

# Management of Advanced Heart Failure

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Heart Failure/LVAD/Cardiac Transplantation

Dallas Cardiovascular Innovations 2015

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No relevant disclosures



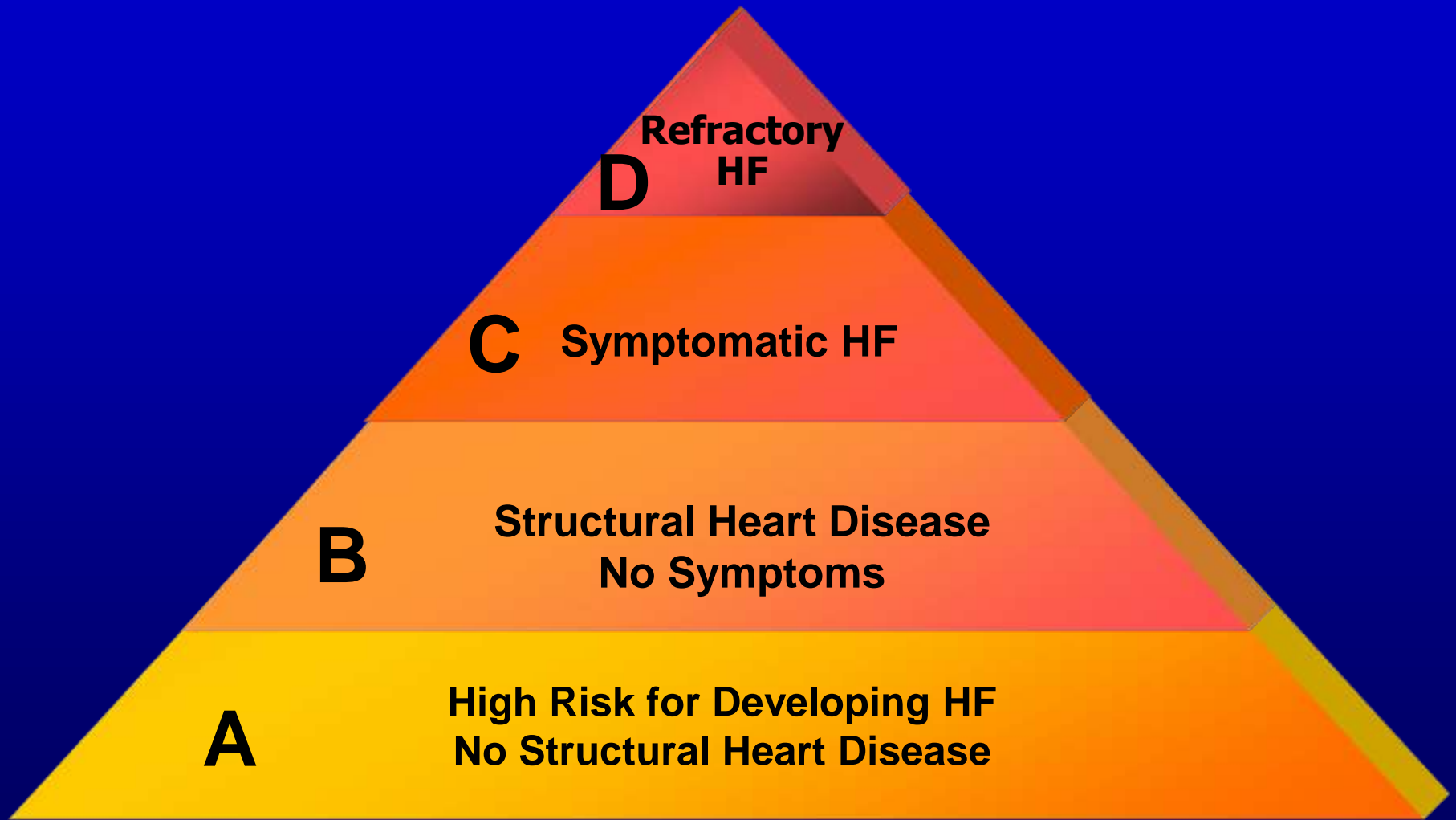
# Outline

- Advanced Heart Failure
  - Identification (simple clinical clues)
  - Treatment (LVAD/Heart Transplantation)

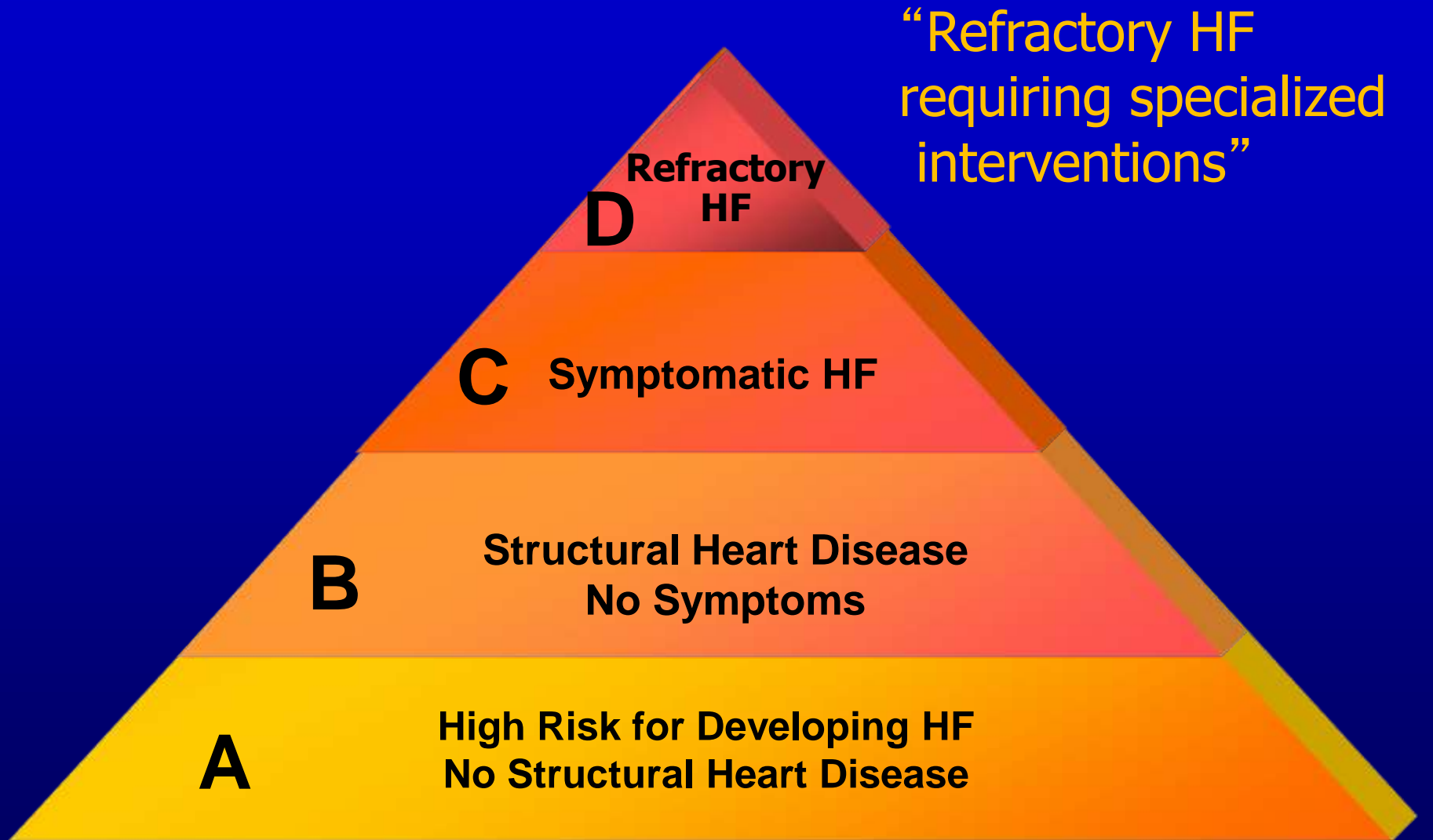
# Defining Advanced HF

- Lack of standard definition
- Various names
  - Advanced HF
  - End-stage HF
  - Refractory HF
  - Stage D HF

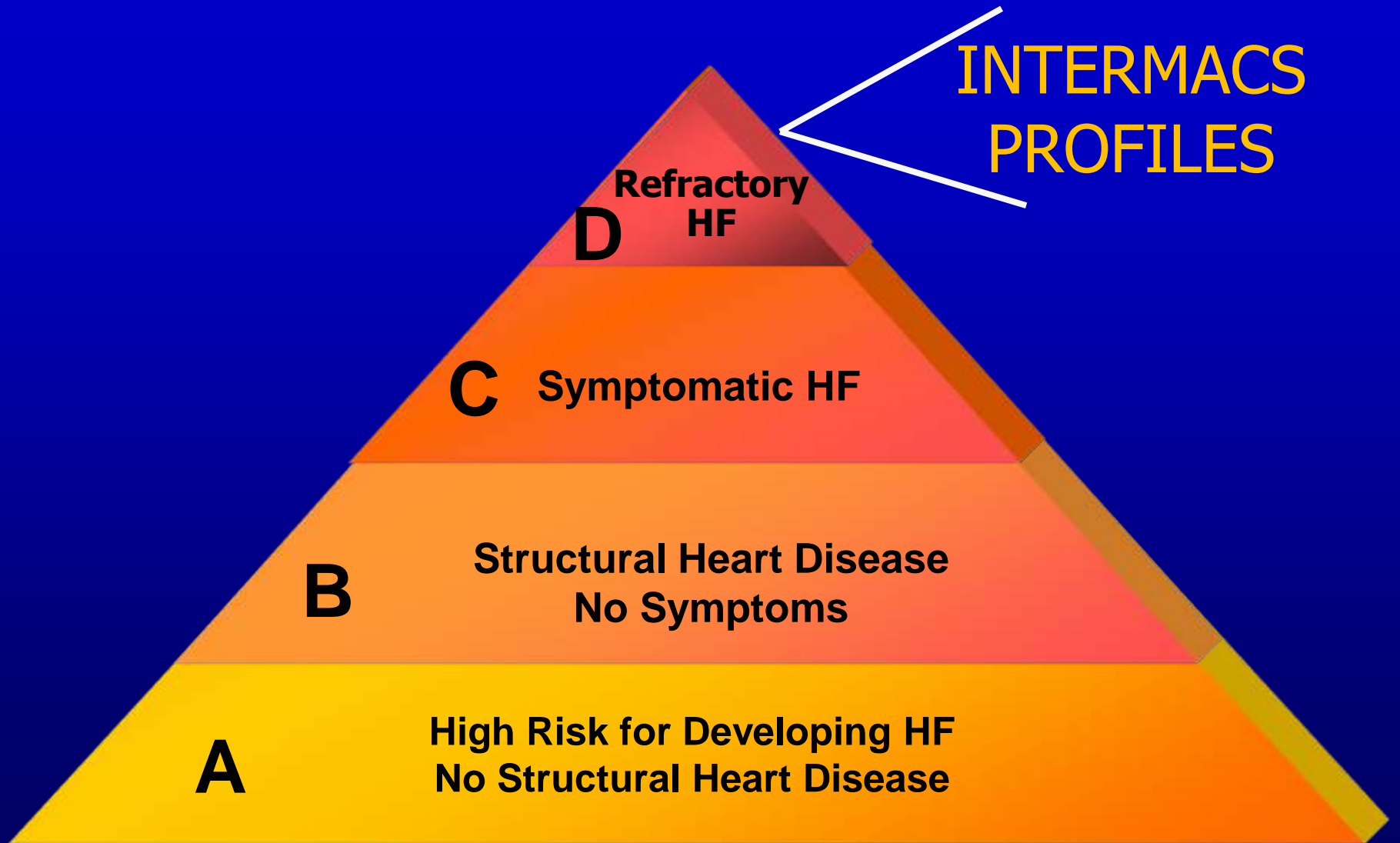
# AHA/ACC Stages of Heart Failure



# AHA/ACC Stages of Heart Failure



# INTERMACS: Refining the Classification of Stage D HF



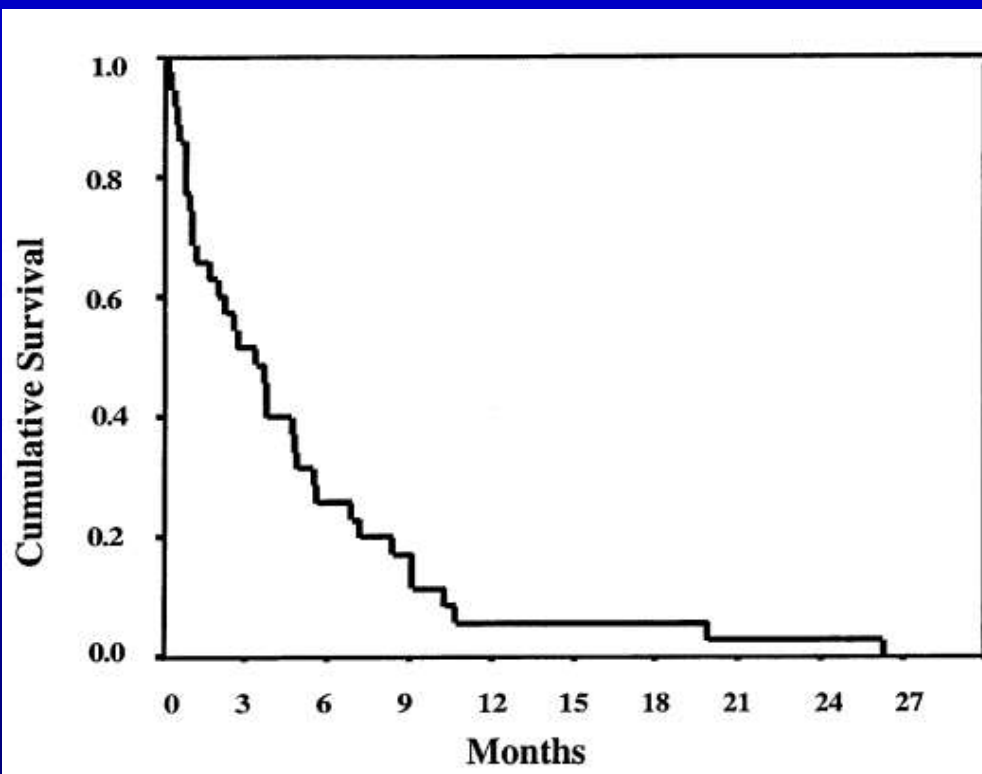
# INTERMACS Profiles

<b>Level</b>	<b>Key feature of level</b>	<b>Descriptive label</b>
1	Critical cardiogenic shock	“Crash and burn”
2	Progressive decline	Inotropes, sliding
3	Stable but inotropic dependent	Inotropes, stable
4	Resting symptoms	Rest symptoms
5	Exertion intolerant	Housebound
6	Exertion limited (fatigue within minutes)	“Walking wounded”
7	Advanced NYHA III	

# How to Identify a Patient with Advanced Heart Failure



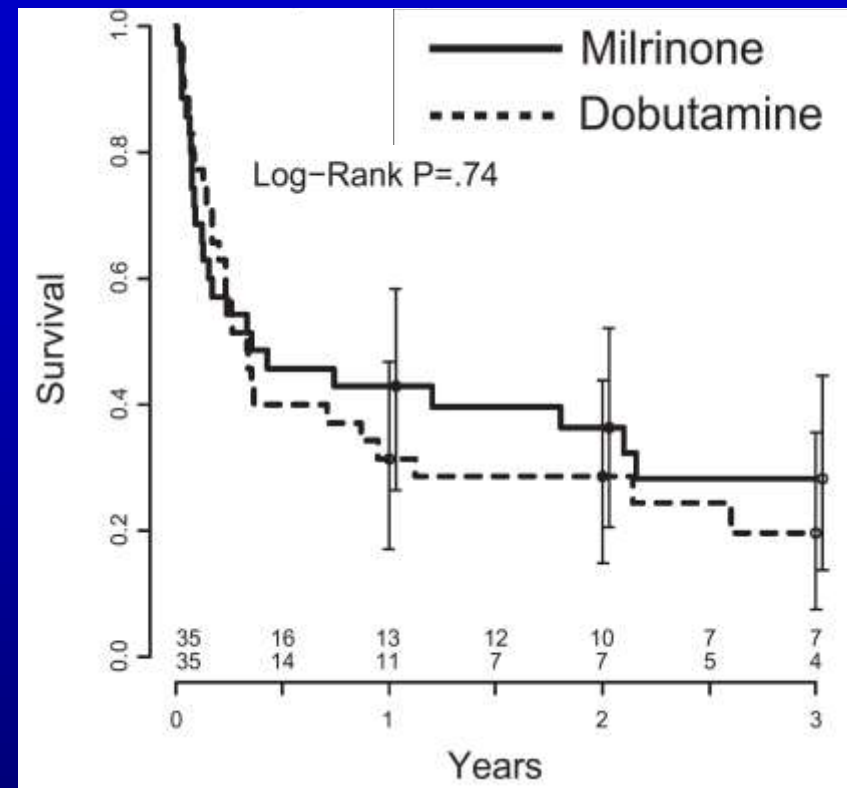
# Chronic Parenteral Inotrope Use Is Associated with Very Poor Outcome



N=36

Oregon Health and Science University

Hershberger, J Cardiac Failure, 2003



Propensity matched

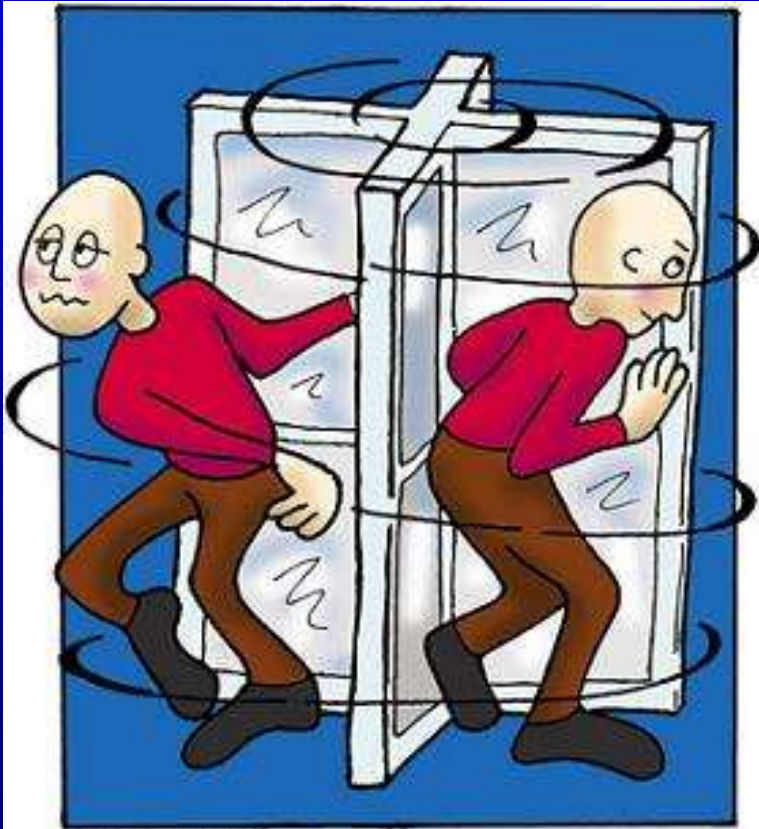
N=112; Cleveland Clinic

Gorodeski, Circ HF, 2009

# Simple Clinical Clues to Identify Advanced Heart Failure

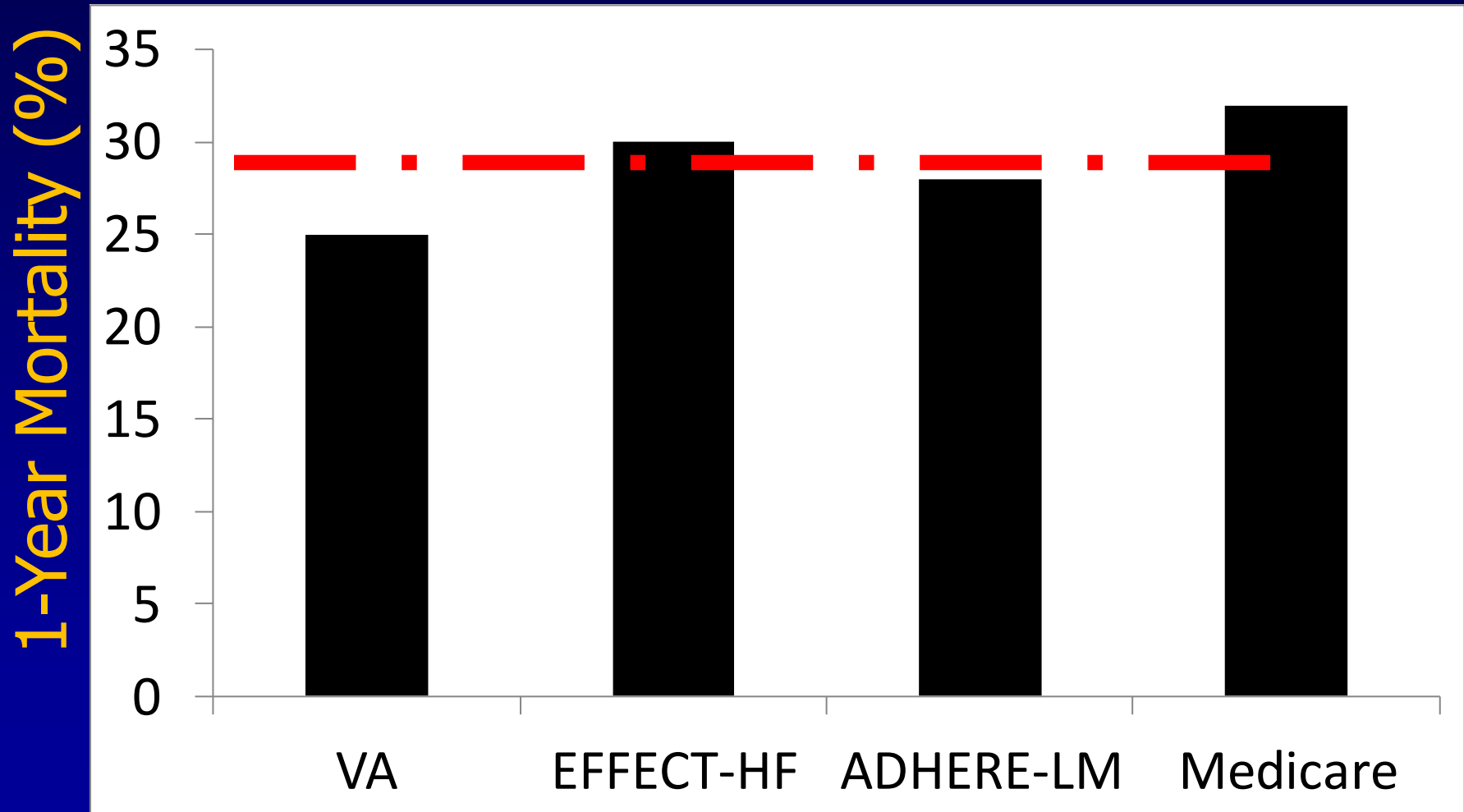
- Rehospitalization for CHF
- Unable to tolerate ACE-I or BBL
- High doses of diuretic
- Bad news from EP
- Labile renal function
- Unintentional weight loss

# Heart Failure Rehospitalizations

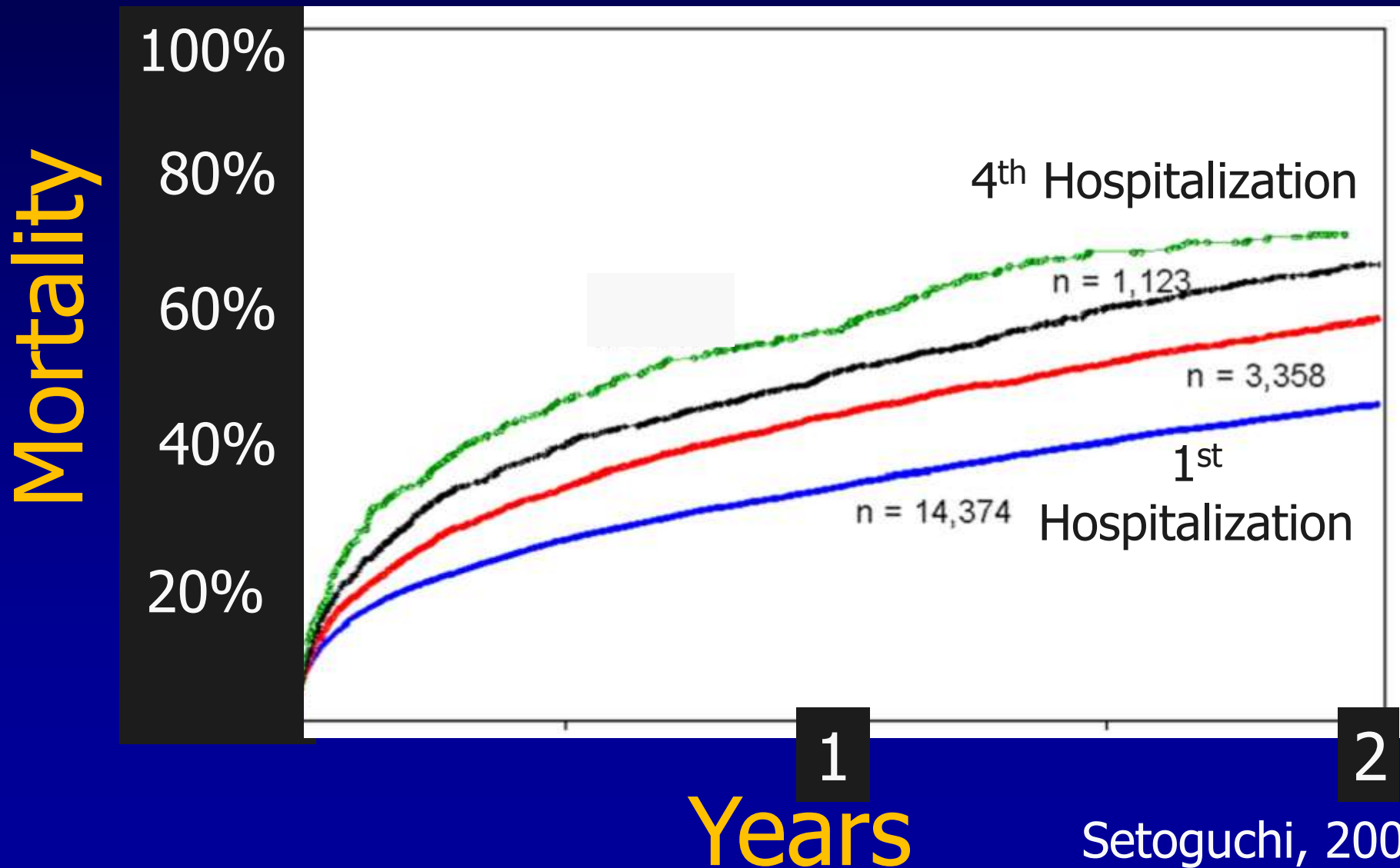


20-25% at 30 days  
~50% at 6 months

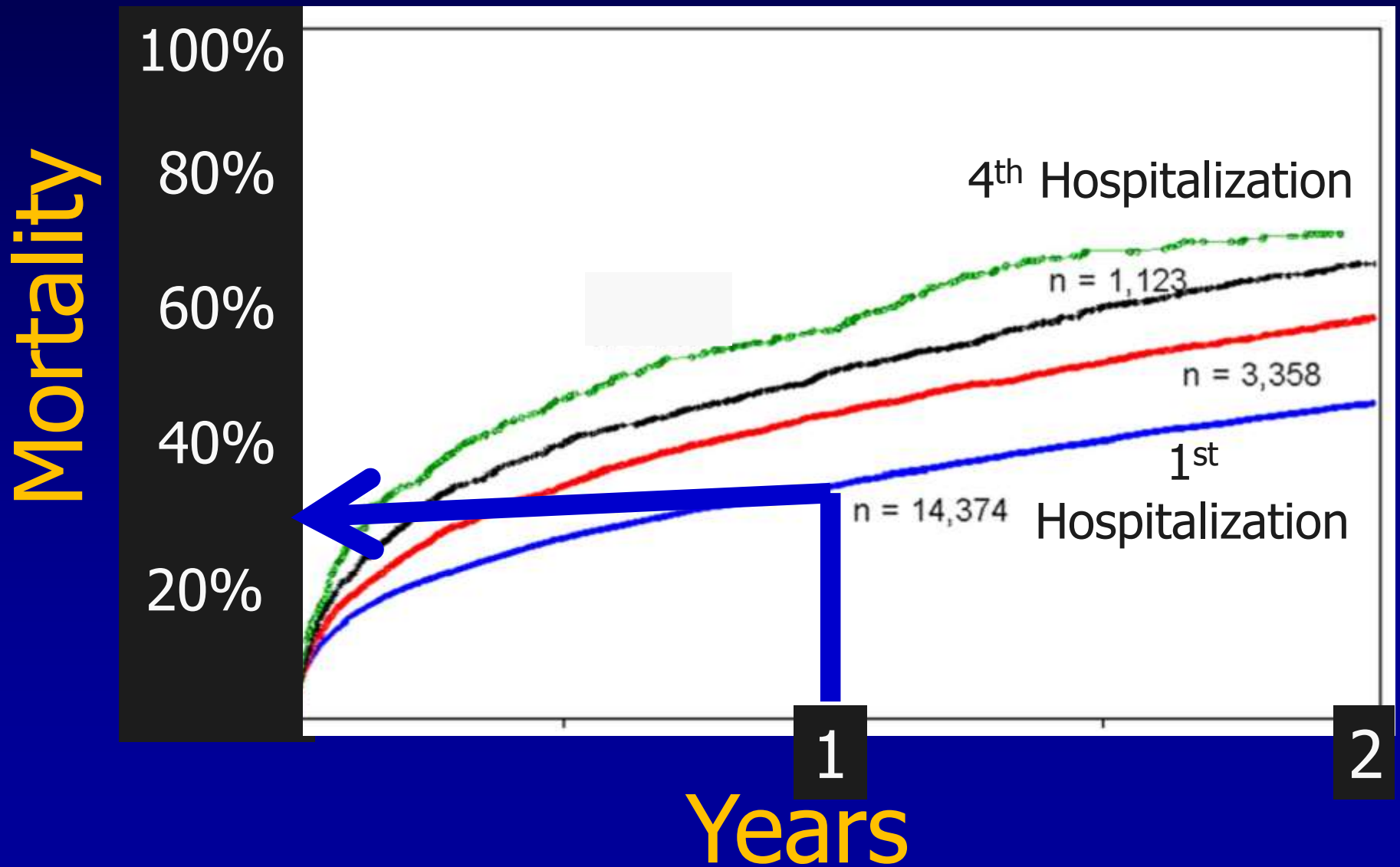
# 1-Year Mortality After Index HF Hospitalization



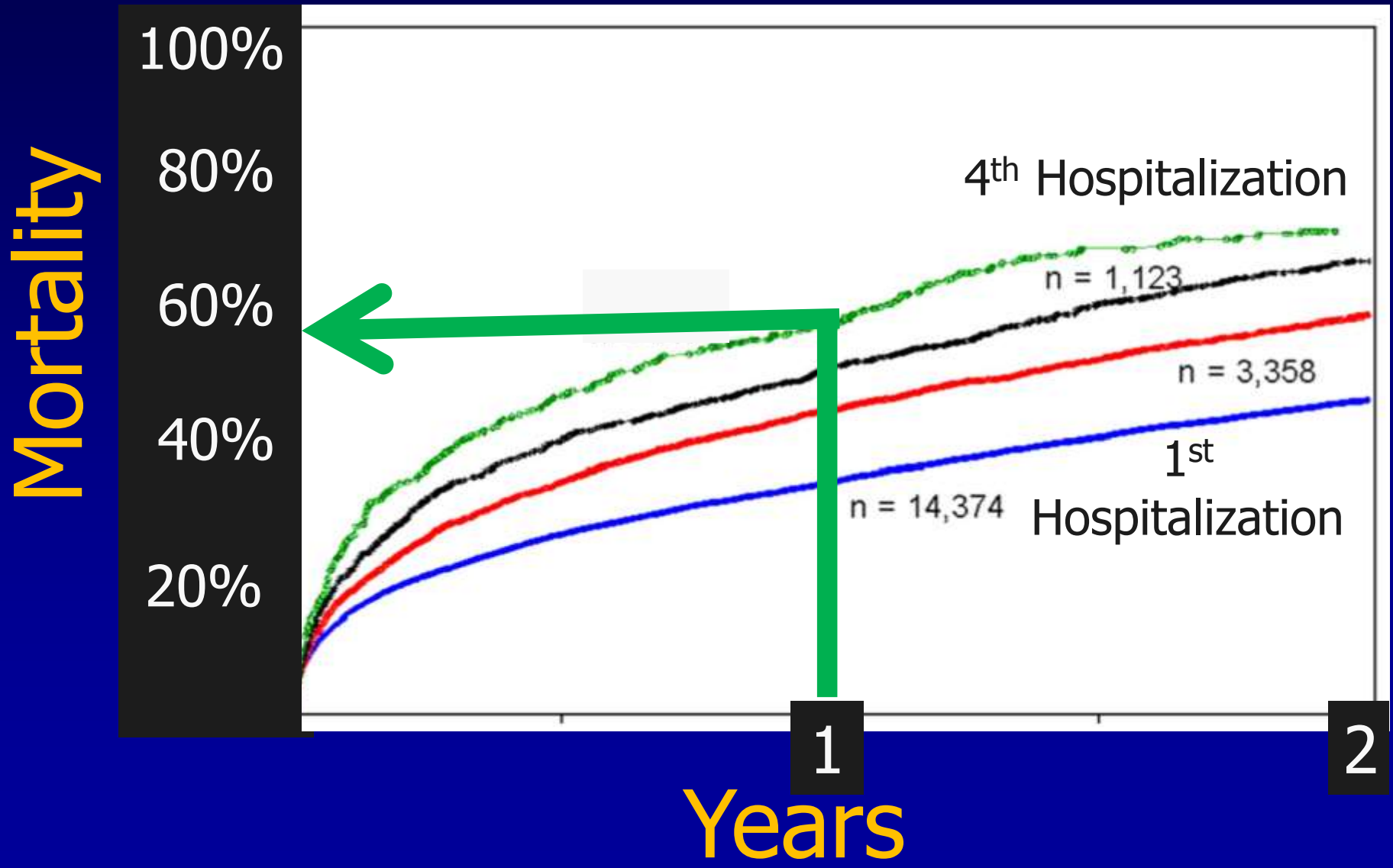
# Number of CHF Hospitalizations is An Adverse Prognostic Factor



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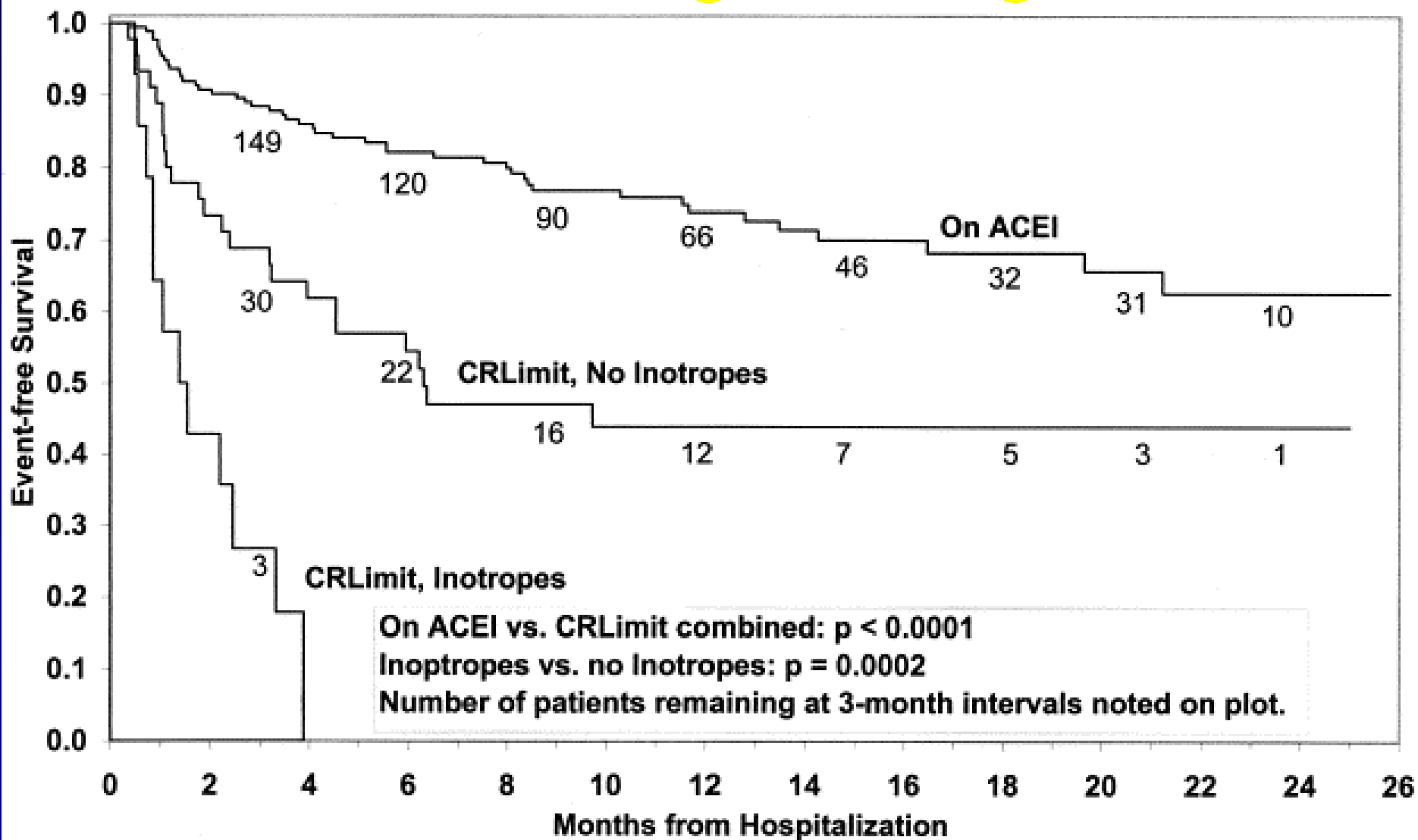


# Simple Clinical Clues to Identify Advanced Heart Failure

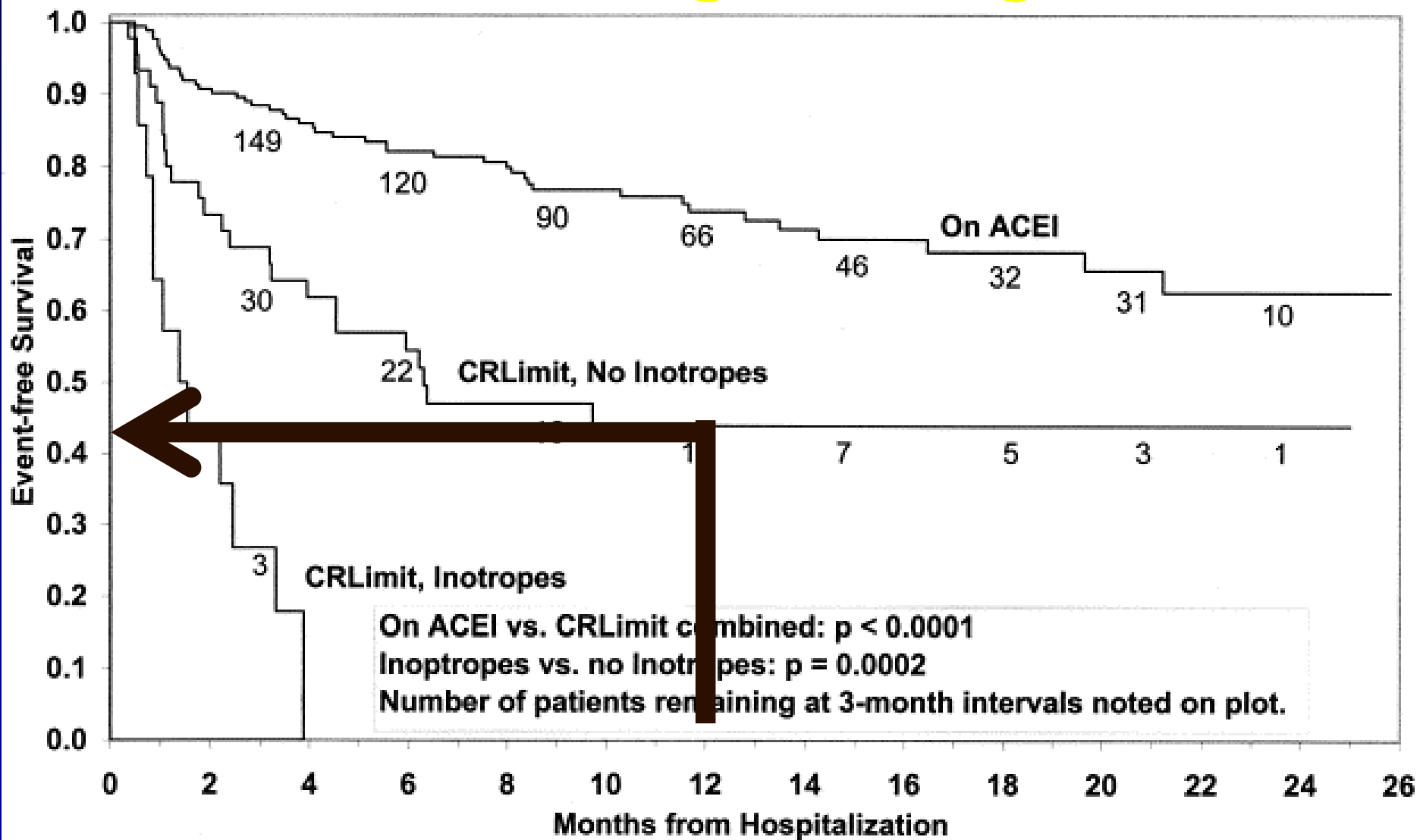
- Rehospitalization for CHF
- Unable to tolerate ACE-I or BBL
- High doses of diuretic
- Bad news from EP
- Labile renal function
- Unintentional weight loss



# ACE-Inhibitor Intolerance is Adverse Prognostic Sign



# ACE-Inhibitor Intolerance is Adverse Prognostic Sign



# Simple Clinical Clues to Identify Advanced Heart Failure

- Rehospitalization for CHF
- Unable to tolerate ACE-I or BBL
- High doses of diuretic
- Bad news from EP
  - ICD shocks
  - Nonresponder to BiV pacing
- Labile renal function
- Unintentional weight loss

# Outline

- Chronic systolic HF
- Advanced Heart Failure
  - Identification (simple clinical clues)
  - Treatment (LVAD/Heart Transplantation)

# Advanced Therapies for Advanced Heart Failure

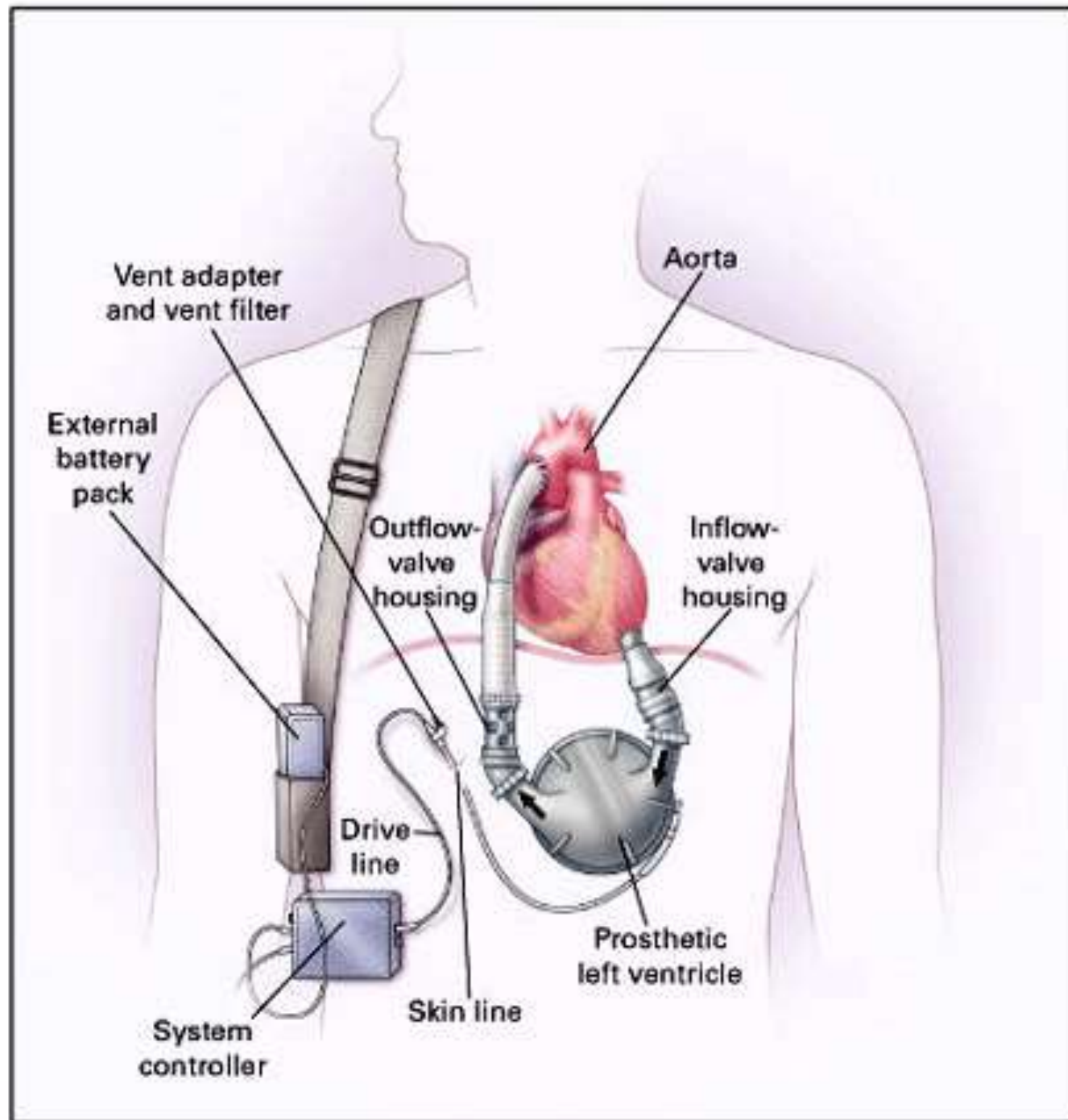
- Chronic Inotropes/Palliative care
- Ventricular Assist Device
- Transplantation

# Advanced Therapies for Advanced Heart Failure

- Chronic Inotropes/Palliative care
- Ventricular Assist Device
- Transplantation

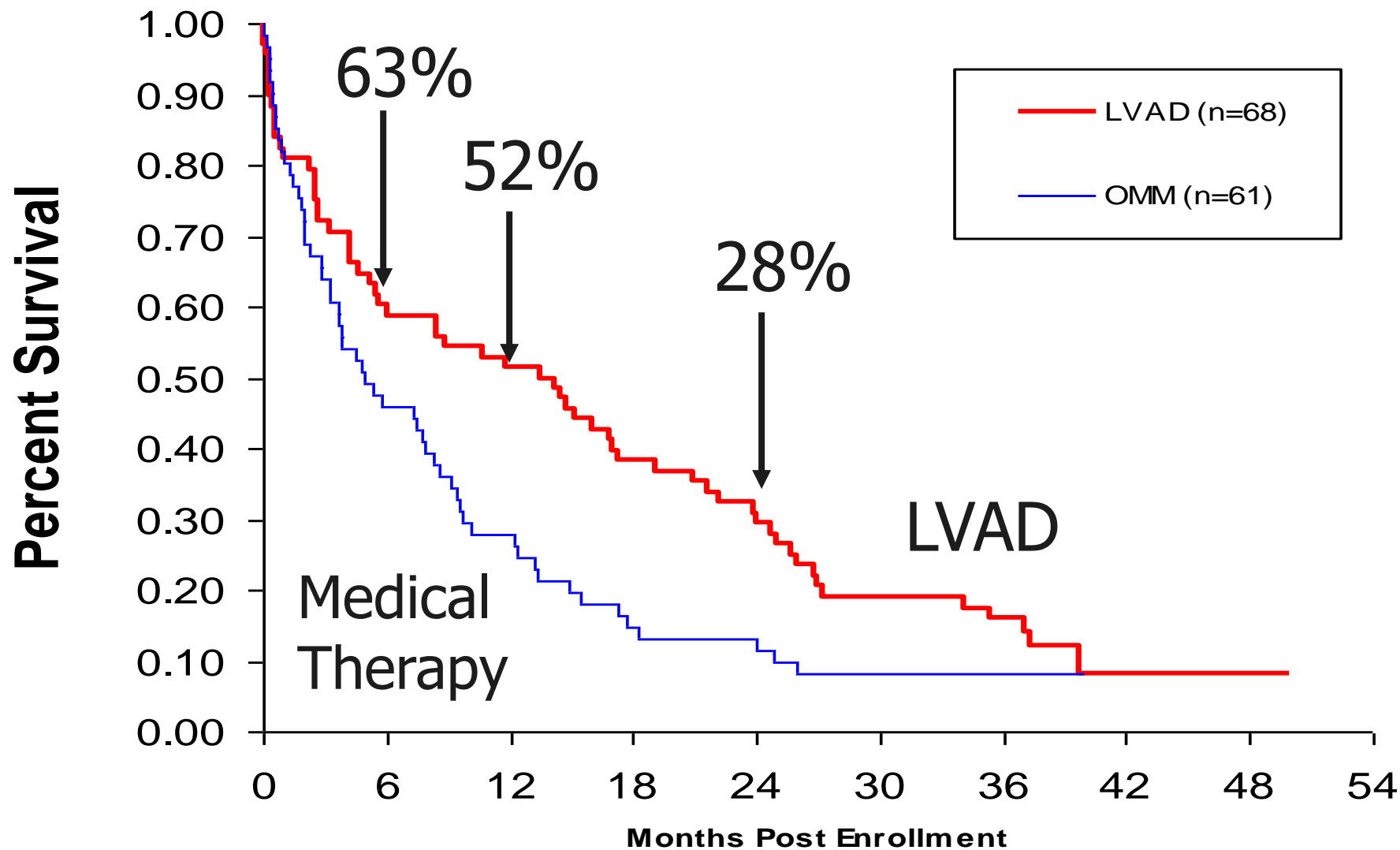
# Primary Roles of VAD

- Bridge to transplant
- Destination therapy (non-transplant candidate)

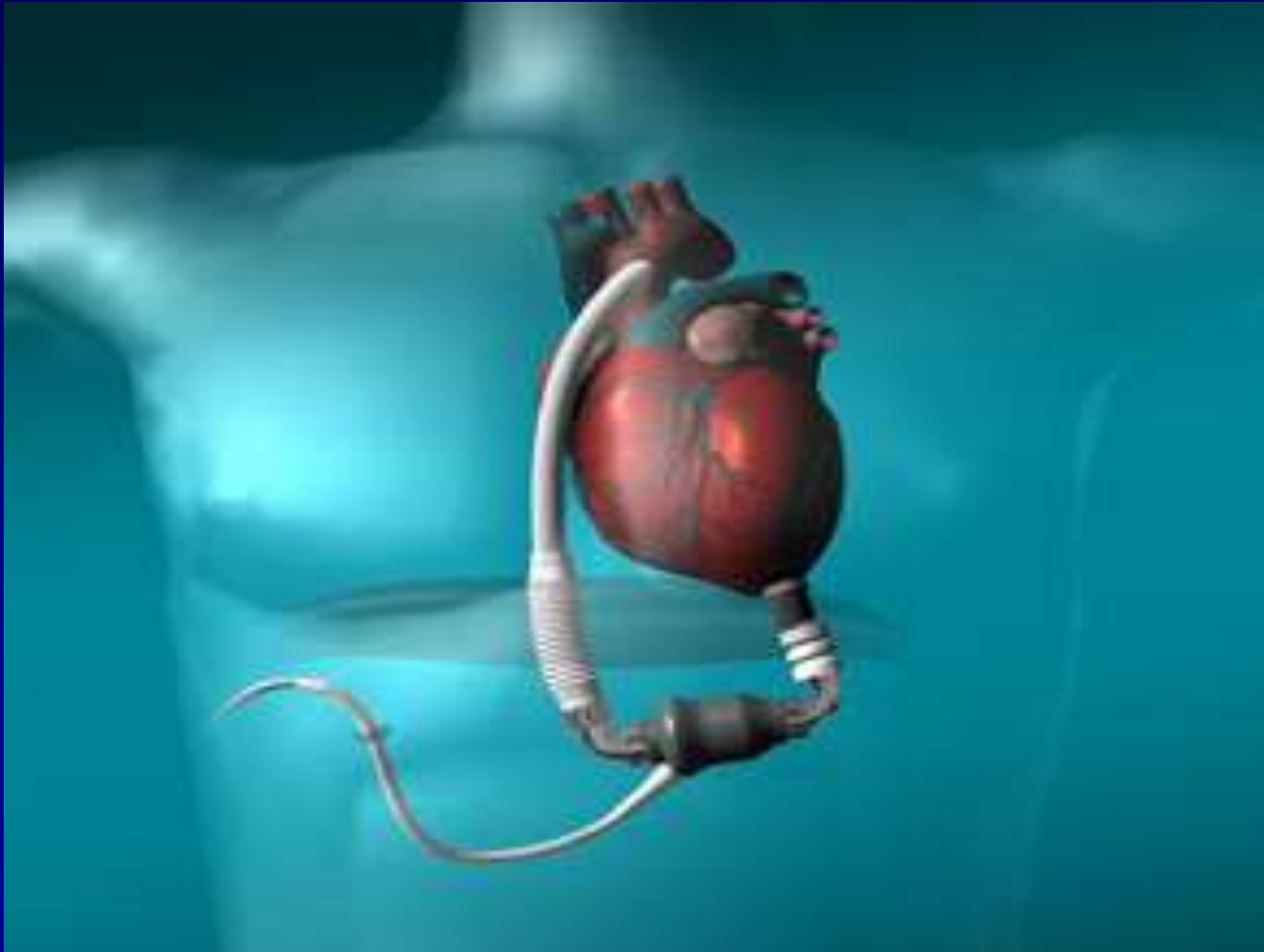




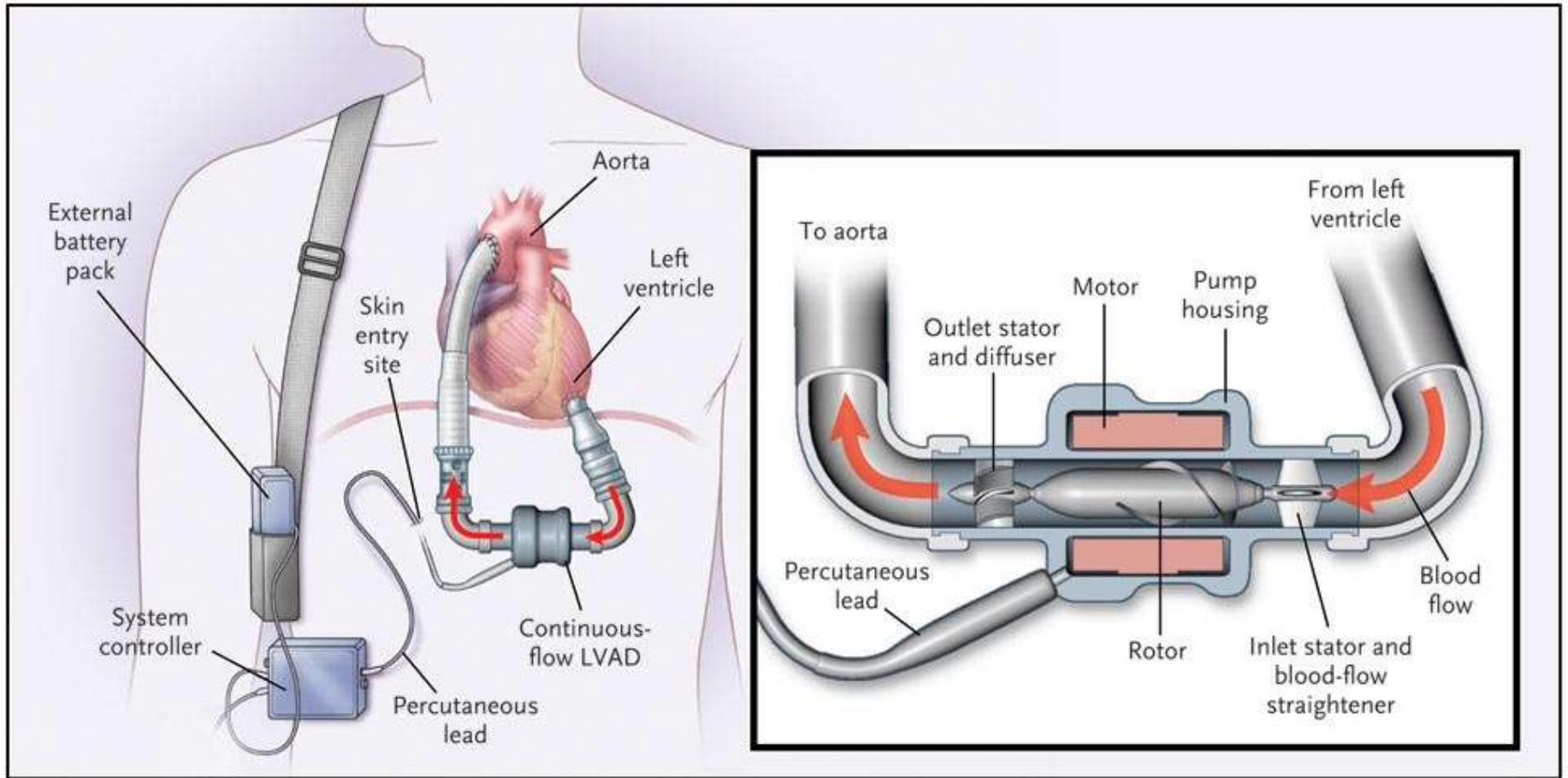
# REMATCH



# 2<sup>nd</sup> Generation VADs: Continuous Flow



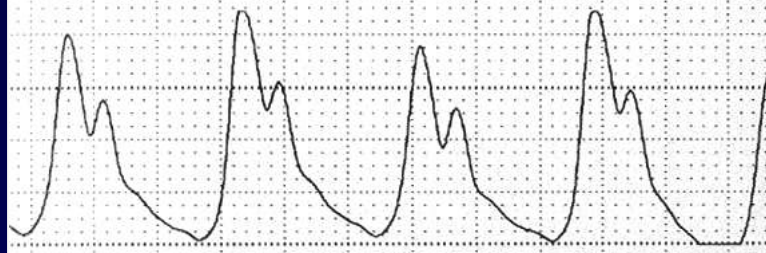
# HeartMate II



Axial flow

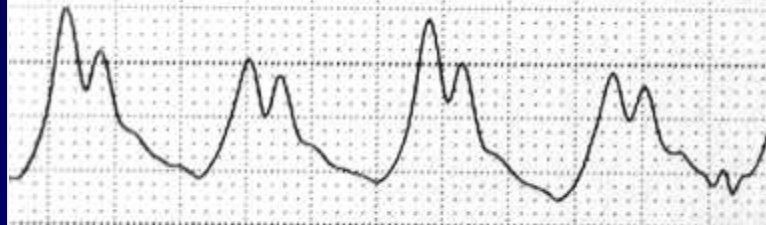
Miller LW et al. N Engl J Med 2007

8,000 RPM



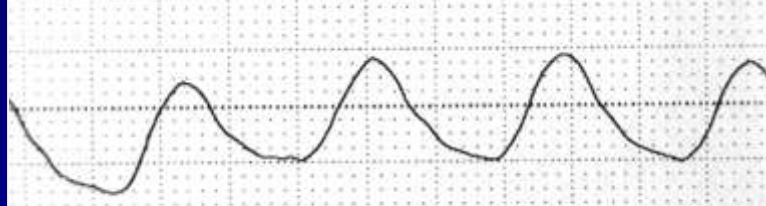
Cardiac Output = 4.3  
Pulse Pressure = 23  
Mean BP = 68

9,000 RPM



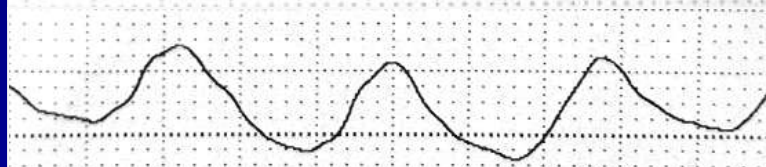
Cardiac Output = 4.4  
Pulse Pressure = 16  
Mean BP = 70

10,000 RPM



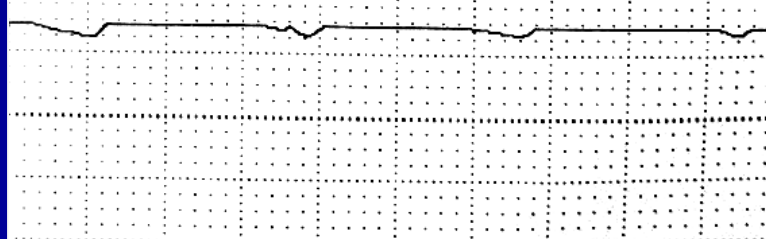
Cardiac Output = 4.5  
Pulse Pressure = 12  
Mean BP = 74

11,000 RPM



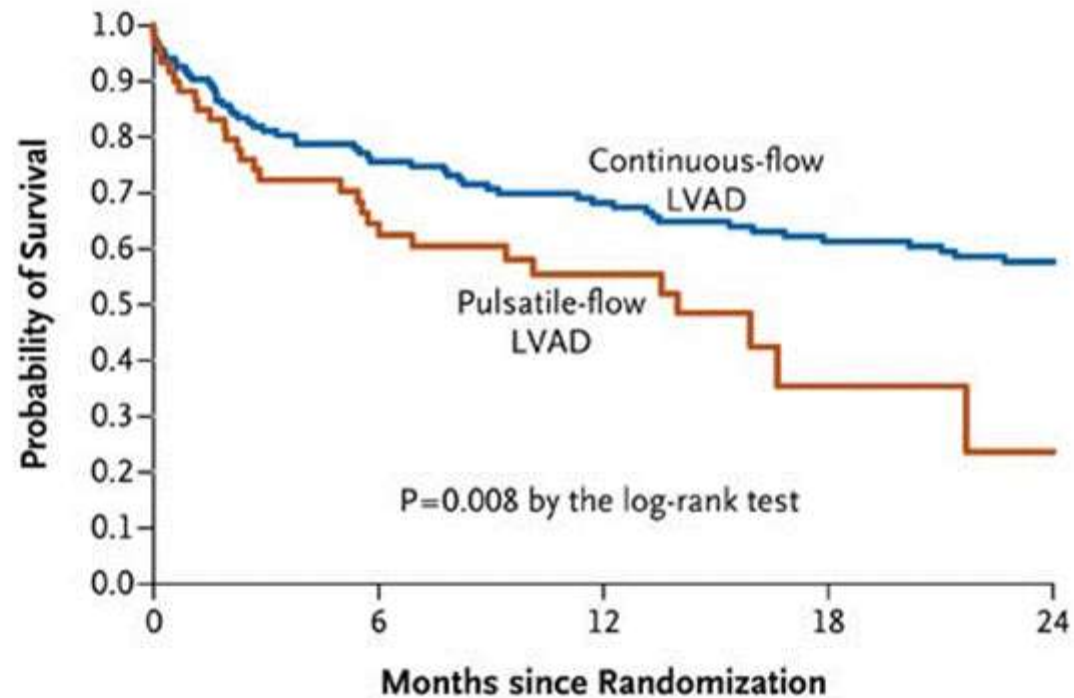
Cardiac Output = 4.9  
Pulse Pressure = 9  
Mean BP = 82

12,000 RPM



Cardiac Output = 5.1  
Pulse Pressure = 6  
Mean BP = 87

# HeartMate II: Destination Outcomes



No. at Risk		0	6	12	18	24
Continuous-flow LVAD		133	95	82	69	62
Pulsatile-flow LVAD		59	32	19	5	2

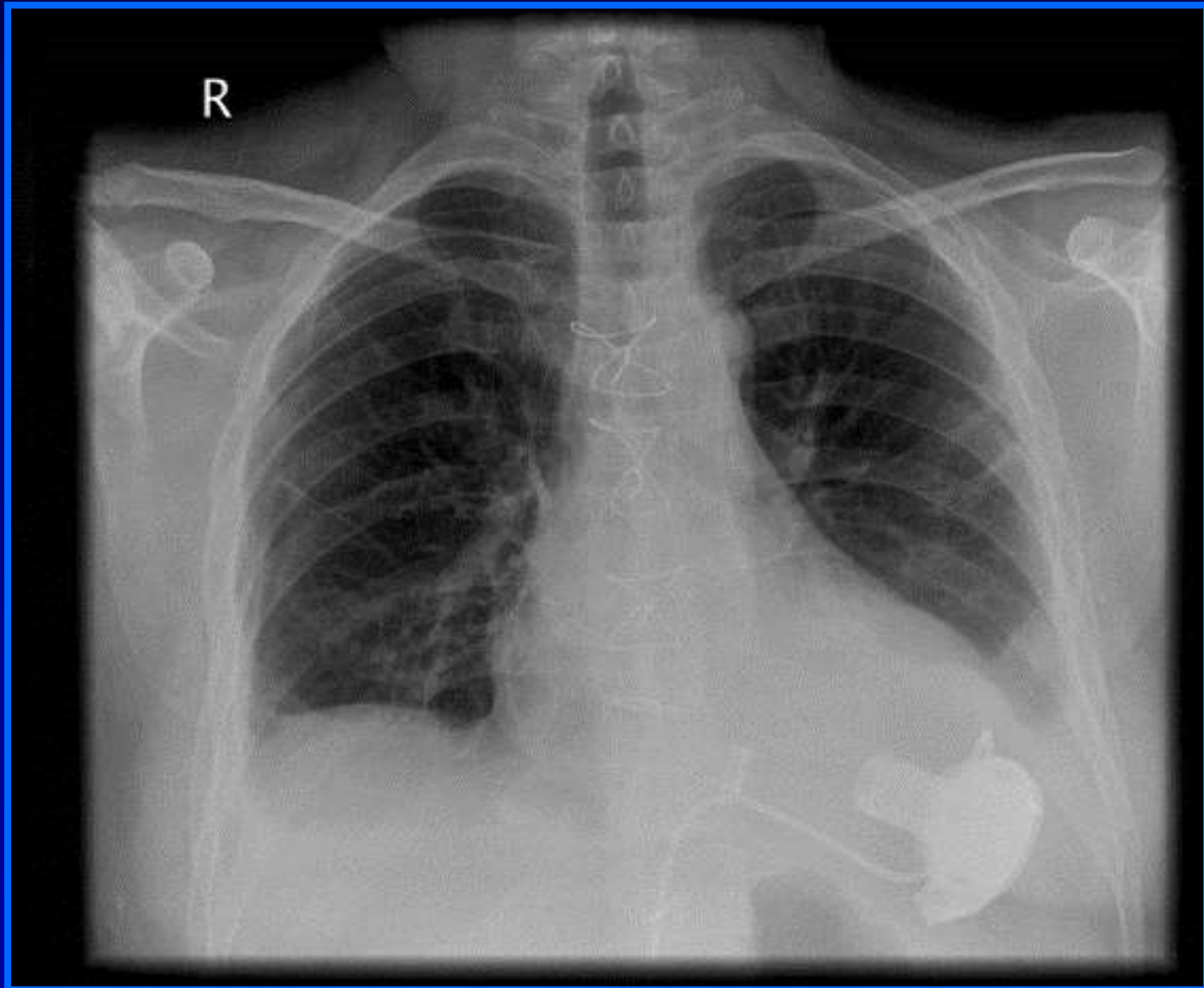
NEJM,  
2009

# HeartWare



Centrifugal flow

# HeartWare



# Which VAD for Which of Your Patients?

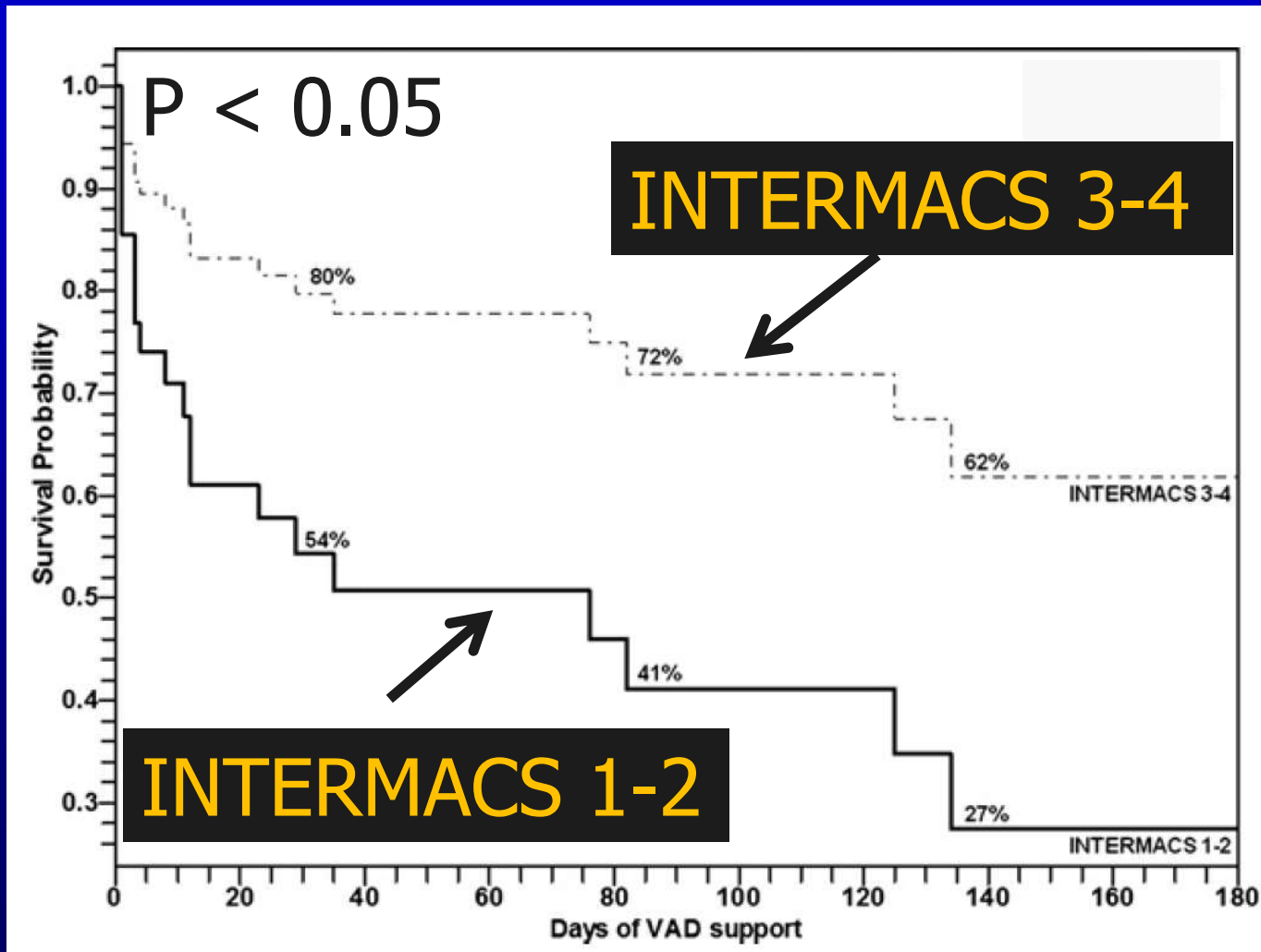
- **Approved**
  - HeartMate II: Bridge to Transplant
  - HeartMate II: Destination Therapy
  - HeartWare: Bridge to Transplant
- **Investigational**
  - HeartWare: Destination Trial



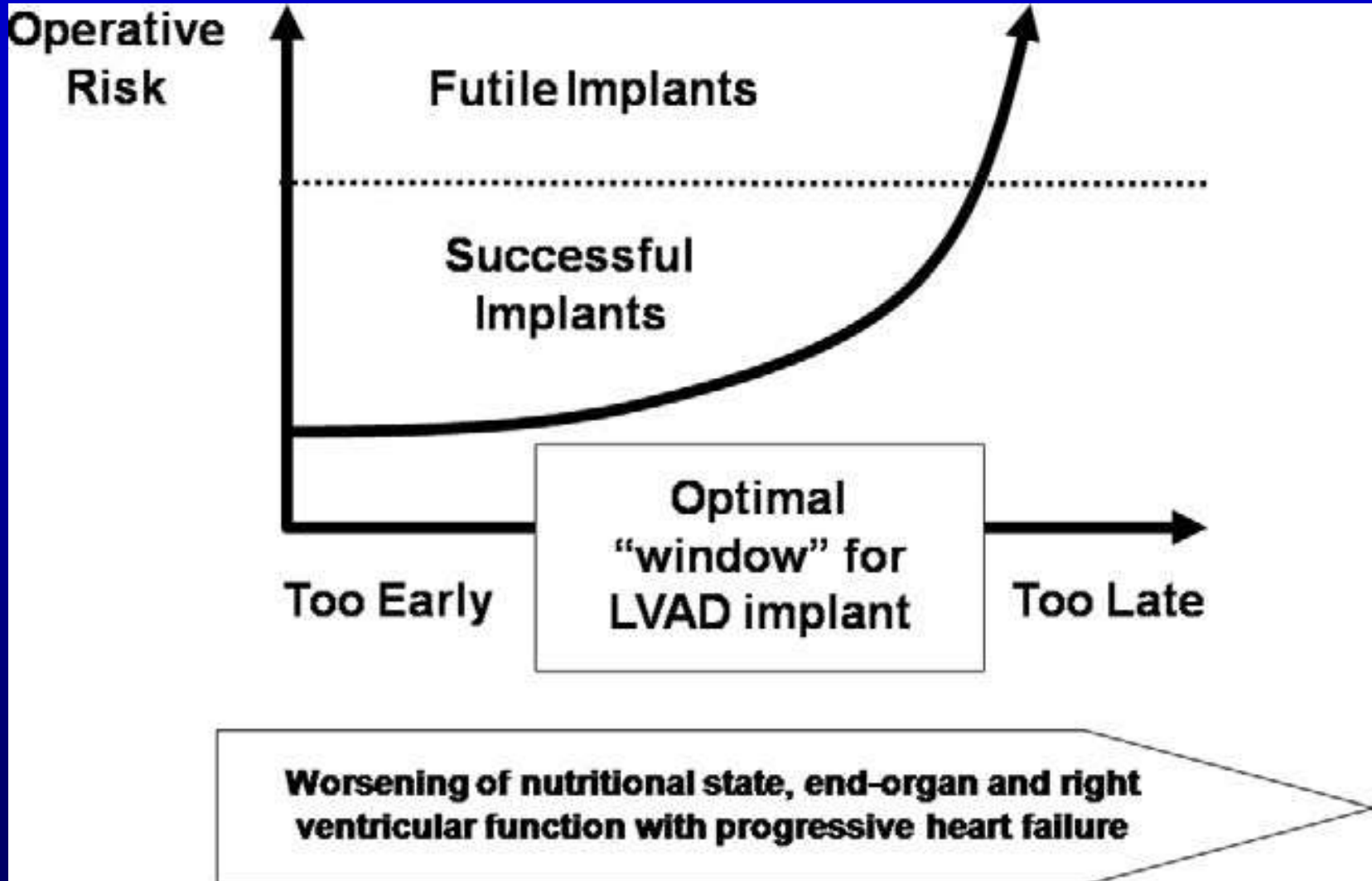
# How to Improve LVAD Outcomes

- Better technology
- Better patient selection

# INTERMACS Profile and Post-VAD 6-Month Outcome



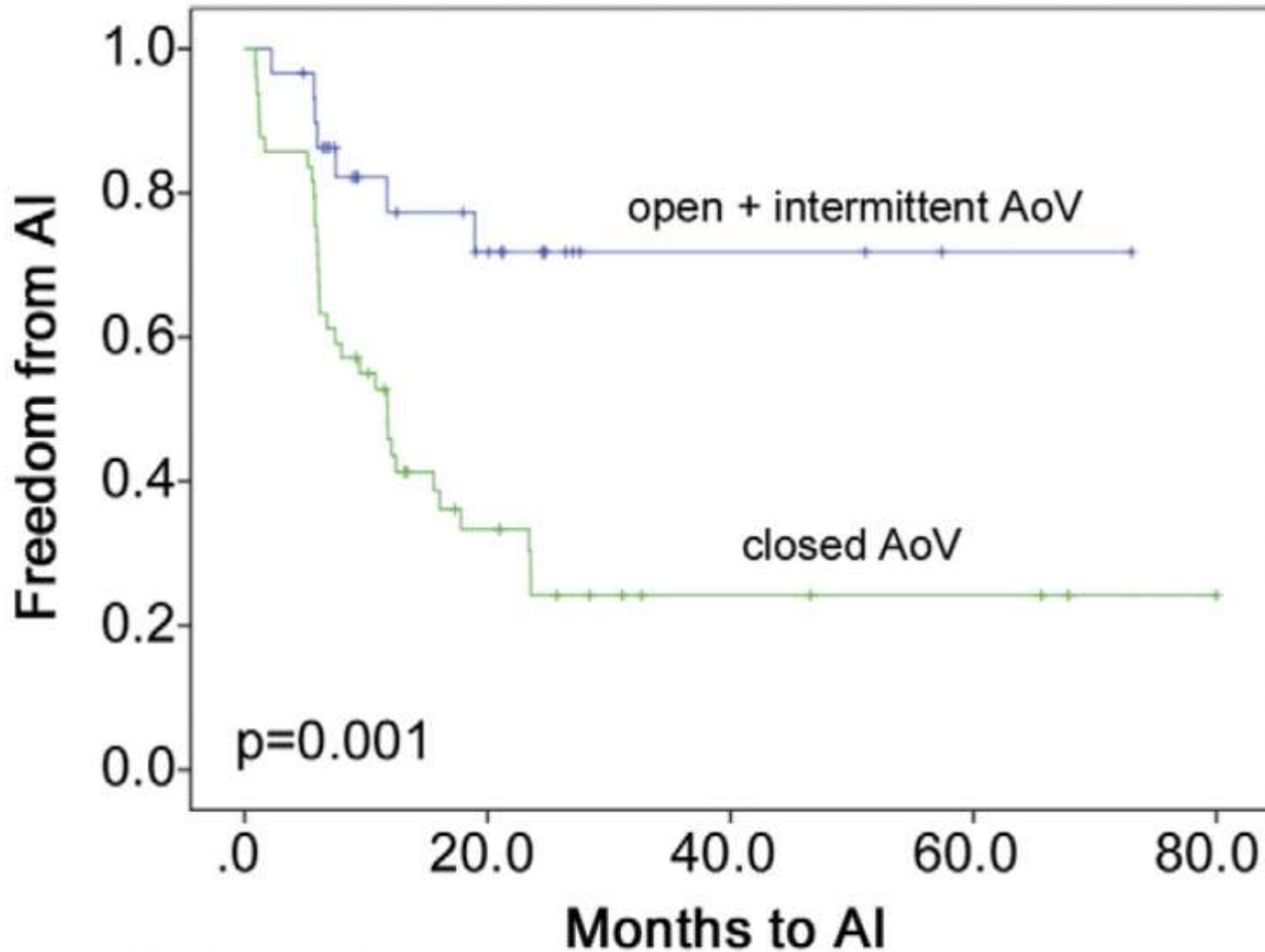
# Finding the “Sweet Spot”



# Complications with Continuous Flow LVADs

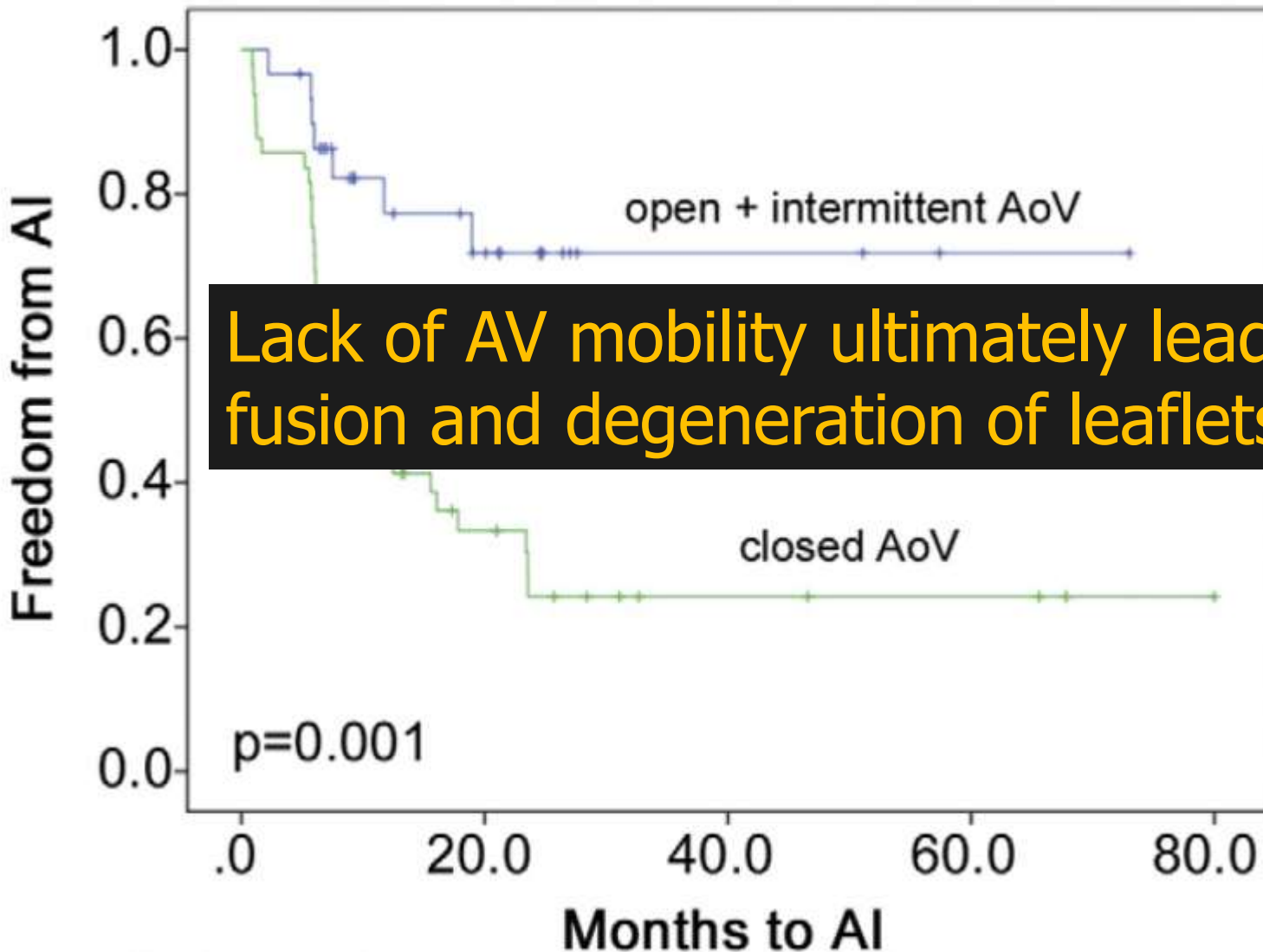
- Right heart failure
- Infections (driveline)
- GI Bleeding (AVMs)
- Aortic valve insufficiency

# AV Closure and Subsequent Development of AI



N = 79  
HM II

# AV Closure and Subsequent Development of AI

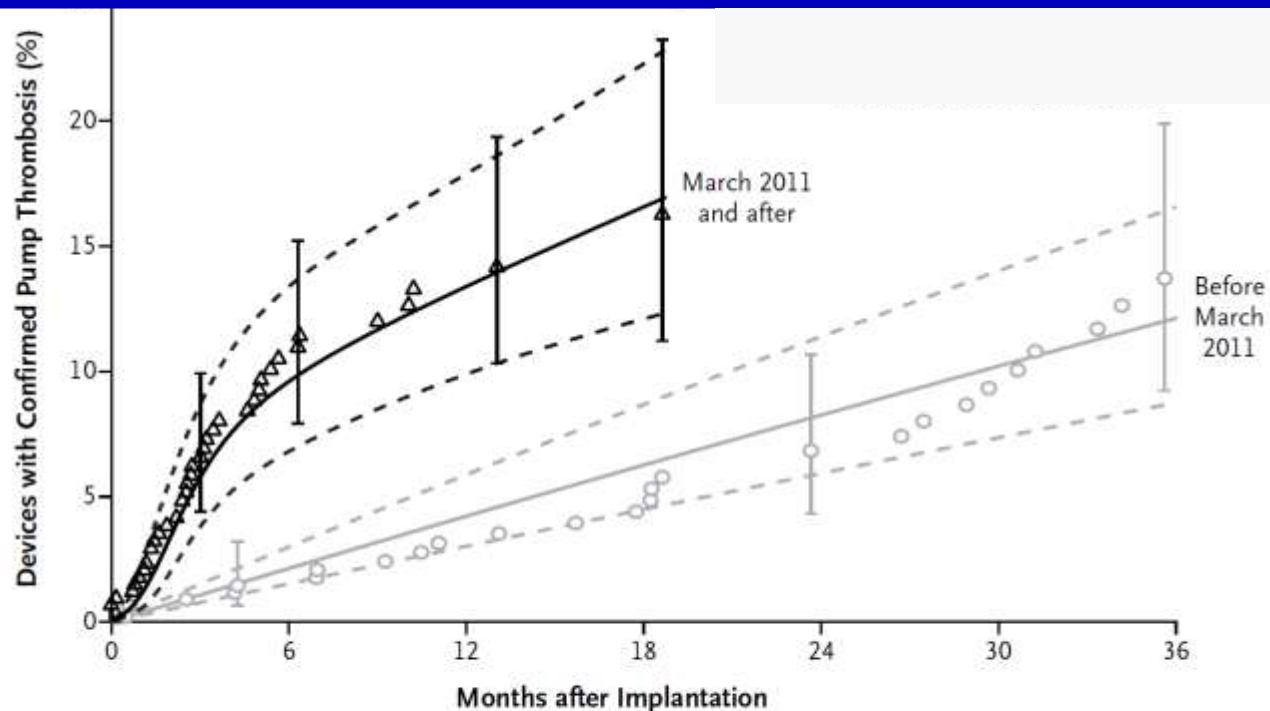


Lack of AV mobility ultimately leads to fusion and degeneration of leaflets → AI

# Complications with Continuous Flow LVADs

- Right heart failure
- Infections (driveline)
- GI bleeding
- Aortic valve insufficiency
- LVAD thrombosis

# Unexpected Abrupt Increase in Left Ventricular Assist Device Thrombosis



### No. at Risk

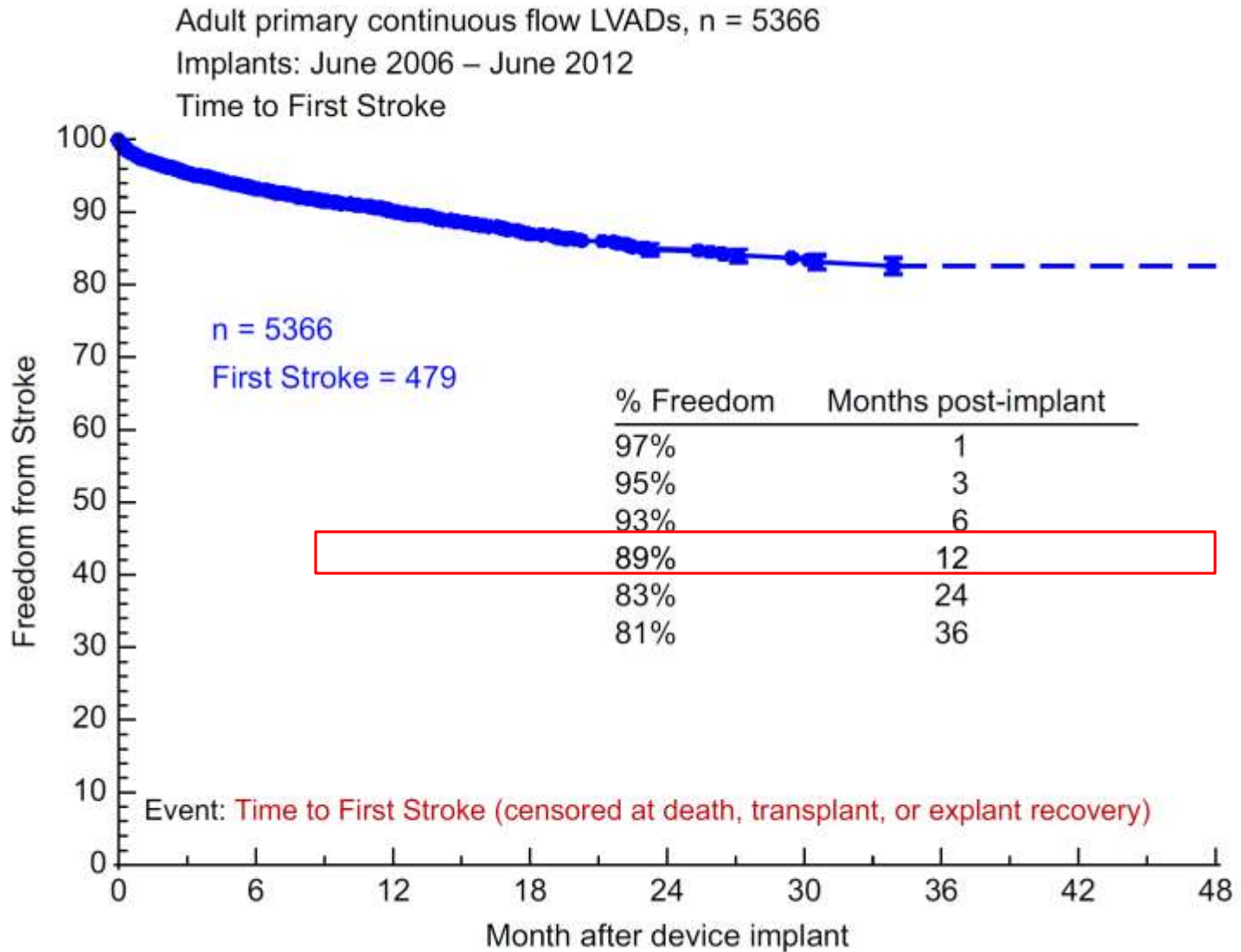
Before March 2011	499	362	264	214	178	138	81
March 2011 and after	396	209	134	98	—	—	—



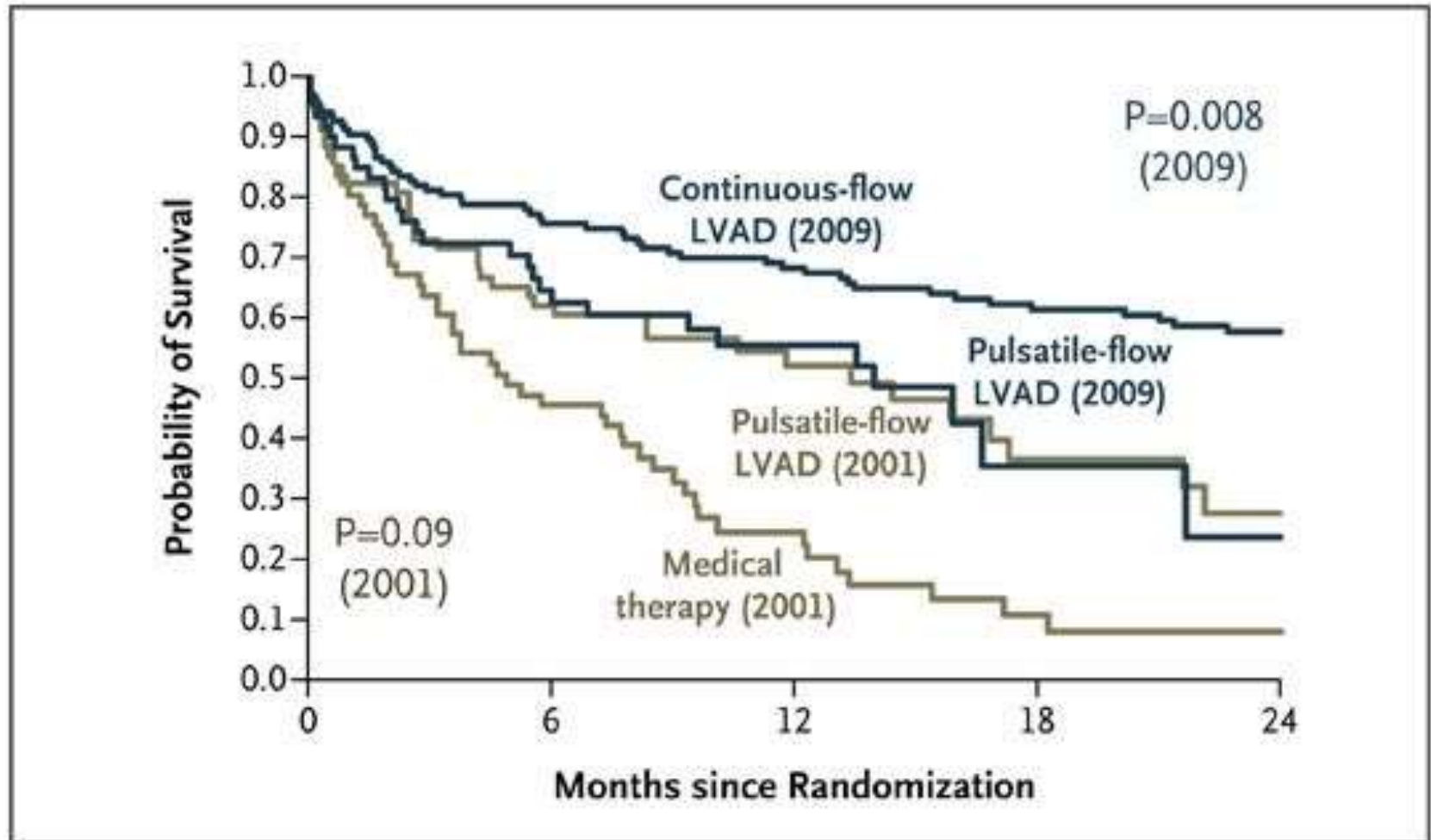
# Complications with Continuous Flow LVADs

- Right heart failure
- Infections (Driveline)
- GI bleeding
- Aortic valve insufficiency
- LVAD thrombosis
- **Strokes**
  - HeartMate II requires coumadin + aspirin
  - 13% per patient year in Destination Trial

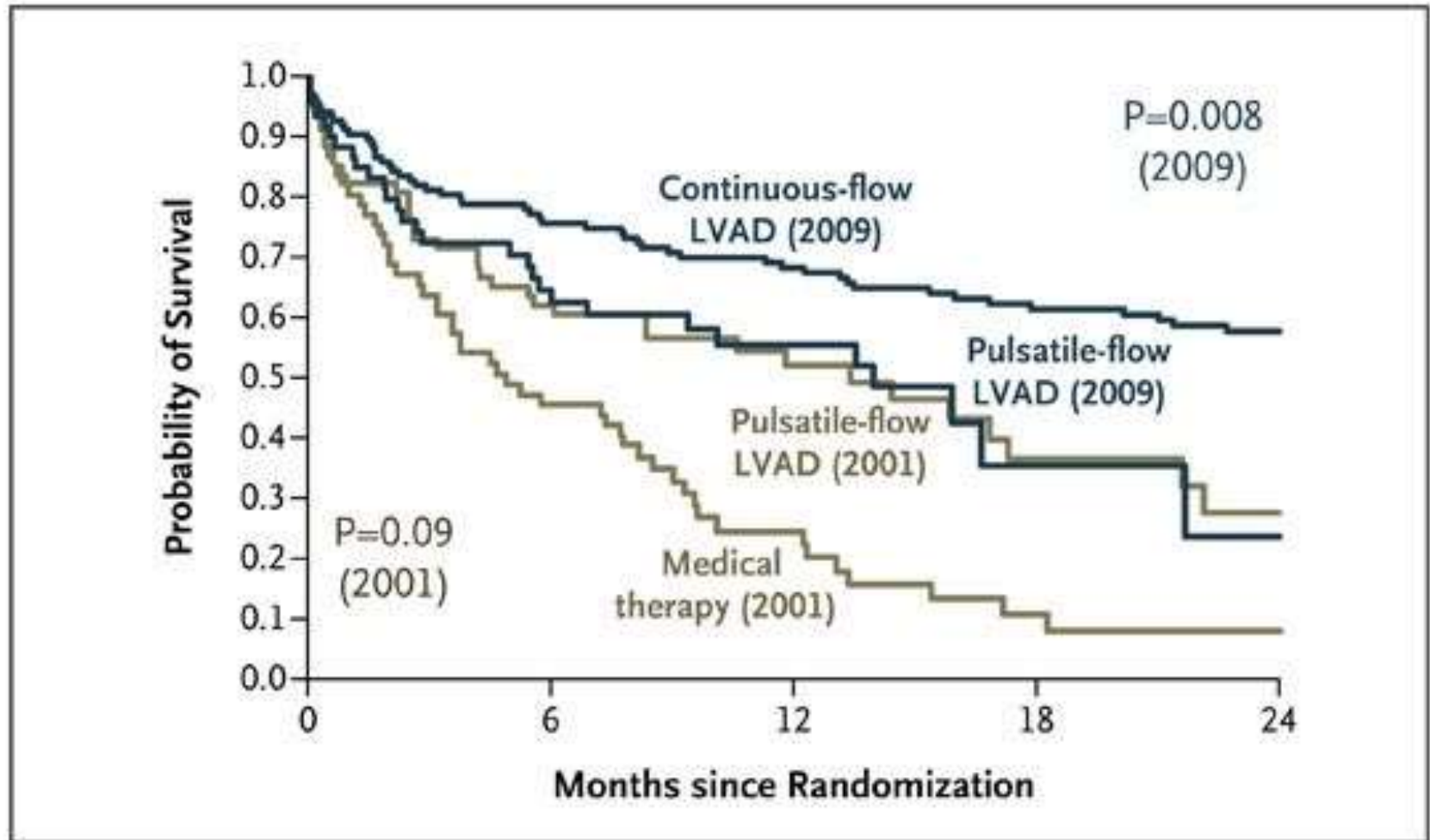
# High Stroke Rate Post-Continuous LVAD



# HeartMate II vs. XVE vs. Medical Therapy



# HeartMate II vs. XVE vs. Medical Therapy

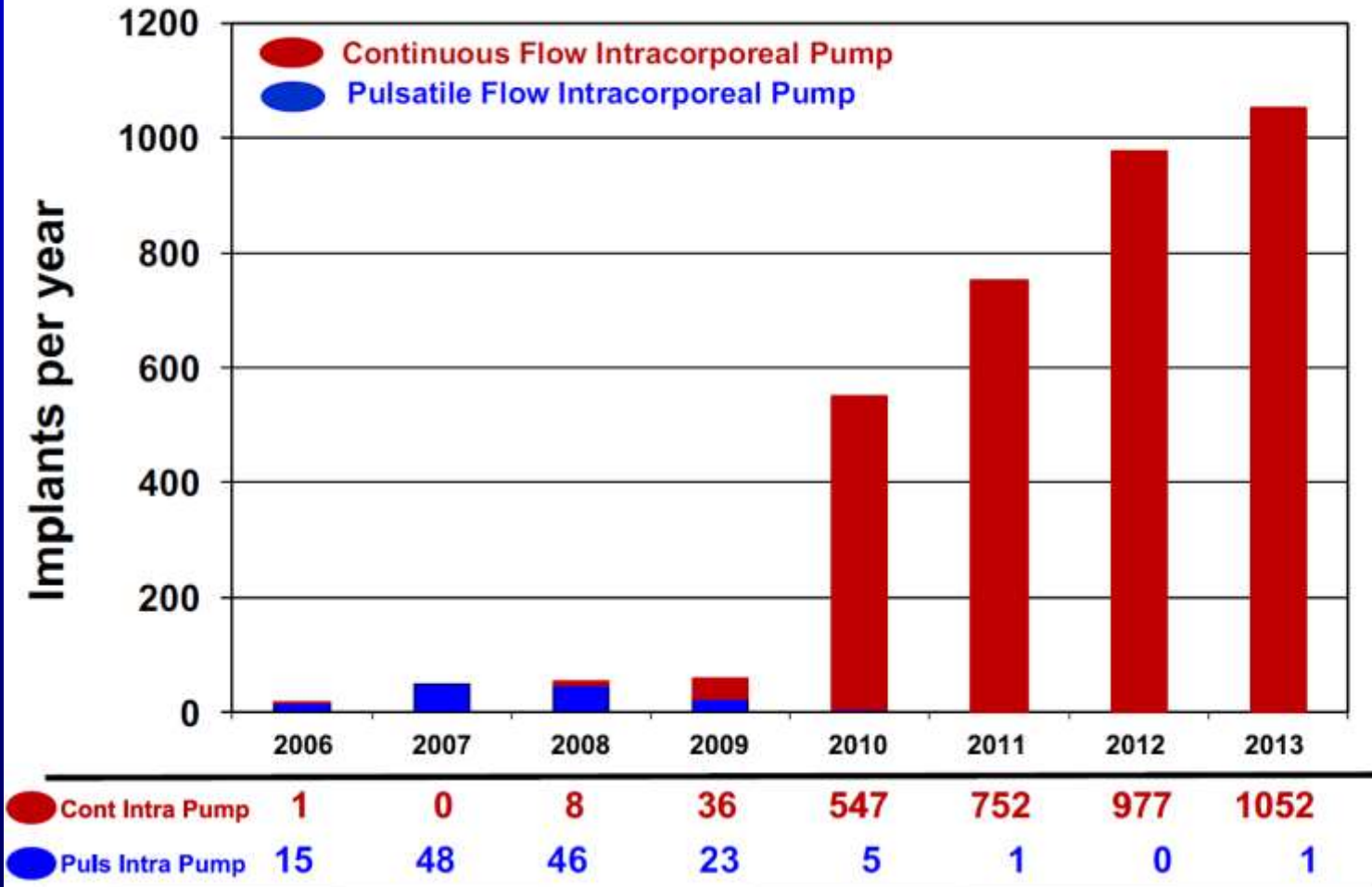


5<sup>th</sup> INTERMACS Survival:  
80% 1 year; 70% 2 years

Fang, NEJM, 2009  
Kirklin, JHLT<sub>x</sub>, 2013

# Rapid Increase in Destination LVADs: 6<sup>th</sup> INTERMACS Report

Intermacs Implants for Destination Therapy: June 2006 – December 2013, n = 3516



*The International No.1 Bestseller*

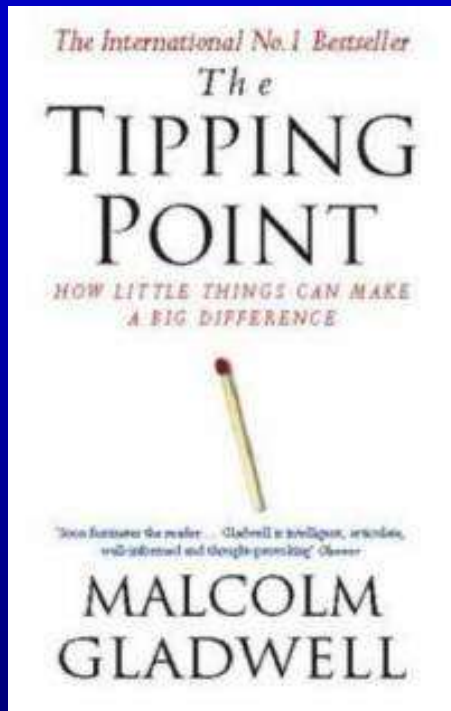
*The*  
**TIPPING  
POINT**

*HOW LITTLE THINGS CAN MAKE  
A BIG DIFFERENCE*



*'Does fascinate the reader... Gladwell is intelligent, articulate,  
well-referenced and thought-provoking' Observer*

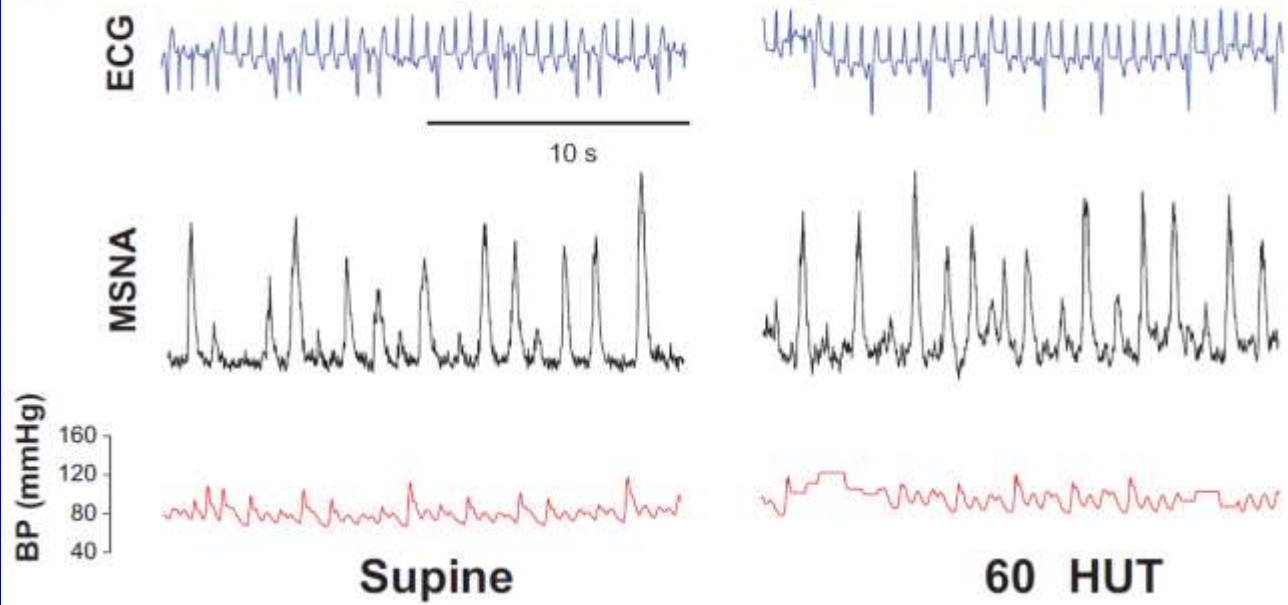
**MALCOLM  
GLADWELL**



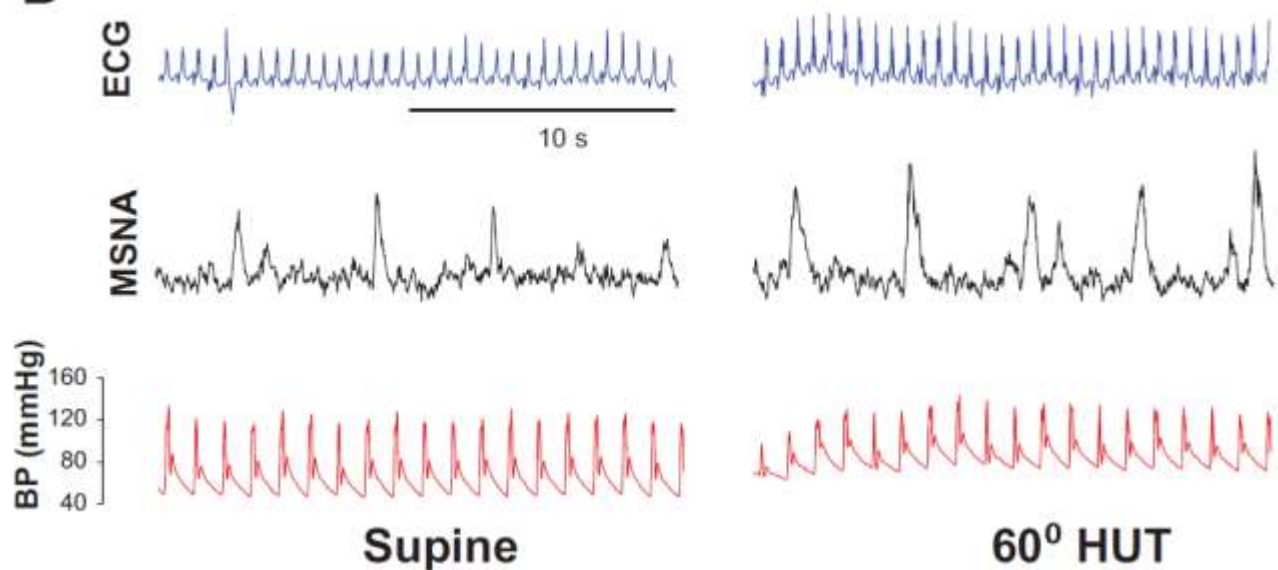
# **Future Ventricular Assist Device Technology to Reintroduce Pulsatility**



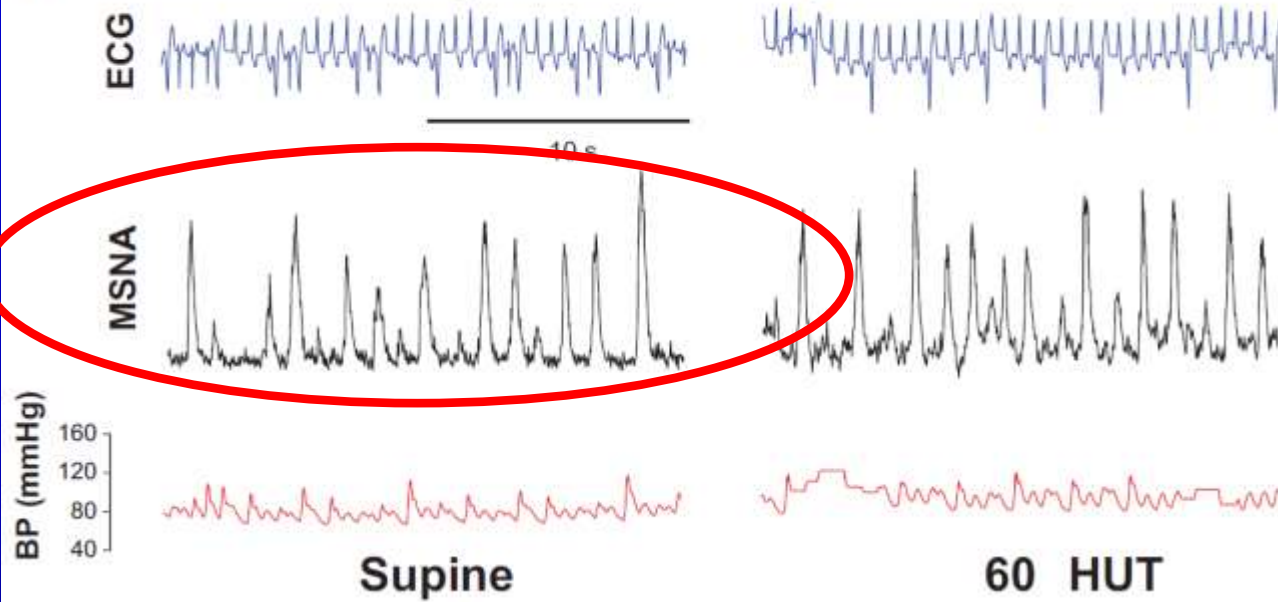
### A Non-pulsatile LVAD patient



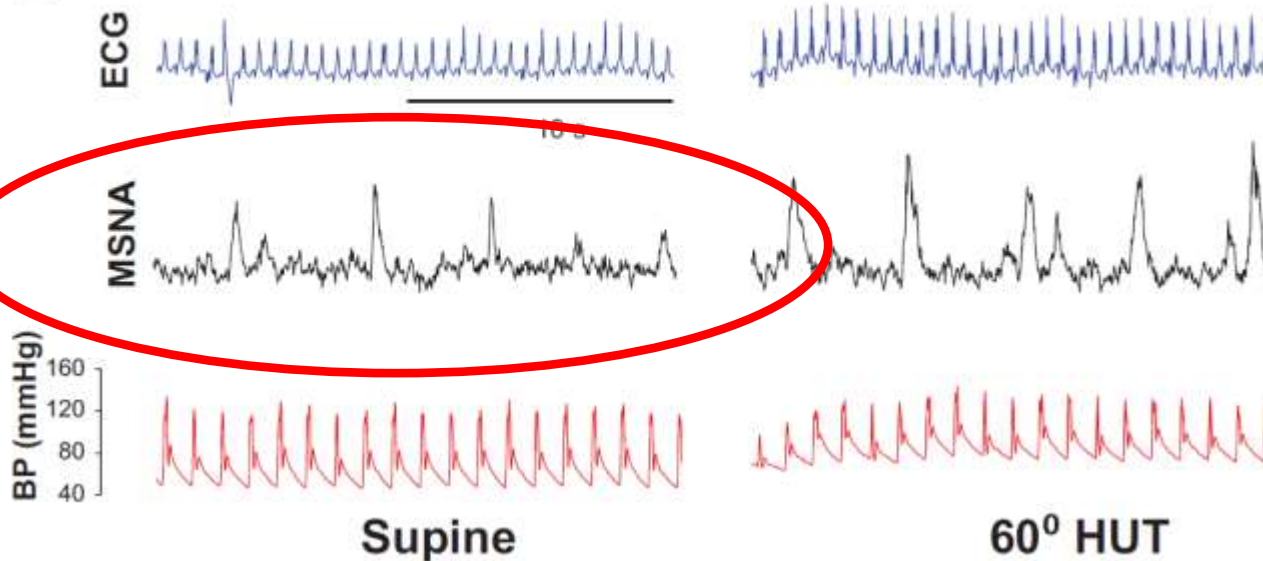
### B Pulsatile LVAD patient



### A Non-pulsatile LVAD patient

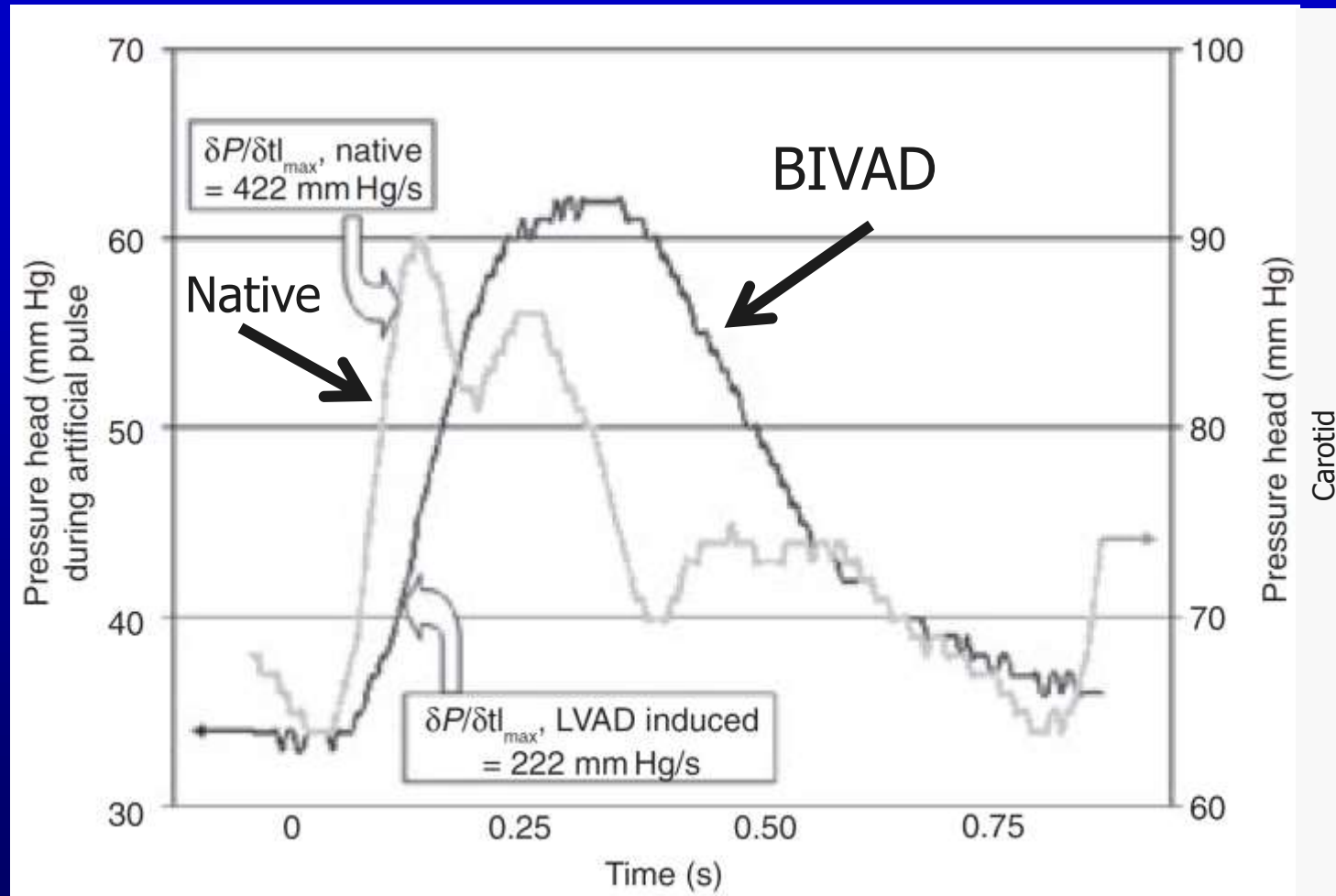


### B Pulsatile LVAD patient



# Generating a Pulse with Continuous Flow BIVAD HeartMate III's

- Adult sheep
- BIVAD HM3
- Alternate speed from 1500 rpm to 5500 rpms (60 times/min)



Native waveform from carotid artery; BIVAD thoracic aorta

Bourque, Artificial Organs, 2006

# Advanced Therapies for Advanced Heart Failure

- Chronic Inotropes/Palliative care
- Ventricular Assist Device
- Transplantation

# 47<sup>th</sup> Anniversary of Heart Transplantation



Louis Washkansky

Dr. Christiaan Barnard

December 3, 1967

# Donor Hearts Are Scarce

- Supply of donor hearts is limited
  - N = 2,000 US donor hearts
  - 40,000+ could potentially benefit from heart transplant
- Donor hearts are a precious resource
- Cannot solve CHF from public health perspective

# Adult Heart Transplants Kaplan-Meier Survival by Era (Transplants: January 1982 – June 2012)



# Adult Heart Transplants Kaplan-Meier Survival by Era (Transplants: January 1982 – June 2012)





# Conclusions

- Advanced HF represents spectrum of illness
  - INTERMACS
- Dependence on inotropes is ominous
- For those not on inotropes, simple clinical clues
  - Rehospitalization
  - Intolerance to ACEi / BBL; need for high-dose diuretic
  - Worsening renal function
  - ICD shock/nonresponder to BiV-pacemaker
  - Cachexia

# Conclusions (continued)

- **VADs** are rapidly emerging
  - Survival better than medical therapy
  - Complications including GI bleeding, Aortic insufficiency, LVAD thrombosis, Stroke
  - Improved LVAD technologies and patient selection
  - ? Tipping point
- **Transplantation** provides excellent option but limited number of donors

