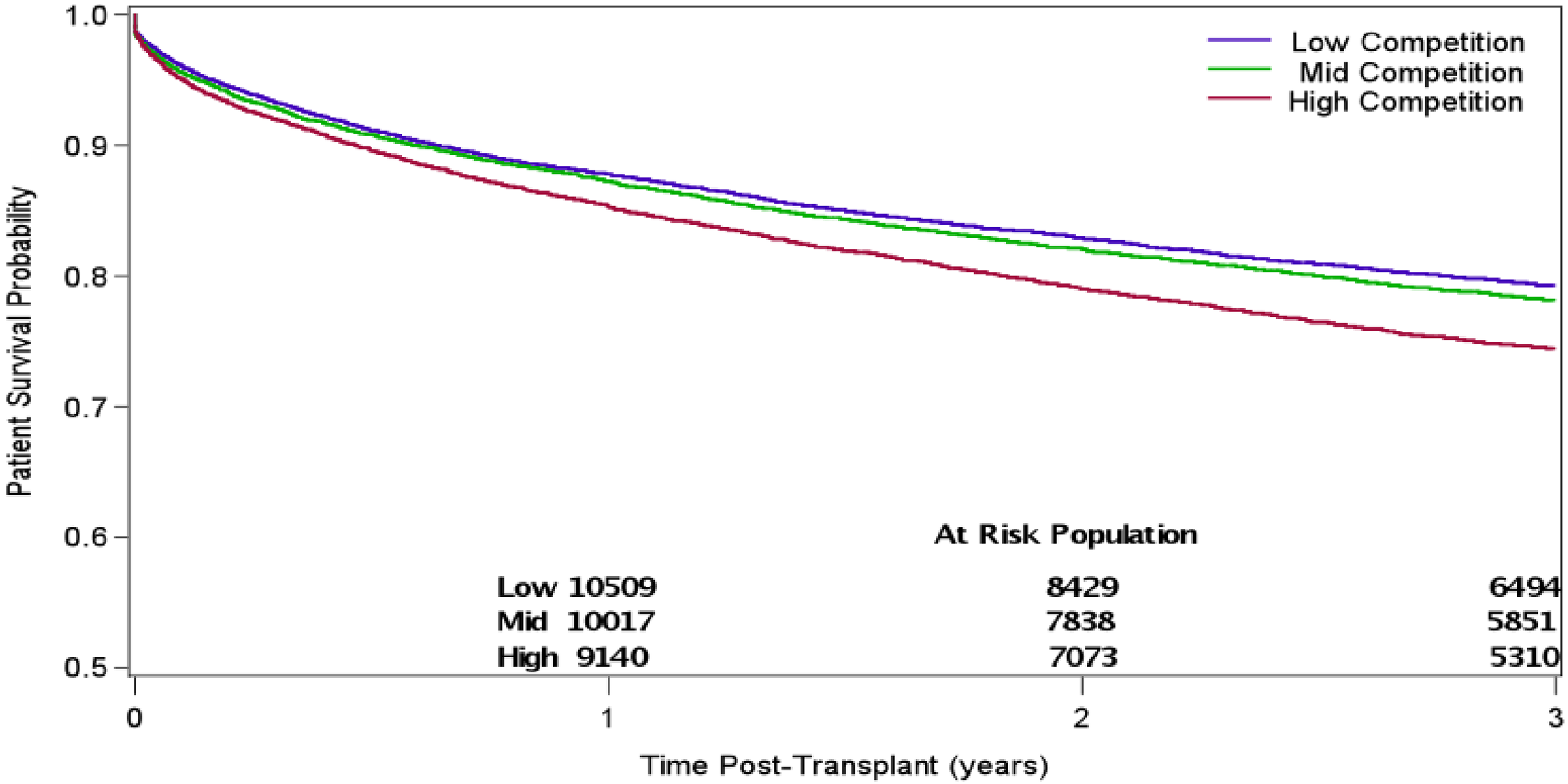
Example 3: A market consisting of a single center. HHI=10,000 (100^2)

Distribution of HHI



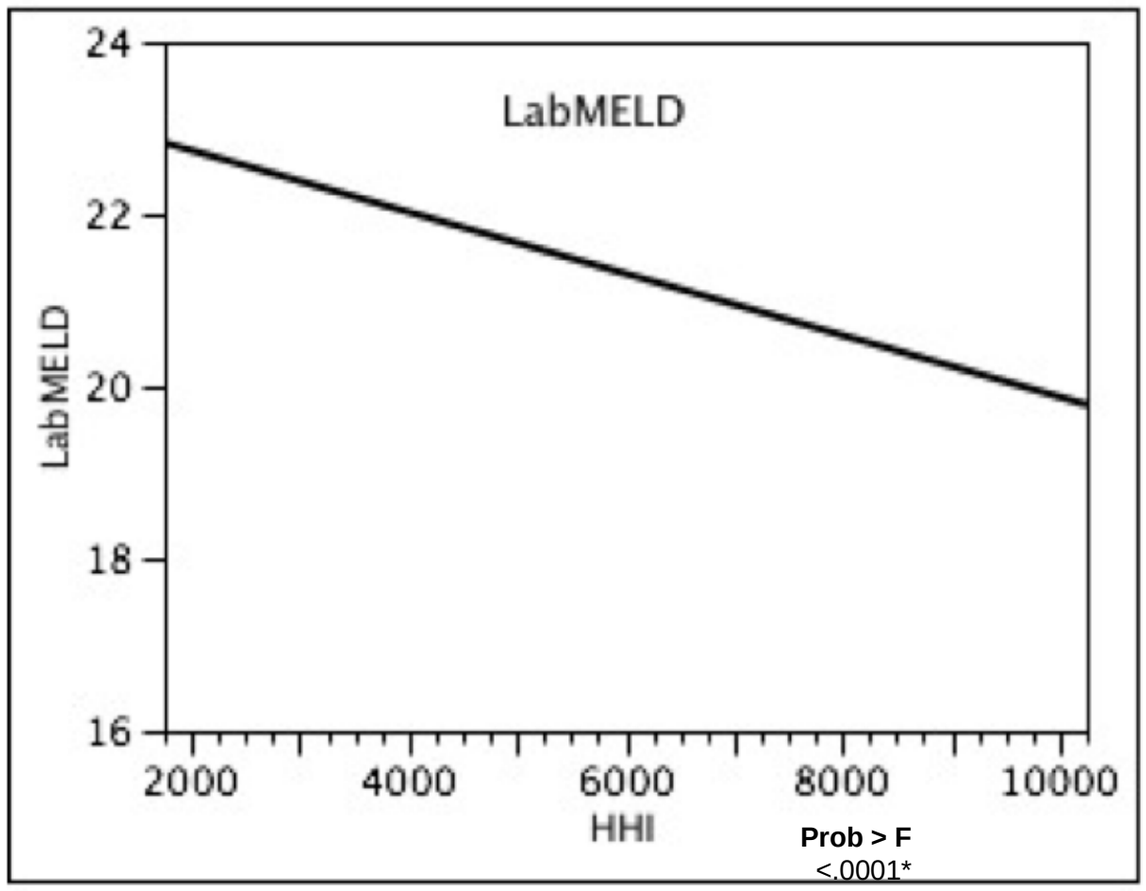
HHI

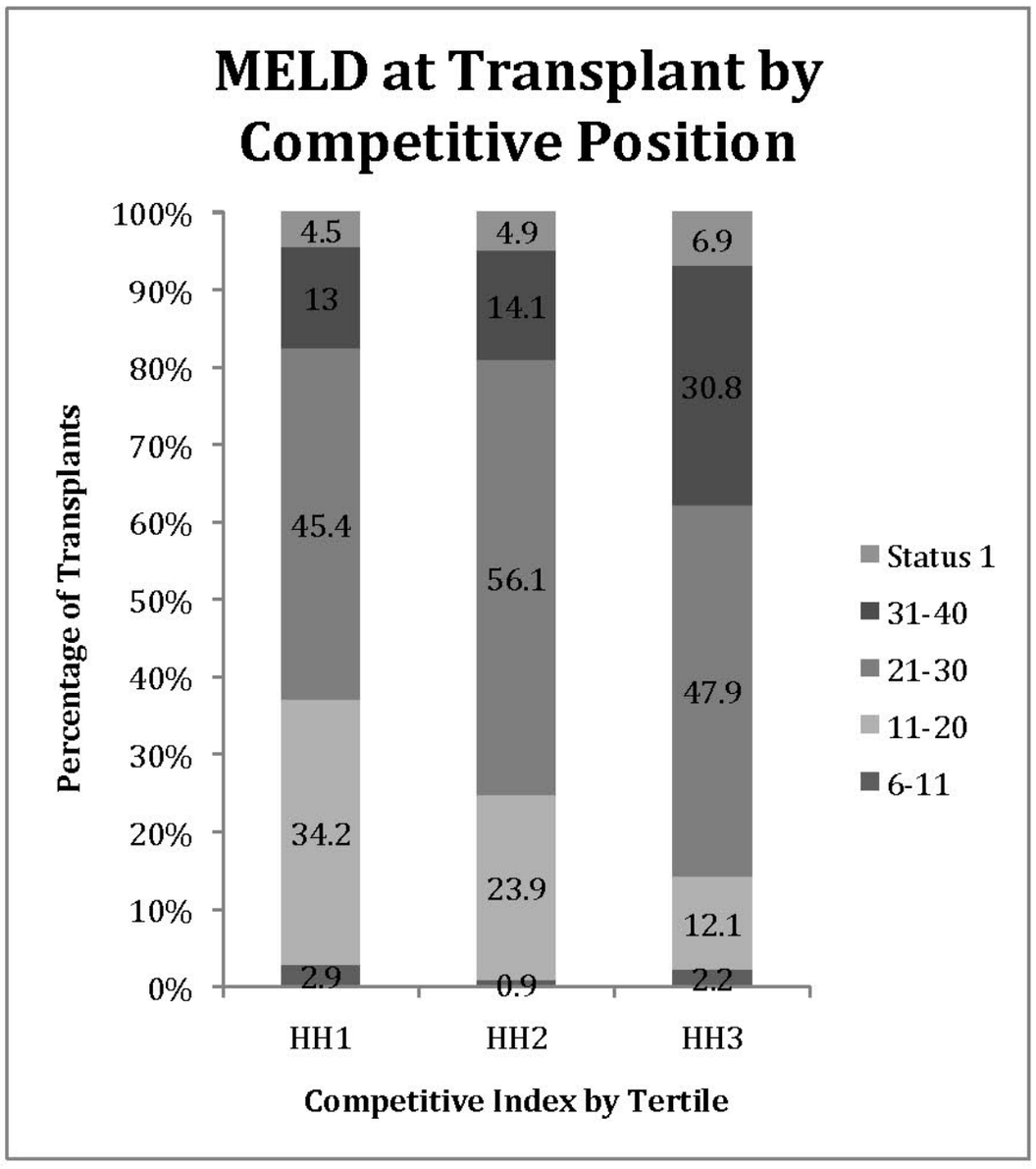
Post Transplant Survival and Competition



Recipient Risk and Competition

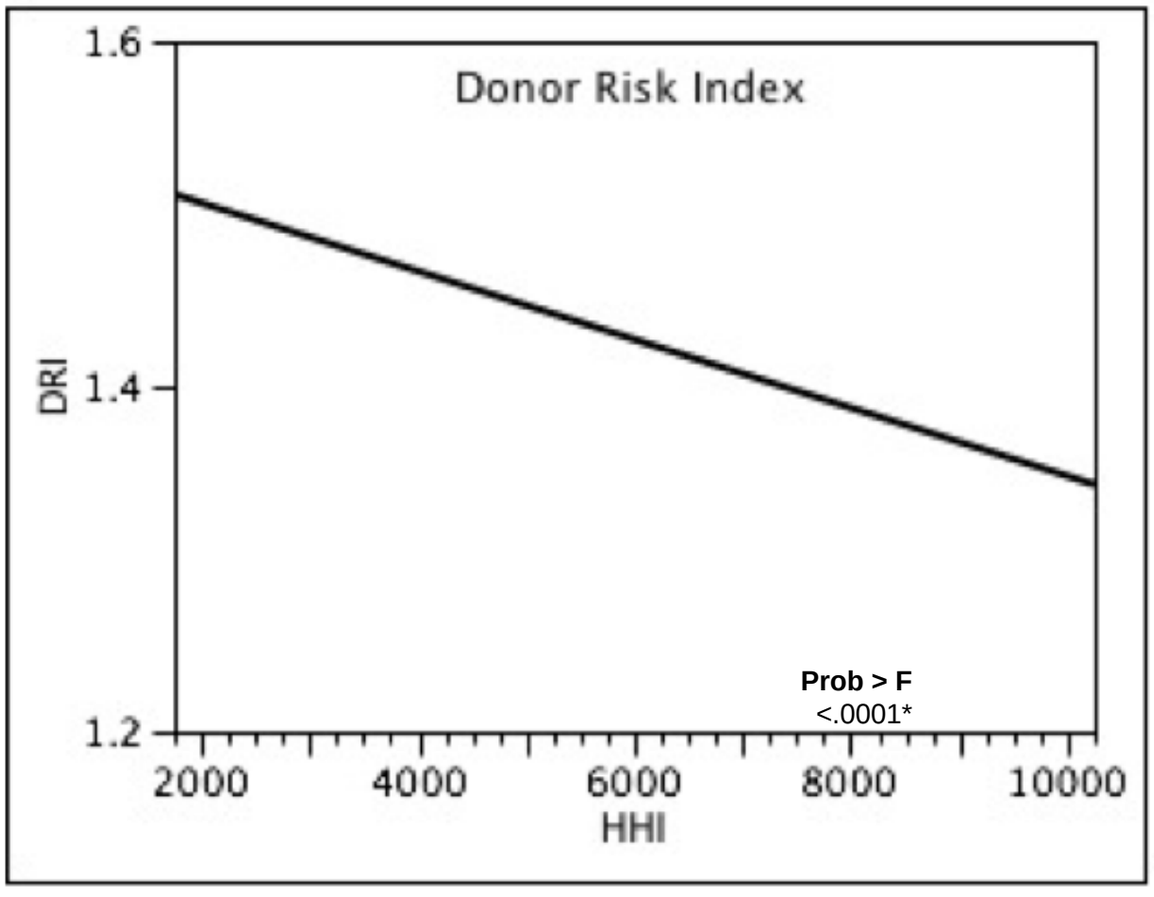
Transplant MELD vs. HHI

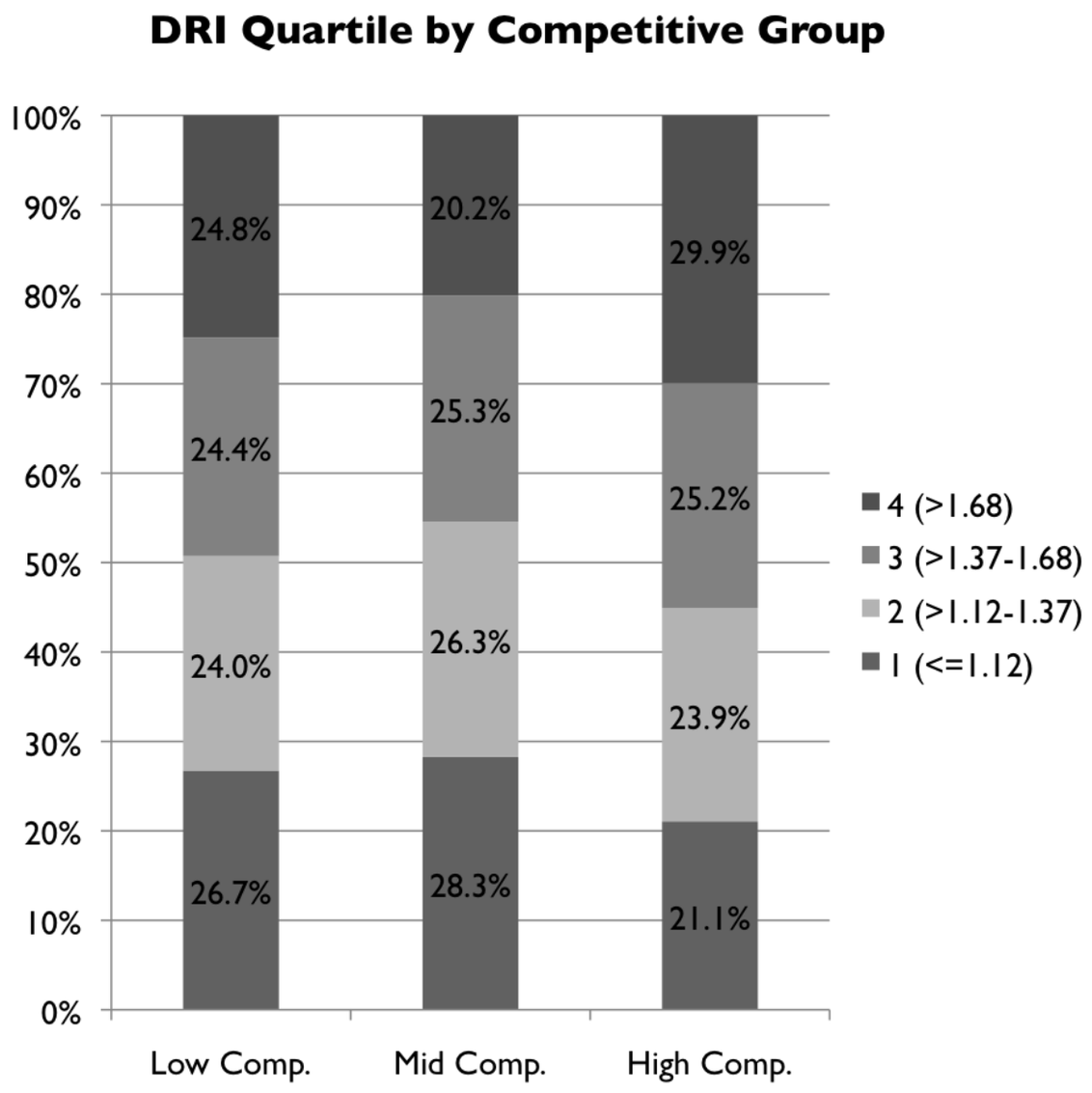




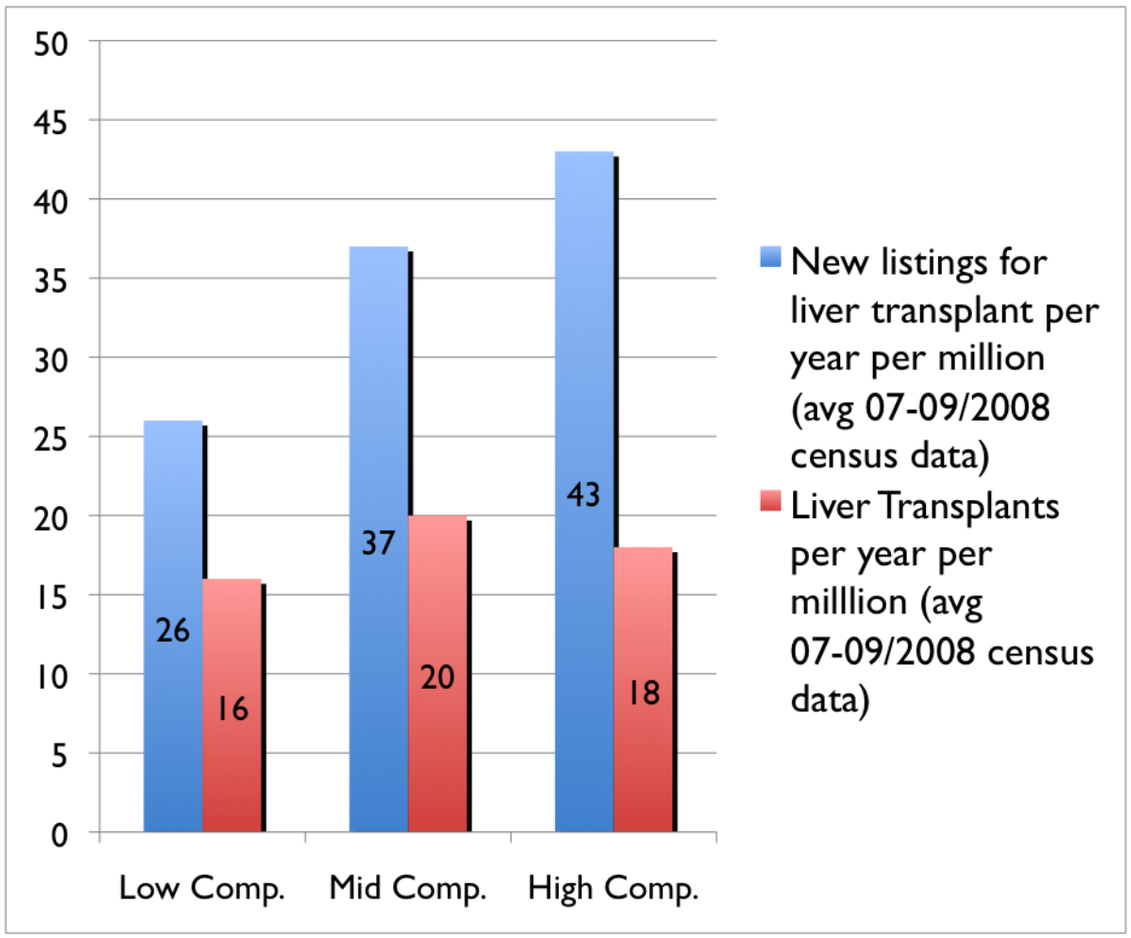
Donor Risk and Competition

DRI vs. HHI

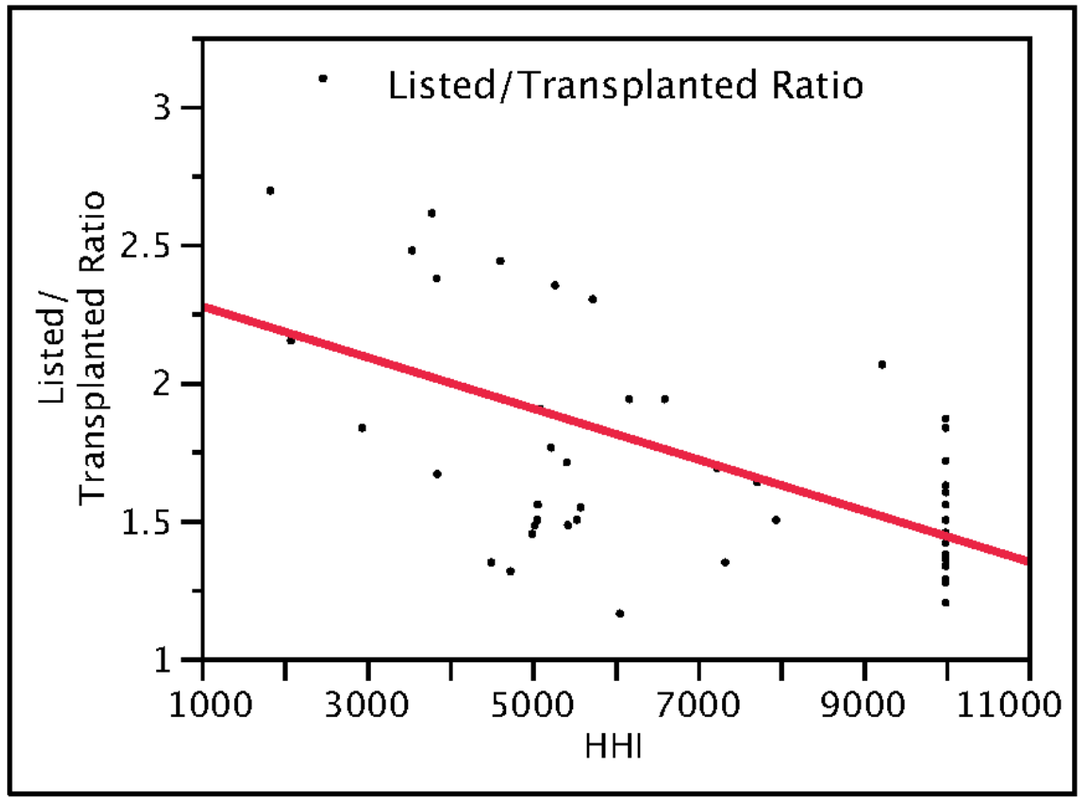




Listed/Transplanted Ratio and Competition



Listed/p.m.p and Transplanted/p.m.p. by HHI tertile



Listed/Transplanted ratio by HHI (OPO Center Data)

Impact of Competition

Univariate and Multivariate Analysis

		Univariate			Multivariate	
Risk of patient death (D)						
Characteristic	HR	95% CI	p-value	HR	95% CI	p-value
HHI tertile						
1 (low comp, >0.57)	1.00			1.00		
2 (mid comp, 0.38-0.57)	1.05	1.00-1.11	0.037	1.04	0.99-1.09	0.133
3 (high comp, <0.38)	1.23	1.18-1.29	<0.001	1.04	0.99-1.10	0.119

Comparison of donor and recipient characteristics by DSA competition level (described by HHI tertile) (characteristics significant in SRTR reports.)

Competition for Limited Resources in Liver Transplantation

Poorer Outcomes

Increased Disease Severity/
Resource Utilization and Cost

Adam Smith??

Greatly Improved Access to Listing

Small Improvement In Access to Transplantation

“Tragedy of the Commons”

“We can make little progress ... until we explicitly exorcize the spirit of Adam Smith, ... the idea that an individual who "intends only his own gain," is, "led by an invisible hand to promote ... the public interest"

Garritt Hardin, Science Dec. 13, 1968

Hardin’s Example: Herdsman sharing a common pasture are each individually motivated to add more cattle to their herd. The result is an overgrazed common in which the animals starve.

Two Dead Since Arizona Medicaid Program Slashed Transplant Coverage

(ABCNEWS.com) AUTO START: ON | OFF

ABC WORLD NEWS WITH DIANE SAWYER

By JANE E. ALLEN (@JaneEAllenABC) , ABC News Medical Unit

Jan. 6, 2011

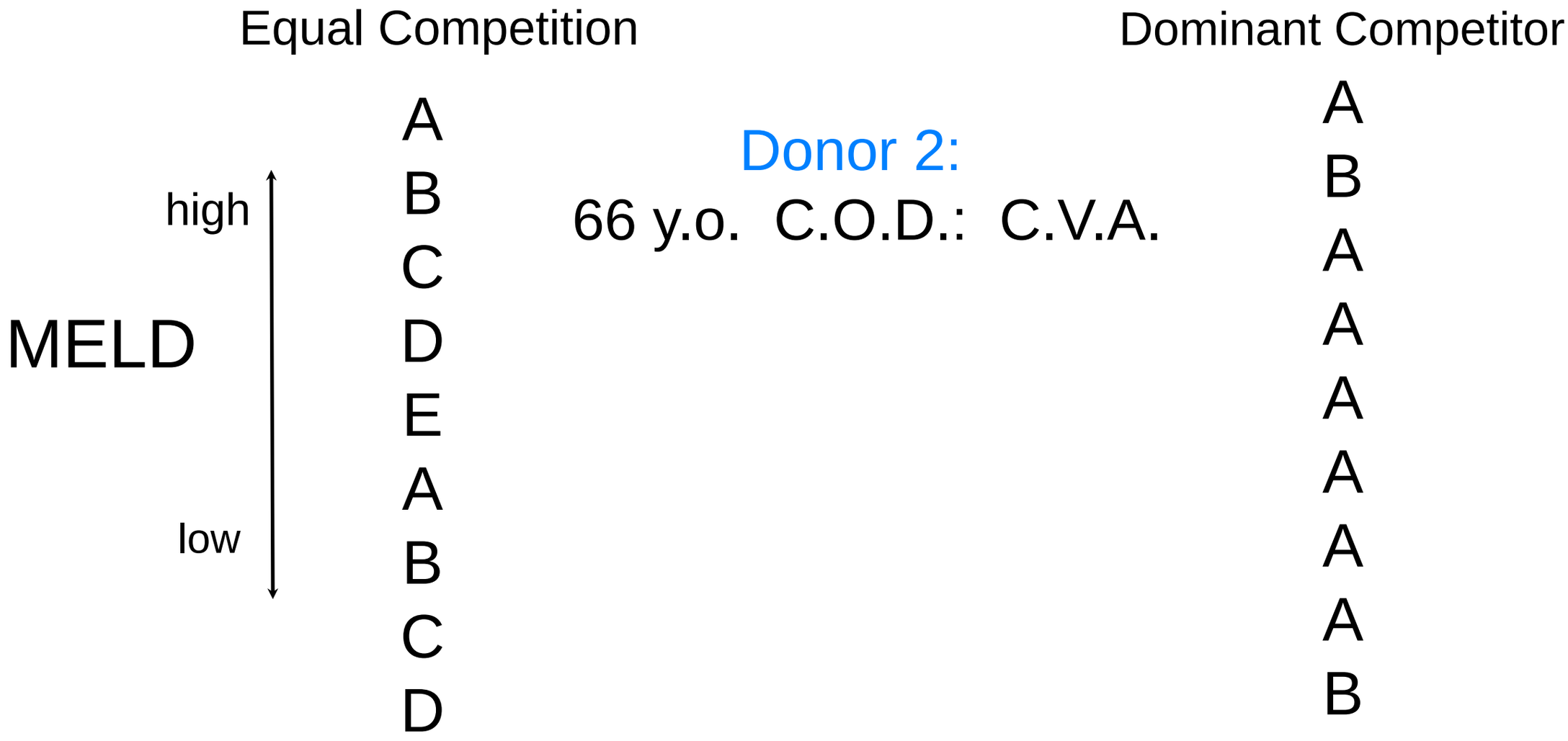
Proposed Mechanism:
Match List Competition

No Competition	Equal Competition	Dominant Competitor
A	A	A
A	B	B
A	C	A
A	D	A
A	E	A
A	A	A
A	B	A
A	C	A
A	D	B

Absence of Competition Accept "Best Match"

Under Competition Accept "Maximum Tolerated Risk"

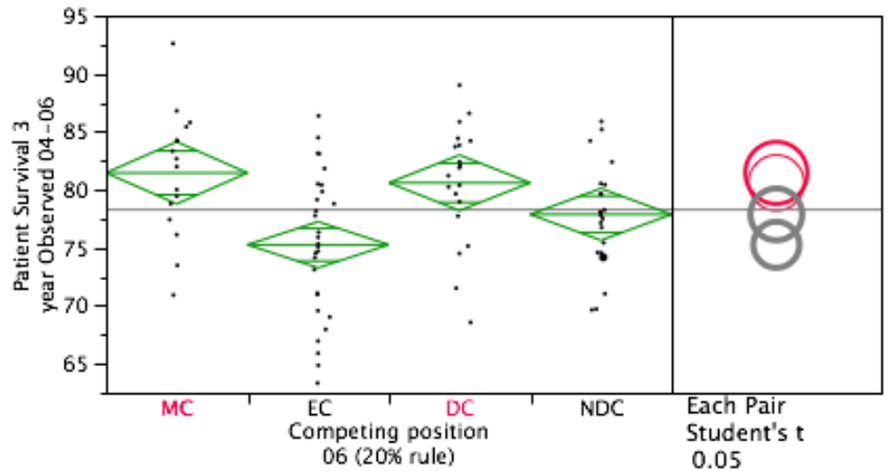
Donor/Recipient Matching in Liver Transplantation, the Advantage of List Dominance (ECD Donor)



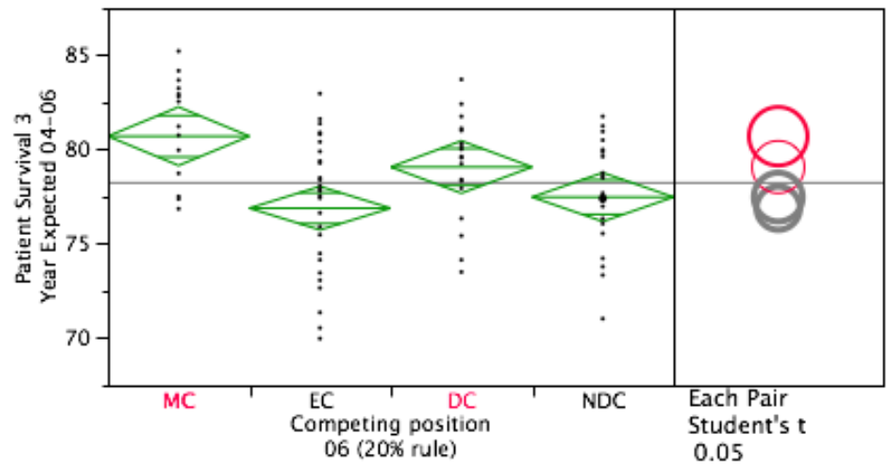
Outcome vs. Market Position

MC=Monopoly Center, EC=Equal-Competitor,
DC Dominant Competitor, NDC Non-Dominant Competitor

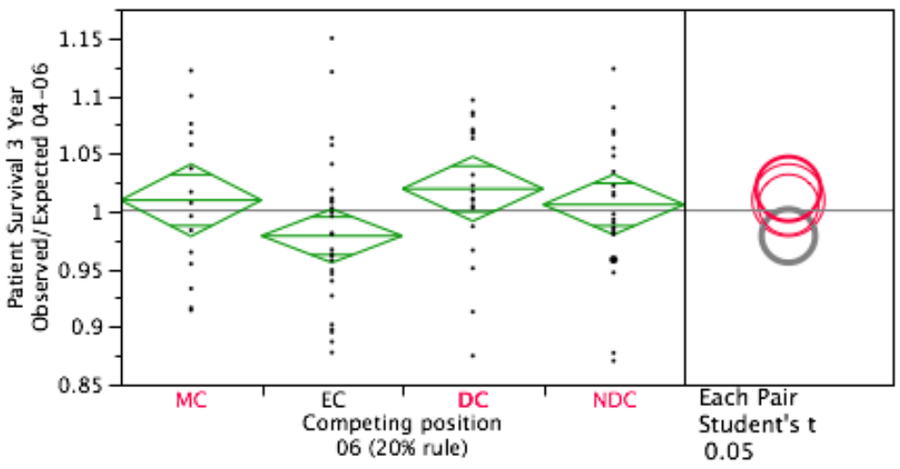
Observed 3 Year Patient Survival



Expected 3 Year Patient Survival



Observed/Expected



Competition, Utilization, and MELD

Less Competition

More Competition

-Opportunity for better control of Donor/Recipient Risk and Matching

-Decreased Access to listing

-Risk Aversion/Decreased Utilization

-Inability to control match risk for both donors and recipients

-Poorer Outcomes/Higher Cost in “Sickest First” Paradigm

What Should We Compete For?

How do we Avoid a “Race to the Bottom” in “Sickest first” Allocation?

Is it time for the Liver transplant community to better balance utility against disease severity in allocation policy?

What can be done on a local level to mitigate the negative influence of competition

Acknowledgements

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