

Recipient Risk Factors for Cardiac Transplantation

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CUTTING EDGE OF
TRANSPLANTATION

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RESOLVING THE ORGAN SHORTAGE



PRACTICE |



POLICY |

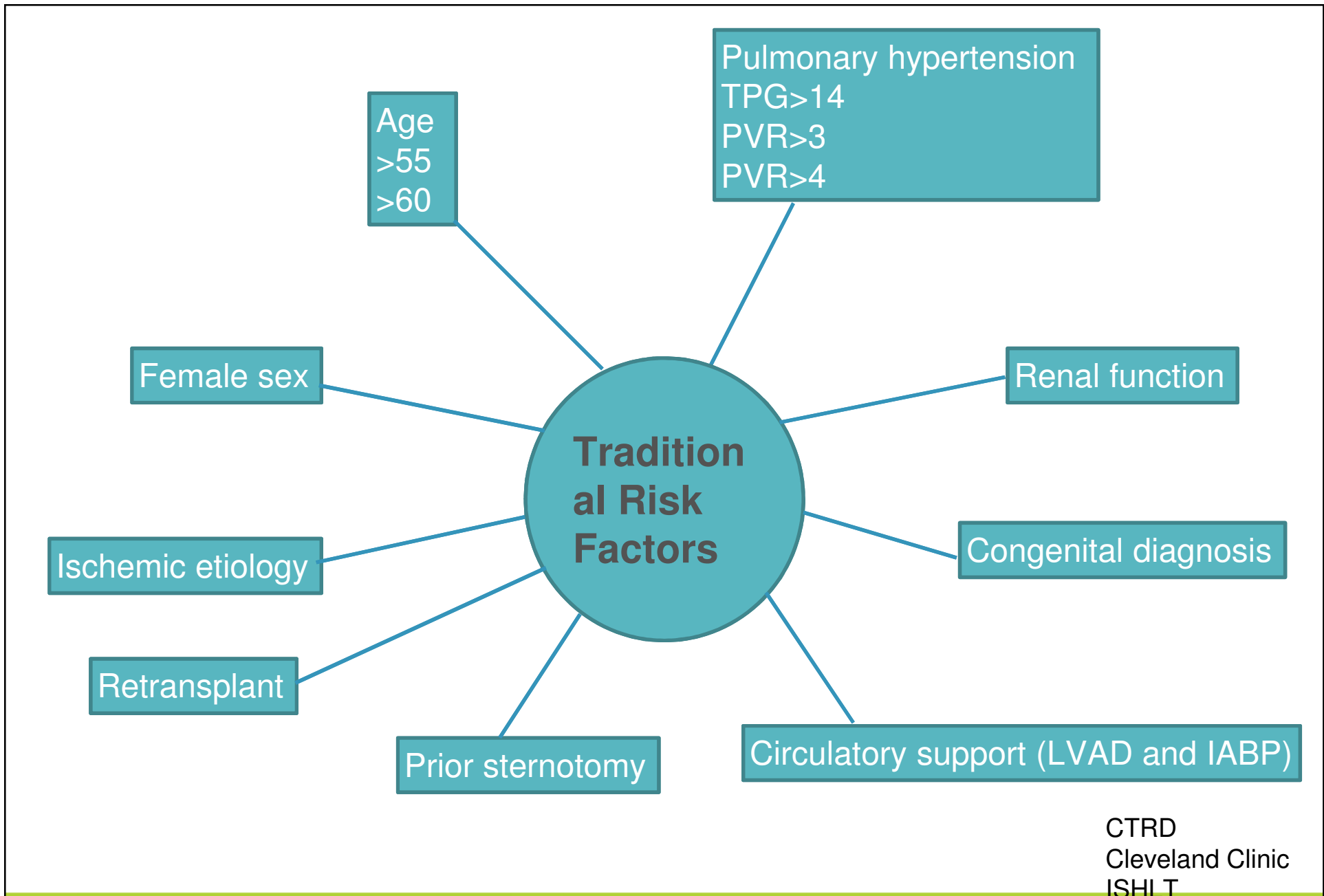


POLITICS

FEBRUARY 25-27, 2016 • PHOENIX, ARIZONA

Conflict of Interest Disclosure

- I have no relevant financial relationships to disclose.



CTRD
 Cleveland Clinic
 ISHLT

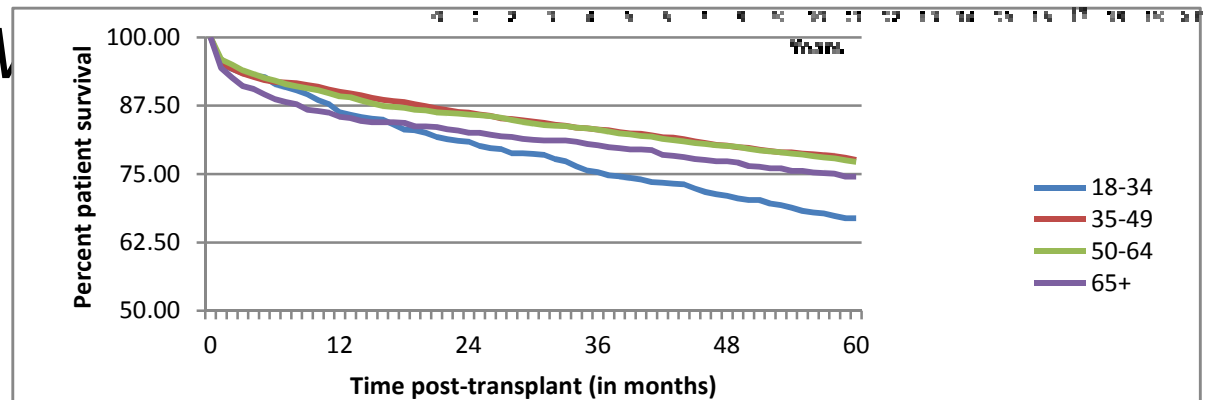
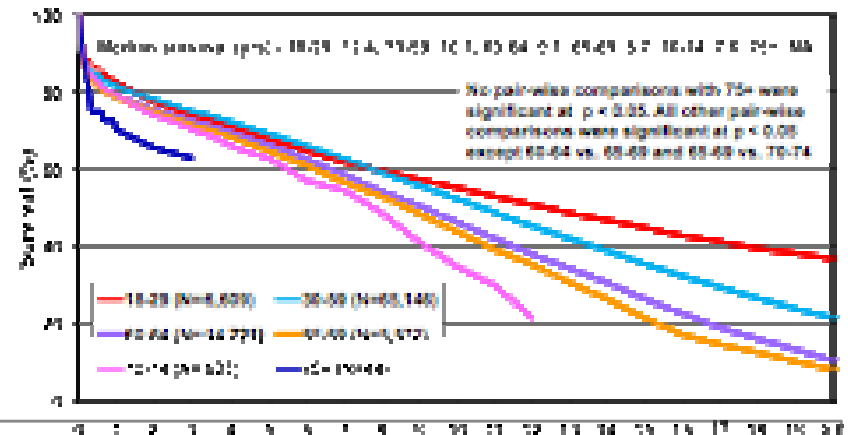
Age

No significant effect on mortality

- *Rickenbacher et al. Eur H J 1997-54 yrs*
- *Crespo-Leiro et al. Transplant Proc 1999-65 yr*
- *Baron et al. Transplant Proc 1999-60 yrs*
- *Blanche et al. JTCV 70 yrs*

Effect on mortality

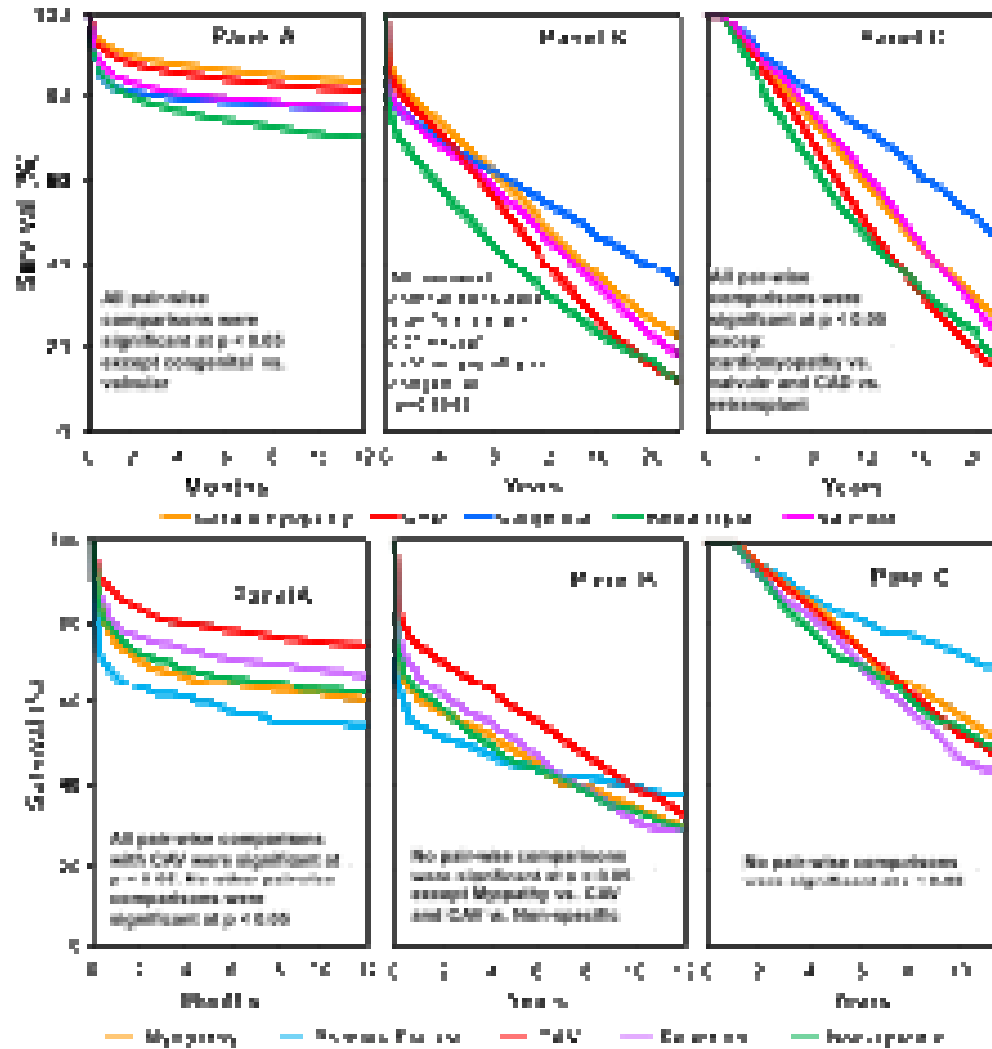
- *Borkon et al. JHLT 1999-55 yrs (56% vs. 78% at 5 yrs)*



Pulmonary Hypertension

- *Murali et al. AHJ 1993*
 - Preoperative TPG \geq 15 associated with increased 0-2 day mortality
- *Erikson et al. JHLT 1990*
 - Prep PVR, PAS, and PVRi not predictive of short-term mortality.
 - 6-month mortality TPG \geq 12 mmHg 24% vs 5% TPG <12 mmHg; p = 0.003
 - 12-month mortality 36% vs 5%; p = 0.0005
- *Frigerio et al. G Ital Cardiol 1995*
 - Right atrial pressure \geq 12, pulmonary vascular resistance index \geq 8, and transpulmonary gradient \geq 15 associated with increased mortality and RV failure
- PVR > 3 (or more)

Retransplant



Poor predictors
 Transplant during
 the first year
 Transplant for
 graft failure

1y 70% vs. 85%
 10yr 38% vs. 69%

Lund et al. JHLT 2014

Changing Risk Factors: CTRD

Variable name	p-value	Relative risk
Early-phase recipient variables		
Date of transplant	<0.0001	2.0 (10 years)
Age	0.001	1.3 (60 vs 45), no VAD
Idiopathic cardiomyopathy	0.05	0.8
Ischemic cardiomyopathy	0.05	0.8
Number of previous sternotomies	<0.0001	1.2 (1 vs 0)
Creatinine clearance at listing	0.0002	1.1 (50 vs 90)
Serum creatinine at transplant	<0.0001	1.3 (1.5 vs 1.0)
Mean RA pressure at pre-transplant cath	0.0009	1.2 (13 vs 5)
Non-parous female	0.004	1.8
VAD support at time of transplant	0.13	0.9 (VAD vs no VAD at age 30)
Interaction of age and VAD support	0.02	1.7 (VAD vs no VAD at age 60)

N=7013
26 institutions
41,213 pt-yrs
1990-2008

Tallaj et al. JHLT 2014

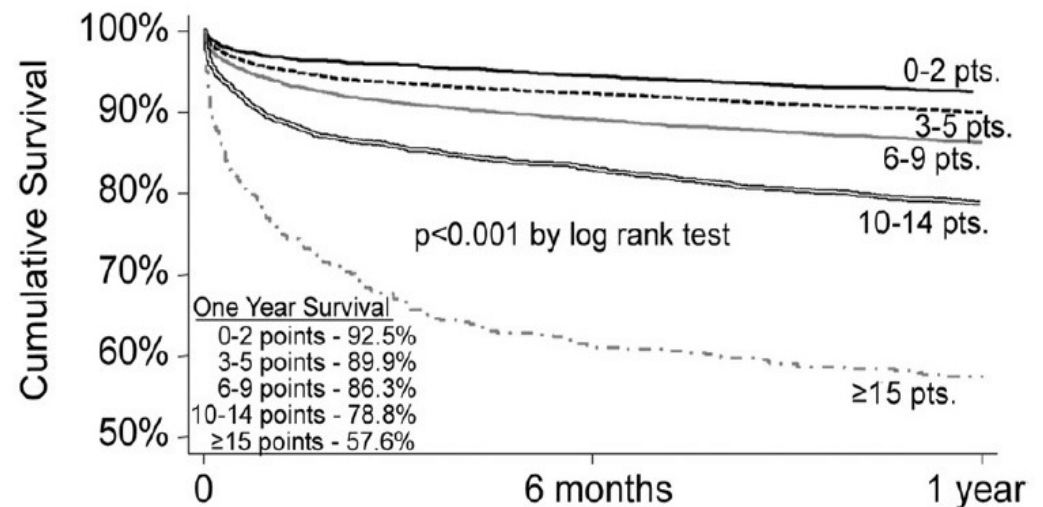
Risk Factors > 1year

Late-phase recipient variables		
Date of transplant	0.0002	Interaction, see below
Age	<0.0001	1.5 (2005 vs 1995; age 25 y)
Interaction of transplant date and age	<0.0001	0.6 (2005 vs 1995; age 60 y)
African-American ethnicity	<0.0001	2.6 (black vs non-black; age 25 y)
Interaction of age and ethnicity	0.01	1.6 (black vs non-black; age 60 y)
Grade of diabetes	<0.0001	1.4 (none vs IDDM)
Hypertrophic cardiomyopathy	0.06	0.5
Ischemic cardiomyopathy	0.006	1.2
History of smoking—quit >6 months before listing	0.006	1.2
History of smoking within 6 months of listing	<0.0001	1.7
Percent ideal body weight	<0.0001	1.2 (125% vs 100%)
History of peripheral vascular disease	0.002	1.4

Tallaj et al. JHLT 2014

IMPACT Score

- UNOS registry, N=21,000+, 1997-2008
- Outcome: 1-year mortality
- 50-point scoring system with 12 recipient-specific variables



Weiss, Ann Thorac Surg, 2011

Identifying Recipients at Risk for Graft Failure

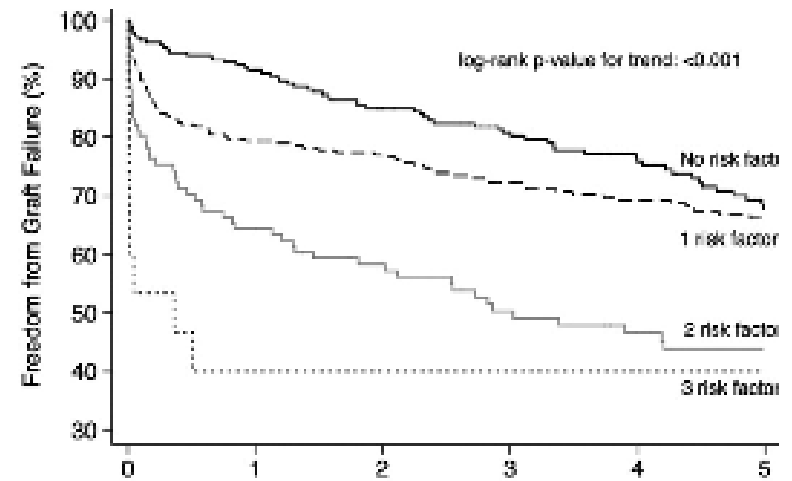
- UNOS data 1997-2009
- n=671, 45% grafts failed
- 35 recipient variables
- Adjusted for donor variables (donor age and ischemic time)

Kilic et al. ATS 2012

Recipient Risk Factors

Recipient Covariate	Univariate Analysis OR (95% CI)	p Value	Multivariable Analysis OR (95% CI)	p Value
Age (increasing)	1.02 (1.01–1.03)	0.002	1.02 (1.01–1.04)	0.005
Serum creatinine (increasing)				<0.001
Mechanical ventilation				<0.001
Transcatheter CAD				0.12
Primary graft failure	2.87 (1.66–4.95)	<0.001	1.21 (0.59–2.49)	0.60
Intraaortic	2.18 (1.20–3.95)	0.01	1.14 (0.56–2.31)	0.72

Increasing age
Serum creatinine
Mechanical ventilation



- Decade increase in recipient age conferred a 20% increase in graft failure
- 1-mg/dL increase in creatinine increased graft failure odds by 59%
- Mechanical ventilation increased graft failure odds by > 3.5-fold

Kilic et al. ATS 2012

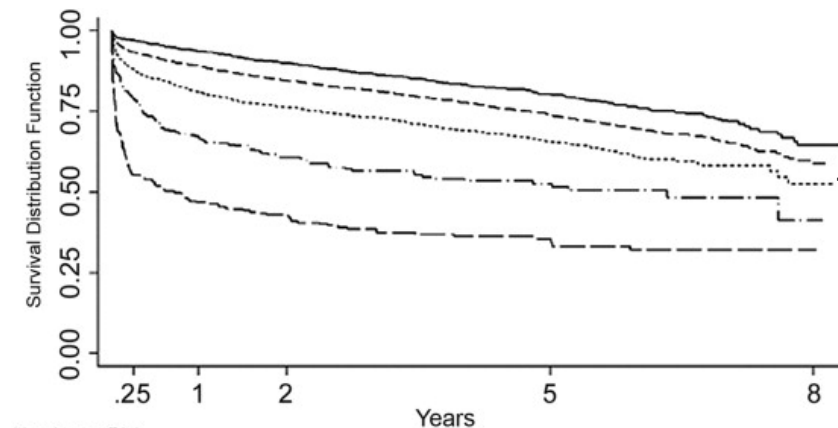
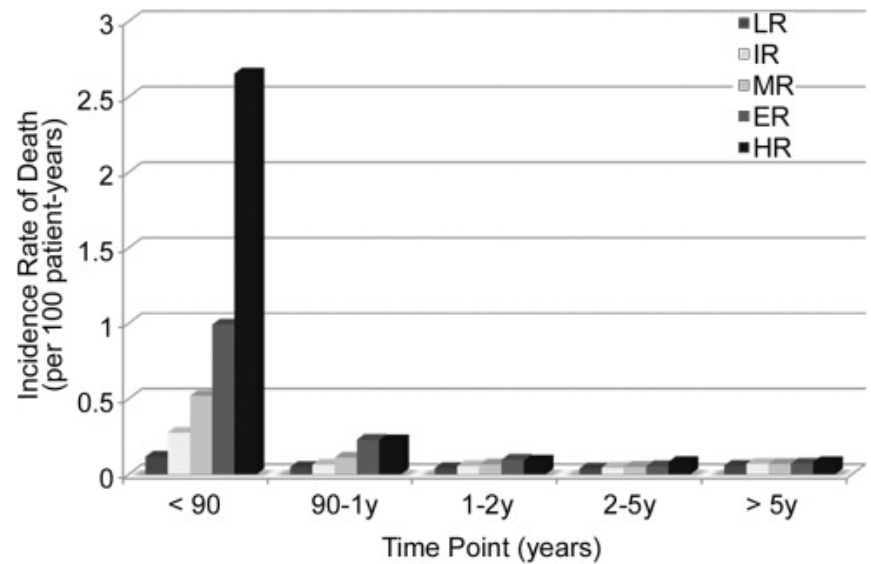
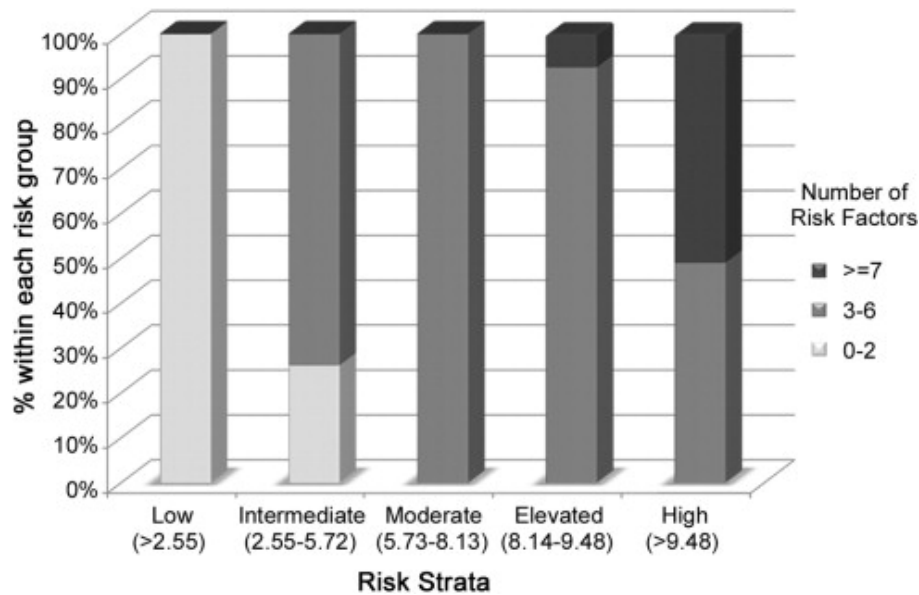
The High Risk Recipient: UNOS data 2001-2007

Risk Factors	Weight	Odds Ratio	Upper 95% CI	Lower 95% CI	p Value
Comorbidities					
Recipient age: >70 yo	2.1	2.069	1.387	3.086	0.000
Recipient age: 55-70 yo	1.2	1.216	1.075	1.375	0.002
Previous cardiac surgery	1.3	1.269	1.117	1.442	0.000
Etiology: congenital	2.3	2.219	1.754	3.068	0.000
Etiology: amyloidosis	1.8			3.798	0.154
Diabetes complicated by CVA	1.4			2.022	0.138
eGFR < 33	2.8			3.333	0.000
eGFR 33-53	1.4			1.584	0.000
Total bilirubin > 2	1.7			2.020	0.000
Acuity					
Intubated	1.8	1.784	1.338	2.379	0.000
Hospitalized	1.2	1.172	1.038	1.323	0.011
Mechanical Support					
RVAD-only	4.7	4.739	1.982	11.331	0.000
ECMO	3.9	3.852	1.993	7.446	0.000
Extracorporeal LVAD	2.7	2.748	1.836	4.114	0.000
Total artificial heart	2.4	2.400	1.311	4.391	0.005
Paracorporeal LVAD	1.2	1.250	0.969	1.612	0.086

Recipient age > 70
 Congenital diagnosis
 GFR<33
 MCS (ECMO and RVAD)

n=11,703
 Primary outcome-1 yr graft failure

Hong et al. ATS 2011



Number at Risk	.25	1	2	5	8
— LR	3242	3194	3030	2364	1446
--- MR	6347	6306	6013	4942	3425
- - - IR	1543	1519	1479	1289	994
--- ER	310	300	292	271	226
- - - HR	252	251	250	242	235

Hong et al. ATS 2011

Recipient Risk Factors 1-yr Program Specific Reports December 2015

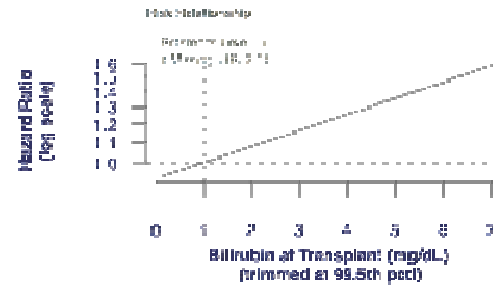
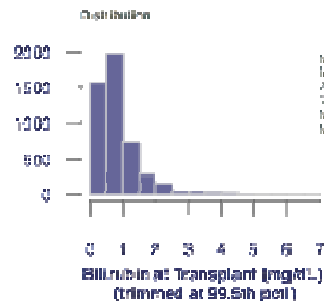
<http://srtr.org/csr/current/modtabs.aspx>

New First-Year, Adult Graft Survival Model

Candidate/Recipient Factors

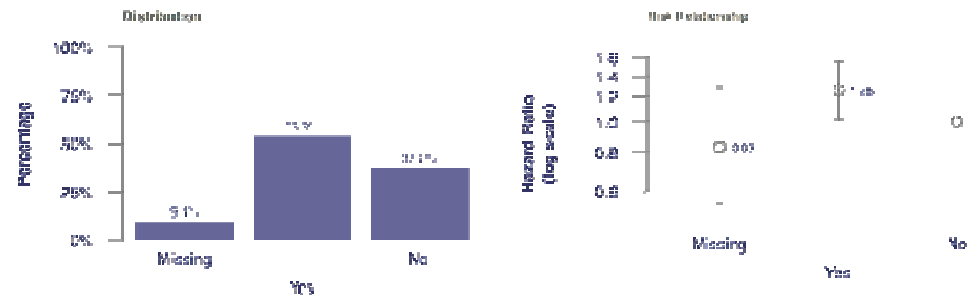
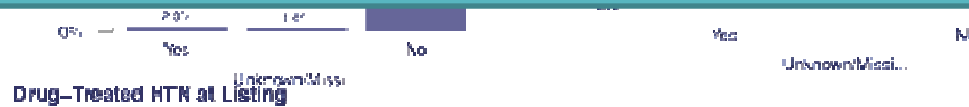
- Diabetes
- Highest Ed. Level
- History of Cigarette Use
- Any Previous Malignancy
- Race
- Urgency Status at Transplant
- Age
- BMI
- CO (L/min)
- Prior CABG
- Multiple Prior Cardiac Surgeries
- Other Prior Cardiac Surgery
- CMV serostatus
- Dialysis since listing
- EBV serostatus
- Patient on ECMO at Tx
- HBV Surface Antigen
- HCV serostatus
- Patient on LVAD at Tx
- Patient on RVAD at Tx
- Patient on TAH at Tx
- Medical Condition at Tx
- Serum Creatinine
- Total Bilirubin
- Patient on Life Support at Tx
- Previous Solid Organ Transplant
- Primary Diagnosis
- Primary Source of Payment
- PA (diastolic and systolic)
- PCW (mean)
- Transfusions since listing
- Patient on Ventilator at Tx

Bilirubin at Transplant (mg/dL)

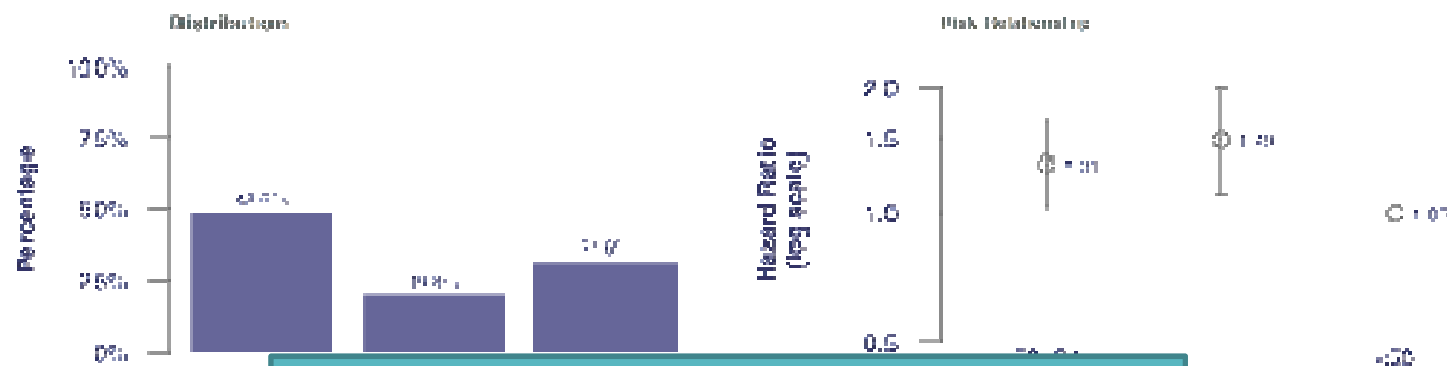


Dialysis at Transplant

Bilirubin HR 1.6
Dialysis HR 1.85
Drug-treated hypertension at listing HR 1.26

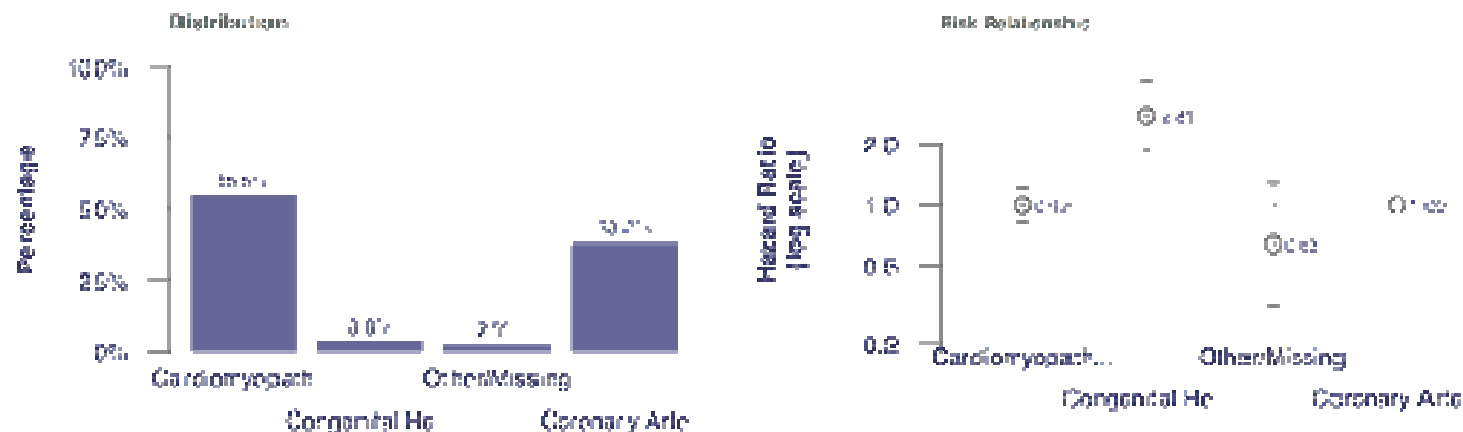


Recipient Age at Transplant

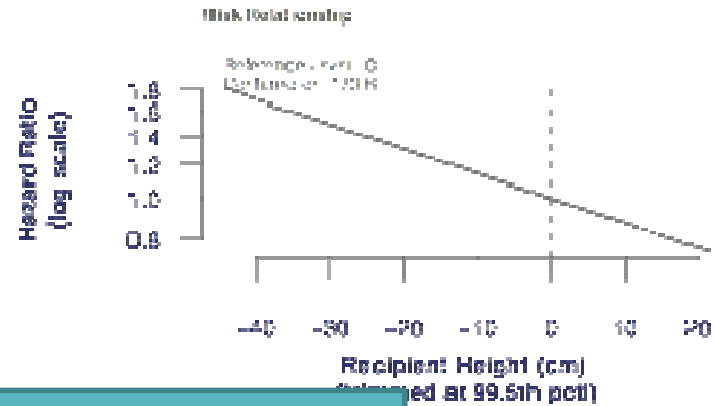
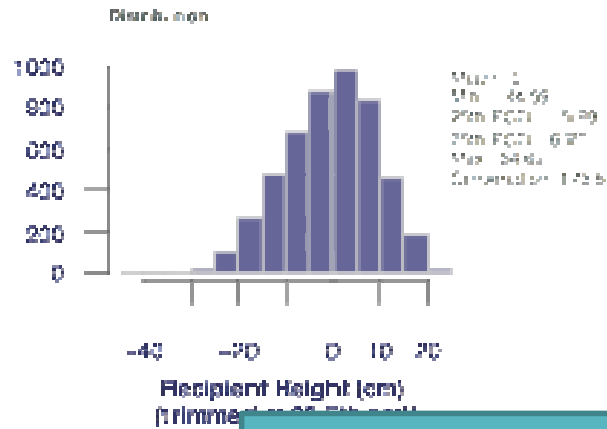


Recipient age 50-64 HR 1.31
 Recipient age 65+ HR 1.49
 Congenital heart disease HR 2.81

Recipient Diagnosis

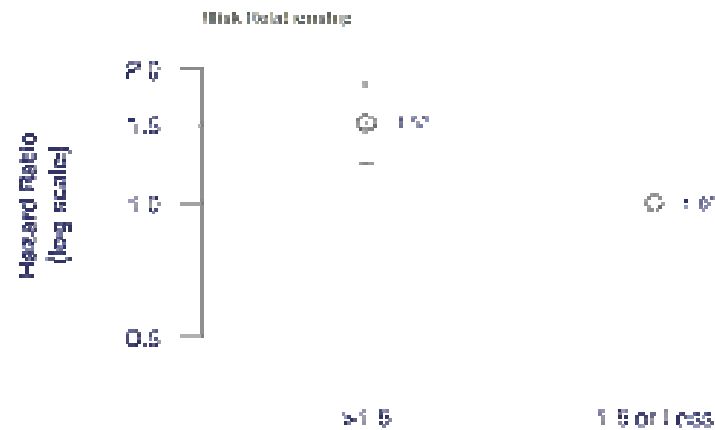
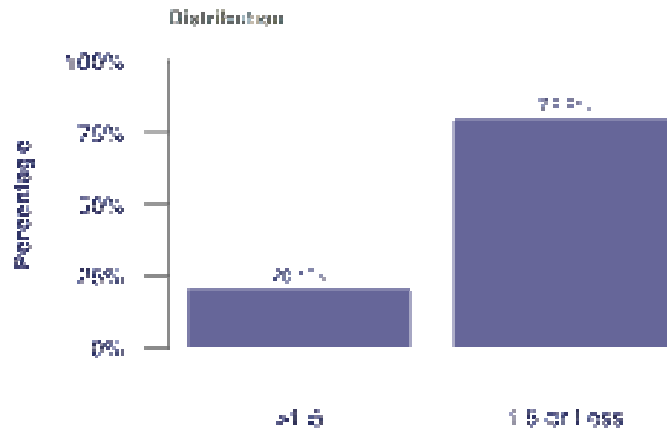


Recipient Height (cm)

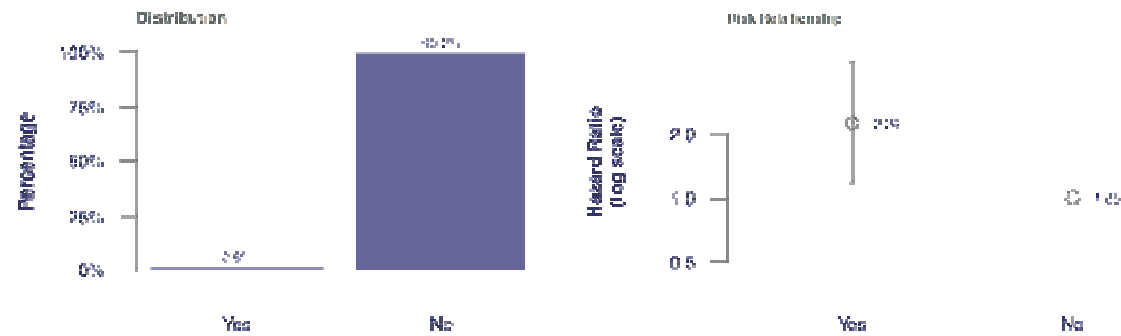


Recipient height HR 1.8
 serum creatinine >1.5 HR 1.52

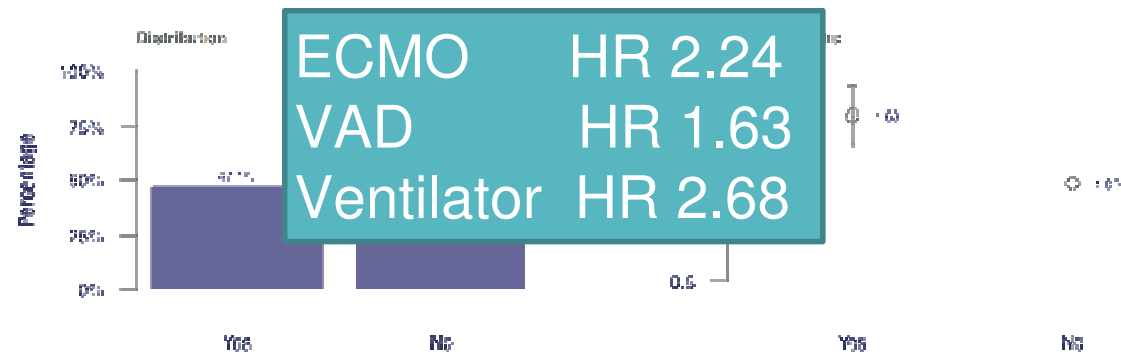
Recipient Serum Creatinine



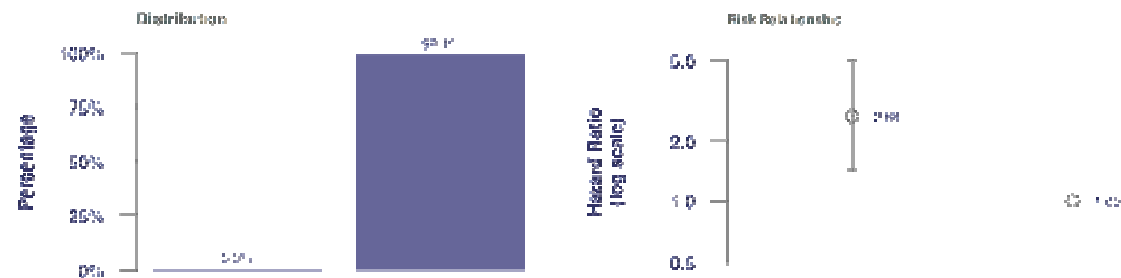
Recipient on Life Support (ECMO)



Recipient on VAD



Recipient on Ventilator



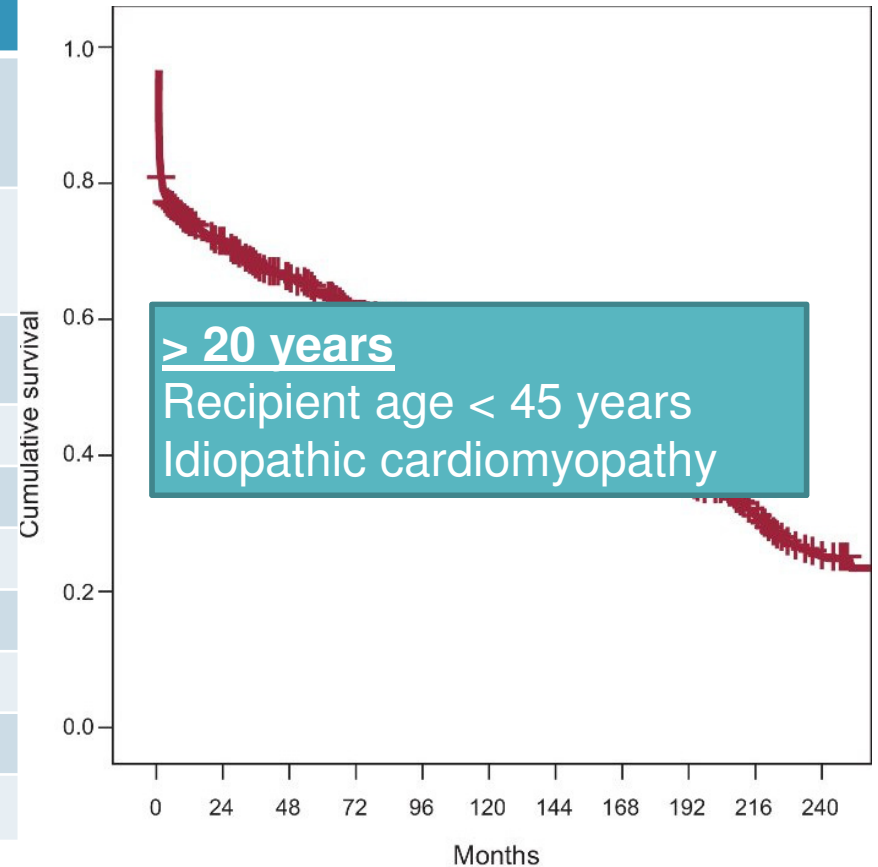
Important variables but not statistically significant

- Medical condition (ICU/hospitalized)
- Most recent cPRA/PRA
- PA systolic
- Previous heart transplant
- Race/Ethnicity
- Sudden death at listing

Long-term survival

Significant Covariates in Multivariable Logistic Regression for 10-Year Survival				
Covariates				
OR (95% CI)				
Recipient age < 55 y				<0.001
White race				<0.001
Mechanical ventilation				0.001
Diabetes				<0.001
Decreasing ischemic time				<0.001
Decreasing donor age	1.02 (1.01–1.02)	<0.001	1.01 (1.01–1.02)	<0.001
Annual center volume ≥ 9 OHT/y	1.19 (1.13–1.26)	<0.001	1.31 (1.17–1.47)	<0.001

> 10 years
 Recipient age < 55 years
 White race
 Decreasing ischemic time
 Diabetes and Mechanical ventilation decreased 10-yr survival



Kilic et al. ATS 2011

Jaramillo et al. Rev Esp Cardiol. 2013;66:797-802

Limitations to evaluating recipient risk factors

- Individual and center-specific practices
- Modifiable risks should be taken into account
- “Risk factors” markers of other factors (frailty, acuity)
- Interactions with donor factors