STS/EACTS Latin America Cardiovascular Surgery Conference

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# Outcomes of MCS as a Bridge to Heart Transplantation: Are We Compromising Short- and Long-term Outcomes?

The Society of Thoracic Surgeons

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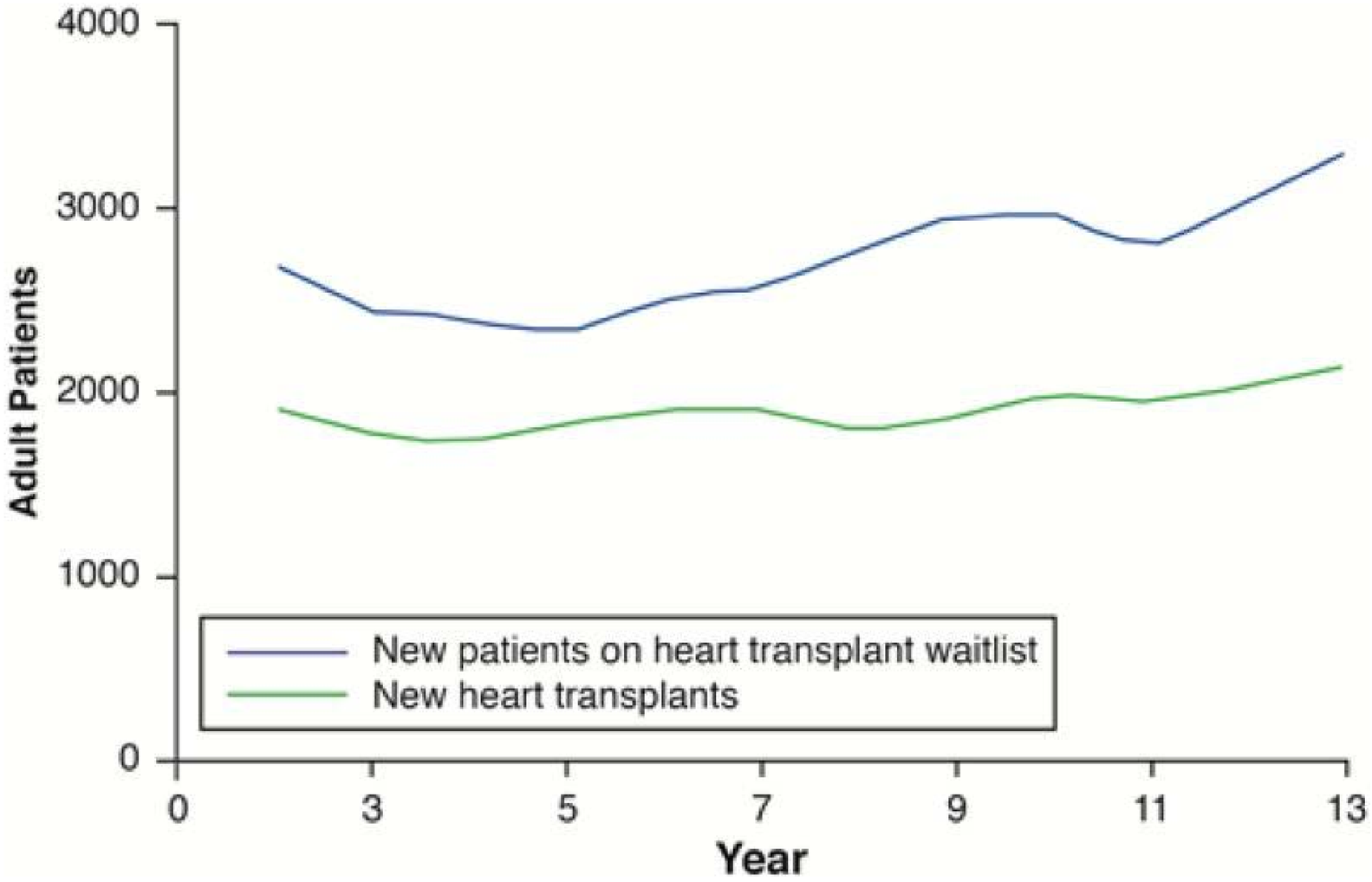
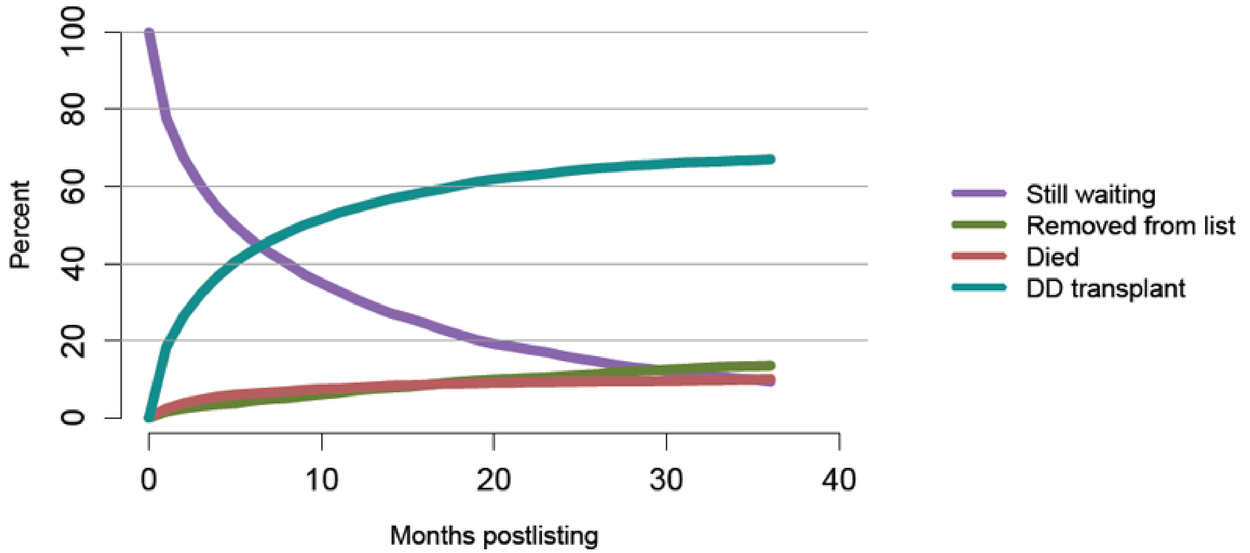
European Association For Cardio-Thoracic Surgery

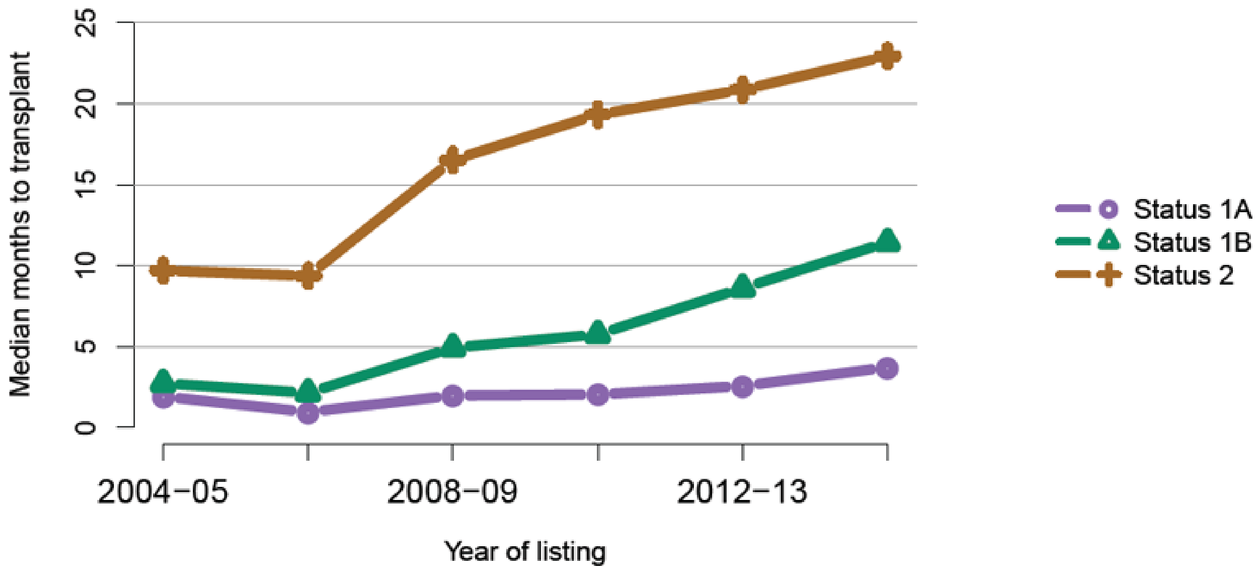
# US Heart Transplant: United Network Organ Sharing (UNOS) Report

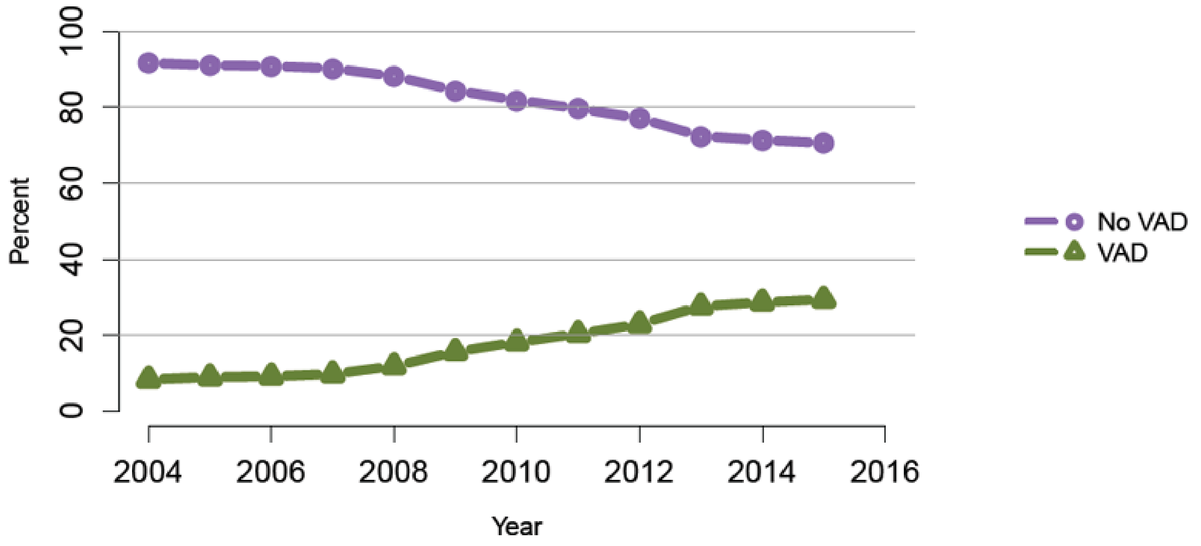



Colvin et al. OPTN/SRTR 2015 Annual Data Report: Heart. Am J Transplant. 2017

# US Heart Transplant: United Network Organ Sharing (UNOS) Report




Colvin et al. OPTN/SRTR 2015 Annual Data Report: Heart. Am J Transplant. 2017

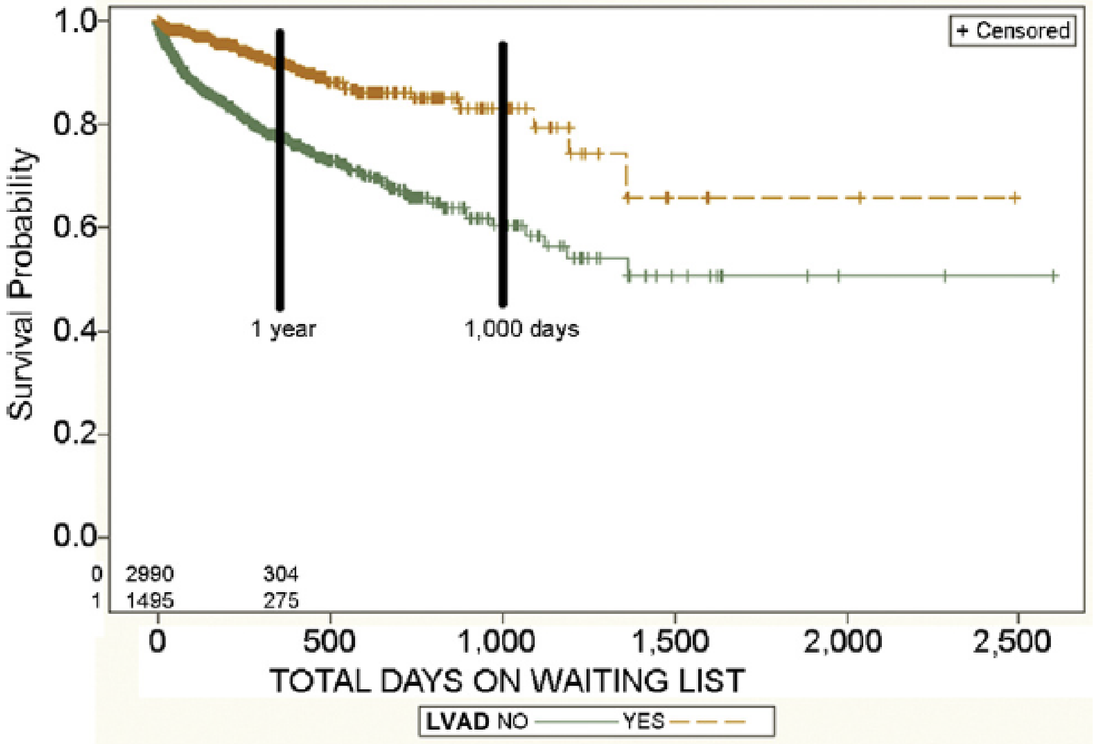
# Bridging to Heart Transplantation

- Increased competition for hearts has increased the use of durable LVADs as a bridge to heart transplant
- Has the use of durable LVAD adversely affected transplant outcomes?

# Survival on the Heart Transplant Waiting List: Impact of Continuous Flow Left Ventricular Assist Device as Bridge to Transplant

Jaimin R. Trivedi, MD, MPH, Allen Cheng, MD, Ramesh Singh, MD, Matthew L. Williams, MD, and Mark S. Slaughter, MD

Division of Thoracic and Cardiovascular Surgery, University of Louisville, Louisville, Kentucky



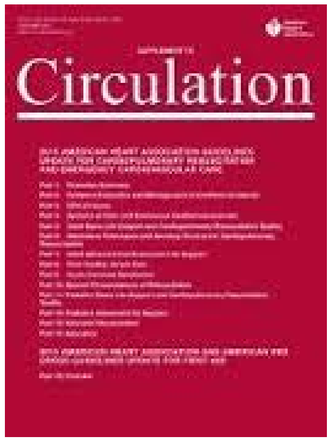


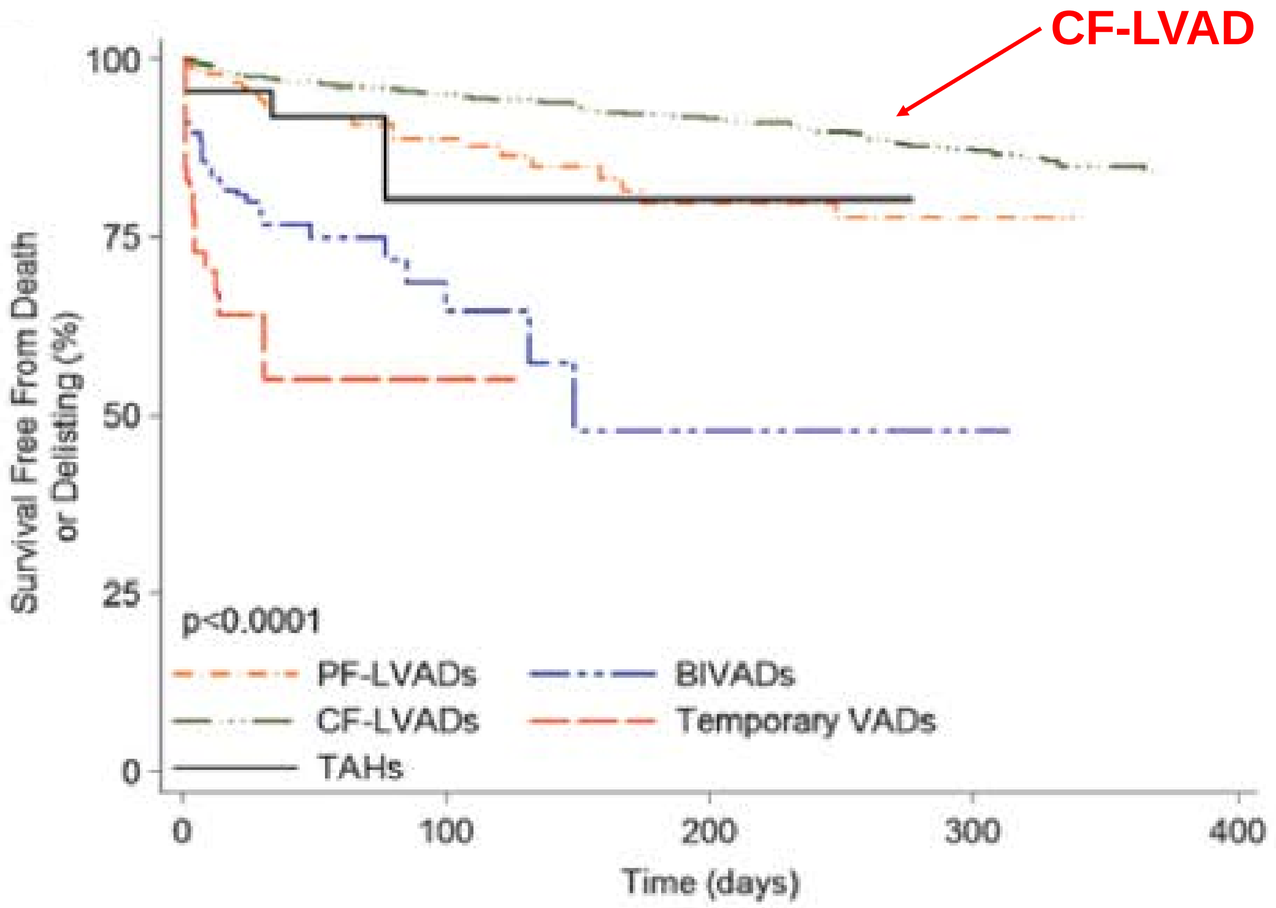

Trivedi et al. Ann Thorac Surg 2014;98:830–4

## ORIGINAL RESEARCH ARTICLE

Morbidity and Mortality in Heart Transplant Candidates Supported with Mechanical Circulatory Support. Is Reappraisal of the Current UNOS Thoracic Organ Allocation Policy Justified?

**Omar Wever-Pinzon, Stavros G. Drakos, Abdallah G. Kfoury, Jose N. Nativi, Edward M. Gilbert, Melanie Everitt, Rami Alharethi, Kim Brunisholz, Feras**




*Circulation*. 2013 January 29; 127(4): 452–462. doi:10.1161/CIRCULATIONAHA.112.100123.

## ORIGINAL RESEARCH ARTICLE

# Morbidity and Mortality in Heart Transplant Candidates Supported with Mechanical Circulatory Support. Is Reappraisal of the Current UNOS Thoracic Organ Allocation Policy Justified?

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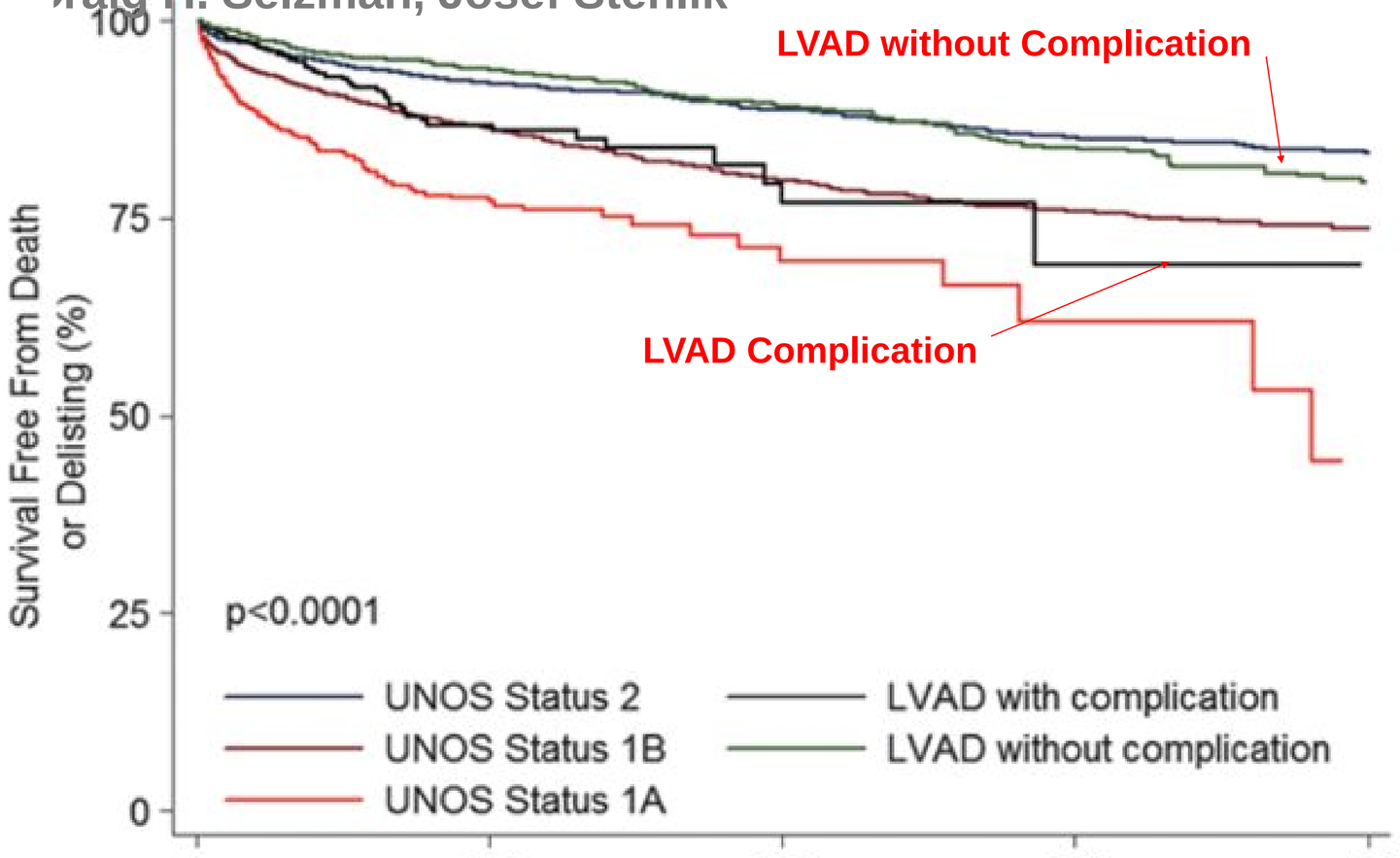
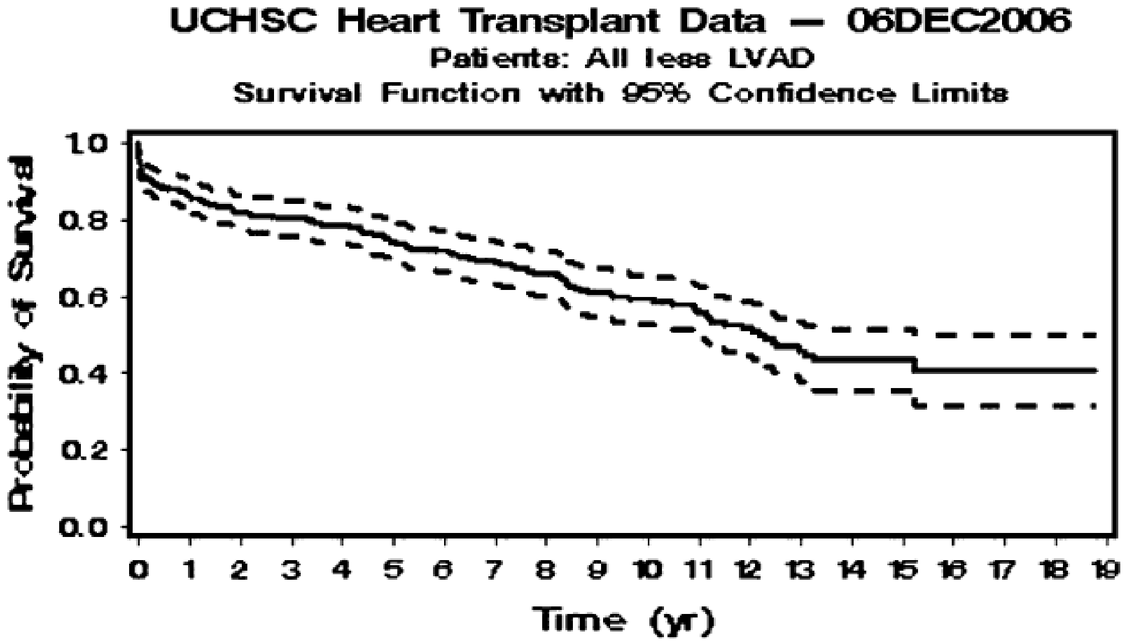
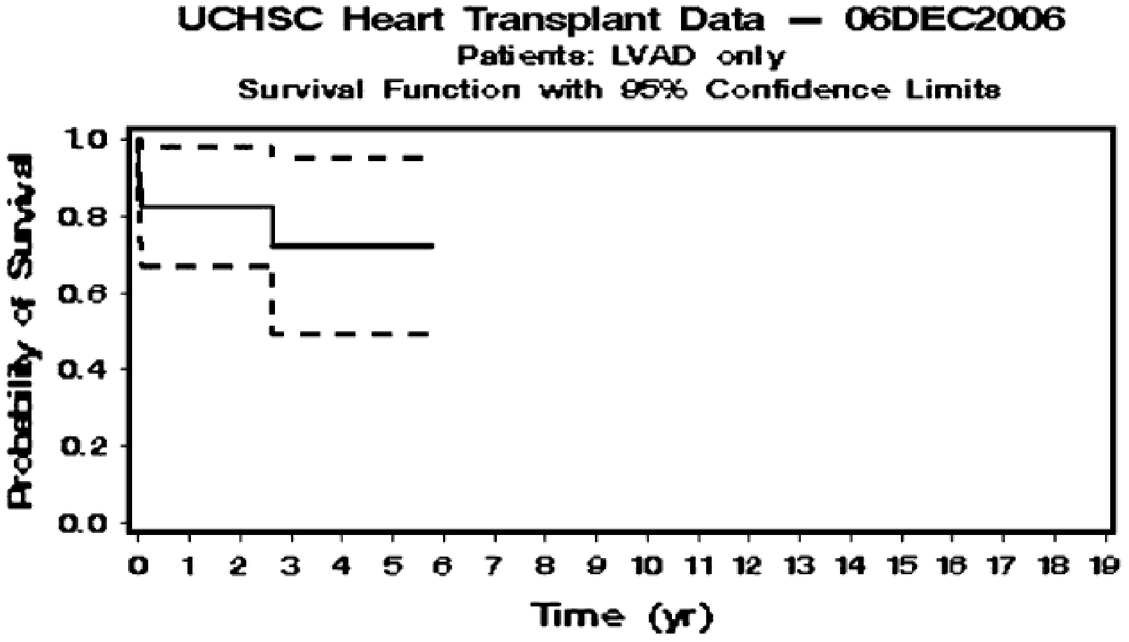



*Circulation*. 2013 January 29; 127(4): 452–462. doi:10.1161/CIRCULATIONAHA.112.100123.

# Left ventricular assist device as bridge to transplantation does not adversely affect one-year heart transplantation survival

Joseph C. Cleveland, Jr, MD,[a] Frederick L. Grover, MD,[a] David A. Fullerton, MD,[a] David N. Campbell, MD,[a] Max B. Mitchell, MD,[a] JoAnn Lindenfeld, MD,[b] Eugene E. Wolfel, MD,[b] Brian D. Lowes, MD,[b] Simon F. Shakar, MD,[b] Andreas Brieke, MD,[b] Anne Cannon, RN, BSN,[a] and Alastair D. Robertson, PhD[b]






Cleveland et al. J Thorac Cardiovasc Surg 2008;136:774-7

# Heart transplantation outcomes in patients with continuous-flow left ventricular assist device-related complications

The Journal of Heart and Lung Transplantation
http://www.jhltonline.org

Mohammed A. Quader, MD, Luke G. Wolfe, MS, and Vigneshwar Kasirajan, MD

*From the Division of Cardiothoracic Surgery, Virginia Commonwealth University, Richmond, Virginia.*

**Table 5** Post-Heart Transplant Survival by Continuous-Flow Left Ventricular Assist Device Complication: Yes or No

| | LVAD complication | | |
|---|---|---|---|
| Post-HTx survival | Yes, % (n = 954) | No, % (n = 1,159) | *p*-value |
| 1 year | 85.60 | 89.90 | 0.0143 |
| 2 years | 82.20 | 86.40 | 0.0132 |
| 3 years | 77.90 | 82.70 | 0.0116 |

HTx, heart transplant; LVAD, left ventricular assist device.

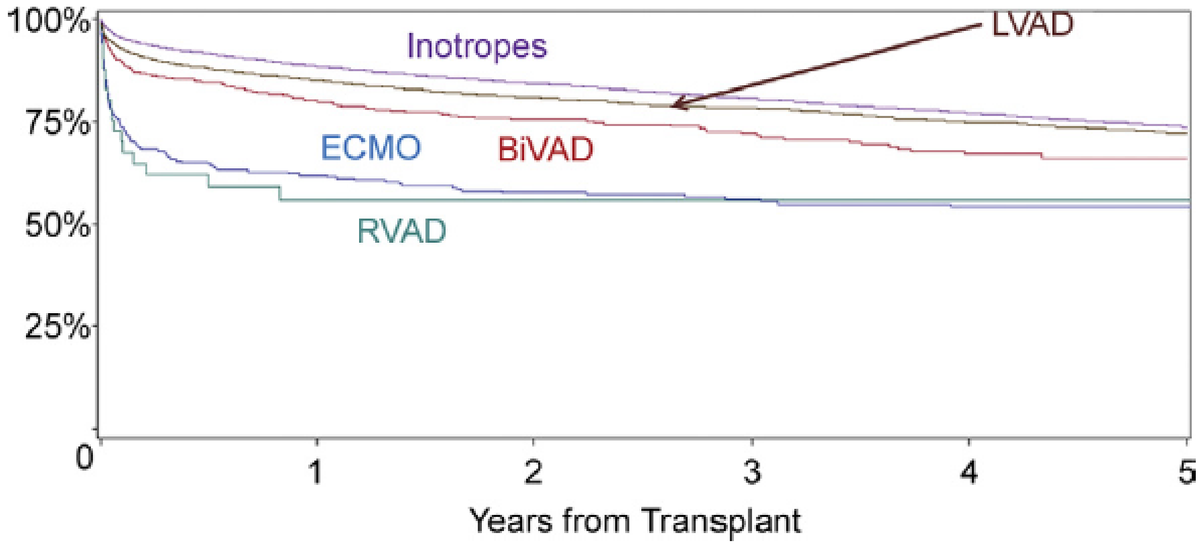


J Heart Lung Transplant 2015;34:75–81

# Mechanical Circulatory Support Pathways That Maximize Post-Heart Transplant Survival

Tara Karamlou, MD, MS, Jill Gelow, MD, Brian S. Diggs, PhD, Frederick A. Tibayan, MD, James M. Mudd, MD, Steven W. Guyton, MD, Matthew S. Slater, MD, and Howard K. Song, MD, PhD

Division of Pediatric Cardiothoracic Surgery, University of California, San Francisco, California; and Division of Cardiova Medicine, Department of General Surgery, and Division of Cardiothoracic Surgery, Oregon Health and Science Universit Portland, Oregon




Unadjusted Survival

*Table 2. Multivariable Factors Associated With Posttransplant Mortality*

| Variable | Hazard Ratio | 95% CI | *p* Value |
|---|---|---|---|
| Female | 1.207 | 1.110–1.311 | <0.001 |
| Most recent PRA, per % | 1.003 | 1.001–1.006 | 0.02 |
| Age, per year | 1.009 | 1.007–1.011 | <0.001 |
| Region 6 | 0.727 | 0.571–0.929 | 0.001 |
| African American | 1.576 | 1.445–1.720 | <0.001 |
| Dx of CHD | 1.819 | 1.560–2.120 | <0.001 |
| Dx of ischemic CM | 1.210 | 1.111–1.318 | <0.001 |
| Dx or RCM | 1.411 | 1.109–1.796 | 0.005 |
| Retransplant | 1.756 | 1.464–2.107 | <0.001 |
| Longer ischemic time, per hour | 1.092 | 1.056–1.129 | <0.001 |
| * LVAD at transplant | 0.707 | 0.593–0.844 | <0.001 |
| RVAD at transplant | 1.886 | 1.140–3.121 | 0.01 |
| Inotropes at transplant | 1.1416 | 1.018–1.290 | 0.02 |
| ECMO at transplant | 2.177 | 1.776–2.670 | <0.001 |
| Higher mean PA pressure at transplant, per mm Hg | 1.008 | 1.004–1.011 | 0.001 |

(Ann Thorac Surg 2013;95:480–5)

# Mechanical Circulatory Support Pathways That Maximize Post-Heart Transplant Survival

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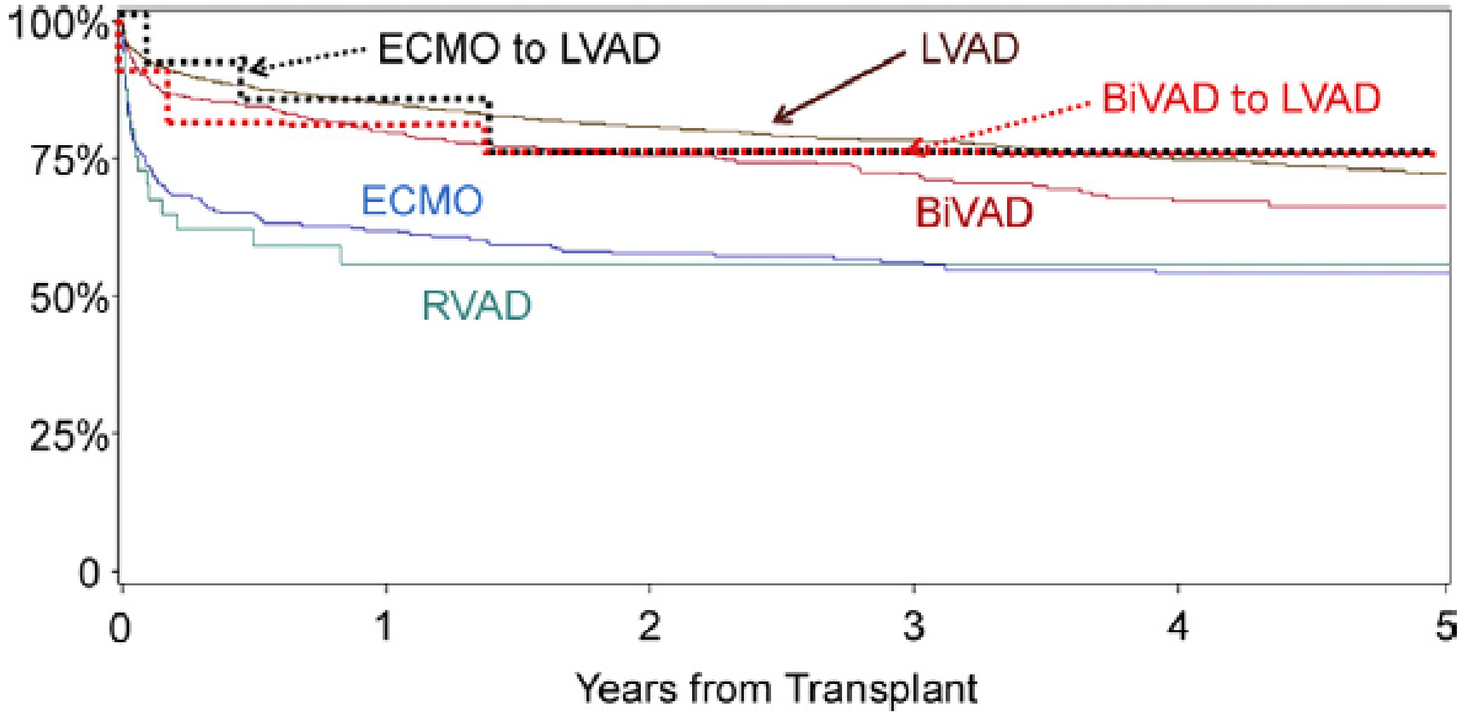
Division of Pediatric Cardiothoracic Surgery, University of California, San Francisco, California; and Division of Cardiovascular Medicine, Department of General Surgery, and Division of Cardiothoracic Surgery, Oregon Health and Science University, Portland, Oregon



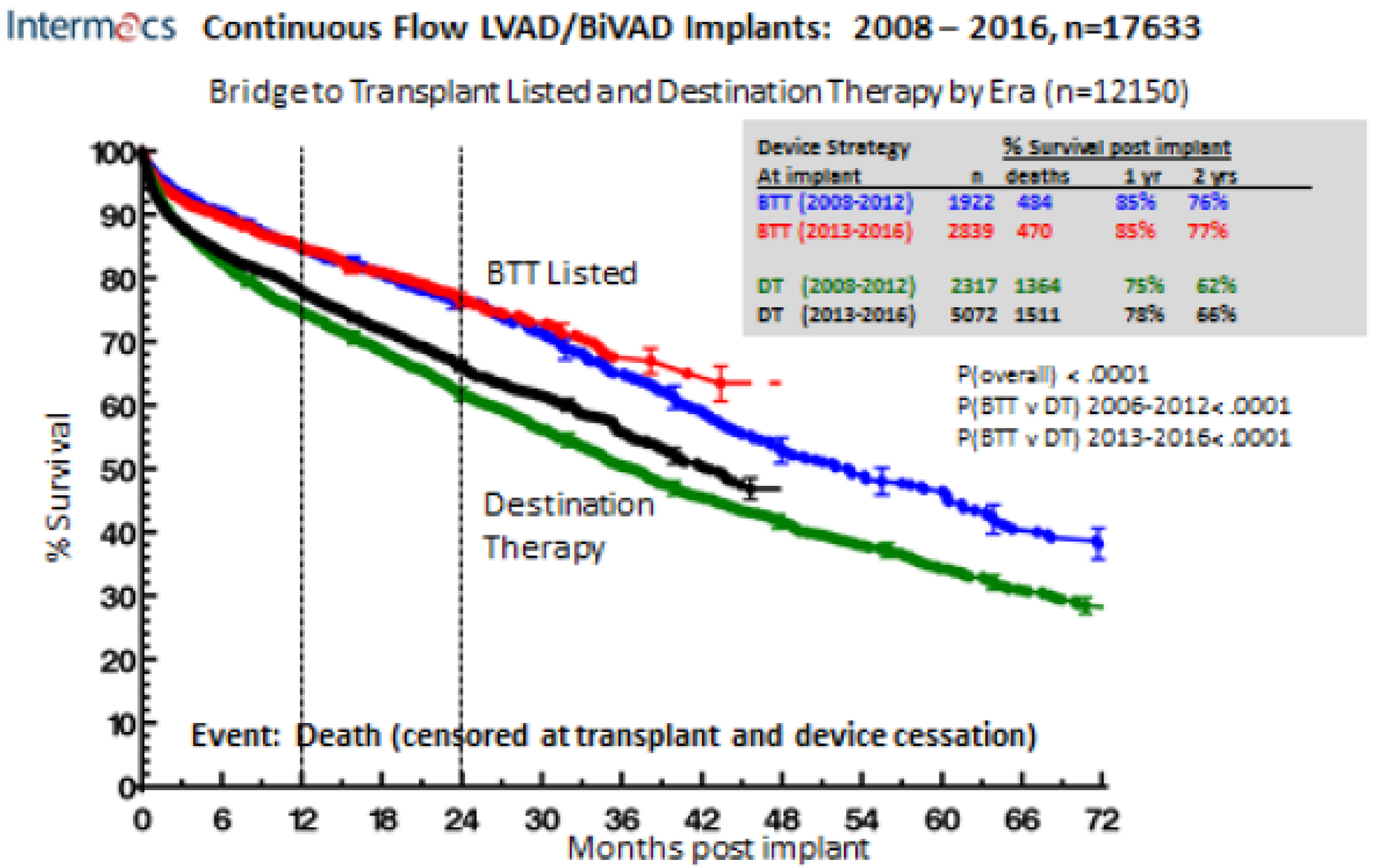



(Ann Thorac Surg 2013;95:480–5)

# LVAD Bridge to Transplantation

- Survival to transplant improved compared to UNOS Status 1A bridged with inotropes or IABP
- LVAD complications adversely affect waitlist survival
- Durable LVADs have superior outcomes compared to temporary LVADs
- The duration of bridging does not affect post-transplant survival

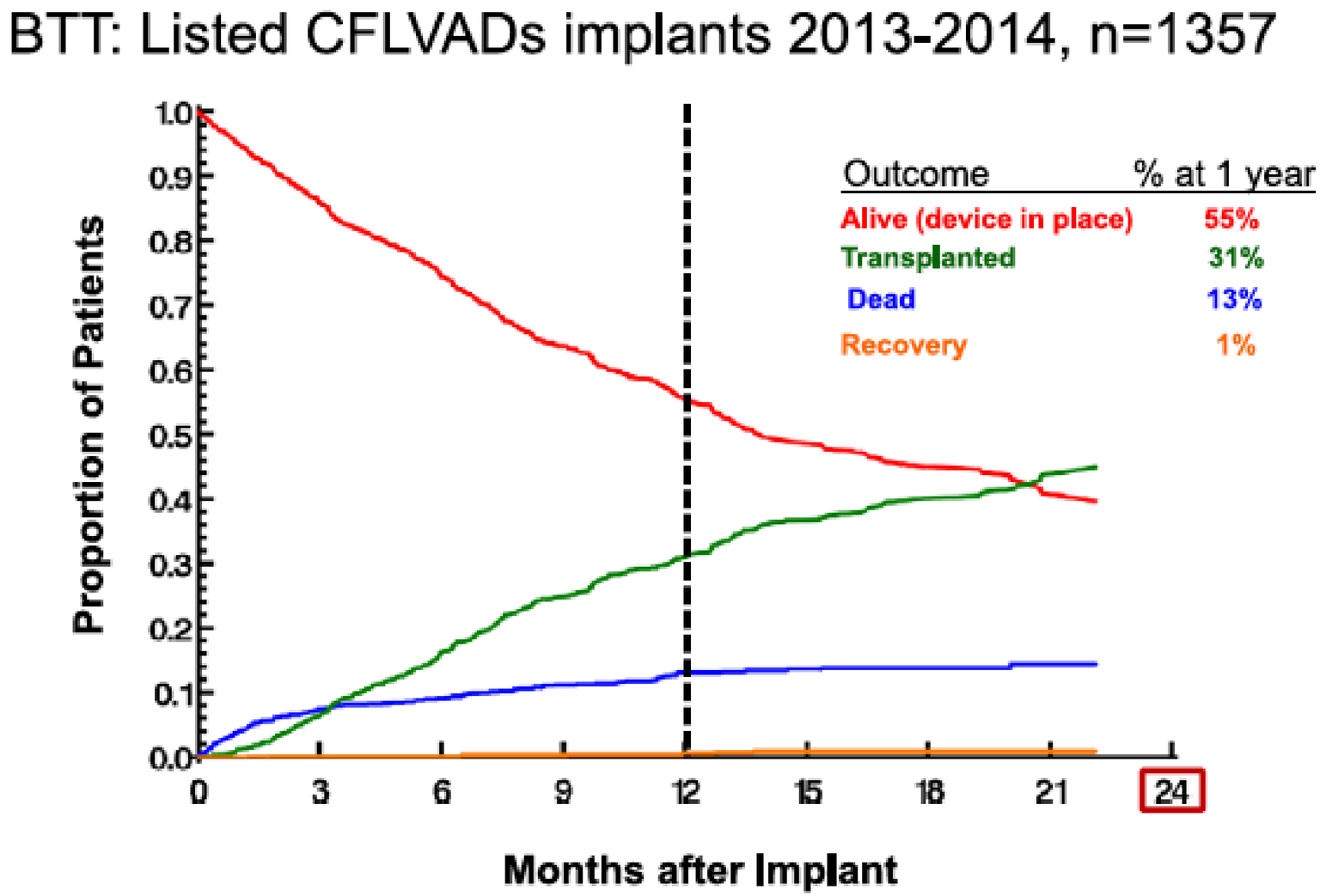
# Survival by Indication




STS/EACTS Latin America Cardiovascular Surgery Conference 2017

Kirklin et al. Eighth Annual Intermacs Report: Special focus on framing the impact of adverse events. J Heart Lung Transplant. 2017;xx:xx-xx. http://dx.doi.org/10.1016/j.healun.2017.07.005

# Competing Outcomes for BTT Indication

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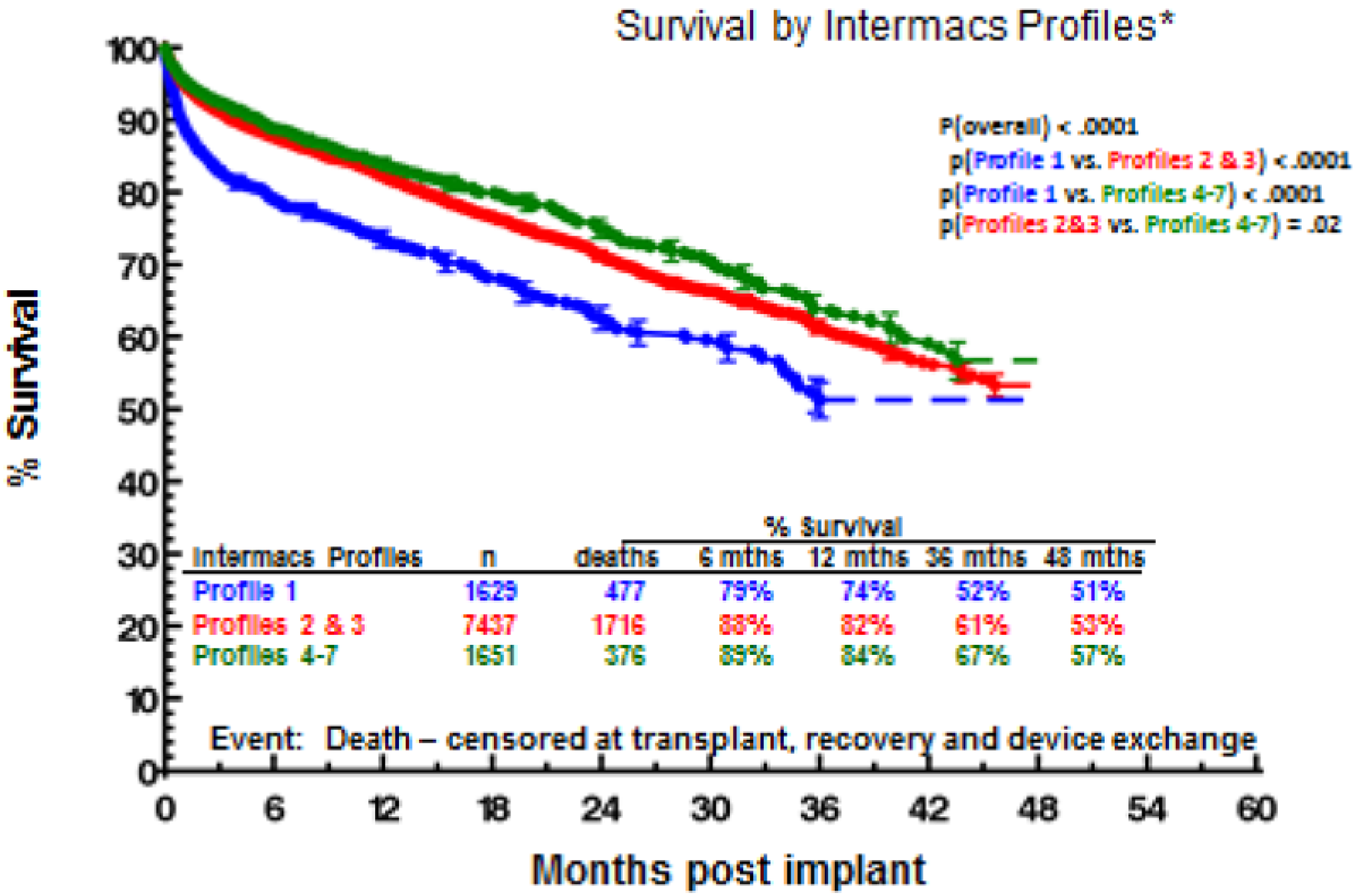
Kirklin et al. Seventh Annual Intermacs Report: 15,000 patients and counting. J Heart Lung Transplant. 2017;34(12):1495-1504.

# Survival by Intermacs Patient Profile




| Intermacs Profiles | n | deaths | % Survival 6 mths | 12 mths | 36 mths | 48 mths |
|---|---|---|---|---|---|---|
| Profile 1 | 1629 | 477 | 79% | 74% | 52% | 51% |
| Profiles 2 & 3 | 7437 | 1716 | 88% | 82% | 61% | 53% |
| Profiles 4-7 | 1651 | 376 | 89% | 84% | 67% | 57% |

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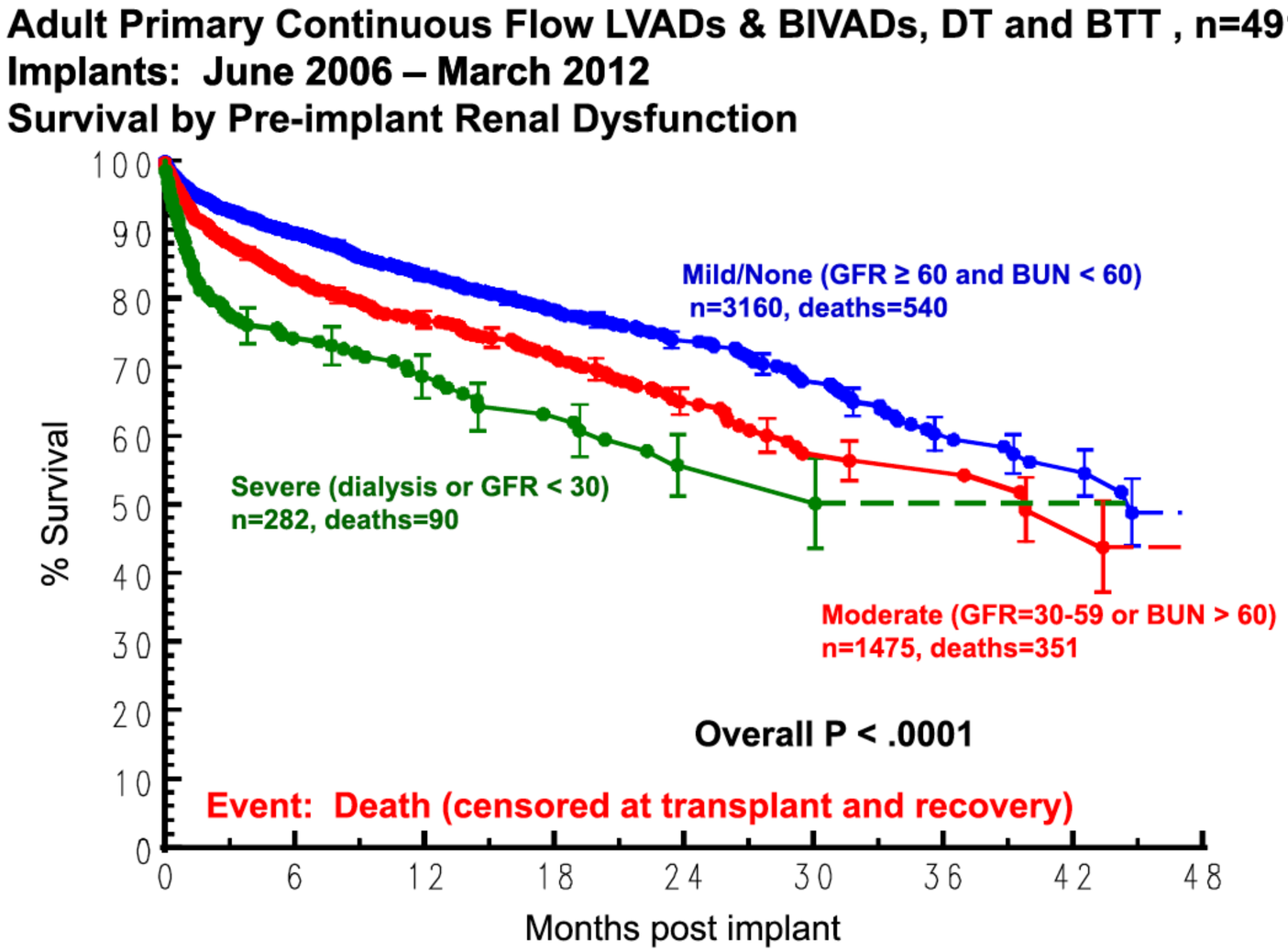
Kirklin et al. Eighth Annual Intermacs Report: Special focus on framing the impact of adverse events. J Heart Lung Transplant. 2017;xx:xx-xx. http://dx.doi.org/10.1016/j.healun.2017.07.005

# Survival by Degree of Renal Dysfunction



Adult Primary CF LVADs and BiVADs Implants: April 2008 to December 2014 ($n = 12{,}030$)

| | Early hazard | | Late hazard | |
|---|---|---|---|---|
| Risk factors for death | Hazard ratio | *p*-value | Hazard ratio | *p*-value |
| Demographics | | | | |
| Age (older) | 1.03 | <0.0001 | 20.75 | 0.008 |
| Female | 1.32 | <0.0001 | | |
| BMI (higher) | 1.10 | <0.0001 | | |
| Blood type not O | | | 10.24 | 0.004 |
| Clinical status | | | | |
| History of stroke | 1.33 | 0.03 | | |
| Ventilator | 1.25 | 0.02 | | |
| ICD | 1.30 | 0.0001 | | |
| INTERMACS Level 1 | 1.55 | <0.0001 | | |
| INTERMACS Level 2 | 1.37 | <0.0001 | | |
| NYHA Class IV | | | 10.23 | 0.03 |
| Destination therapy | 1.23 | <0.0001 | | |
| Non-Cardiac Systems | | | | |
| Albumin (lower) | 1.14 | 0.0007 | | |
| Creatinine (higher) | 1.06 | 0.04 | 10.15 | 0.002 |
| Dialysis | 2.34 | <0.0001 | | |
| BUN (higher) | 1.05 | <0.0001 | | |

Adult Primary CF LVADs and BiVADs Implants: April 2008 to December 2014 ($n = 12{,}030$)

| | Early hazard | | Late hazard | |
|---|---|---|---|---|
| Risk factors for death | Hazard ratio | *p*-value | Hazard ratio | *p*-value |
| Right heart dysfunction | | | | |
| Right atrial pressure (higher) | 1.13 | 0.0004 | | |
| RVAD in same operation | 2.57 | <0.0001 | | |
| Bilirubin (higher) | 1.48 | <0.0001 | | |
| Surgical complexities | | | | |
| History of cardiac surgery | 1.24 | 0.003 | | |
| History of CABG | 1.17 | 0.04 | | |
| Concomitant cardiac surgery | 1.26 | <0.0001 | | |

Kirklin et al. J Heart Lung Transplant. 2015;34:1495-1504.

# Device Landscape 2017

HeartMate 3

HeartMate II

HVAD

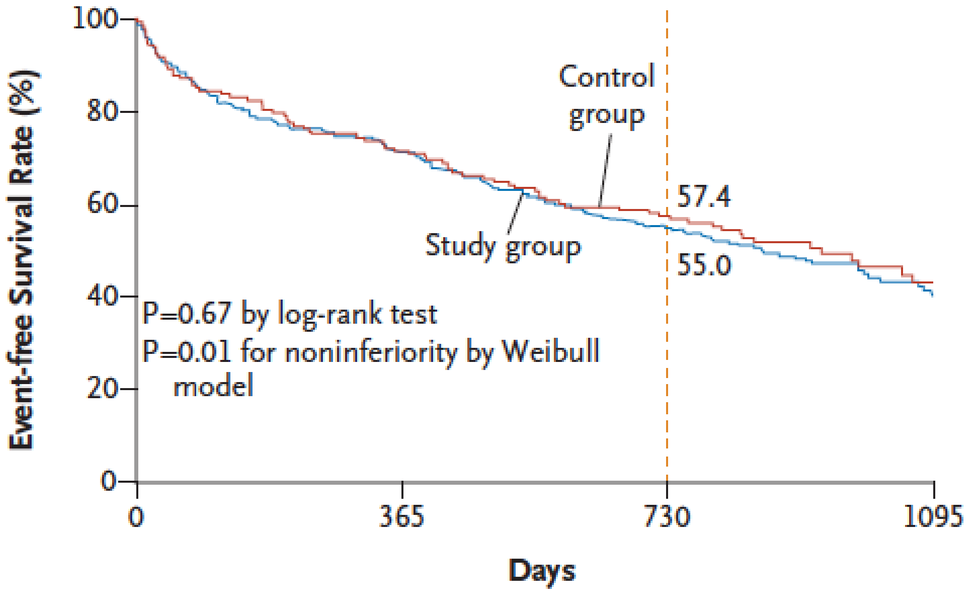
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

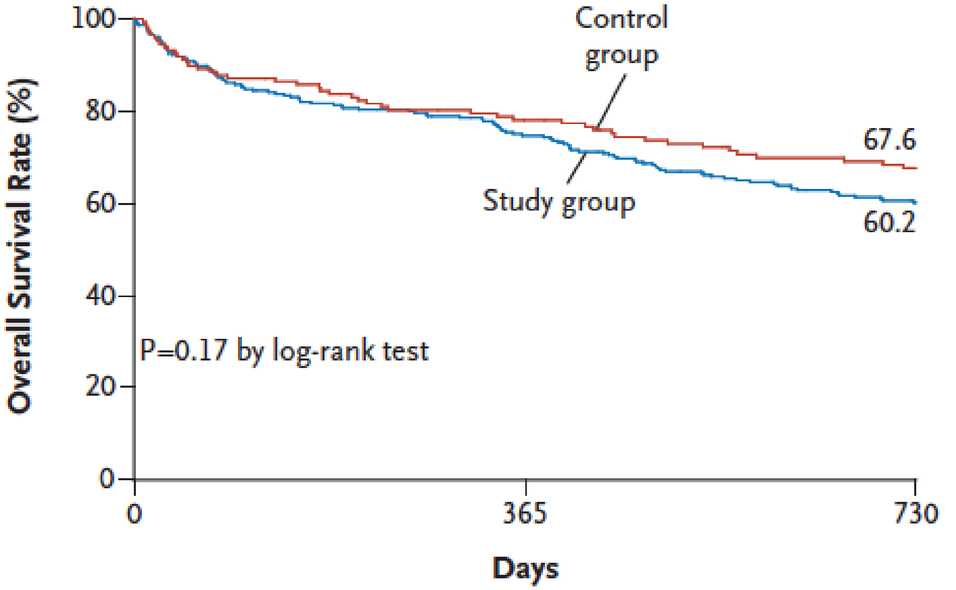
# Intrapericardial Left Ventricular Assist Device for Advanced Heart Failure

Joseph G. Rogers, M.D., Francis D. Pagani, M.D., Ph.D., Antone J. Tatooles, M.D., Geetha Bhat, M.D., Mark S. Slaughter, M.D., Emma J. Birks, M.B., B.S., Ph.D., Steven W. Boyce, M.D., Samer S. Najjar, M.D., Valluvan Jeevanandam, M.D., Allen S. Anderson, M.D., Igor D. Gregoric, M.D., Hari Mallidi, M.D., Katrin Leadley, M.D., Keith D. Aaronson, M.D., O.H. Frazier, M.D., and Carmelo A. Milano, M.D.

N Engl J Med 2017;376:451-60.
DOI: 10.1056/NEJMoa1602954




| No. at Risk | | | | |
|---|---|---|---|---|
| Study group | 297 | 211 | 159 | 33 |
| Control group | 148 | 106 | 82 | 19 |




| No. at Risk | | | |
|---|---|---|---|
| Study group | 296 | 213 | 161 |
| Control group | 149 | 109 | 88 |

N Engl J Med 2017;376:451-60.
DOI: 10.1056/NEJMoa1602954

The NEW ENGLAND JOURNAL of MEDICINE

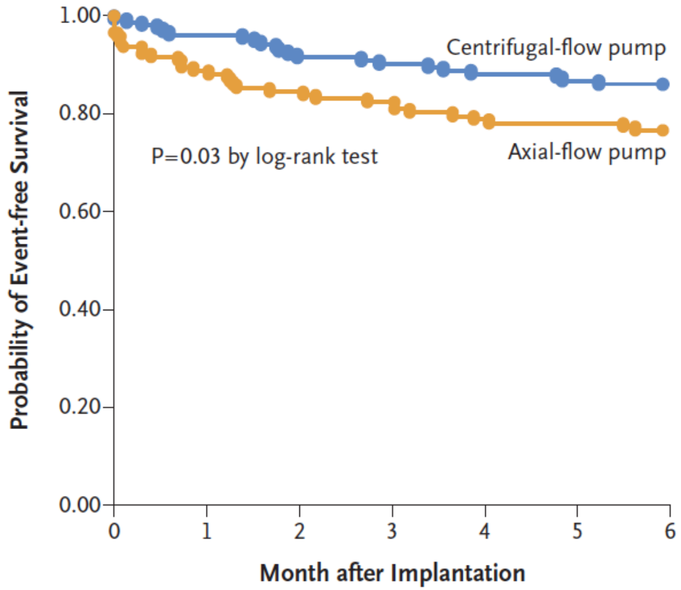
ORIGINAL ARTICLE

# A Fully Magnetically Levitated Circulatory Pump for Advanced Heart Failure

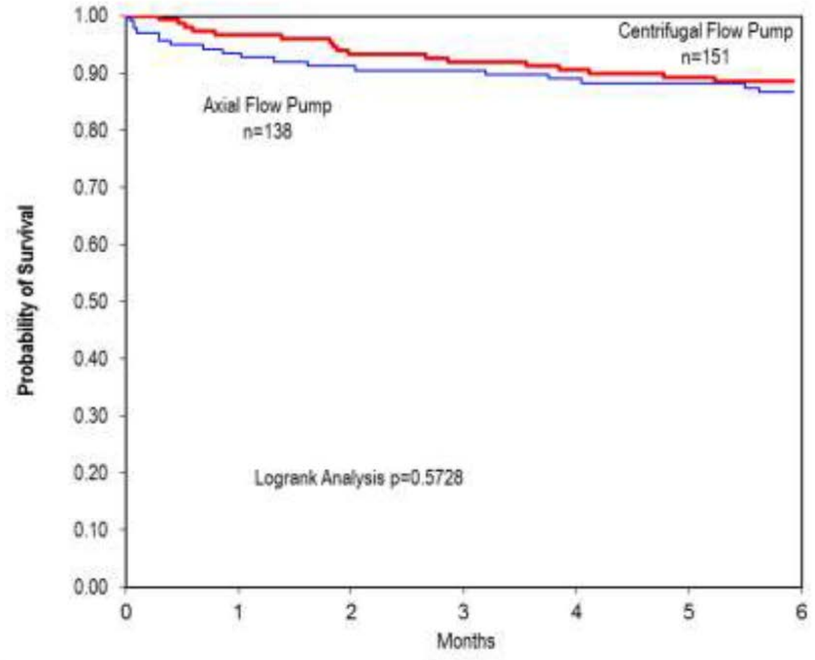
Mandeep R. Mehra, M.D., Yoshifumi Naka, M.D., Nir Uriel, M.D., Daniel J. Goldstein, M.D., Joseph C. Cleveland, Jr., M.D., Paolo C. Colombo, M.D., Mary N. Walsh, M.D., Carmelo A. Milano, M.D., Chetan B. Patel, M.D., Ulrich P. Jorde, M.D., Francis D. Pagani, M.D., Keith D. Aaronson, M.D., David A. Dean, M.D., Kelly McCants, M.D., Akinobu Itoh, M.D., Gregory A. Ewald, M.D., Douglas Horstmanshof, M.D., James W. Long, M.D., and Christopher Salerno, M.D., for the MOMENTUM 3 Investigators*

N Engl J Med 2017;376:440-50.
DOI: 10.1056/NEJMoa1610426

# HeartMate 3: US MOMENTUM TRIAL Short Term Cohort: 6 Months




| No. at Risk | | | | | | | |
|---|---|---|---|---|---|---|---|
| Centrifugal-flow pump | 152 | 146 | 138 | 135 | 130 | 128 | 127 |
| Axial-flow pump | 142 | 125 | 119 | 116 | 110 | 106 | 103 |




| no. at risk | | | | | | | |
|---|---|---|---|---|---|---|---|
| Centrifugal Flow Pump | 151 | 146 | 140 | 137 | 133 | 131 | 130 |
| Axial Flow Pump | 138 | 128 | 123 | 121 | 116 | 112 | 110 |

This article was published on November 16, 2016, at NEJM.org.
DOI: 10.1056/NEJMoa1610426

# Conclusions

- Durable LVADs improve survival to transplant over other bridging strategies
- Transplant outcomes are not affected unless bridging with LVAD complication
- Patient selection key to optimal outcomes
- New devices offer reduced risk of device thrombosis

# STS/EACTS Latin America Cardiovascular Surgery Conference

September 21-22, 2017 | Cartagena, Colombia

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# Thank You

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