Donor/Recipient Risk Scores: Review of Published Approaches from Europe and the US

Michael M. Givertz, MD

Medical Director, Heart Transplant and MCS

Brigham and Women's Hospital

Professor of Medicine, Harvard Medical School

Boston, Massachusetts

CEOT

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Conflict of Interest Disclosure

- I have no relevant financial relationships to disclose

Why Do We Need Donor/Recipient Risk Scores?

Recipient	Donor*	Early Death
69 male AMI c/b shock CentriMag LVAD, RVF TIAs, SAH, MRSA inf.	48 male Head trauma 2° MVA HTN, smoker, min. CAD	Sepsis 2° aspiration pneumonia, E. Coli bact. Recurrent CVAs
65 male CMP HeartMate II LVAD Thrombocytopenia	22 male Homicide GSWTTH	Cirrhosis, hepatic failure
67 female VT, CMP HeartMate II LVAD Multiple GIBs	27 male Oxycontin OD	Pleural, mediastinal, pre-peritoneal fluid Disseminated aspergillus

*All local donors, no body size mismatch

2016 ISHLT Listing Criteria

- Heart failure prognosis scores should be performed along with cardiopulmonary exercise test to determine prognosis and guide listing for transplantation for ambulatory patients (Class IIb, Level of Evidence C).
- Listing patients solely on the criteria of heart failure survival prognostic scores should not be performed (Class III, Level of Evidence C).

Mehra et al., J Heart Lung Transplant 2016;35:1

Heart Failure Survival Models

Model	Cohorts	N	C-statistic
HFSS	8	2,240	0.56-0.79
Seattle HFM	14	16,057	0.63-0.81
PACE Risk Score	1	905	0.69
SHOCKED Predictors	1	27,893	0.74
Frankenstein et al.	1	676	0.66-0.68

- Externally validated models showed inconsistent performance
- HFSS and SHFM demonstrated modest discrimination with questionable calibration

Alba et al., Circ Heart Fail 2013;6:881

2010 ISHLT Care Guidelines

- Specific recommendations on donor age, infection, drug/alcohol use, preexisting cardiac abnormalities and ischemic time
- Donor-recipient size matching:

> As a general rule, the use of hearts from donors whose body weight is no greater than 30% below that of the recipient is uniformly safe. Furthermore, a male donor of average weight (70 kg) can be safely used for any size recipient irrespective of weight. Use of a female donor whose weight is more than 20% lower than that of a male recipient should be viewed with caution.

  - Class I, Level of Evidence C

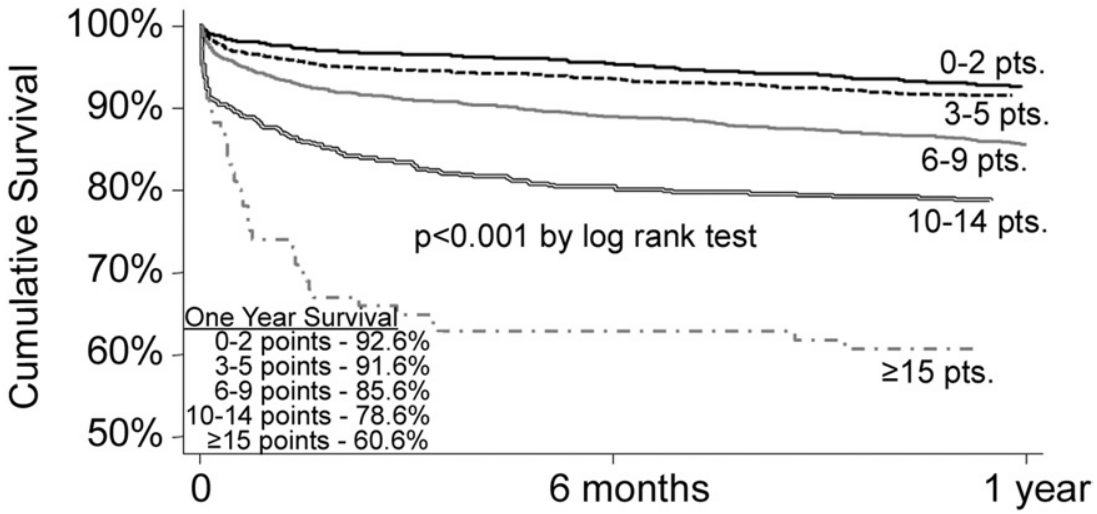
Costanzo et al., J Heart Lung Transplant 2010;29:914

Developing a Risk Score

- Accuracy of derivation cohort
- Predictive accuracy of validation cohort
- Simplicity to aid clinicians in assessing risk in real time
- Impact on use of high-risk donors and/or listing of high-risk (alternate) recipients

IMPACT Score: UNOS Data

Recipient variable	Points assigned
Age > 60 years	3
Serum bilirubin, mg/dl	
0-0.99	0
1-1.99	1
2-3.99	3
≥4	4
Creatinine clearance, ml/min	
≥50	0
30-49	2
<30	5
Dialysis between listing and transplant	4
Female sex	3
Heart failure etiology	
Idiopathic	0
Ischemic	2
Congenital	5
Other	1
Recent infection	3
Intra-aortic balloon pump	3
Mechanical ventilation pre-transplant	5
Race	
Caucasian	0
African American	3
Hispanic	0
Other	0
Temporary circulatory support [a]	7
Ventricular assist device	
Older-generation pulsatile	3
Newer-generation continuous[b]	5
Heartmate II	0
Total points possible	50



Validation Cohort, N = 4,299

Weiss et al., Ann Thorac Surg 2011;92:914

IMPACT Score: UNOS Data

- 52 yo woman
- Idiopathic CMP
- CrCl 40 ml/min
- PAC/inotropes

IMPACT score = 5

Expected 1YS 89%

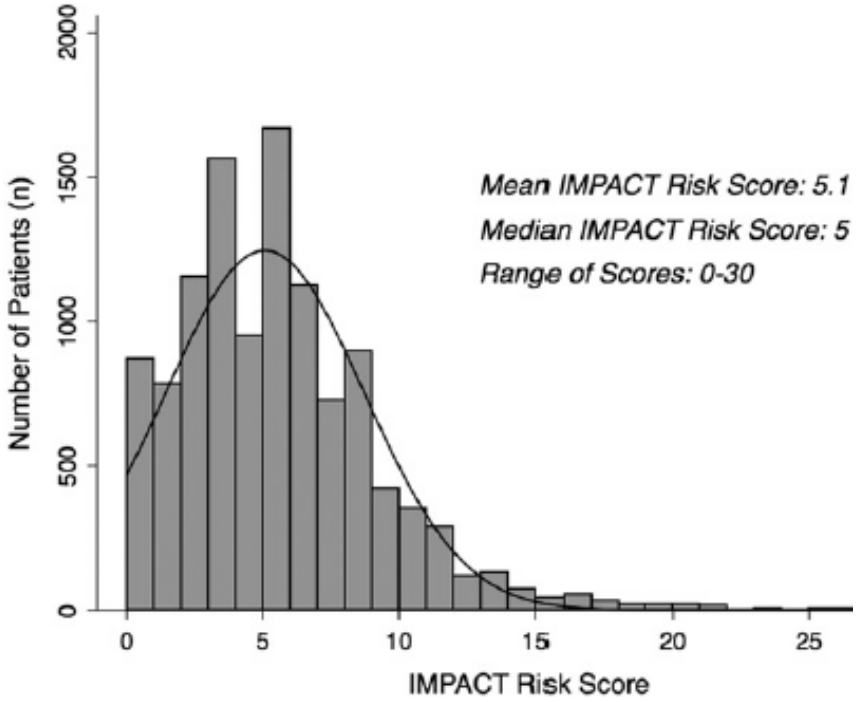
- 65 yo woman
- Ischemic CMP
- IABP
- Recent pneumonia

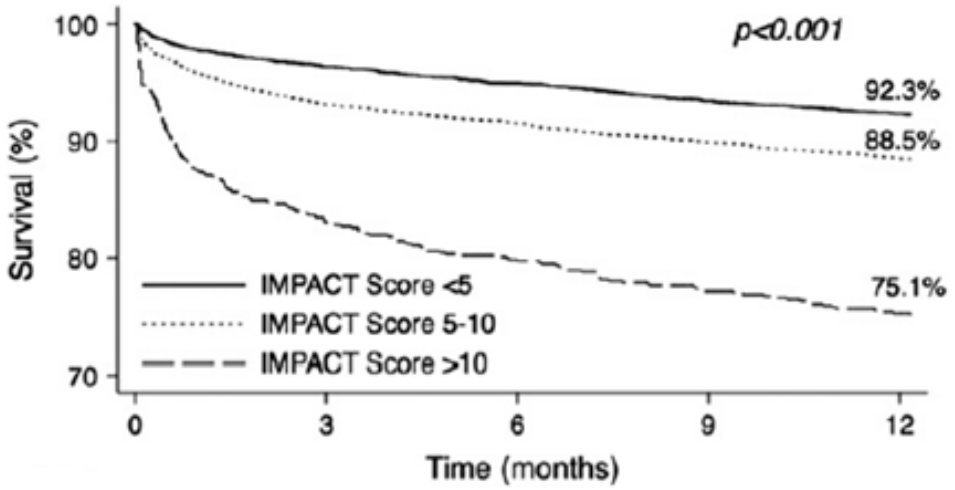
IMPACT score = 12

Expected 1YS 77%

Weiss et al., Ann Thorac Surg 2011;92:914

IMPACT Score: ISHLT Data



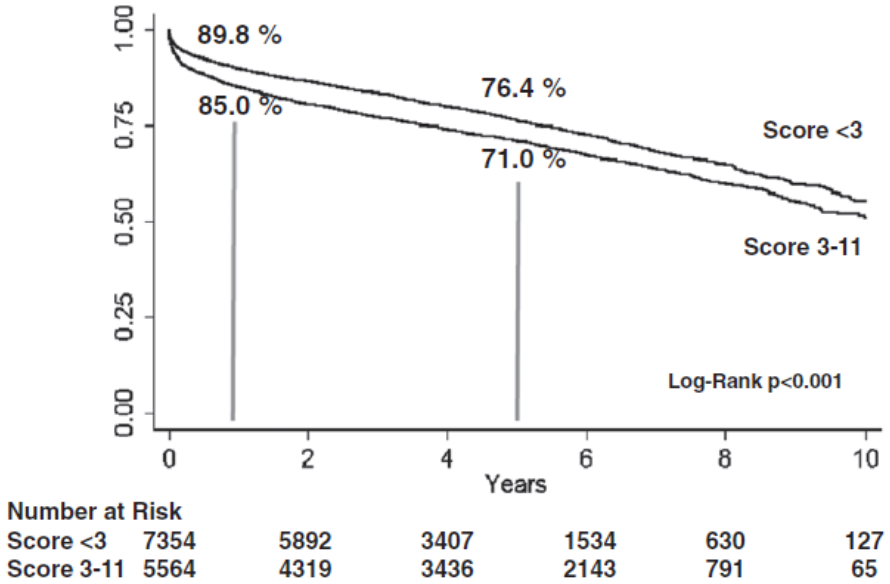


Kilic et al., J Heart Lung Transplant 2013;32:492

Columbia CARRS Score

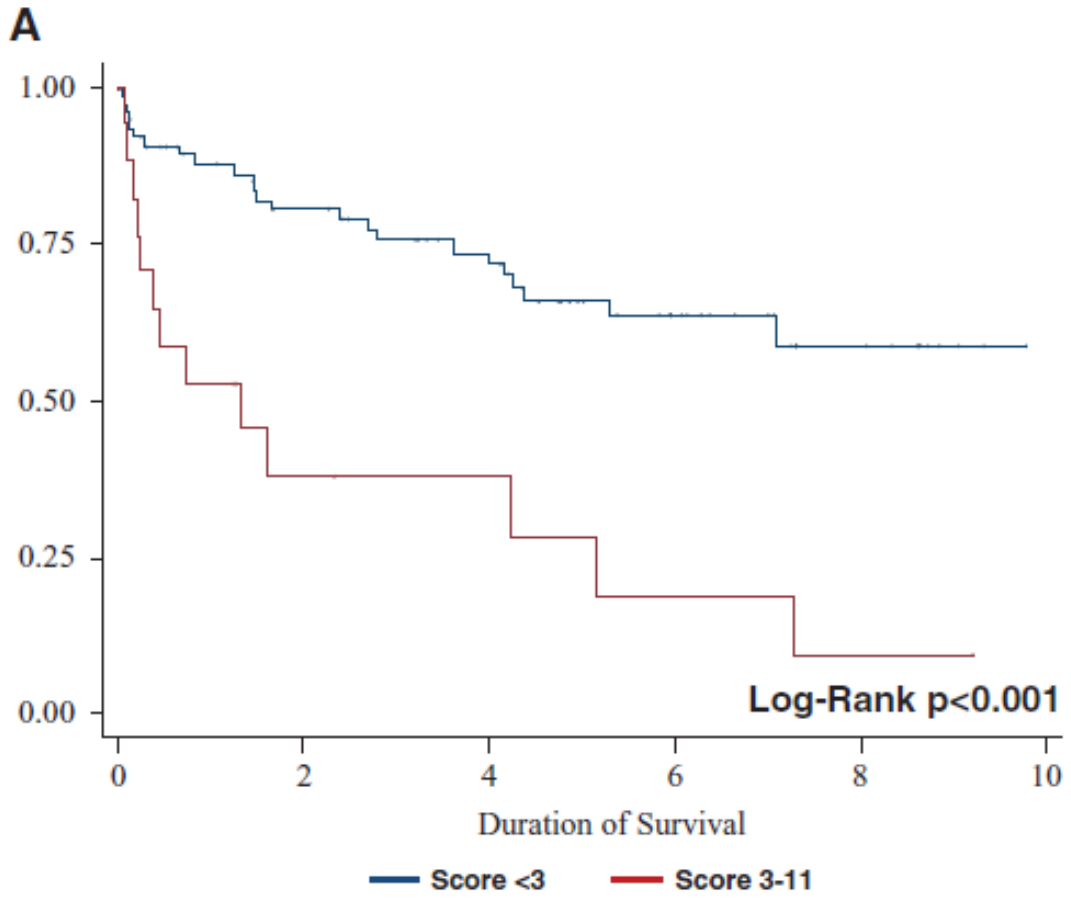
- CARRS
  - CVA
  - Albumin < 3.5
  - Re-transplant
  - Renal dysfunction (GFR < 40)
  - Sternotomies > 2
- 2 points for each (except 1 for RD)

High-risk = 3+ Low-risk = 0-2



Schulze et al., Circ Heart Fail 2013;6:527

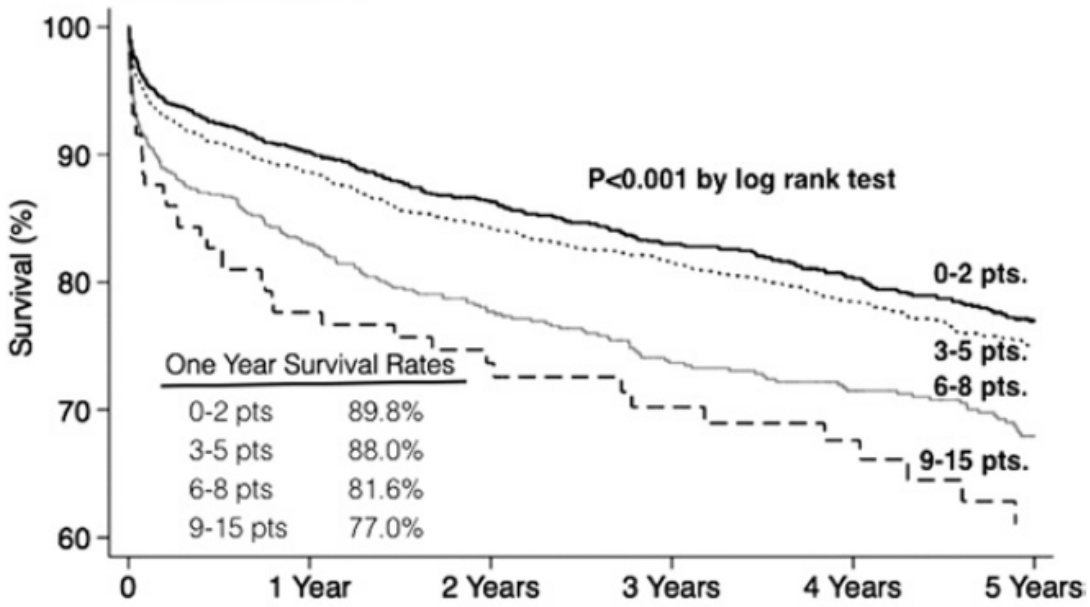
CARRS Applied to Alternate List



Schulze et al., Circ Heart Fail 2013;6:527

Donor Risk Index

Variable	Points assigned
Ischemic time	
<2 hours	1
2–3.9 hours	2
4–5.9 hours	3
6–7.9 hours	4
≥8 hours	5
Donor age	
<40 years	0
40–49 years	3
≥50 years	5
Race mismatch	2
BUN/creatinine ratio ≥30	3
Total points possible	15

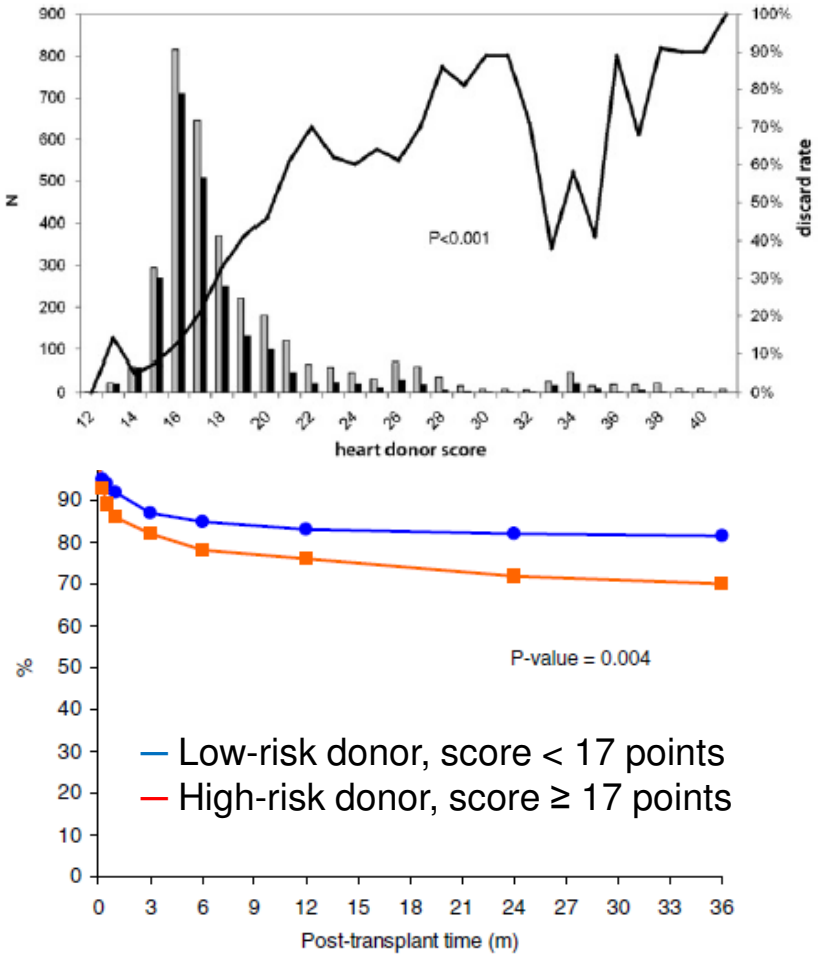


Weiss et al., J Heart Lung Transplant 2012;31:266

Donor Risk Score

Donor factor	Donor 1	Points	Donor 2	Points
Age (years)	59	5	49	2
Cause of death	TC	1	CVA	2
Donor history	Not compromised	1	Not compromised	1
Hypertension	No	1	Yes	2
Cardiac arrest	No	1	Yes	2
Ejection fraction (%)	56	1	50	4
Valve function	Normal	1	Normal	1
Ventricular hypertrophy (mm)	12	1	14	2
Coronary angiogram	Normal	1	Normal	1
Serum sodium (mmol/liter)	140	1	144	1
Noradrenaline (μg/kg/min)	0.4	1	0.3	1
Dopamine/dobutamine (μg/kg/min)	6.0	1	7	1
Heart donor score–total points		16		20

CVA, cerebrovascular accident; TC, trauma capitis.

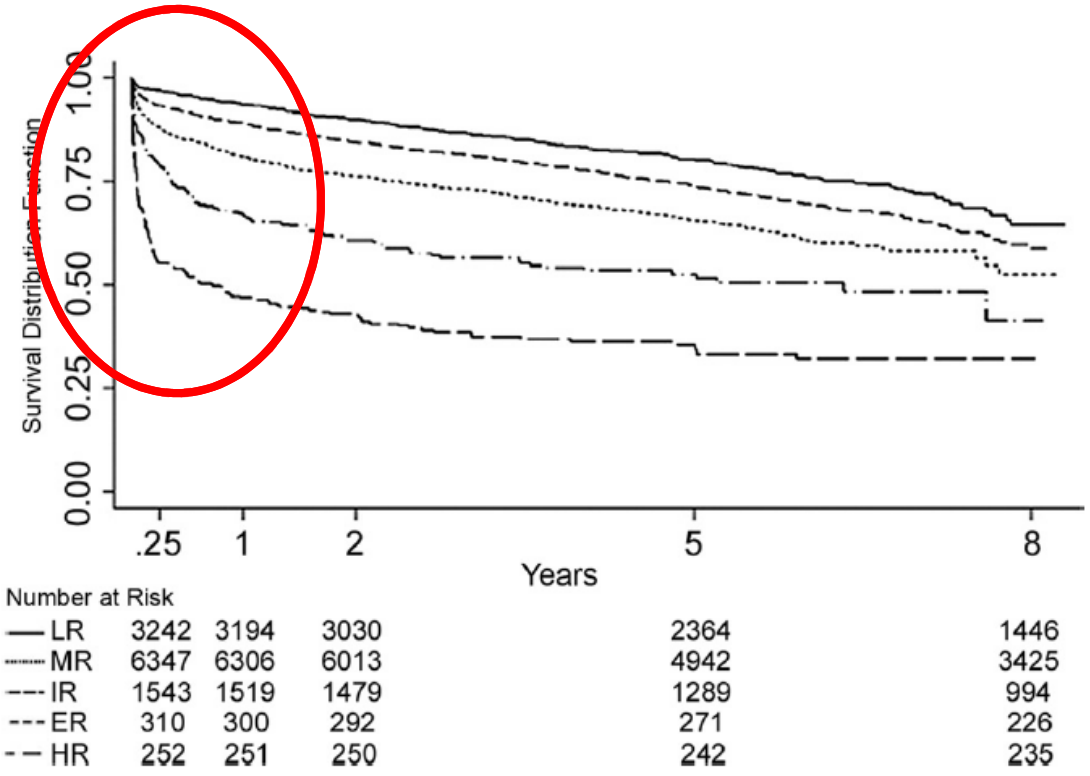


Smits et al., J Heart Lung Transplant 2012;31:387

Donor and Recipient Risk

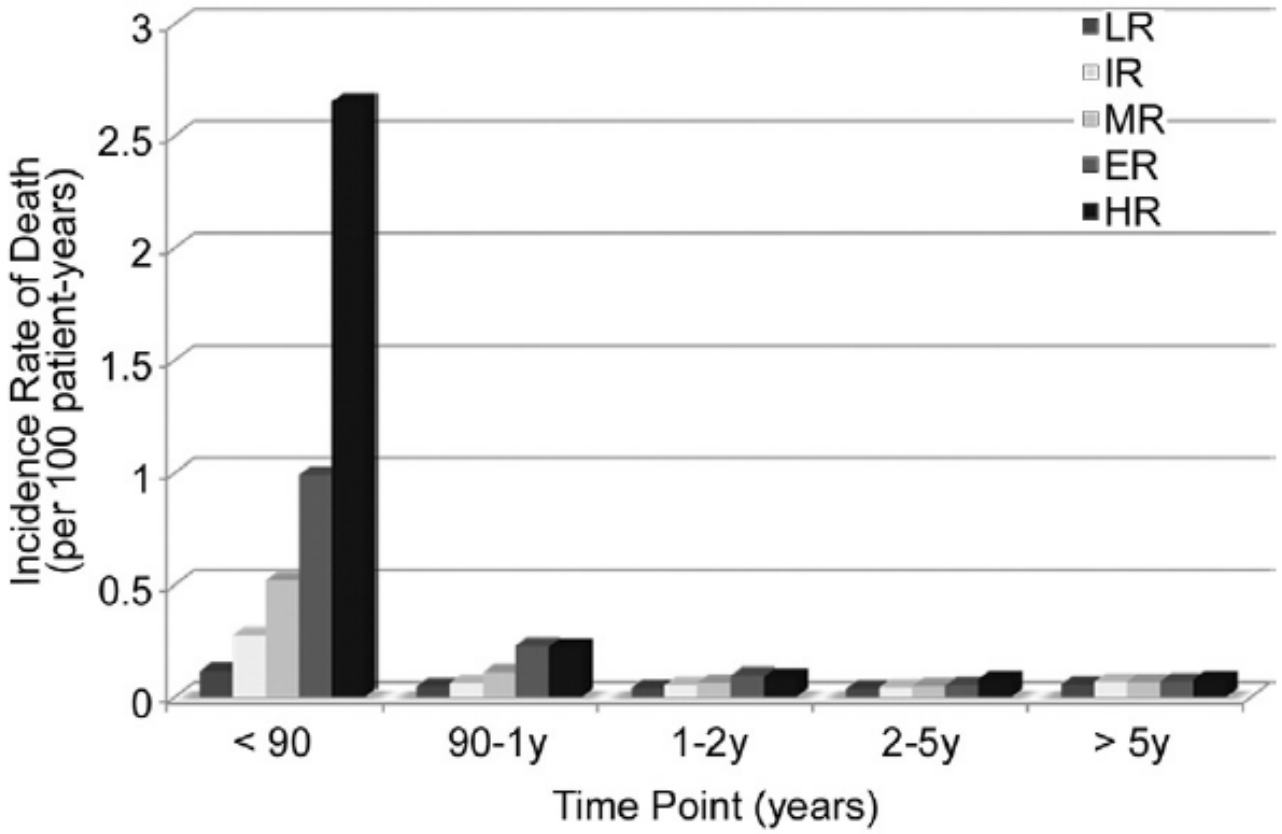
- Recipient (0-23)
  - Age
  - Etiology
  - Renal function
  - Hepatic function
  - Ventilator
  - MCS*
- Donor (0-8)
  - Age
  - Ischemic time
  - Female
  - HCV+

*RVAD, ECMO, TAH, extracorporeal LVAD



Hong et al., Ann Thorac Surg 2011;92:520

Donor and Recipient Risk



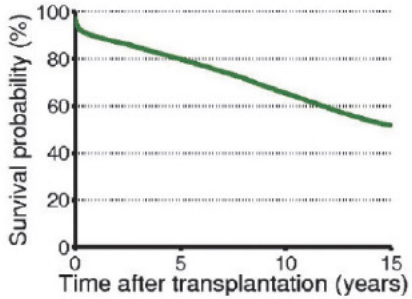
Hong et al., Ann Thorac Surg 2011;92:520

International Heart Transplant Survival Algorithm

Results

	1 year	5 years	10 years
Survival	91 %	81 %	67 %
Mortality	9 %	19 %	33 %

Median life expectancy 15.3 years



Recipient data

Diagnosis	Non-ischemic cardiomyopathy
Age (years)	51
Gender	Male
Height (cm)	174
Weight (kg)	78
Insulin treated diabetes	☐
Hypertension†	☐
Infection within two weeks‡	☐
Antiarrhythmic drugs prior to transplant	☐
Amiodarone prior to transplant	☐
Recipient blood group	A
Previous blood transfusion	☐
Previously transplanted*	☐
Previous cardiac surgery	☐

Medical condition at transplant

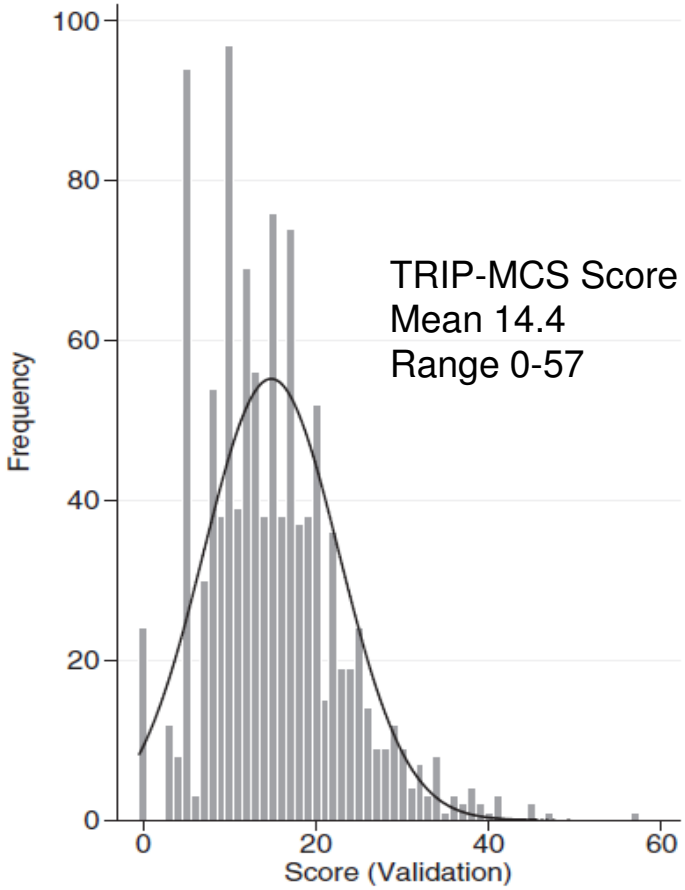
Intensive care unit	☐
Mechanical ventilation	☐
ECMO	☐
Ventricular assist device	☐
Transplant era	2006-
SPP (mmHG)	44
PVR (wood units)	2.6
Creatinine (µmol/l)	119
Serum bilirubin (µmol/l)	24
Use (mg/dl) instead of (µmol/l)	☐
PRA > 10 %	☐
HLA-DR 2 mismatch	☐

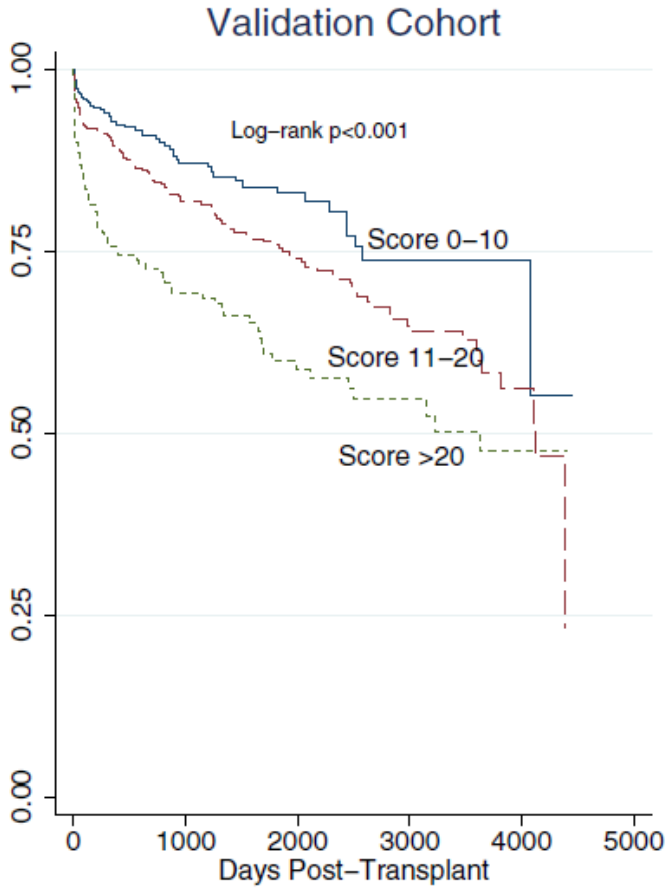
Donor data

Age (years)	34
Gender	Male
Height (cm)	175
Weight (kg)	78
Duration of ischemia (min)	188
Donor blood group	A
Donor cause of death	Head trauma

Nilsson et al., PLoS ONE 2015;10;e0118644

Transplantation Risk with MCS





Johnston et al., JACC Heart Fail 2016, in press

Eurotransplant Cardiac Allocation Score

- Waitlist mortality computed using HFSS and SHFM
- Post-transplant mortality estimated by IMPACT
- CAS = estimated post-transplant survival – 2 (estimated waitlist survival)
  - Prioritizes patients with a high risk of dying while waiting, but only if they have a good chance of survival post-transplant
  - Analogous to Lung Allocation Score

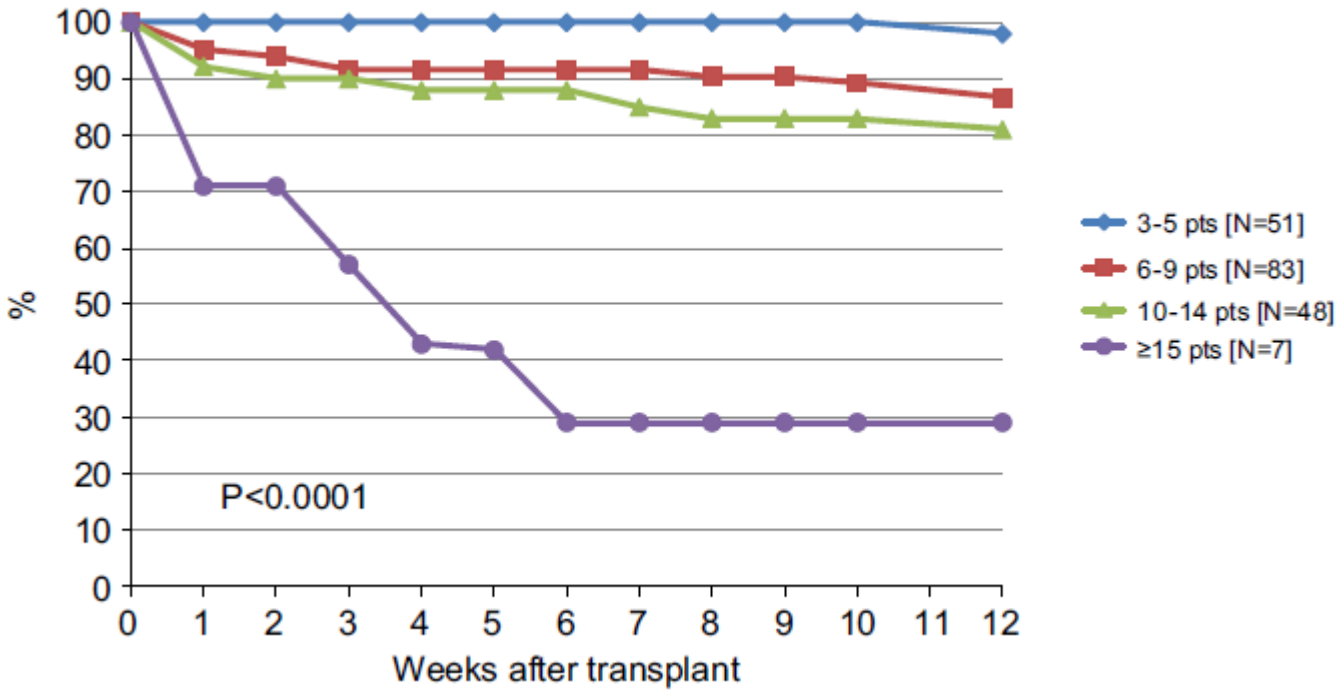
Smits et al., J Heart Lung Transplant 2013;32:873

Eurotransplant Cardiac Allocation Score

- N = 448 urgent or high-urgent
  - 42% transplanted, 11% died waiting, 47% still waiting
  - 26% VAD and 15% extracorporeal support
- SHFM was better than HFSS in predicting waitlist mortality; neither score predicted mortality in VAD patients
- IMPACT score performed well for predicting post-transplant mortality in non-VAD patients

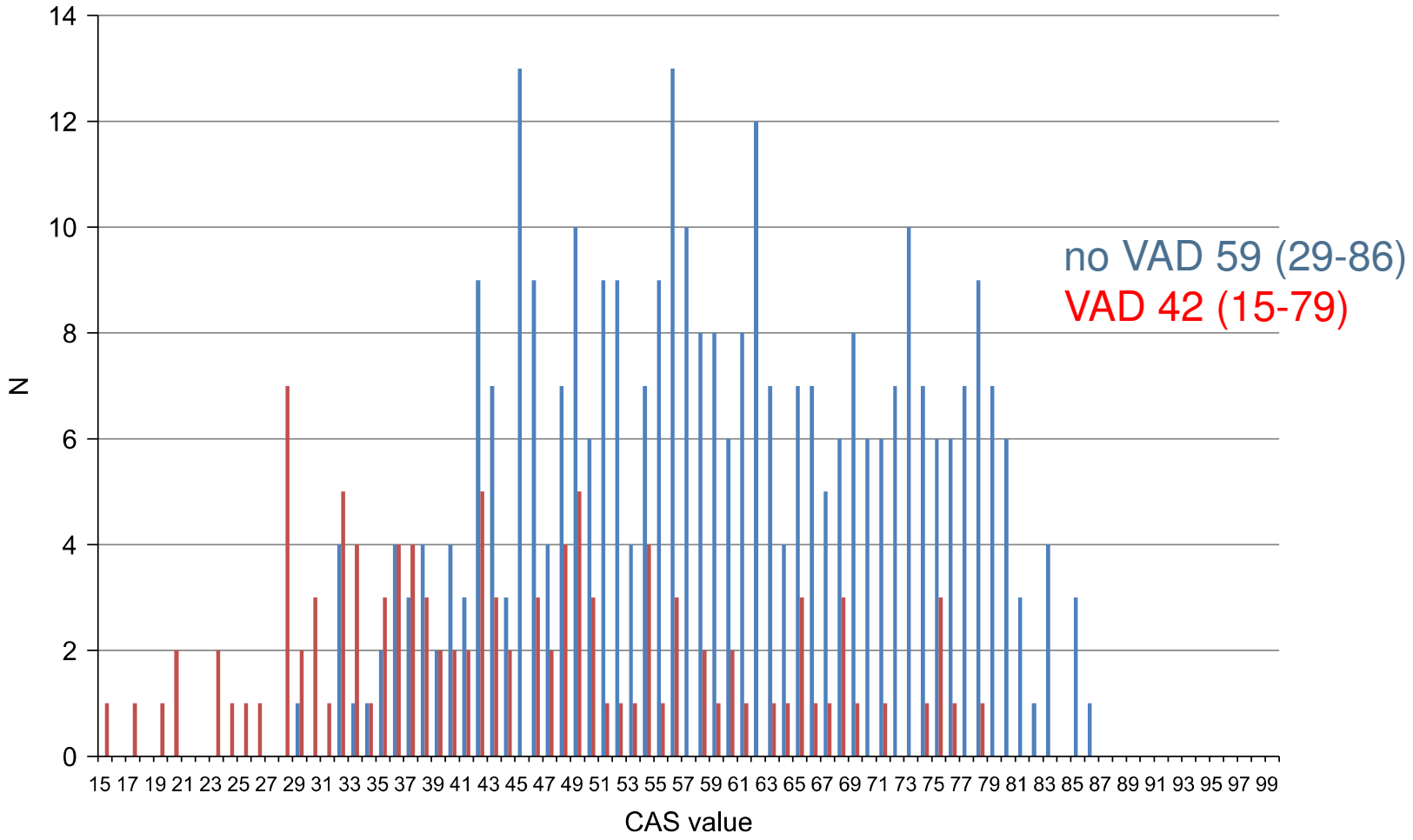
Smits et al., J Heart Lung Transplant 2013;32:873

Post-Transplant Survival by IMPACT Score



Smits et al., J Heart Lung Transplant 2013;32:873

Cardiac Allocation Score (CAS)



Smits et al., J Heart Lung Transplant 2013;32:873

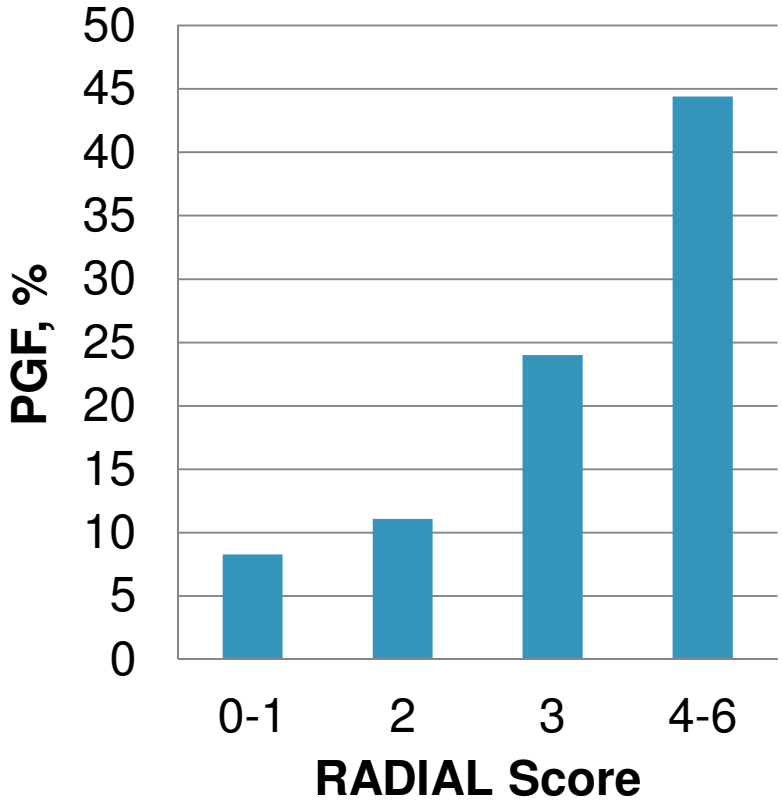
It's Not All About Survival

Other Prediction Scores for:

- Primary graft failure: RADIAL score
  - Segovia et al. JHLT 2011
- Renal failure (Kilic et al. JTCS 2014)
- Rejection (Kilic et al. Circ 2013)
- CAV (Mehra et al. JACC 1995)

Predicting Risk of Primary Graft Failure: RADIAL Score

- RA pressure ≥ 10
- Age ≥ 60
- Diabetes
- Inotrope dependence
- Donor Age ≥ 30
- Length of ischemic time ≥ 240 min



Segovia et al., J Heart Lung Transplant 2011;30:644

Summary

- "It's tough to make predictions, especially about the future"
- Recent progress in recipient, donor and recipient/donor risk scores
- Challenges remain:
  - Clinical relevance especially for VAD patients
  - Simplicity to aid clinicians in real time
  - Predicting other important outcomes
  - Predicting late (vs. early) outcomes
  - Discussing risk with patients, families and care team

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Thank you for your attention…

Michael M. Givertz, MD
(617) 525-7052
mgivertz@partners.org

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