

Understanding Advanced Heart Failure - *when patients cross the line*

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Disclosure

- No financial or commercial conflict of interest for this talk



Heart Failure Epidemic – Growing problem

- Prevalence - 6 million
- By 2030 - > 8 million
- Over 75,000 deaths per year
- #1 cause for admission among patients > 65 years
- Cost - \$32 billion (2013 estimate)
- By 2030 - \$70 billion



AHA/ACC Stages A, B C, D

A. At high risk for HF but no structural heart disease or HF symptoms.
B. Structural heart disease but no HF signs or symptoms.

C. Structural heart disease with prior or current HF symptoms.
D. Refractory HF requiring specialized interventions.

NYHA Class I, II, III, IV

I. No limitation of physical activity.
II. Slight limitation of physical activity.
III. Marked limitation of physical activity.
IV. Inability to carry on any physical activity.


Advanced HF

Intermacs Profiles
1 to 7

Adapted from Truby et al, J am Coll Cardio HF 2020; 8(7) 523-36



INTERMACS Profiles

ADULT PROFILES	Current CMS - DT Functional Indication	IV INO*	Official Shorthand	NYHA CLASS Assumed	Modifier option
INTERMACS LEVEL 1	Met	}	“Crash and burn”	IV	TCS A
INTERMACS LEVEL 2	Met		“Sliding fast” on inotropes	IV	TCS A
INTERMACS LEVEL 3	Met		“Stable” continuous inotrope dependent *	IV	TCA if hosp FF if home A
INTERMACS LEVEL 4	+ Peak $VO_2 \leq 12$	}	Resting symptoms on oral therapy at home	AMB IV	FF A
INTERMACS LEVEL 5	+ Peak $VO_2 \leq 12$		“Housebound”, Comfortable at rest, symptoms with minimum activity ADL	AMB IV	FF A
INTERMACS LEVEL 6			“Walking wounded”-ADL possible but meaningful activity limited	IIIB 	FF A
INTERMACS LEVEL 7			Advanced Class III	III	A only

* Intravenous inotropic therapy only approved for refractory Class IV symptoms

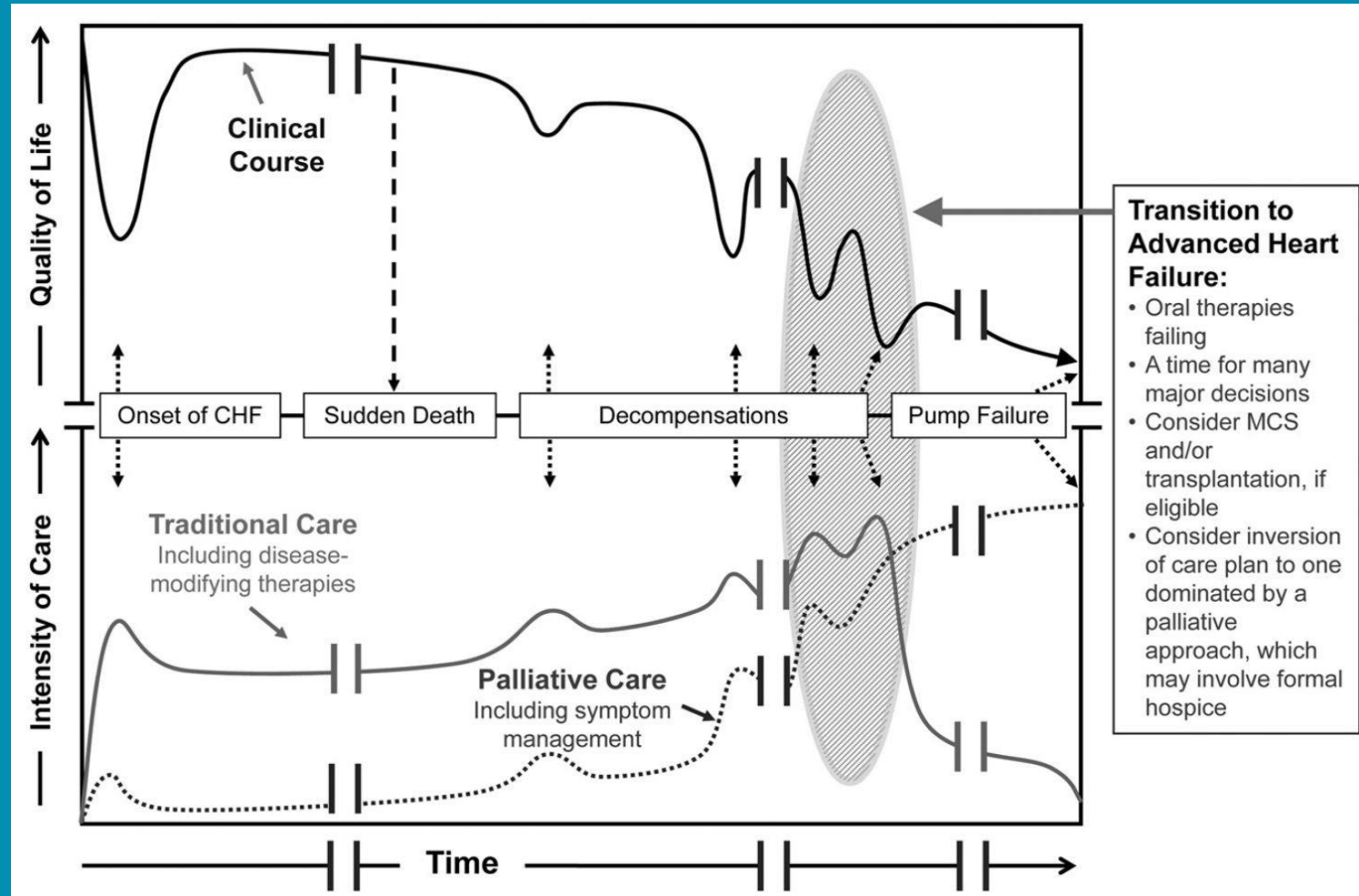
Stewart G C , and Stevenson L W Circulation 2011;123:1559-1568

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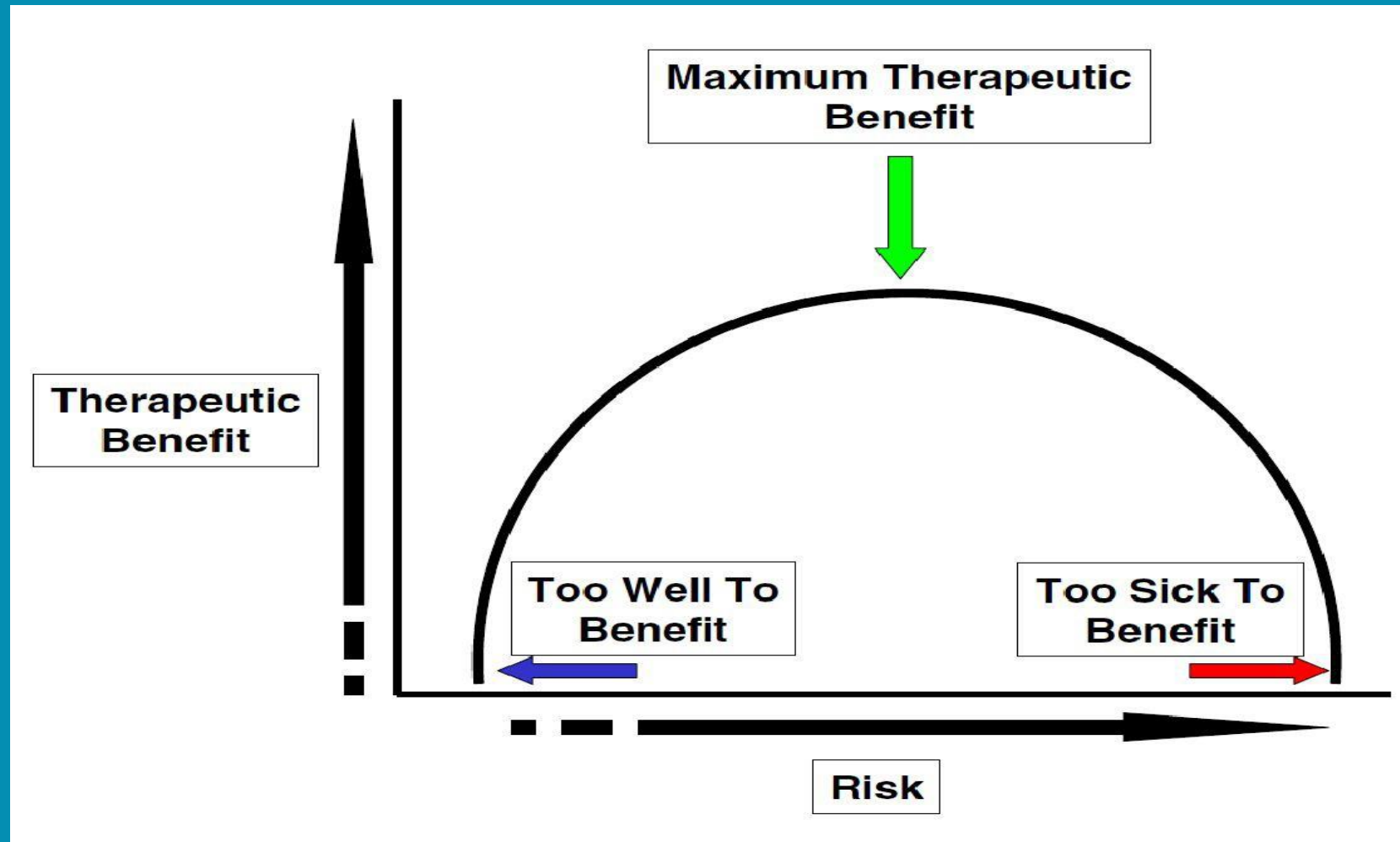


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Natural Course of Heart Failure



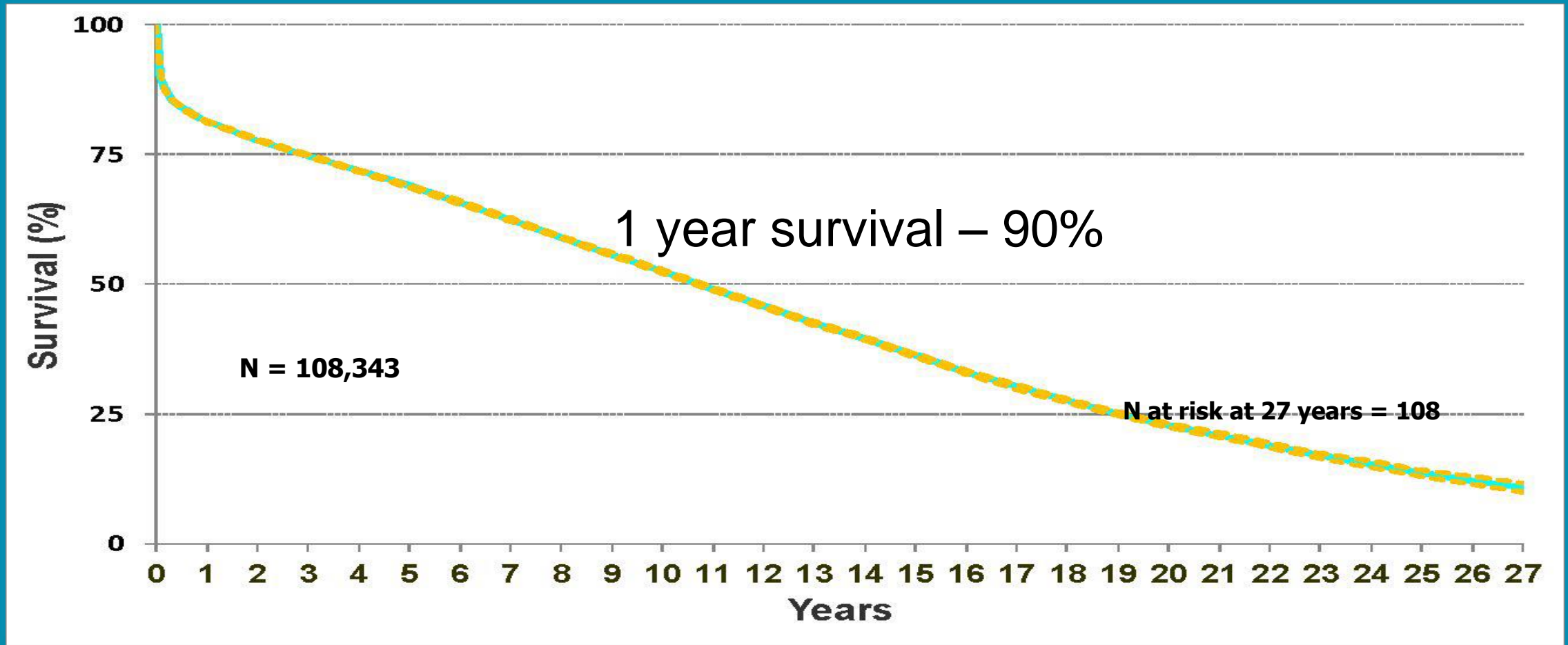
Importance of transition point



Advanced Heart Failure Therapies

- It's all about prognosis!
- Continued medical therapy
- Advanced options – Heart transplant or LVAD ?

Adult and Pediatric Heart Transplants Kaplan-Meier Survival



INTERMACS Annual Report-2020

- The Society of Thoracic Surgeons (STS)-Interagency Registry for Mechanically Assisted Circulatory Support (Intermacs) 2020 Annual Report reviewed outcomes on 25,551 patients undergoing primary isolated continuous-flow left ventricular assist device (LVAD) implantation between 2010 and 2019.
- The 1- and 2-year survival in the most recent era from 2015 to 2019 has improved compared with 2010 to 2014 (82.3% and 73.1% vs 80.5% and 69.1%, respectively; $P < .0001$)



Predicting HF Mortality

- Clinical
 - HF etiology
 - HF duration
 - History of syncope
 - Hospitalization
 - Need for inotropes
- Hemodynamic/imaging
 - PAPI
 - Cardiac index
 - LVEF/RVEF
- Arrhythmias
 - Atrial fibrillation
 - VT/VF/Shocks
- Functional capacity
 - NYHA FC
 - Peak VO₂
 - 6MWT
- Neurohormonal
 - Serum sodium
 - BUN/Crea
 - proBNP

Predicting HF Mortality

Multivariate Risk Scores

Heart Failure Survival Score (HFSS)

Seattle Heart Failure Model (SHFM)

CHARM Risk Score

CORONA Risk Score

I-PRESERVE Score (HFpEF)



Seattle Heart Failure Model Calculator

File Info

	Baseline			Intervention		
	1 Year	2 Year	5 Year	1 Year	2 Year	5 Year
Survival	80%	64%	33%	94%	88%	74%
Mortality	20%	36%	67%	6%	12%	26%
Mean life expectancy	4.1	years		9.4	years	

Clinical **Medications** **Diuretics** **Lab Data**

Age: 65 ACE-I Furosemide: 80 Hgb (g/dL): 14 **Devices**

Gender: Male Beta-blocker Bumetanide: 0 Lymphocyte %: 25 None

NYHA Class: 3A ARB Torsemide: 0 Uric Acid (mg/dL): 8 BIV Pacer

Weight (kg): 80 Statin Metolazone: 0 Total Chol (mg/dL): 190 ICD

EF: 30 Allopurinol HCTZ: 0 Sodium: 137 BIV ICD

Syst BP: 120 Aldosterone blocker QRS > 120 msec

Ischemic

Interventions **Devices**

ACE-I ARB Beta-blocker None

Statin Aldosterone blocker BIV Pacer BIV ICD

ICD LVAD

Note: Some devices may be disabled if CMS clinical criteria are not met

Copyright 2004-2007 Wayne Levy and David Linker



Predicting HF Outcomes

Multivariate Risk Scores

- Cumbersome, not practical
- Hard to memorize
- Uses variables that require additional testing
- Overestimates survival in real-world practice

Predicting HF Outcomes

- Simple clinical markers
- Predictive of outcome during next year
- When any are present, should warrant consideration of advance therapies



ACC/AHA Guidelines 2013: Identifying patients with Advanced HF

- Repeated (≥ 2) hospitalizations or ED visits in past year
- Progressive decline in renal function
- Declining serum sodium < 133
- Weight loss without other cause
- Intolerance to ACEI
- Intolerance to beta-blockers
- Inability to walk 1 block
- Dyspnea with dressing or bathing
- Escalating doses of diuretics (furosemide > 160 mg/d) and/or use of metolazone
- SBP < 90
- Frequent AICD shocks



I-NEED-HELP from Baumwol-2017

- I =inotropes;
- N=NYHA class
- E=end-organ dysfunction (renal, liver);
- E=LVEF $\leq 25\%$
- D=defibrillator shock;
- H=at least 1 HF hospitalization in the prior 12 months
- E=edema, escalating diuretics;
- L=low blood pressure
- P=prognostic medications (inability to increase or need to decrease GDMT)

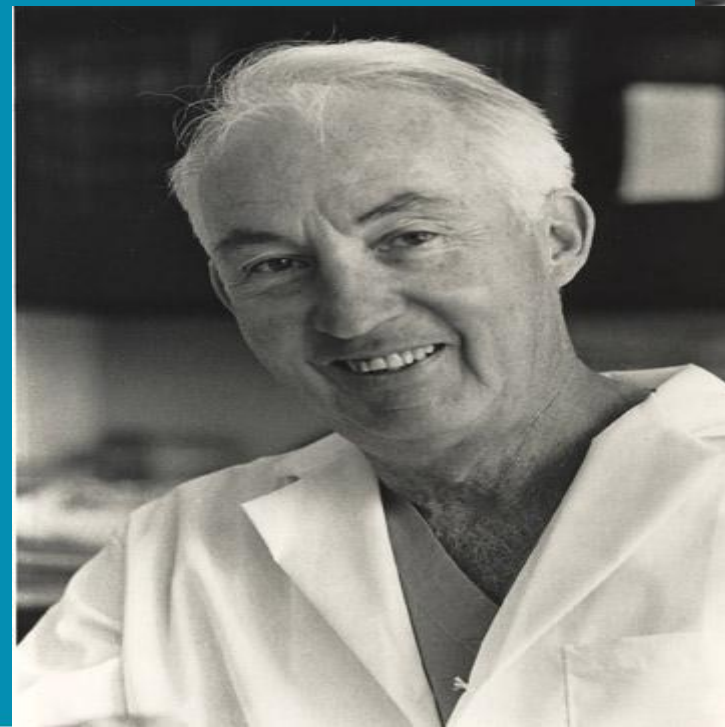


Advanced Heart Failure Therapies



Heart Transplantation

- Christiaan Barnard – December 3, 1967
- Norman Shumway – January 6, 1968
- Worldwide attention
- Gift of life

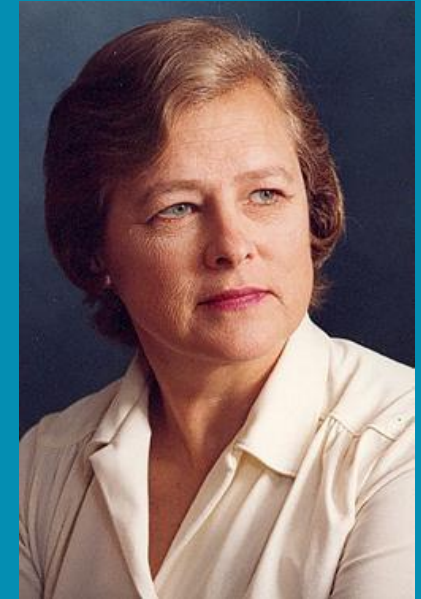




- Great initial enthusiasm - >100 transplants done in 1968
- Poor survival
- 1969 – 17 transplants

Resurgence of Cardiac Transplantation

- 1970's – Introduction of Caves' biotome
- 1970's – Billingham develops system for reading biopsy specimens
- 1980's – Cyclosporine introduced
- 1990's – Tacrolimus and MMF
- Outcomes now better-15 years
- 139 transplant centers in US

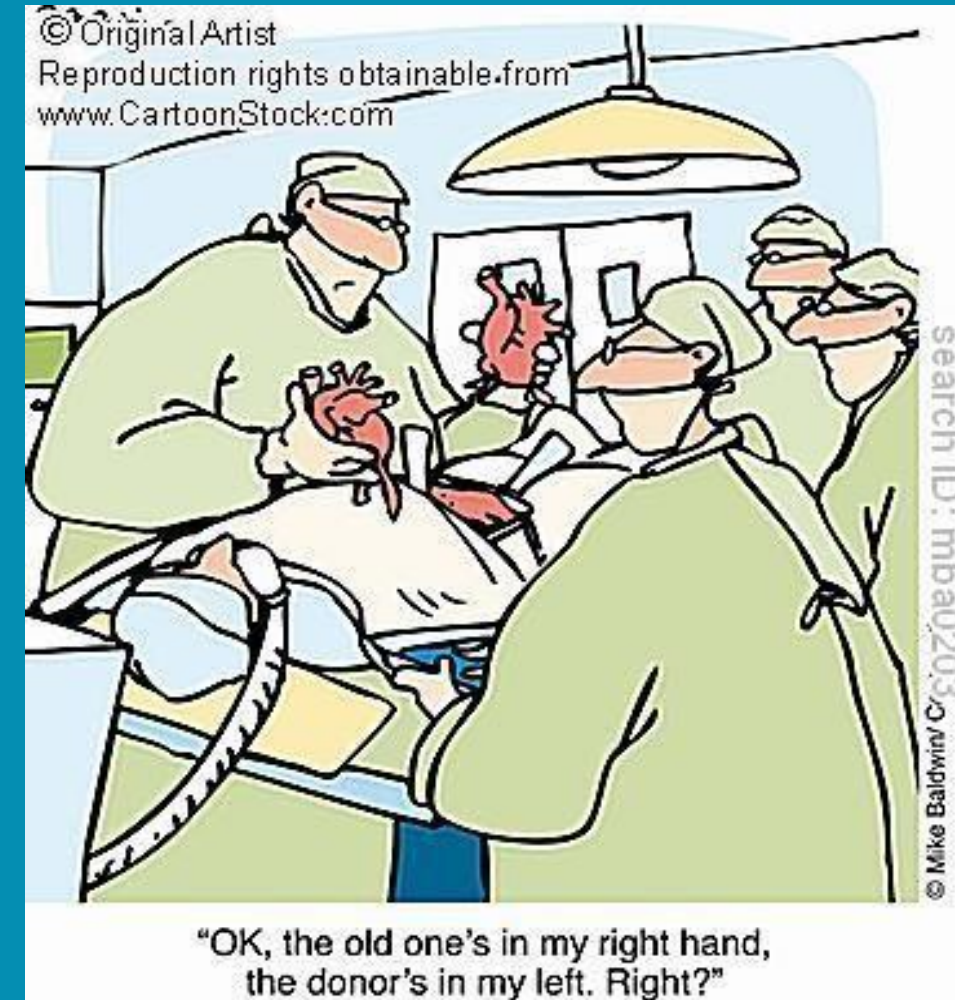


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Heart Transplantation

Ongoing Challenges

- Short-term Complications
 - Primary graft failure/RV failure
 - Infections
 - Rejections
- Long-term Complications
 - Renal failure
 - Malignancy
 - Cardiac allograft vasculopathy



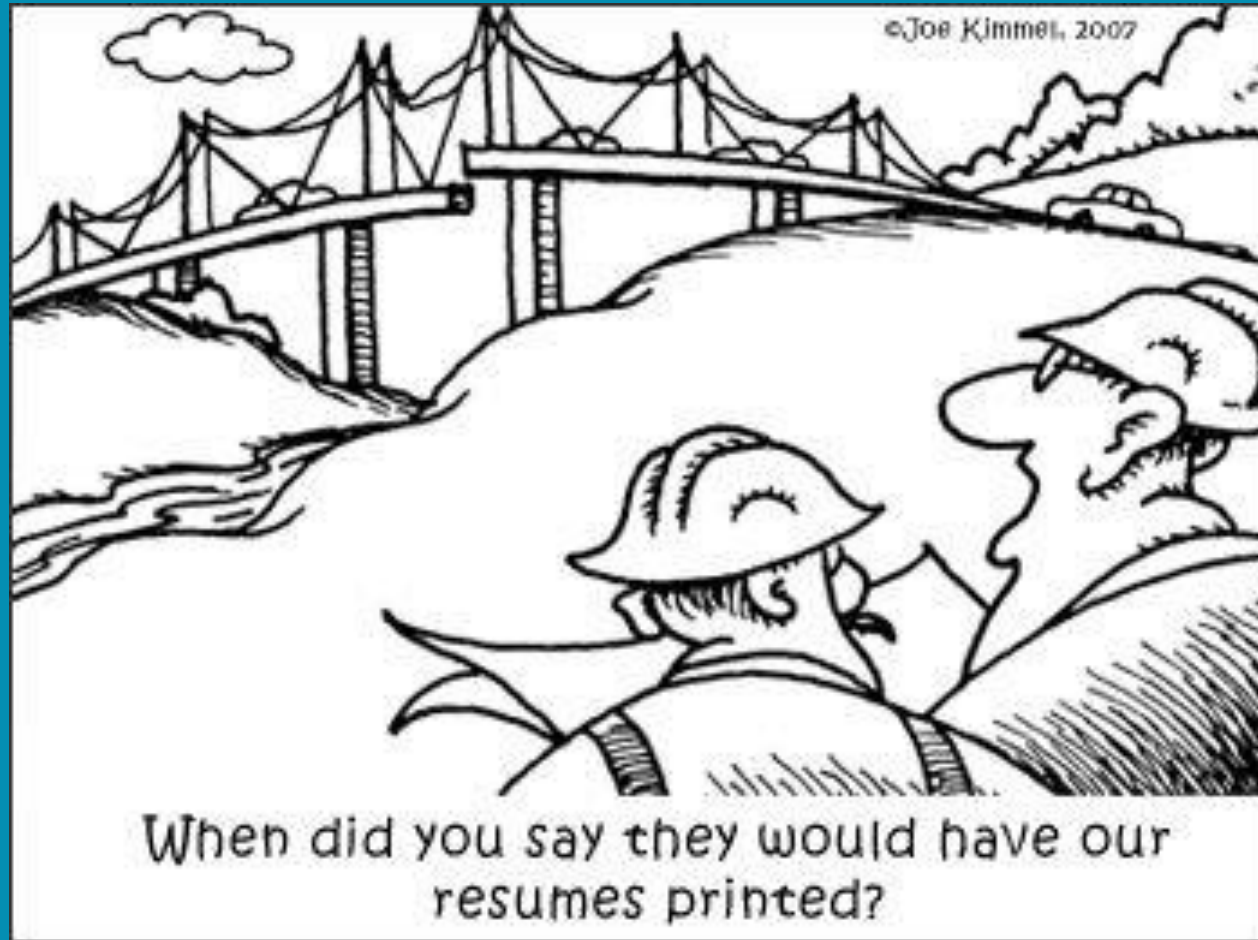
Heart Transplantation

Limitations

- Age cut-off
- Irreversible PH
- Recent malignancies
- Multi-organ failure
- But real limitation – DONORS
- HEPc and DCD donors
- Approx 6000 transplants



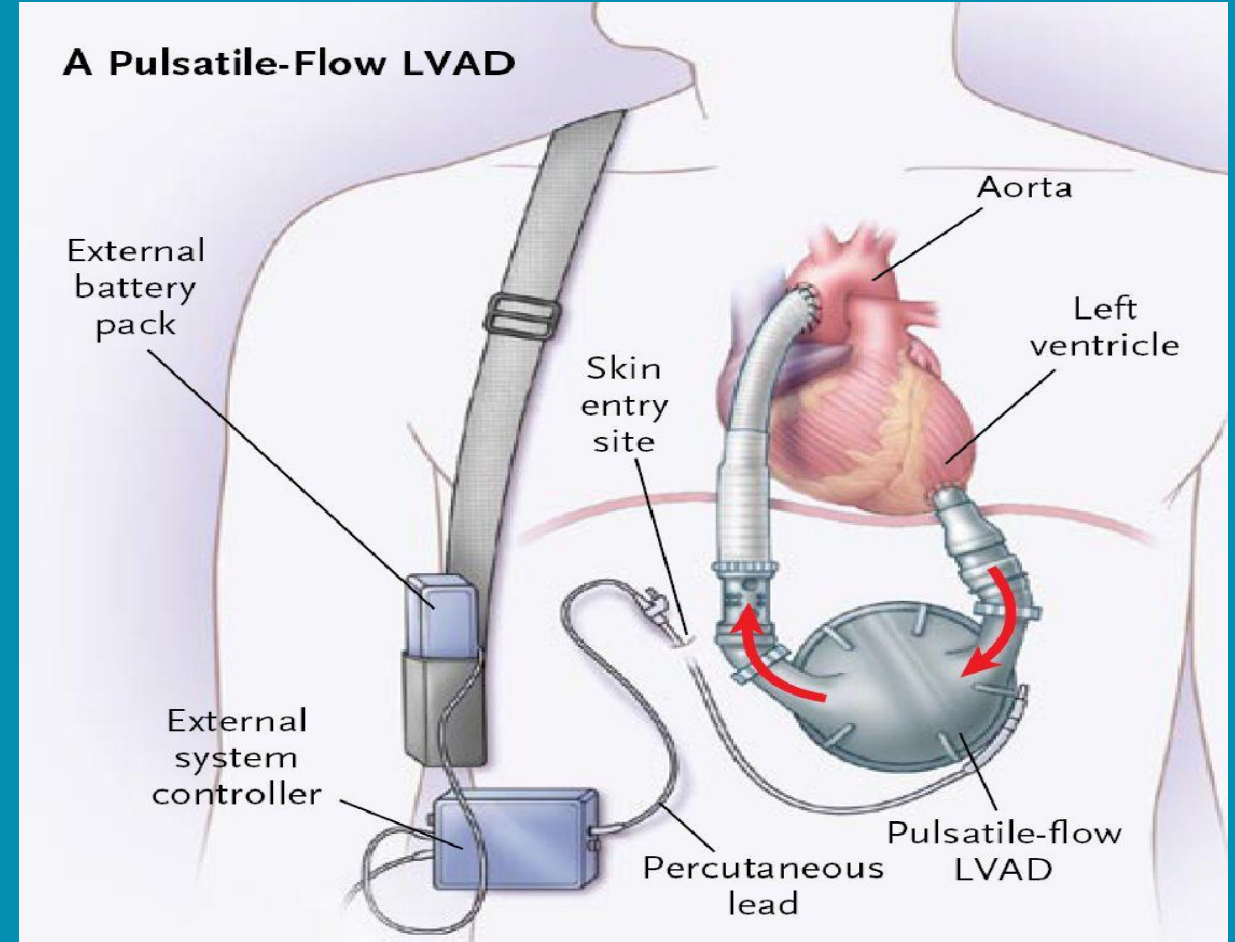
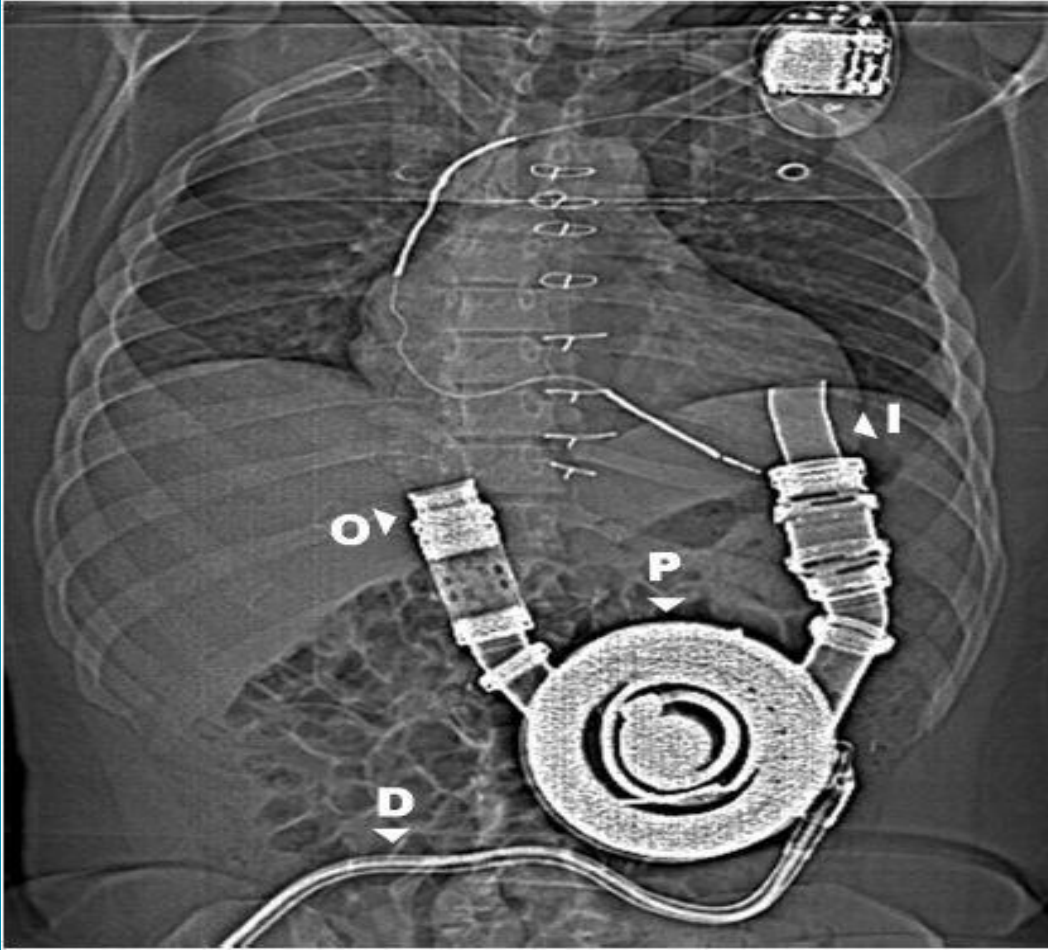
How do we bridge the gap?

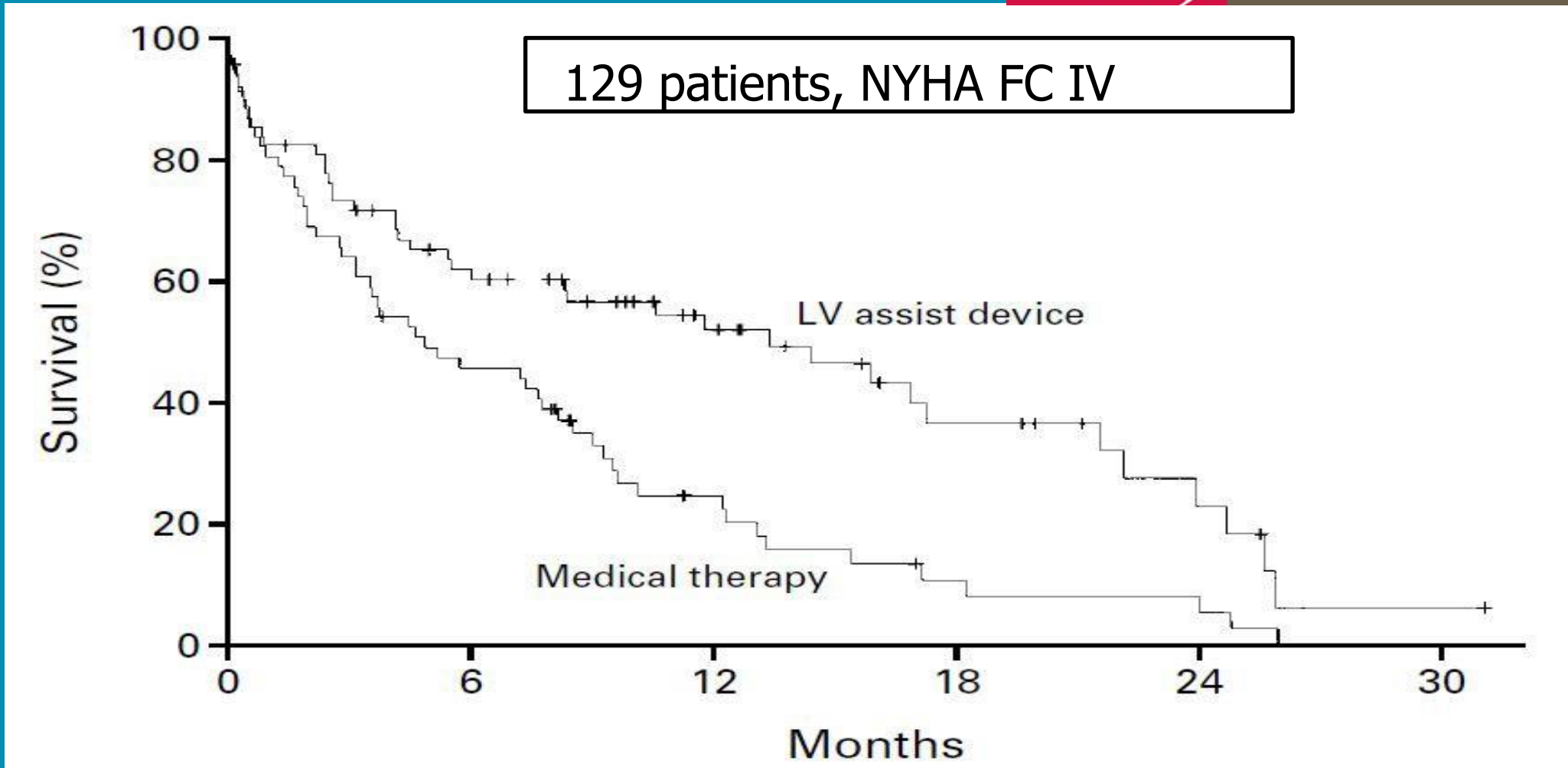


Left Ventricular Assist Devices: Rise of the Machines



LVAD Evolution: The Beginning REMATCH Trial 2001





Survival

OMM

LVAD

1 year

25%

52%

2 years

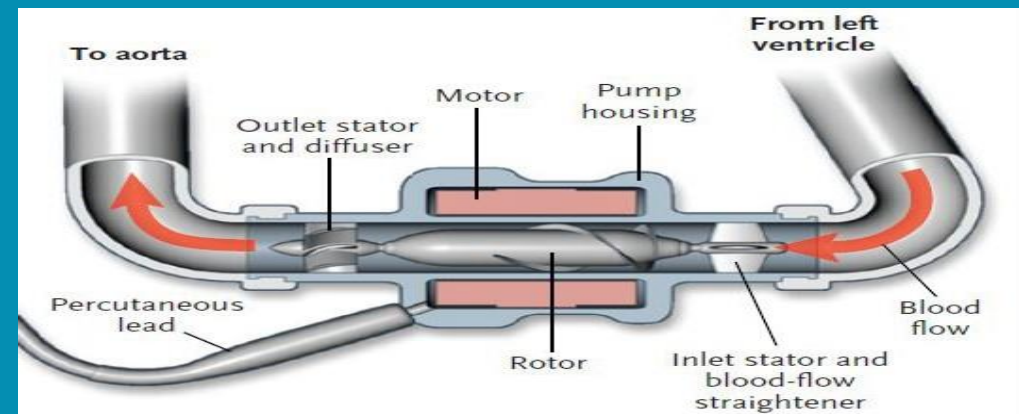
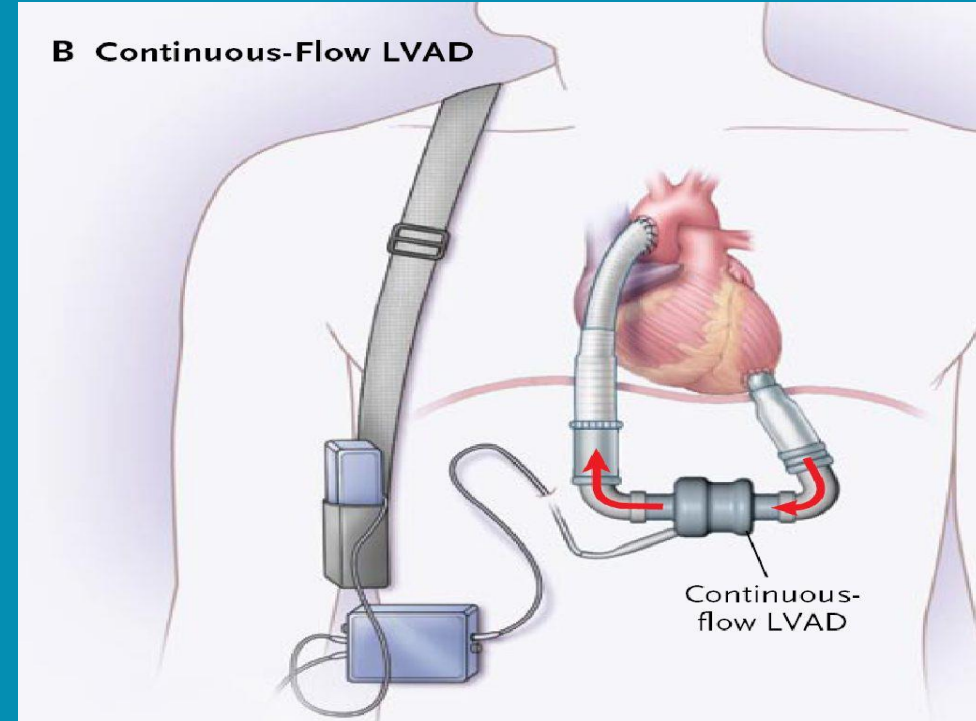
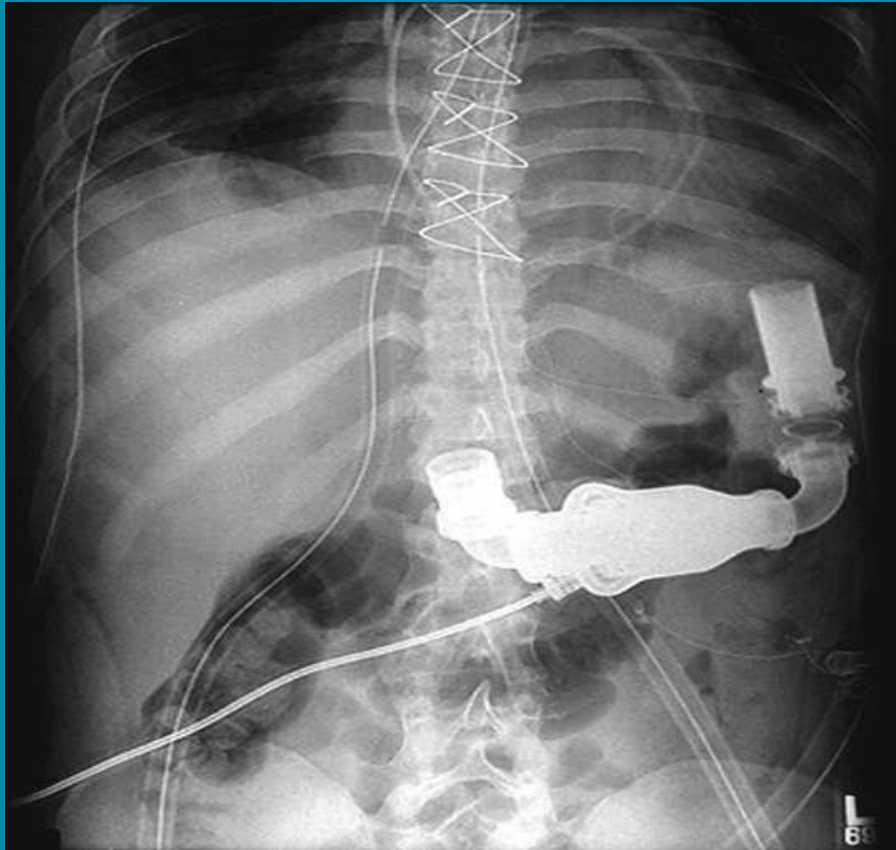
8%

23%

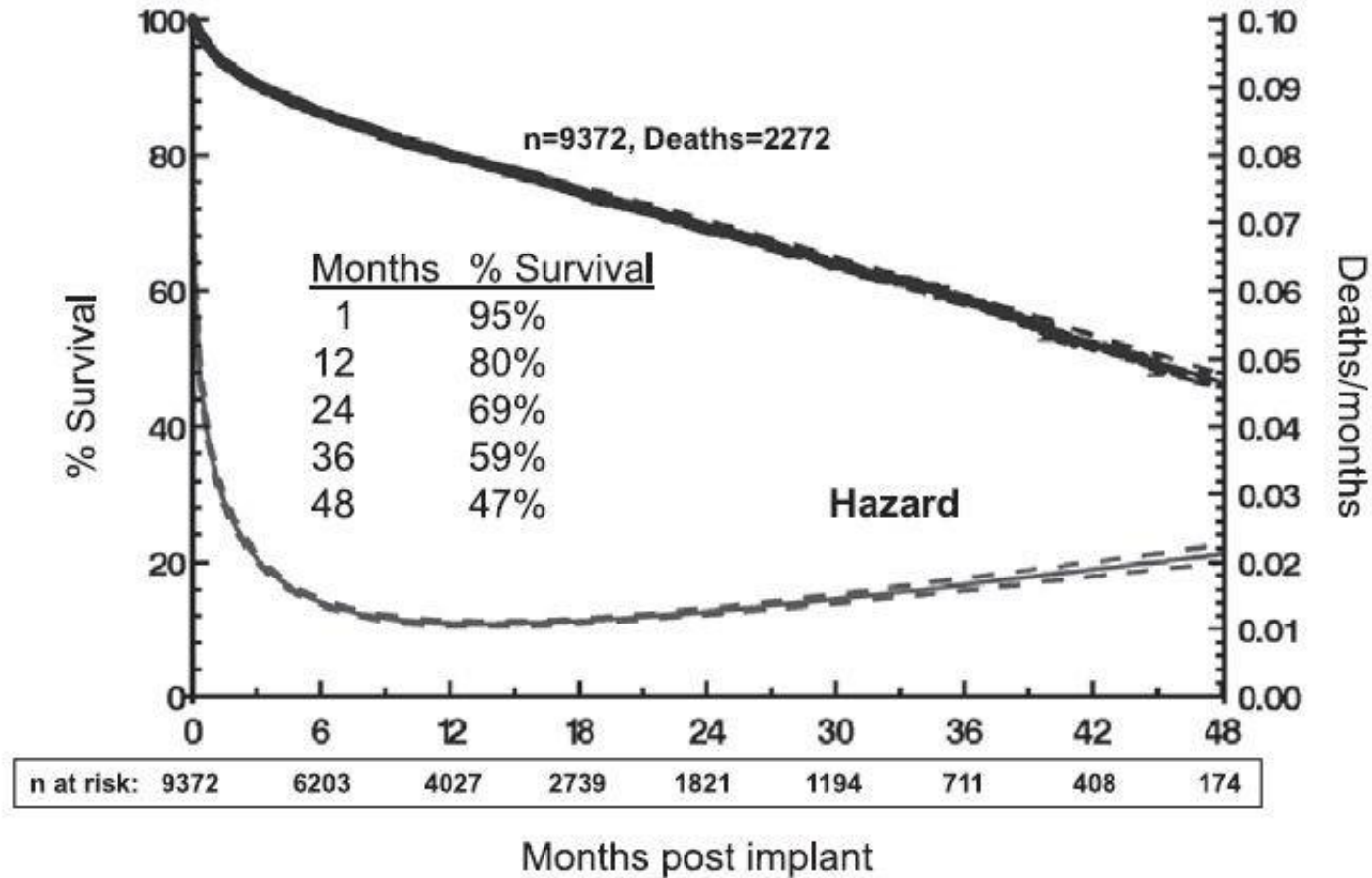


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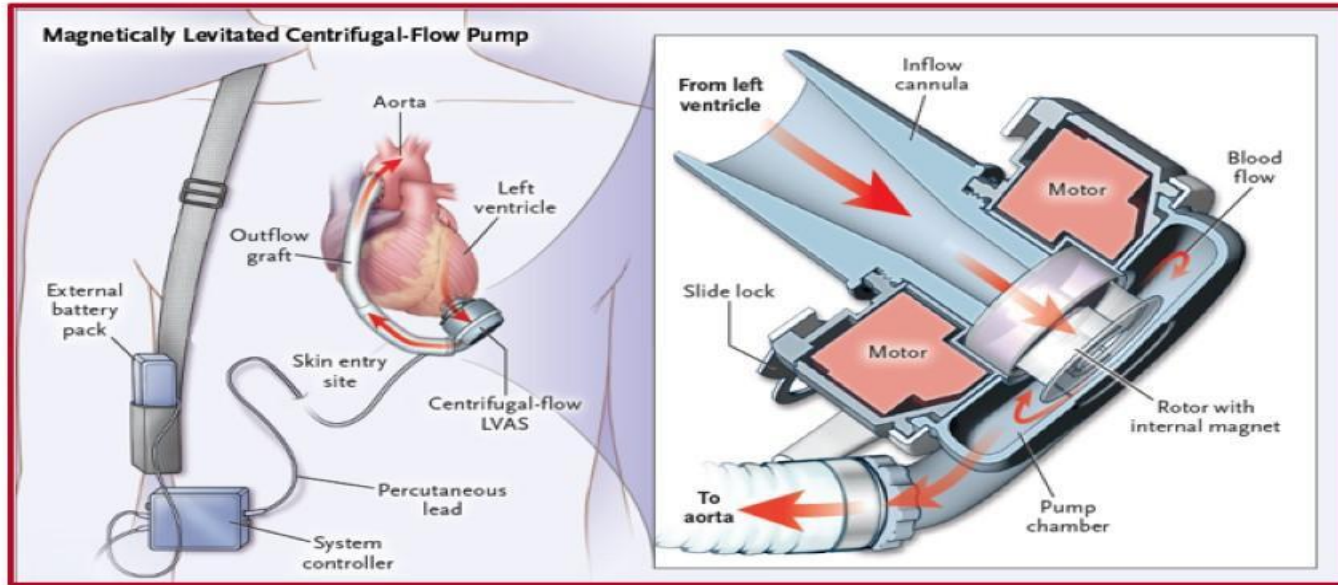
The Next Generation: Heart Mate II



Interm@cs **Continuous Flow LVAD/BiVAD Implants: 2008 – 2013, n = 9**



HeartMate 3 Left Ventricular Assist System: MOMENTUM 3 Trial



- **Wide** blood-flow passages to reduce shear stress
- **Frictionless** with absence of mechanical bearings
- **Intrinsic Pulse** designed to reduce stasis and avert thrombosis

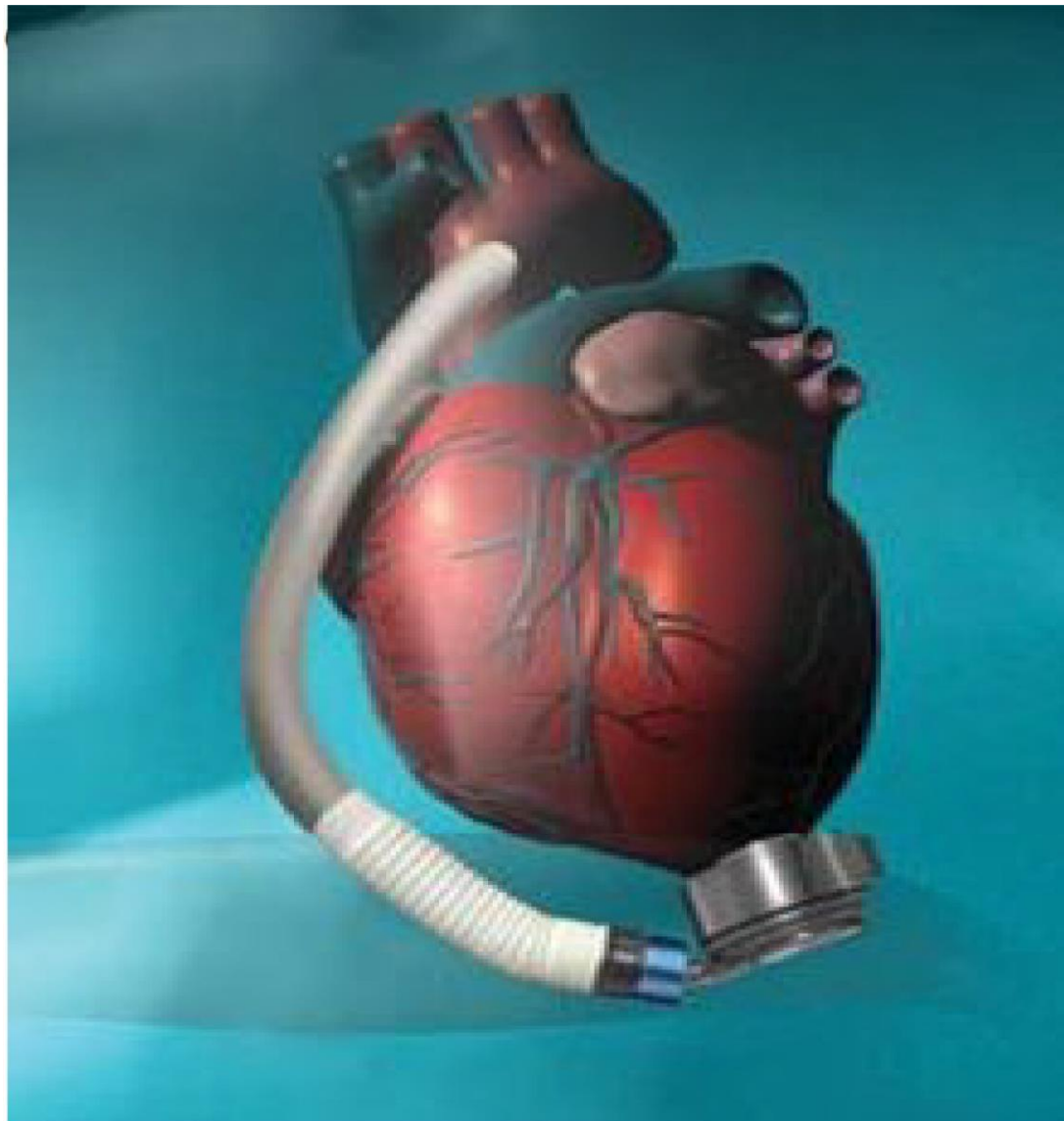
Mehra MR et al. Two-Year Outcomes with a Magnetically Levitated Cardiac Pump in Heart Failure. *N Engl J Med.* 2018;378(15):1386-1395.
Mehra MR et al. A Fully Magnetically Levitated Left Ventricular Assist Device - Final Report. *N Engl J Med.* 2019 Apr 25;380(17):1618-1627.

MOMENTUM 3

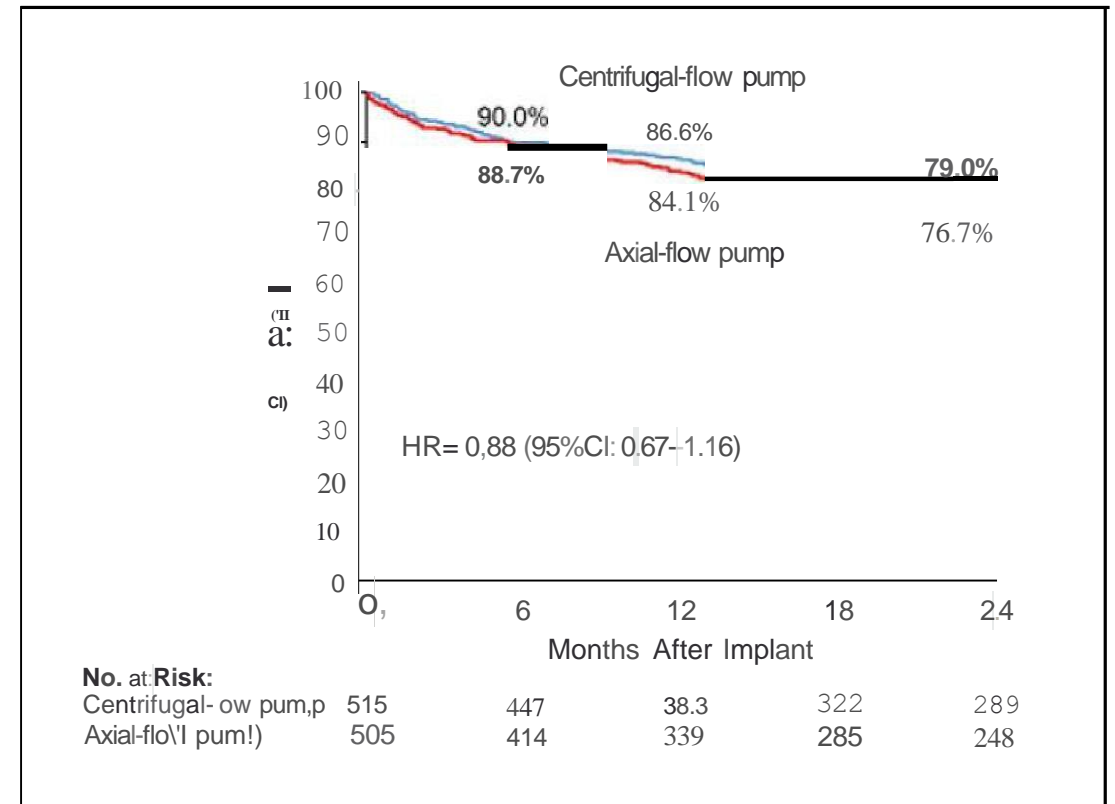


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Main Outcomes of MOMENTUM 3 at 2 Years

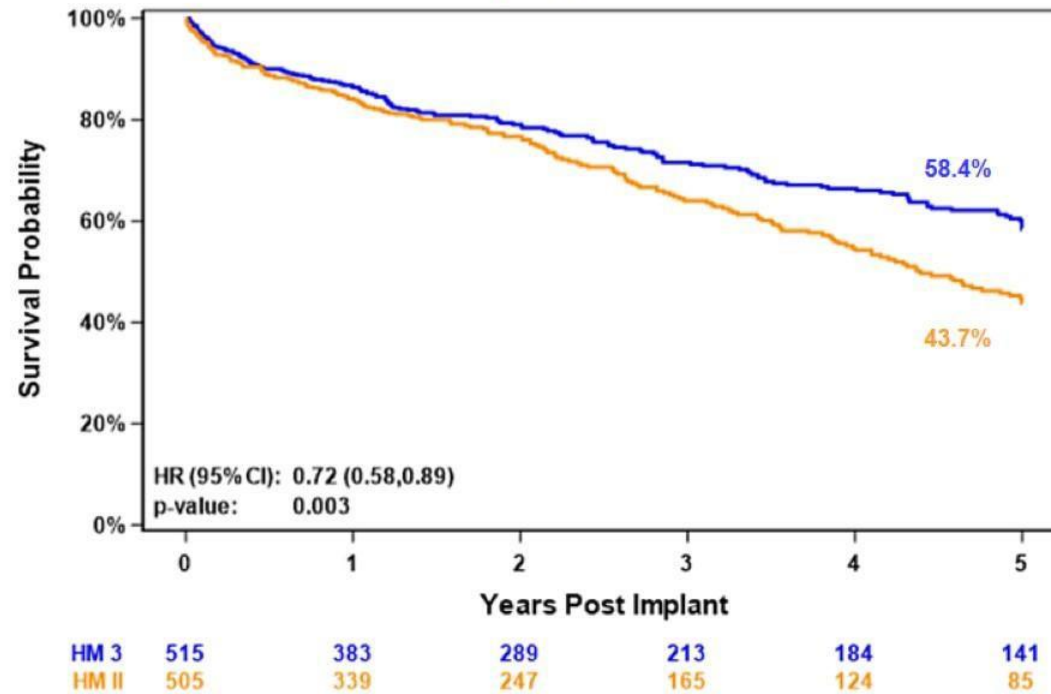


**Overall Survival
(per protocol population)**



Overall Survival

A) All Patients



Hazard ratio presented for HM3 vs HMII and p-value from Cox regression. CI, confidence intervals; HM3, HeartMate 3; HMII, HeartMate II; HR, hazard ratio

MOMENTUM 3



Left Ventricular Assist Devices

- Getting better with every generation
- Still with limitations
 - Requires good RV function
 - Need for chronic anticoagulation
 - Needs driveline care, batteries, cables
 - Can't get device wet
 - Complications
 - Driveline infections
 - Bleeding
 - Strokes/device thrombosis



Future Direction of LVADs

- Smaller devices, lighter controllers/batteries
- VADs for biventricular support
- Compatible blood-device interface – eliminate anticoagulation
- Totally implantable device – eliminate driveline

Chronic Inotropic Therapy

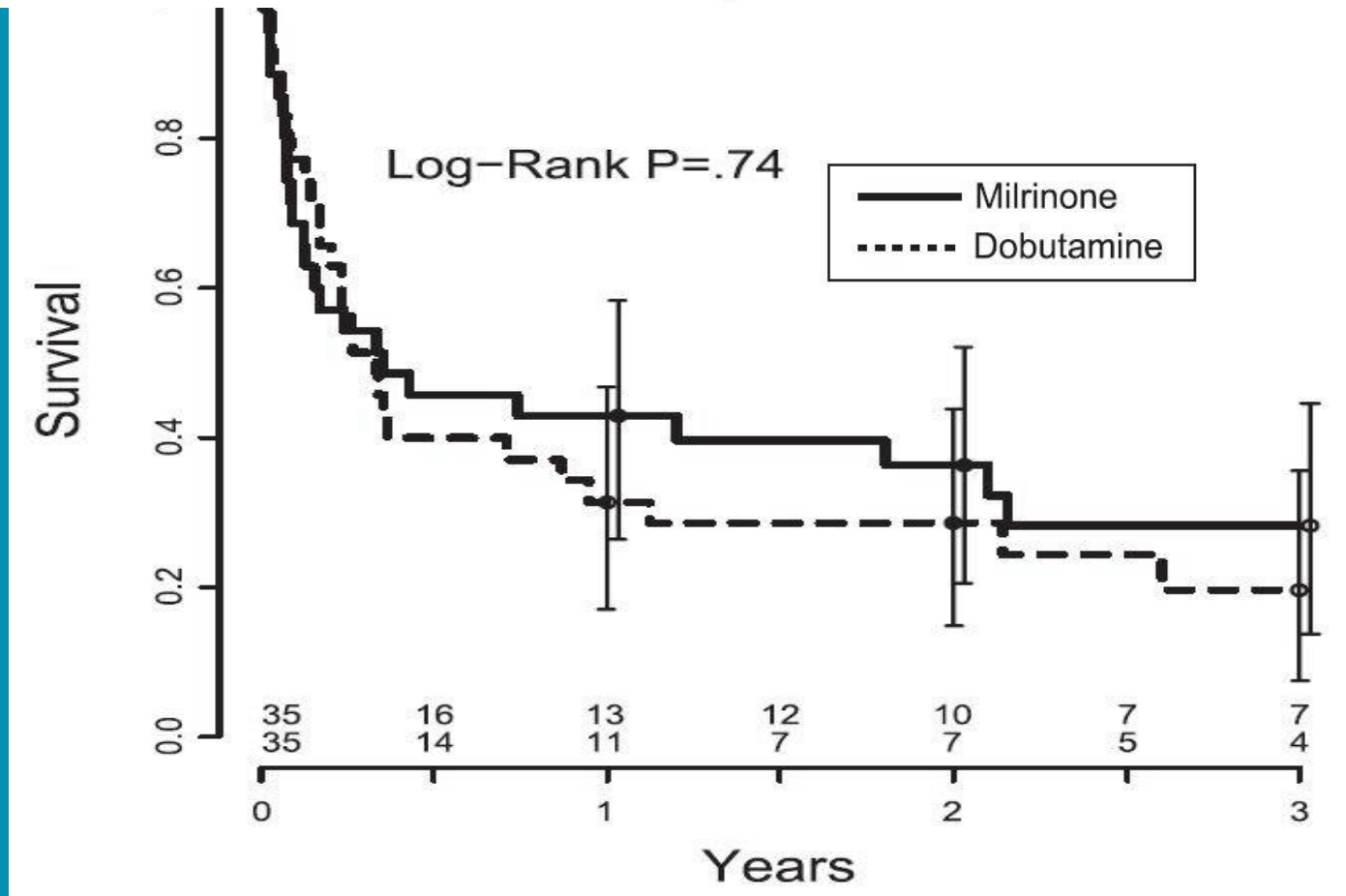
- Milrinone and Dobutamine - comparable
- Last resort – if not candidate for transplant or LVAD
- Poor 1 year survival
- Symptomatic care - palliation

Chronic Inotropic Therapy

Prognosis on Chronic Dobutamine or Milrinone Infusions for Stage D Heart Failure

Eiran Z. Gorodeski, MD, MPH; Eric C. Chu, BS; Jennifer R. Reese, BSN, RN;
Mehdi H. Shishehbor, DO, MPH; Eileen Hsich, MD; Randall C. Starling, MD, MPH

and Cohort



SUMMARY

- HF is a progressive disease
- Identify advanced HF pts before it's too late
- Use clinical markers to assess prognosis
- If has ≥ 1 clinical marker \square refer for advanced therapies
- Transplant or LVAD (palliative inotropes?)
- Timing of referral is key
- Early is better – get to know patient

LIFE ON EARTH

by Ham



The Future?

Thank you!