

Advanced Heart Failure

2022
ANNUAL
REPORT

Cedars-Sinai is proud to be the **#1** choice for cardiology and cardiac surgery patients.

Ranked **#1** for Cardiology and Cardiac Surgery in California by *U.S. News & World Report*

Find out more

To refer a patient, please call **310-423-3300**.

To schedule a consult, please call **1 800 CEDARS1** (1-800-233-2771).

Please visit our website: **cedars-sinai.org/heart**

Adult Heart Transplant

- * More adult heart transplants than any other U.S. program 2016–2021
- * The No. 1 choice for complex heart transplant patients in the U.S. and around the world

Lung Transplant

- * The leading program for minimally invasive lung transplantation
- * More thoracic organ transplants than any other program in California in 2021

Mechanical Circulatory Support

- * 135 total artificial hearts 2012–2021
- * Over 30,000 hours of ECMO care in 2021

Advanced Heart Failure

- * The best outcomes nationally for patients with advanced heart failure

Robotic Cardiac Surgery

- * >1,000 robotic mitral repairs with >99% success rates
- * The largest robotic cardiac surgery team in the U.S.

Structural Heart Disease

- * The No. 1 choice for complex and high-risk structural heart disease in the U.S.
- * >5,000 TAVR procedures performed to date
- * >1,000 MitraClip procedures performed 2017–2021
- * >200 transcatheter tricuspid repairs and replacements

Aortic Disease

- * >3,000 aortic valve replacements and repairs 2011–2021

Coronary Disease

- * Top outcomes nationally for patients with coronary artery disease
- * National leaders in advanced percutaneous, surgical and hybrid coronary revascularization

Electrophysiology

- * National leaders in cardiac arrest prevention

Pediatric and Congenital Heart Disease

- * First-in-Man with novel percutaneous pulmonary valve replacement
- * The first choice for congenital cardiac care, from conception to advanced age

Contents

- 4 Transformative Research Themes
- 6 Advanced Heart Failure
- 8 Heart and Lung Transplant and Mechanical Circulatory Support
- 10 Mitral and Tricuspid Valve
- 12 Aortic Valve
- 14 Coronary Disease
- 16 Aortic and Vascular Surgery
- 17 Electrophysiology
- 18 Women's Heart
- 19 Congenital Heart Disease
- 21 Metrics

Dear Colleagues,

It is with considerable pride that we share our annual report for 2022. We are particularly proud that the Smidt Heart Institute takes exceptional care of the patients with the most complex and challenging conditions, which have often been deemed too risky for intervention elsewhere. We don't always succeed in turning the tide of disease, but we never stop trying. We are here for you and your patients. Please feel free to reach out if we can help, at any time.



Smidt Heart Institute

Executive Director: Eduardo Marbán, MD, PhD
Mark Siegel Family Foundation Distinguished Chair
Professor of Cardiology



Department of Cardiology

Chair: Christine M. Albert, MD, MPH
Lee and Harold Kapelovitz Distinguished Chair in Cardiology
Professor of Cardiology
President 2020–2021, Heart Rhythm Society



Department of Cardiac Surgery

Chair: Joanna Chikwe, MD
Irina and George Schaeffer Distinguished Chair
in Cardiac Surgery in honor of Alfredo Trento, MD
Professor of Cardiac Surgery
Editor-in-Chief, *The Annals of Thoracic Surgery*

Transformative Research Themes

REGENERATIVE MEDICINE

Team Leader: Eduardo Marbán, MD, PhD

Questions: How can you reverse “irreversible” injury to the heart? Can cells and their products be used to create new biological agents?

Accomplishments: Cutting-edge clinical trials of cell therapy in Duchenne muscular dystrophy and in heart failure. Major discovery program for novel RNA-based drugs based on exosome contents.

NOVEL THERAPIES FOR CARDIAC ARRHYTHMIAS

Team Leaders: Eugenio Cingolani, MD;

Peng-Sheng Chen, MD

Question: Are there viable alternatives to devices and ablation for heart rhythm disorders?

Accomplishments: First biological pacemakers in clinically relevant animal models. Novel nondestructive treatment of refractory ventricular tachycardia by biologics. New approaches to autonomic system modulation.

VASCULAR BIOLOGY

Team Leaders: Prediman K. Shah, MD; Ali Azizzadeh, MD

Questions: Can atherosclerosis be prevented or reversed? How can we spare major surgery in vasculopathic patients?

Accomplishments: Proof of principle for anti-cholesterol vaccine strategy. Proteomics-based discovery of novel pathways mediating vascular injury. Clinical testing of new percutaneous approaches to complex bifurcating lesions.

BIOMARKER DISCOVERY AND VALIDATION

Team Leader: Jennifer Van Eyk, PhD

Question: How can we detect disease before it is clinically apparent?

Accomplishments: Bench-to-bedside approach implemented to facilitate biomarker discovery. Use of inflammatory biomarkers to monitor coronary disease progression in large populations.

COVID-19

Team Leader: Susan Cheng, MD, MHP, MMSc

Question: What factors predispose to bad outcomes in COVID-19?

Accomplishments: First major population-based prospective study, CORALE, used to detect autoimmune activation in COVID-19 healthcare providers.

HYPERTENSION

Team Leader: Natalie Bello, MD, MPH

Question: How can we best treat high blood pressure in vulnerable populations?

Accomplishments: Clinical trials of community-based intervention. Mechanisms of hypertension in women and minorities.

HEART FAILURE

Team Leaders: Joshua Goldhaber, MD;

Jon A. Kobashigawa, MD; Fardad Esmailian, MD

Questions: What are the basic mechanisms of HFpEF? What are the optimal immunosuppression regimens for transplant patients?

Accomplishments: Discovery of fundamental abnormalities of calcium cycling and excitability in models of HFpEF. Clinical trials of transplant management regimens.

WOMEN'S HEART HEALTH

Team Leader: C. Noel Bairey Merz, MD

Question: What sex-specific factors underlie chest pain and heart failure?

Accomplishments: Clinical studies documenting INOCA in women with angina. Epidemiology of Takotsubo cardiomyopathy revealed.

SUDDEN CARDIAC DEATH

Team Leaders: Christine Albert, MD, MPH;

Sumeet Chugh, MD

Questions: Why do people with seemingly normal hearts die suddenly? Can we identify populations at high risk for focused intervention?

Accomplishments: Major epidemiological studies in multiple cohorts reveal disparities in sudden death related to socioeconomic status. Relationships with modest ventricular dysfunction elucidated.

VALVULAR HEART DISEASE

Team Leaders: Raj Makkar, MD; Joanna Chikwe, MD

Questions: When should we do surgery versus percutaneous intervention? How often are artificial valves plagued by thrombus?

Accomplishments: Leading pivotal trials comparing SAVR vs. TAVR and surgical vs. transcatheter mitral repair. First-in-human studies on tricuspid valve replacement. Discovery of common clinically inapparent thrombi on surgical and percutaneous valves.

HEALTHCARE DELIVERY OPTIMIZATION

Team Leader: Joseph Ebinger, MD

Question: How can we produce better clinical outcomes while minimizing resource utilization?

Accomplishments: Real-time monitoring of costs and outcomes to enable tests of change in realistic clinical settings.

IMAGING

Team Leaders: Daniel Berman, MD; Debiao Li, PhD

Questions: How can we interpret clinical imaging studies optimally? Can we image coronary lesions without dye?

Accomplishments: Use of artificial intelligence to read echocardiograms and nuclear studies. Novel pulse protocols to offset MRI cardiac motion artifacts.

Highest-Impact Publications

from the Smidt Heart Institute at Cedars-Sinai

Nature and Nature Journals

- **Ouyang D**, He B, Ghorbani A, Yuan N, **Ebinger J**, et al. Video-based AI for beat-to-beat assessment of cardiac function. *Nature*. 2020 Apr;580(7802):252-256. PMID: 32269341.
- Ranek MJ, Kokkonen-Simon KM, Chen A, Dunkerly-Eyring BL, Vera MP, Oeing CU, Patel CH, Nakamura T, Zhu G, Bedja D, Sasaki M, **Holewinski RJ**, **Van Eyk JE**, et al. PKG1-modified TSC2 regulates mTORC1 activity to counter adverse cardiac stress. *Nature*. 2019 Feb;566(7743):264-269. PMID: 30700906
- Lee DI, Zhu G, Saski T, Cho GS, Hamdani N...**Van Eyk J** et al. Phosphodiesterase 9A controls nitric oxide-independent cGMP and hypertrophic heart disease. *Nature*. 2015; 519: 472-6. PMID 25799991
- **Ebinger JE**, **Fert-Bober J**, Printsev I, Wu M, Sun N, Prostko JC, Frias EC, Stewart JL, **Van Eyk JE**, Braun JG, **Cheng S**, Sobhani K. Antibody responses to the BNT162b2 mRNA vaccine in individuals previously infected with SARS- CoV-2. *Nat Med*. 2021 Jun;27(6):981-984.PMID: 33795870.
- Wu E, Wu K, Daneshjou R, **Ouyang D**, Ho DE, Zou J. How medical AI devices are evaluated: limitations and recommendations from an analysis of FDA approvals. *Nat Med*. 2021 Apr;27(4):582-584. PMID: 33820998.
- Laperle AH, Sances S, et al **Van Eyk JE**, Tagliati M, **Svendsen CN**. iPSC modeling of young-onset Parkinson's disease reveals a molecular signature of disease and novel therapeutic candidates. *Nat Med*. 2020;26(2):289-299.
- **Bairey Merz CN**, Dember LM, Ingelfinger JR, et al; Sex and the Kidneys: Current Understanding and Research Opportunities. *Nature Reviews Nephrology*. 2019. Epub 2019/10/06.PubMed PMID: 31586165.
- Salosensaari A, Laitinen V, Havulinna AS, Meric G, **Cheng S** et al Taxonomic signatures of cause-specific mortality risk in human gut microbiome. *Nat Commun*. 2021 May 11;12(1):2671. PMID: 33976176
- Ranek MJ, Oeing C, Sanchez-Hodge R, et al Agrawal V, Hahn V, Lee DI, Sasaki M, **Van Eyk JE**, et al. CHIP phosphorylation by protein kinase G enhances protein quality control and attenuates cardiac ischemic injury. *Nat Commun*. 2020 Oct 20;11(1):5237. PMID: 33082318

- Adhikari S, Nice EC, Deutsch EW et al **Van Eyk JE**, et al. A high-stringency blueprint of the human proteome. *Nat Commun*. 2020 Oct 16;11(1):5301. PMID: 33067450;
- Giraddi RR, **Shehata M**, Gallardo M, et al. Stem and progenitor cell division kinetics during postnatal mouse mammary gland development. *Nat Commun*. 2015 Oct 29;6:8487. doi: 10.1038/ncomms9487. PMID: 2651166

Science, Cell, The Lancet, Journal of Clinical Investigation, Proceedings of the National Academy of Science

- McDonald CM, MD, **Marbán E MD, PhD**, Hendrix S, et al. Human Cardiosphere-derived Cells in Late-stage Duchenne Muscular Dystrophy: a multicentre, randomised, double-blind, placebo-controlled, phase 2 trial. *Lancet* 2021 In Press
- **Gottlieb RA**, Bernstein D. METABOLISM. Mitochondria shape cardiac metabolism. *Science*. 2015 Dec 4;350(6265):1162-3 PMID: 26785456
- Wolf AJ, Reyes CN, Liang W, Becker C et al, **Arditi M**, Underhill DM. Hexokinase Is an Innate Immune Receptor for the Detection of Bacterial Peptidoglycan. *Cell*. 2016 Jul 28;166(3):624-36. PMID: 27374331
- Mishra R, Haldar S, Placencio V, Madhav A, Rohena-Rivera K, Agarwal P, Duong F, Angara B, Tripathi M, Liu Z, **Gottlieb RA**, Wagner S, Posadas EM, Bhowmick NA. Stromal epigenetic alterations drive metabolic and neuroendocrine prostate cancer reprogramming. *J Clin Invest*. 2018 Oct 1;128(10):4472-4484. PMID: 30047926
- **Chung HS**, Kim GE, **Holewinski RJ**, **Venkatraman V**, Zhu G, Bedja D, Kass DA, **Van Eyk JE**. Transient receptor potential channel 6 regulates abnormal cardiac S-nitrosylation in Duchenne muscular dystrophy. *Proc Natl Acad Sci U S A*. 2017;114(50)
- Vadakke-Madathil S, LaRocca G, **Raedschelders K**, Yoon J, **Parker SJ**, et al **Van Eyk JE**, Chaudhry HW. Multipotent fetal-derived Cdx2 cells from placenta regenerate the heart. *Proc Natl Acad Sci U S A*. 2019 11;116(24):11786-11795

Advanced Heart Failure

EXPERTISE

Advanced Heart Failure
Valvular Cardiomyopathy
Implantable Monitors
Amyloidosis
Constrictive Pericarditis
Mechanical Support
Hypertrophic Cardiomyopathy
Non-Compaction
Cardiomyopathy
Gene Therapy
Ischemic Cardiomyopathy
Pulmonary Hypertension
Heart Transplantation
Sarcoidosis
Chemotherapy
Cardiomyopathy
Mechanical Support
Postpartum Cardiomyopathy
Arrhythmogenic RV Dysplasia
Gene Therapy
Myocarditis
Cardiac Tumors
Advanced Outpatient Therapy
Diastolic Heart Failure
Adult Congenital Heart Disease

MAJOR PROGRAMS

Advanced Heart Failure Program
Director: Michele Hamilton, MD, Vice-Chair of Clinical Affairs, Department of Cardiology, Director of the Heart Failure Program and Professor of Cardiology

Hypertrophic Cardiomyopathy Program
Director: Robert J. Siegel, MD, S. Rexford Kenamer, MD Chair in Cardiac Ultrasound, and Professor of Cardiology

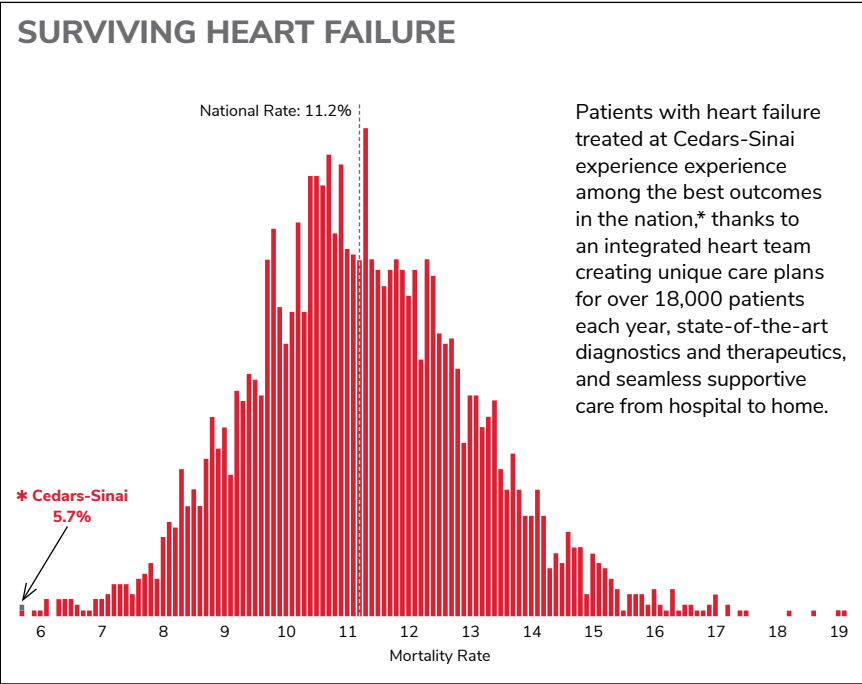
Cardiac Amyloid Program
Director: Jignesh K. Patel, MD, PhD, Clinical Professor of Medicine

Pulmonary Hypertension Program
Directors: Antoine Hage, MD; Michael Lewis, MD

Cardio-oncology Program
Director: C. Noel Bairey Merz, MD, Irwin and Sheila Allen Chair in Women's Heart Research, and Professor of Cardiology

Coronary Care Unit
Director: Bojan Cercek, MD, PhD, Eleanore and Harold Foonberg Chair in Cardiac Intensive Care in honor of Prediman K. Shah, MD, and Professor of Cardiology

Cardiac Surgery Intensive Care Unit
Medical Director: Michael Nurok, MD, Associate Professor of Cardiac Surgery
Surgical Director: Dominic Emerson, MD, Assistant Professor of Cardiac Surgery



*Source: Hospital Compare. Learn more at cedars-sinai.org/heartfailure

Highest-Impact Publications from the Smidt Heart Institute at Cedars-Sinai

Nature

- **Ouyang D**, He B, Ghorbani A, Yuan N, **Ebinger J**, et al. Video-based AI for beat-to-beat assessment of cardiac function. *Nature*. 2020 Apr;580(7802):252-256. PMID: 32269341.

New England Journal of Medicine

- Mehra MR, Uriel N, Naka Y, et al **MOMENTUM 3 Investigators**. A Fully Magnetically Levitated Left Ventricular Assist Device – Final Report. *N Engl J Med*. 2019;380(17):1618-1627.PMID: 30883052
- McMurray JJ, Krum H, Abraham WT, et al **ATMOSPHERE Committees Investigators**. Liskiren, Enalapril, or Aliskiren and Enalapril in Heart Failure. *N Engl J Med*. 2016;374:1521-32. PMID: 27043774
- **Victor RG**, Lynch K, Li N, **Blyler C**, **Muhammad E**, Handler J, Brettler J, **Rashid M**, **Hsu B**, **Foxx-Drew D**, **Moy N**, **Reid AE**, Elashoff RM. A Cluster-Randomized Trial of Blood-Pressure Reduction in Black Barbershops. *N Engl J Med*. 2018;378(14):1291-1301. PMID: 29527973
- Maurer MS, Schwartz JH, Gundapaneni B, et al; **ATTR-ACT Study Investigators**. Tafamidis Treatment for Patients with Transthyretin Amyloid Cardiomyopathy. *N Engl J Med*. 2018;379:1007-1016. PMID: 30145929
- Stone GW, Lindenfeld J, Abraham WT, **Kar S**, et al; **COAPT Investigators**. Transcatheter Mitral-Valve Repair in Patients with Heart Failure. *N Engl J Med*. 2018 Dec 13;379(24):2307-2318. PMID: 30280640

The Lancet

- Azizi M, Schmieder RE, Mahfoud F, Weber MA, Daemen J, Davies J, Basile J, Kirtane AJ, Wang Y, Lobo MD, Saxena M, Feyz L, **Rader F**, et al; **RADIANCE-HTN SOLO** Investigators. Endovascular ultrasound renal denervation to treat hypertension (RADIANCE-HTN SOLO): a multicentre, international, single-blind, randomised, sham-controlled trial. *Lancet*. 2018 Jun 9;391(10137):2335-2345. PMID: 29803590

- Patel AN, **Henry TD**, Quyyumi AA, et al; ixCELL-DCM Investigators. Ixmyelocel-T for patients with ischaemic heart failure: a prospective randomised double-blind trial. *Lancet*. 2016 Jun 11;387(10036):2412-21. PMID: 27059887
- Ardehali A, **Esmailian F**, Deng M, Soltesz E, Hsich E, Naka Y, Mancini D, Camacho M, Zucker M, Leprince P, Padera R, **Kobashigawa J**; PROCEED II trial investigators. Ex-vivo perfusion of donor hearts for human heart transplantation (PROCEED II): a prospective, open-label, multicentre, randomised non-inferiority trial. *Lancet*. 2015 Apr 14. pii: S0140-6736(15)60261-6. PMID: 25888086

Journal of the American College of Cardiology

- **Emerson D**, **Chikwe J**, **Catarino P**, **Hassenein M**, Deng L, Cantor RS, **Roach A**, **Cole R**, **Esmailian F**, **Kobashigawa J**, **Moriguchi J**, Kirklin JK. Contemporary Left Ventricular Assist Device Outcomes in an Aging Population: AN STS Intermacs Analysis. *J Am Coll Cardiol* 2021; 78: 883-894

Circulation

- Djoussé L, Cook NR, Kim E, Bodar V, Walter J, Bubes V, Luttmann-Gibson H, Mora S, Joseph J, Lee IM, **Albert CM**, Buring JE, Gaziano JM, Manson JE; VITAL Research Group. Supplementation With Vitamin D and Omega-3 Fatty Acids and Incidence of Heart Failure Hospitalization: VITAL-Heart Failure. *Circulation*. 2020 Mar 3;141(9):784-786.
- **Kittleson MM**, Maurer MS, Ambardekar AV, Bullock-Palmer RP, Chang PP, Eisen HJ, Nair AP, Nativi-Nicolau J, Ruberg FL; American Heart Association Heart Failure and Transplantation Committee of the Council on Clinical Cardiology. Cardiac Amyloidosis: Evolving Diagnosis and Management: A Scientific Statement From the American Heart Association. *Circulation*. 2020 Jul 7;142(1):e7-e22

Heart and Lung Transplant and Mechanical Circulatory Support

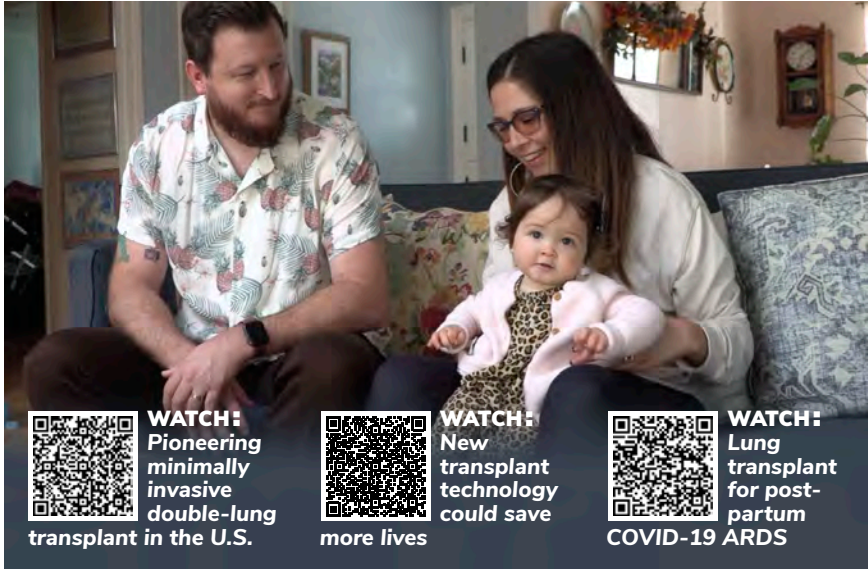
EXPERTISE

Heart Transplantation
Lung Transplantation
Minimally Invasive Lung Transplantation
Heart-Kidney Transplantation
Multi-Organ Lung Transplantation
Heart-Liver Transplantation
Heart-Lung Transplantation
Sensitized Transplantation
Advanced Transplant Immunology
Complex and Re-Transplantation
HLA Immunogenetics
Cardiac Biopsy
Organ Circulatory Support Transplantation
Organ Circulatory Support Transplantation
Pulmonary Fibrosis
Next-Generation Ventricular Assist Devices
Emphysema
Total Artificial Heart Program
COVID-19 Acute Respiratory Distress Syndrome
Percutaneous Mechanical Circulatory Support
COVID-19 Pulmonary Fibrosis
Pulmonary Hypertension

MAJOR PROGRAMS

Heart Transplant and Mechanical Circulatory Support Program
Director: Jon A. Kobashigawa, MD, DSL/Thomas D. Gordon Chair in Transplantation Medicine and Professor of Cardiology
Surgical Director: Fardad Esmailian, MD, Professor of Cardiac Surgery
Medical Directors: Jignesh Patel, MD, PhD, Professor of Medicine
Lawrence Czer, MD, Professor of Medicine

Lung Transplant Program
Surgical Director: Dominick Megna, MD, Assistant Professor of Cardiac Surgery
Medical Director: Reinaldo Rampolla, MD, Associate Professor of Medicine



602

heart transplants performed at Cedars-Sinai 2017-2021

More adult heart transplants than any other U.S. program

157

thoracic organ transplants performed in FY2021

The No. 1 choice for less invasive lung transplant

135

Total artificial hearts implanted at Cedars-Sinai 2012-2021

144 days: longest successful ECMO support at Cedars-Sinai

Highest-Impact Publications from the Smidt Heart Institute at Cedars-Sinai

New England Journal of Medicine

- Roach A, Chikwe J, Catarino P, Emerson D, Megna D, Rampolla R, Noble P, Egorova N, Keshavjee S, Kirklin JK. Lung Transplantation for COVID-19 Respiratory Failure in the United States. *N Engl J Med*. 2022 doi: 10.1056/NEJMc2117024
- Mehra MR, Uriel N, Naka Y et al; **MOMENTUM 3** Investigators. A Fully Magnetically Levitated Left Ventricular Assist Device - Final Report. *N Engl J Med*. 2019 Apr 25;380(17):1618-1627. doi: 10.1056/NEJMoa1900486. Epub 2019 Mar 17. PMID: 30883052

The Lancet

- Leprince P, Padera R, **Kobashigawa J**; PROCEED II trial investigators. Ex-vivo perfusion of donor hearts for human heart transplantation (PROCEED II): a prospective, open-label, multicentre, randomised non-inferiority trial. *Lancet*. 2015 Apr 14. pii: S0140-6736(15)60261-6. doi: 10.1016/S0140-6736(15)60261-6. PMID: 25888086

Circulation

- **Kittleson MM**, Maurer MS, Ambardekar AV, et al; AHA Heart Failure and Transplantation Committee of the Council on Clinical Cardiology. Cardiac Amyloidosis: Evolving Diagnosis and Management: A Scientific Statement From the AHA. *Circulation*. 2020 Jul 7;142(1):e7-e22 PMID: 32476490.
- **Kittleson MM**, Garg S. Solid Gold, or Liquid Gold?: Towards a New Diagnostic Standard for Heart Transplant Rejection. *Circulation*. 2021 Mar 23;143(12):1198-1201 PMID: 33750203.
- Colvin MM, Cook JL, Chang PP, Hsu DT, Kiernan MS, **Kobashigawa JA**, et al; American Heart Association Heart Failure and Transplantation Committee of the Council on Clinical Cardiology; Sensitization in Heart Transplantation: Emerging Knowledge: A Scientific Statement From the American Heart Association. *Circulation*. 2019 Mar 19;139(12):e553-e578. PMID: 30776902
- Stehlik J, **Kobashigawa J**, Hunt SA, Reichenspurner H, Kirklin JK. Honoring 50 Years of Clinical Heart Transplantation in Circulation: In-Depth State-of-the-Art Review. *Circulation*. 2018 Jan 2;137(1):71-87.

Journal of the American College of Cardiology

- Emerson D, Chikwe J, Catarino P, Hassenein M, Deng L, Cantor RS, **Roach A**, Cole R, Esmailian F, **Kobashigawa J**, Moriguchi J, Kirklin JK. Contemporary Left Ventricular Assist Device Outcomes in an Aging Population: AN STS Intermacs Analysis. *J Am Coll Cardiol* 2021; 78: 883-894
- Fearon WF, Okada K, **Kobashigawa JA**, Kobayashi Y, Luikart H, Sana S, Daun T, Chmura SA, Sinha S, Cohen G, Honda Y, Pham M, Lewis DB, Bernstein D, Yeung AC, Valantine HA, Khush K. Angiotensin-Converting Enzyme Inhibition Early After Heart Transplantation. *J Am Coll Cardiol*. 2017 Jun 13;69(23):2832-2841. doi: 10.1016/j.jacc.2017.03.598. PMID: 28595700

Journal of Heart and Lung Transplantation

- Messer S, Abu-Omar Y, Large SR, Berman M, Page A, Kaul P, Arrowsmith JE, Quigley R, Cheshire C, Patterson C, Thomas D, Awallwrok J, Parmar J, **Catarino P**. Combined heart-lung Transplantation from a donor after circulatory death donor. *J Heart Lung Transplant* 2020; 39: 1366-1371
- Van Raemdonck D, Keshavjee S, Levey B, Cherikh WS, Snell G, Erasmus M, Simon A, Glanville AR, Clark S, D'Ovidio F, **Catarino P** et al. International Society for Heart and Lung Transplantation. Donation after circulatory death in lung transplantation—five-year follow-up from ISHLT registry. *J Heart Lung Transplant* 2019; 38: 1235-1245
- **Kittleson MM**, Chamber DC, Cypel M, Potena L. COVID-19 in recipients of heart and lung transplantation: learning from experience. *J Heart Lung Transplant* 2021; 40: 948-950

American Journal of Transplantation

- **Kobashigawa J**, Dadhania D, Farr J, et al. Consensus Conference on Heart-Kidney Transplantation. *Am J Transplant*. 2021 Jul;21(7):2459-2467

Mitral and Tricuspid Valve

EXPERTISE

Robotic Mitral Repair
Transcatheter Mitral Repair
Mitral Valve Prolapse
Barlow's Mitral Repair
Transcatheter Mitral Replacement
Mitral Valve Endocarditis
Redo-Mitral Repair
Transcatheter Tricuspid Repair
Mitral Annular Calcification
Tricuspid Repair
Transcatheter Tricuspid Replacement
Tricuspid Regurgitation
Atrial Ablation
Left Atrial Appendage Closure
Valvular Carcinoid

MAJOR PROGRAMS

Department of Cardiac Surgery
Chair: Joanna Chikwe, MD, Irina and George Schaeffer Distinguished Chair in Cardiac Surgery in honor of Alfredo Trento, and Professor of Cardiac Surgery
Director Emeritus: Alfredo Trento, MD, Estelle, Abe and Marjorie Sanders Chair in Cardiac Surgery and Professor of Cardiac Surgery

Cardiac Interventional Services
Director: Raj Makkar, MD, Stephen R. Corday, MD Chair in Interventional Cardiology, Vice President of Cardiovascular Innovation and Intervention and Professor of Cardiology

Robotic Cardiac Surgery Program
Director: Danny Ramzy, MD, Associate Professor of Cardiac Surgery



MITRAL VALVE REPAIR

>1,000

robotic mitral repairs
with >99% success rates

Highest national STS 3-star
ratings for mitral surgery
quality 2017–2021

TRANSCATHETER VALVE REPAIR

1,033

MitraClips performed 2017–2021

>200

transcatheter tricuspid repairs
and replacements

Highest-Impact Publications from the Smidt Heart Institute at Cedars-Sinai

New England Journal of Medicine

- Chikwe J, Gaudino M. The Price of Freedom from Tricuspid Regurgitation. *N Engl J Med.* 2022; PMID: 34767707
- Stone GW, Lindenfeld J, Abraham WT, Kar S, et al; COAPT Investigators. Transcatheter Mitral-Valve Repair in Patients with Heart Failure. *N Engl J Med.* 2018;379:2307–2318. PMID: 30280640
- Chikwe J, Blackstone EH, Adams DH. Prosthesis Type for Aortic- and Mitral-Valve Replacement. *N Engl J Med.* 2018 Feb 22;378(8):778. doi: 10.1056/NEJMc1716336.

The Lancet

- Praz F, Spargias K, Chrissoheris M, Büllsfeld L, Nickenig G, Deuschl F, Schueler R, Fam NP, Moss R, Makar M, Boone R, Edwards J, Moschovitis A, Kar S, et al S. Compassionate use of the PASCAL transcatheter mitral valve repair system for patients with severe mitral regurgitation: a multicentre, prospective, observational, first-in-man study. *Lancet.* 2017; 390: 773–780. PMID: 28831993

European Heart Journal

- Yoon SH, Whisenant BK, et al Chakravarty T, Makkar RR. Outcomes of transcatheter mitral valve replacement for degenerated bioprostheses, failed annuloplasty rings, and mitral annular calcification. *Eur Heart J.* 2019;40:441–451. PMID: 30357365
- Abramowitz Y, Kazuno Y, Chakravarty T, Kawamori H, Maeno Y, Anderson D, Allison Z, Mangat G, Cheng W, Gopal A, Jilaihawi H, Mack MJ, Makkar RR. Concomitant Mitral Annular Calcification and Severe Aortic Stenosis: Prevalence, Characteristics and Outcomes following Transcatheter Aortic Valve Replacement. *Eur Heart J* 2017; 38: 1194–1203

Journal of the American College of Cardiology

- Chikwe J, O'Gara P, Fremes S, Sundt T, Habib RH, Gammie J, Gaudino M, Badhwar V, Gillinov M, Acker M, Rowe G, Gill G, Goldstone AB, Schwann T, Gelijns A, Trento A, et al. Mitral Surgery after Transcatheter Edge-to-Edge Repair: Society of Thoracic Surgeons Database Analysis. *J Am Coll Cardiol.* 2021:S0735–1097(21)04888–9. PMID: 33945832
- Arnold SV, Chinnakondepalli KM, Spertus JA, Magnuson EA, Baron SJ, Kar S, et al; COAPT Investigators. Health Status After Transcatheter Mitral-Valve Repair in Heart Failure and Secondary Mitral Regurgitation: COAPT Trial. *J Am Coll Cardiol.* 2019;73:2123–2132. PMID: 30894288
- Guerrero M, Urena M, Himbert D, Wang DD, Eleid M, Kodali S, George I, Chakravarty T, et al, Makkar R, et al. 1-Year Outcomes of Transcatheter Mitral Valve Replacement in Patients With Severe Mitral Annular Calcification. *J Am Coll Cardiol.* 2018;7:1841–1853PMID: 29699609
- Yoon SH, Whisenant BK, Bleiziffer S, et al, Makkar RR. Transcatheter Mitral Replacement for Degenerated Bioprosthetic Valves and Failed Annuloplasty Rings. *J Am Coll Cardiol* 2017; 70: 1121–1131
- Chikwe J, Toyoda N, Anyanwu AC, et al. Relation of Mitral Valve Surgery Volume to Repair Rate, Durability, and Survival. *J Am Coll Cardiol.* 2017 Apr 24:S0735–1097(17)30677–0.

JAMA Cardiology

- Whisenant B, Kapadia SR, Eleid MF, Kodali SK, McCabe JM, Krishnaswamy A, Morse M, Smalling RW, Reisman M, Mack M, O'Neill WW, Bapat VN, Leon MB, Rihal CS, Makkar RR, Guerrero M. One-Year Outcomes of Mitral Valve-in-Valve Using the SAPIEN 3 Transcatheter Heart Valve. *JAMA Cardiol.* 2020 Nov 1;5(11):1245–1252.. PMID: 32745164; PMCID: PMC7391176.
- Badhwar V, Vemulapalli S, Mack MA, Gillinov AM, Chikwe J, et al. Volume–Outcome Association of Mitral Valve Surgery in the United States. *JAMA Cardiol.* 2020 Oct 1;5(10):1092–1101.

Aortic Valve

EXPERTISE

Aortic Valve Repair
TAVR
Ross Procedure
Valve-in-Valve TAVR
Valve-Sparing Root Replacement
Bicuspid Aortic Valve
Minimally Invasive Aortic Replacement
Aortic Insufficiency
Redo-Aortic Valve and Root Reconstruction

MAJOR PROGRAMS

Cardiac Interventional Services
Director: Raj Makkar, MD, Stephen R. Corday, MD Chair in Interventional Cardiology, Vice President of Cardiovascular Innovation and Intervention and Professor of Cardiology

Aortic Surgery Program
Director: Pedro Catarino, MD, Professor of Cardiac Surgery



TRANSCATHETER AORTIC VALVE REPLACEMENT

3,000

TAVRs FY2017–2021

>5,000

TAVRs performed to date

AORTIC VALVE SURGERY

>3,000

aortic valve replacements and repairs 2011–2021

Highest-Impact Publications from the Smidt Heart Institute at Cedars-Sinai

New England Journal of Medicine

- **Makkar RR**, Thourani VH, Mack MJ, Kodali SK, Kapadia S, Webb JG, **Yoon SH**, **Trento A**, et al; PARTNER 2 Investigators. Five-Year Outcomes of Transcatheter or Surgical Aortic-Valve Replacement. *N Engl J Med*. 2020 Jan 29;382(9):799-809. PMID: 31995682.
- **Makkar RR**, Mack MJ, Leon MB. Five-Year Outcomes with Transcatheter Aortic-Valve Replacement. Reply. *N Engl J Med*. 2020 Aug 6;383(6):595-596. PMID: 32757532.
- De Backer O, Dangas GD, Jilaihawi H, Leipsic JA, Terkelsen CJ, **Makkar R**, et al. Reduced leaflet motion after transcatheter aortic-valve replacement. *N Engl J Med*. 2019. PMID: 31733182
- Dangas GD, Tijssen JGP, Wöhrle J, Søndergaard L, Gilard M, Möllmann H, **Makkar RR**, et al; GALILEO Investigators. A Controlled Trial of Rivaroxaban after Transcatheter Aortic-Valve Replacement. *N Engl J Med*. 2020;382(2):120-129. PMID: 31733180.
- Mack MJ, Leon MB, Thourani VH, **Makkar R**, et al; PARTNER 3 Investigators. Transcatheter Aortic-Valve Replacement with a Balloon-Expandable Valve in Low-Risk Patients. *N Engl J Med*. 2019; 380(18):1695-1705. PMID: 30883058
- **Chikwe J**, Blackstone EH, Adams DH. Prosthesis Type for Aortic- and Mitral-Valve Replacement. *N Engl J Med*. 2018 Feb 22;378(8):778. doi: 10.1056/NEJMc1716336.

The Lancet

- **Makkar RR**, **Cheng W**, Waksman R, Satler LF, **Chakravarty T**, **Nakamura M**, **Yoon SH**, et al. Self-expanding intra-annular versus commercially available transcatheter heart valves in high and extreme risk patients with severe aortic stenosis (PORTICO IDE): a randomised, controlled, non-inferiority trial. *Lancet*. 2020;396:669-683. PMID: 32593323
- Thourani VH, Kodali S, **Makkar RR**, et al. Transcatheter aortic valve replacement versus surgical valve replacement in intermediate-risk patients: a propensity score analysis. *Lancet*. 2016 May 28;387(10034):2218-25. PMID: 27053442

JAMA

- **Makkar RR**, **Yoon SH**, **Chakravarty T**, Kapadia SR, Krishnaswamy A, Shah PB, Kaneko T, Skipper ER, Rinaldi M, Babaliaros V, Vemulapalli S, **Trento A**, **Cheng W** et al. Association Between Transcatheter Aortic Valve Replacement for Bicuspid vs Tricuspid Aortic Stenosis and Mortality or Stroke Among Patients at Low Surgical Risk. *JAMA*. 2021;326:1034-1044: PMID: 34546301
- **Makkar RR**, **Yoon SH**, Leon MB, **Chakravarty T**, Rinaldi M, Shah PB, Skipper ER, Thourani VH, Babaliaros V, **Cheng W**, **Trento A**, et al. Association Between Transcatheter Aortic Valve Replacement for Bicuspid vs Tricuspid Aortic Stenosis and Mortality or Stroke. *JAMA*. 2019;321(22):2193-2202. PMID: 31184741
- Feldman TE, Reardon MJ, Rajagopal V, **Makkar RR**, et al. Effect of Mechanically Expanded vs Self-Expanding Transcatheter Aortic Valve Replacement on Mortality and Major Adverse Clinical Events in High-Risk Patients With Aortic Stenosis: The REPRISE III Randomized Clinical Trial. *JAMA*. 2018;319(1):27-37. PMID: 29297076

Journal of the American College of Cardiology

- **Yoon SH**, et al, **Chakravarty T**, **Nakamura M**, et al, **Makkar RR**; Bicuspid Aortic Valve Stenosis Transcatheter Aortic Valve Replacement Registry Investigators. Bicuspid Aortic Valve Morphology and Outcomes After Transcatheter Aortic Valve Replacement. *J Am Coll Cardiol*. 2020 Sep 1;76(9):1018-1030. doi: 10.1016/j.jacc.2020.07.005. PMID: 32854836.
- Itagaki S, **Chikwe JP**, Chiang YP, et al. Long-Term Risk for Aortic Complications After Aortic Valve Replacement in Patients With Bicuspid Aortic Valve Versus Marfan Syndrome. *J Am Coll Cardiol*. 2015 Jun 9;65(22):2363-9.

Coronary Disease

EXPERTISE

Complex and High-Risk PCI
Total Arterial
Revascularization
Chronic Total Occlusions
Multi-Arterial
Revascularization
Brachytherapy
Off-Pump and Hybrid
Coronary Bypass
Rotational Atherectomy
Robotic Coronary Artery
Bypass
Intravascular Ultrasound
Redo-Coronary Artery Bypass
Surgery
Primary Revascularization
High-Risk Coronary Artery
Bypass Surgery
Coronary CT Angiography

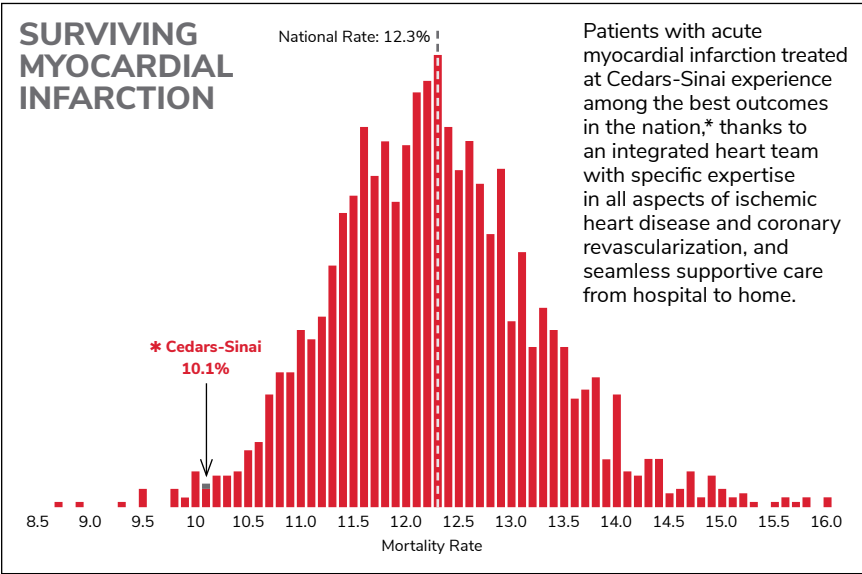
MAJOR PROGRAMS

Atherosclerosis and Prevention
Director: Prediman K. Shah, MD, Shapell and Webb Family Chair in Clinical Cardiology, Director of the Oppenheimer Atherosclerosis Research Center, Professor of Medicine

Coronary Care Unit
Director: Bojan Cercek, MD, PhD, Eleanore and Harold Foonberg Chair in Cardiac Intensive Care in honor of Prediman K. Shah, MD, and Professor of Cardiology

Cardiac Interventional Services
Director: Raj Makkar, MD, Stephen R. Corday, MD Chair in Interventional Cardiology, Vice President of Cardiovascular Innovation and Intervention and Professor of Cardiology

Department of Cardiac Surgery
Chair: Joanna Chikwe, MD, Irina and George Schaeffer Distinguished Chair in Cardiac Surgery in honor of Alfredo Trento, MD, and Professor of Cardiac Surgery
Director Emeritus: Alfredo Trento, MD, Estelle, Abe and Marjorie Sanders Chair in Cardiac Surgery and Professor of Cardiac Surgery



*Source: Hospital Compare.

418

high-risk percutaneous coronary interventions performed with Impella support

150

robotic minimally invasive coronary bypass operations

Highest-Impact Publications from the Smidt Heart Institute at Cedars-Sinai

Nature Journals

- Ranek MJ, Oeing C, Sanchez-Hodge R, Kokkonen-Simon KM, Dillard D, Aslam MI, Rainer PP, Mishra S, Dunkerly-Eyring B, Holewinski RJ, Virus C, Zhang H, Mannion MM, Agrawal V, Hahn V, Lee DI, Sasaki M, **Van Eyk JE**, et al. CHIP phosphorylation by protein kinase G enhances protein quality control and attenuates cardiac ischemic injury. *Nat Commun.* 2020 Oct 20;11(1):5237. PMID: 33082318

New England Journal of Medicine

- Maron DJ, Hochman JS, Reynolds HR, Bangalore S, O'Brien SM, Boden WE, Chaitman BR, Senior R, López-Sendón J, Alexander KP, Lopes RD, Shaw LJ, Berger JS, Newman JD, Sidhu MS, Goodman SG, Ruzyllo W, Gosselin G, Maggioni AP, White HD, Bhargava B, Min JK, Mancini GBJ, **Berman DS** et al, ISCHEMIA Research Group. Initial Invasive or Conservative Strategy for Stable Coronary Disease. *N Engl J Med.* 2020; 382: 1395-1407 PMID: 32227755
- Victor RG, Lynch K, Li N, Blyler C, Muhammad E, Handler J, Brettler J, Rashid M, Hsu B, Foxx-Drew D, Moy N, Reid AE, Elashoff RM.** A Cluster-Randomized Trial of Blood-Pressure Reduction in Black Barbershops. *N Engl J Med.* 2018 Apr 5;378(14):1291-1301. PMID: 29527973
- Panza JA, Ellis AM, Al-Khalidi HR, Holly TA, **Berman DS** et al; Myocardial viability and long-term outcomes in Ischemic Cardiomyopathy. *N Engl J Med.* 2019;382:120-129. PMID: 31733180

The Lancet

- Vogel B, Acevedo M, Appelman Y, **Bailey Merz CN**, et al. The Lancet Women and Cardiovascular Disease Commission: Reducing the Global Burden by 2030. *Lancet* 2021; 397: 2385-2438

JAMA

- Wei J, Cheng S, Bailey Merz CN.** Coronary Microvascular Dysfunction Causing Cardiac Ischemia in Women. *JAMA* 2019; 322: 2334-2335
- Bailey Merz CN.** Testing for Coronary Microvascular Dysfunction. *JAMA* 2019; 322: 2358

Journal of the American College of Cardiology

- Chikwe J, Sun E, Hannan EL, et al.** Outcomes of second arterial conduits in patients undergoing multivessel coronary artery bypass. *J Am Coll Cardiol* 2019; 74: 2238-2248
- Arai AE, Schulz-Menger J, **Berman D**, et al; GadaCAD Investigators. Gadobutrol-Enhanced Cardiac Magnetic Resonance Imaging for Detection of Coronary Artery Disease. *J Am Coll Cardiol.* 2020;76:1536-1547.PMID: 32972530.
- Adams DH, **Chikwe J.** On-Pump CABG in 2018: Still the Gold Standard. *J Am Coll Cardiol.* 2018 Mar 6;71(9):992-993.
- Chikwe J, Lee T, Itagaki S,et al.** Long-Term Outcomes After Off-Pump Versus On-Pump Coronary Artery Bypass Grafting by Experienced Surgeons. *J Am Coll Cardiol.* 2018 Sep 25;72(13):1478-1486.
- Samadashvili Z, Sundt TM 3rd, Wechsler A, **Chikwe J**, et al. Multiple Versus Single Arterial Coronary Bypass Graft Surgery for Multivessel Disease. *J Am Coll Cardiol.* 2019 Sep 10;74(10):1275-1285.

Circulation

- Damluji AA, van Diepen S, Katz JN, Menon V, Tamis-Holland JE, Bakitas M, Cohen MG, Balsam LB, **Chikwe J**; American Heart Association Council on Clinical Cardiology; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular Surgery and Anesthesia; and Council on Cardiovascular and Stroke Nursing. Mechanical Complications of Acute Myocardial Infarction: A Scientific Statement From the American Heart Association. *Circulation.* 2021. PMID: 34126755.

Aortic and Vascular Surgery

MAJOR PROGRAMS

Clinic for Hypertrophic Cardiomyopathy and Aortopathies

Director: Robert J. Siegel, MD, S. Rexford Kennamer, MD
Chair in Cardiac Ultrasound, and Professor of Cardiology

Aortic Surgery Program

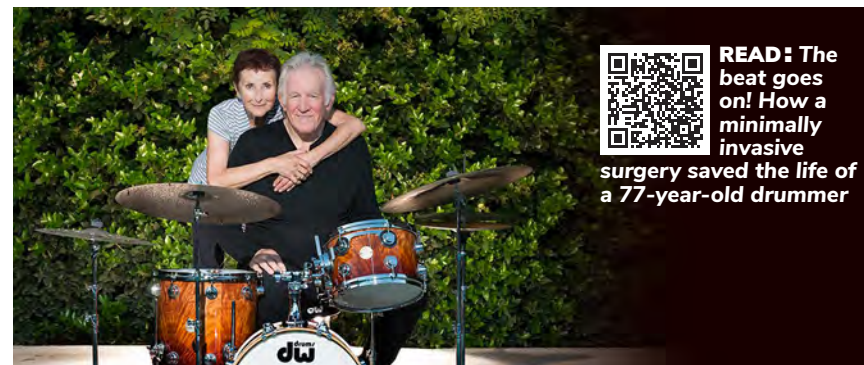
Co-Directors:
Pedro Catarino, MD, Professor of Cardiac Surgery
Ali Azizzadeh, MD, Professor of Surgery

Division of Vascular Surgery

Director: Ali Azizzadeh, MD, Vice Chair Department of Surgery, Associate Director for Vascular Therapeutics, and Professor of Surgery

EXPERTISE

Ascending Aorta Replacement
TEVAR
Arch Replacement
Hybrid Aortic Repair
Descending Aorta Replacement
Aortic Surveillance
Frozen Elephant Trunk
Aortic Dissection
Marfan and Loeys-Dietz Syndromes
Aortic Aneurysm



>2,000

Thoracic aortic repairs
FY2011-2021

Highest-Impact Publications

New England Journal of Medicine

- **Nurok M, Gewertz BL.** Outcomes of Procedures Performed by Attending Surgeons after Night Work. *N Engl J Med.* 2015 Dec 10;373(24):2384. doi: 10.1056/NEJMc1512756#SA3. PMID: 26650167

The Lancet

- Azizi M, Schmieder RE, et al, **Rader F** et al L; RADIANCE-HTN Investigators. Endovascular ultrasound renal denervation to treat hypertension (RADIANCE-HTN SOLO): a multicentre, international, single-blind, randomised, sham-controlled trial. *Lancet.* 2018 Jun 9;391(10137):2335-2345.

Circulation

- Abramowitz Y, Jilaihawi H, **Chakravarty T**, Mack MJ, **Makkar RR.** Porcelain aorta: a comprehensive review. *Circulation.* 2015 Mar 3;131(9):827-36. PMID: 25737502

JAMA

- **Nurok M, Makkar R, Gewertz B.** The Ethics of Interventional Procedures for Patients Too Ill for Surgery. *JAMA.* 2017; 317: 359-360

Annals of Thoracic Surgery, Journal of Thoracic and Cardiovascular Surgery

- Patel HJ, **Azizzadeh A**, Matsumoto AH, et al. Five-Year Outcomes From the United States Pivotal Trial of Valiant Captivia Stent Graft for Blunt Aortic Injury. *Ann Thorac Surg* 2020; 110: 815-820
- Spinelli D, Weaver FA, **Azizzadeh A**, et al. Endovascular treatment of complicated versus uncomplicated acute type B aortic dissection. *J Thorac Cardiovasc Surg* 2021; doi: 10.1016/j.jtcvs.2021
- O'Hara D, McLarty A, Sun E, et al, **Chikwe J.** Type-A Aortic Dissection and Cerebral Perfusion: The Society of Thoracic Surgeons Database Analysis. *Ann Thorac Surg* 2020; 110: 1461-1467
- Bavaria JE, Brinkman WT, et al, **Azizzadeh A**, White RA. Five-year outcomes of endovascular repair of complicated acute type-B aortic dissections. *J Thorac Cardiovasc Surg.* 2020.
- Upchurch GR Jr, Escobar GA, **Azizzadeh A**, Beck AW, Conrad MF, Matsumura JS, Murad MH, Perry RJ, Singh MJ, Veeraswamy RK, Wang GJ. Society for Vascular Surgery clinical practice guidelines of thoracic endovascular aortic repair for descending thoracic aortic aneurysms. *J Vasc Surg.* 2021 Jan;73(1S):55S-83S. doi: 10.1016/j.jvs.2020.05.076. Epub 2020 Jul 3. PMID: 32628988

Electrophysiology

MAJOR PROGRAMS

Center for Cardiac Arrest Prevention

Director: Sumeet Chugh, MD
Pauline and Harold Price Chair in Cardiac Electrophysiology Research, Section Chief of Clinical Electrophysiology, Professor of Cardiology and President of the Cardiac Electrophysiology Society 2020-2021

Atrial Fibrillation Prevention

Director: Christine M. Albert, MD, MPH, Lee and Harold Kapelovitz Distinguished Chair in Cardiology, Professor of Cardiology and President 2020-2021, Heart Rhythm Society

Interventional Electrophysiology

Director: Michael Shehata, MD, Associate Professor of Cardiology

Device Lead Extraction

Director: Raymond Schaerf, MD, Associate Professor of Cardiac Surgery

Electrophysiology Research

Director: Peng-Sheng Chen, MD, Burns and Allen Chair in Cardiology Research, Professor of Cardiology and Editor-in-Chief, *Heart Rhythm*

EXPERTISE

Catheter Ablation
(Radiofrequency & Cryoablation)
Hybrid Surgical Ablation
Electrical Device Implantation, including Leadless Pacemaker
Lead Extraction
Left Atrial Appendage Occlusion
Sudden Cardiac Death
Familial Arrhythmia Syndromes
Long QT Syndrome
Arrhythmogenic RV Dysplasia
Brugada Syndrome
Hypertrophic Cardiomyopathy
Other Familial Syndromes

Highest-Impact Publications

New England Journal of Medicine

- Manson JE, Cook NR, Lee IM, et al, **Albert CM**, et al; VITAL Research Group. Marine n-3 Fatty Acids and Prevention of Cardiovascular Disease and Cancer. *N Engl J Med* 2019; 380: 23-32

JAMA

- **Albert CM**, Cook NR, Pester J, et al. Effect of Marine Omega-3 Fatty Acid and Vitamin D Supplementation of Incident Atrial Fibrillation: A Randomized Clinical Trial *JAMA* 2021; 325: 1061-1073
- **Albert CM**, Bhatt DL. Catheter ablation for Atrial Fibrillation: Lessons learned from CABANA. *JAMA* 2019; 321: 1255-1257
- Choi SH, Weng LC, Roselli C, Lin H, et al, **Albert CM** et al. Association Between Titin Loss of Function Variants and Early Onset Atrial Fibrillation. *JAMA* 2018; 320: 2354-2364

European Heart Journal

- Chatterjee NA, Tikkanen JT, **Albert CM.** The electrocardiogram and sudden death: capturing electrical physiology and arrhythmic substrate. *Eur Heart J.* 2020 Aug 7;41(30):2911-2912.
- **Aro AL, Reinier K, Rusinaru C, Uy-Evanado A, Darouian N, Phan D, Mack WJ, Jui J, Soliman EZ, Tereshchenko LG, Chugh SS.** Electrical risk score beyond the left ventricular ejection fraction: prediction of sudden cardiac death in the Oregon Sudden Unexpected Death Study and the Atherosclerosis Risk in Communities Study. *Eur Heart J.* 2017 Oct 21;38(40):3017-3025.

Journal of the American College of Cardiology

- **Chugh SS**, Jui J, Salvucci A. Pivotal Role in the Community Response to Cardiac Arrest: The Smart Bystander. *J Am Coll Cardiol.* 2020 Jul 7;76(1):54-56.
- Varma N, Marrouche NF, Aguinaga L, **Albert CM** et al. HRS/EHRA/APHRS/ LAHRS/ ACC/AHA Worldwide Practice Update for Telehealth and Arrhythmia Monitoring During and After a Pandemic. *J Am Coll Cardiol.* 2020 Sep 15;76(11):1363-1374. PMID: 32534936;

Circulation

- Gencer B, Djousse L, Al-Ramady OT, Cook NR, Manson JE, **Albert CM.** Effect of Long-Term Marine Omega-3 Fatty Acids Supplementation on the Risk of Atrial Fibrillation in Randomized Controlled Trials of Cardiovascular Outcomes. *Circulation* 2021; 144: 1981-1990
- Reinier K, Stecker EC, Uy-Evanado A, Chugh HS, Binz A, Nakamura K, Sargsyan A, Jui J, **Chugh SS.** Sudden Cardiac Death as First Manifestation of Heart Disease in Women: The Oregon Sudden Unexpected Death Study 2004-2016 *Circulation* 2020; 141: 606-608
- Mesquita T, Zhang R, Cho JH, Zhang R, Lin YN, Sanchez L, **Goldhaber JJ**, Yu JK, Liang JA, Liu W, Trayanova NA, **Cingolani E.** Mechanisms of Sinoatrial Node Dysfunction in Heart Failure with Preserved Ejection Fraction. *Circulation.* 2022 Jan 4;145(1):45-60.
- Everett BM, Moorthy MV, Tikkanen J, Cook NR, **Albert CM.** Markers of Myocardial Stress, Myocardial Injury, and Subclinical Inflammation and the Risk of Sudden Death. *Circulation.* 2020; 142: 1148-1158

Women's Heart

MAJOR PROGRAMS

The Barbra Streisand Women's Heart Center
Director: C. Noel Bairey Merz MD, Irwin and Sheila Allen Chair in Women's Heart Research and Professor of Cardiology

Basic Science Research
Director: Jennifer Van Eyk, PhD, Erika J. Glazer Chair in Women's Heart Health, Director of Advanced Clinical Biosystems in the Department of Biomedical Sciences and Professor of Cardiology

Public Health Research
Director: Susan Cheng, MD, MPH, MMSc, Erika J. Glazer Chair in Women's Cardiovascular Health and Population Science, Director of Cardiovascular Population Sciences and Professor of Cardiology

Women's Hormone and Menopause Program
Director: Chrisandra Shufelt, MD, MS, Anita Dann Friedman Endowed Chair in Women's Cardiovascular Medicine and Research and Professor of Medicine

EXPERTISE

Personalized Risk Assessment and Evaluation
Arrhythmia Diagnosis
Cardio-Oncology
Cardiovascular Diagnostic Intervention
Post-Partum Health Program
Carotid Intima Media Thickness Scan
Women's Hormone and Menopause Program
Coronary Calcium Scan
Risk Management in Women's Health
Coronary Reactivity Testing
Exercise Stress Testing
Enhanced External Counter Pulsation (EECP)
Endothelial Function Testing



READ: Cedars-Sinai study suggests that middle-aged and older women are being diagnosed with broken heart syndrome more frequently than younger women or men of any age.



Highest-Impact Publications

The Lancet

- Mauvais-Jarvis F, **Bairey Merz N**, Barnes PJ, et al. Sex and gender: modifiers of health, disease and medicine. *Lancet* 2020; 396: 565-582
- Vogel B, Acevedo M, Appelman Y, **Bairey Merz CN**, et al. The Lancet women and cardiovascular disease Commission: reducing the global burden by 2030. *Lancet*. 2021;397:2385-2438.

JAMA

- Wei J, Cheng S, Bairey Merz CN**. Coronary microvascular Dysfunction Causing Cardiac Ischemia in Women. *JAMA* 2019; 322: 2358
- Bairey Merz CN**. Testing for Coronary Microvascular Dysfunction. *JAMA* 2019; 322: 2358

European Heart Journal

- Lüscher TF, Miller VM, **Bairey Merz CN**, Crea F. Diversity is richness: why data reporting according to sex, age, and ethnicity matters. *Eur Heart J*. 2020 Sep 1;41(33):3117-3121.
- Shaw LJ, Min JK, Nasir K, Xie JX, **Berman DS**, Miedema MD, Whelton SP, Dardari ZA, Rozanski A, Rumberger J, **Bairey Merz CN**, et al. Sex differences in calcified plaque and long-term cardiovascular mortality: observations from the CAC Consortium. *Eur Heart J*. 2018;39(41):3727-3735.

Journal of the American College of Cardiology

- Park K, **Bairey Merz CN**, **Bello NA**, et al; ACC Cardiovascular Disease in Women Committee and the Cardio- Obstetrics Work Group. Management of Women With Acquired Cardiovascular Disease From Pre-Conception Through Pregnancy and Postpartum. *J Am Coll Cardiol*. 2021 Apr 13;77(14):1799-1812.
- Lindley KJ, **Bairey Merz CN**, Davis MB, Madden T, Park K, **Bello NA**; ACC Cardiovascular Disease in Women Committee and the Cardio-Obstetrics Work Group. Contraception and Reproductive Planning for Women With Cardiovascular Disease. *J Am Coll Cardiol*. 2021;77(14):1823-1834.
- Bello NA, Bairey Merz CN**, Brown H, et al; ACC Cardiovascular Disease in Women Committee and the Cardio- Obstetrics Work Group. Diagnostic Cardiovascular Imaging and Therapeutic Strategies in Pregnancy: JACC Focus Seminar 4/5. *J Am Coll Cardiol*. 2021 Apr 13;77(14):1813-1822.
- Lindley KJ, **Bairey Merz CN**, Asgar AW, **Bello NA**, et al; ACC Cardiovascular Disease in Women Committee and the Cardio-Obstetrics Work Group. Management of Women With Congenital or Inherited Cardiovascular Disease From Pre-Conception Through Pregnancy and Postpartum. *J Am Coll Cardiol*. 2021 Apr 13;77(14):1778-1798.
- AlBadri A, **Bairey Merz CN**, Johnson BD, **Wei J**, Mehta PK, Cook-Wiens G, Reis SE, Kelsey SF, Bittner V, Sopko G, Shaw LJ, Pepine CJ, Ahmed B. Impact of Abnormal Coronary Reactivity on Long-Term Clinical Outcomes in Women. *J Am Coll Cardiol*. 2019 Feb 19;73(6):684-693.

Circulation

- Wei J, Liao JK, Bairey Merz CN**. Challenging Statin Pleiotropy: Pre-eclampsia *Circulation* 2021; 44: 680-683
- Ji H, Niiranen TJ, **Rader F**, Henglin M, Kim A, **Ebinger JE**, Claggett B, **Merz NB, Cheng S**. Sex Differences in Blood Pressure Associations with Cardiovascular Outcomes. *Circulation*. 2021 Feb 16;143(7):761-763.

MAJOR PROGRAMS

The Guerin Family Congenital Heart Program
Director: Evan Zahn MD, Professor of Cardiology

Congenital Heart Surgery Program
Director: Richard Kim MD, Professor of Cardiac Surgery

EXPERTISE

Atrial and Ventricular Septal Defect
Adult Congenital Heart Disease
Coarctation of the Aorta
Pediatric Congenital Heart Disease
Double Outlet Right Ventricle
Pregnancy with Congenital Heart Disease
Hypoplastic Left Heart Syndrome
Fetal Cardiac Evaluation and Diagnosis
Patent Ductus Arteriosus
Genetic Testing and Counselling
Tetralogy of Fallot
Fontan Procedure
Transposition of the Great Arteries
Glenn Shunt
Truncus Arteriosus
Double Switch Repair
Aortic Stenosis and Bicuspid Aortic Disease
Atrial Septal Defect Closure
Ebstein Anomaly
Ventricular Septal Defect Closure
Mitral Regurgitation
Norwood Procedure
Anomalous Pulmonary Venous Drainage
Percutaneous intervention
Pulmonary Atresia and Stenosis
ECMO
Tricuspid Atresia and Regurgitation



#1 for maternal and obstetrics care in Los Angeles

First-in-man with novel pulmonary valve replacement

Highest-Impact Publications

- Zahn EM**, Abbott E, Tailor N, Sathanandam S, Armer D. Preliminary testing and evaluation of the renata minima stent, an infant stent capable of achieving adult dimensions. *Catheter Cardiovasc Interv*. 2021 Jul 1;98(1):117-127. doi: 10.1002/ccd.29706. Epub 2021 May 4.
- Zahn EM**, Chang JC, Armer D, Garg R. First human implant of the Alterra Adaptive PreStent™: A new self-expanding device designed to remodel the right ventricular outflow tract. *Catheter Cardiovasc Interv*. 2018 Mar 9. doi: 10.1002/ccd.27581. [Epub ahead of print]
- Broberg C... **Tompkins RO** et al. COVID-19 in Adults With Congenital Heart Disease. *J Am Coll Cardiol*. 2021 Apr 6;77(13):1644-1655. doi: 10.1016/j.jacc.2021.02.023.
- Shahanavaz S, **Zahn EM**, Levi DS, Aboulhousn JA, Hascoet S, Qureshi AM, Porras D, Morgan GJ, Bauser Heaton H, Martin MH, Keeshan B, Asnes JD, Kenny D, Ringewald JM, Zablah JE, Ivy M, Morray BH, Torres AJ, Berman DP, Gillespie MJ, Chaszczewski K, Zampi JD, Walsh KP, Julien P, Goldstein BH, Sathanandam SK, Karsenty C, Balzer DT, McElhinney DB. Transcatheter Pulmonary Valve Replacement With the Sapien Prosthesis. *J Am Coll Cardiol*. 2020 Dec 15;76(24):2847-2858. doi: 10.1016/j.jacc.2020.10.041.
- Zahn EM**. Self-Explaining Pulmonary Valves for Large Diameter Right Ventricular Outflow Tracts. *Interv Cardiol Clin*. 2019 Jan;8(1):73-80. doi: 10.1016/j.iccl.2018.08.003. Epub 2018 Oct 26.
- Sathanandam SK, Gutfinger D, O'Brien L, Forbes TJ, Gillespie MJ, Berman DP, Armstrong AK, Shahanavaz S, Jones TK, Morray BH, Rockefeller TA, Justino H, Nykanen DG, **Zahn EM**. Amplatzer Piccolo Occluder clinical trial for percutaneous closure of the patent ductus arteriosus in patients ≥700 grams. *Catheter Cardiovasc Interv*. 2020 May 20. doi: 10.1002/ccd.28973. Epub ahead of print.
- Almeida-Jones M, Tang NY, Reddy A, **Zahn EM**. Overview of transcatheter patent ductus arteriosus closure in preterm infants. *Congenit Heart Dis*. 2019 Jan;14(1):60-64. doi: 10.1111/chd.12712.



Metrics

No. 1

- ✧ in the Western U.S. for Cardiology and Heart Surgery by *U.S. News & World Report*
- ✧ in expertise for percutaneous valve procedures in the nation
- ✧ in the nation for adult heart transplants 2016–2021

Cardiac Interventions

Invasive Cardiac Procedures	FY18–21
Coronary Angiography	24,616
Percutaneous Intervention (PCI)	8,022
Transcatheter Valve Replacements	
Aortic (TAVR)	2,421
Mitral (TMVR)	103
Tricuspid (TTVR)	48
Pulmonary (TPVR)	47
Re-Do TAVR (valve-in-valve)	140
MitraClip	834
Tricuspid Clip	171
Valvuloplasty	
Aortic	27
Mitral	24
Pulmonary	7
Carotid Angiography/Carotid Stent	68
Endomyocardial Biopsy	4,259
Intracoronary Stem Cell Injection/Therapy	44
Intravascular Ultrasound	2,768
Coronary Reactivity Testing	101
Percutaneous Alcohol Septal Ablation for Hypertrophic Cardiomyopathy	77
Percutaneous Closure of Paravalvular Leak	77
Percutaneous Closure of Septal Defects	
Atrial Septal Defect (ASD)	89
Patent Foramen Ovale (PFO)	208
Ventricular Septal Defect (VSD)	18
Percutaneous closure of Patent Ductus Arteriosus	36
Percutaneous Left Ventricular Assist Devices	288
Percutaneous Closure of Left Atrial Appendage Occlusion	511
Electrophysiology Studies	2,428
Catheter Ablation Procedures	2,338
Cardiac Electronic Implantable Device (CIED) Implantations	3,167
Leadless Pacemaker Implantations	327

Cardiac Surgery

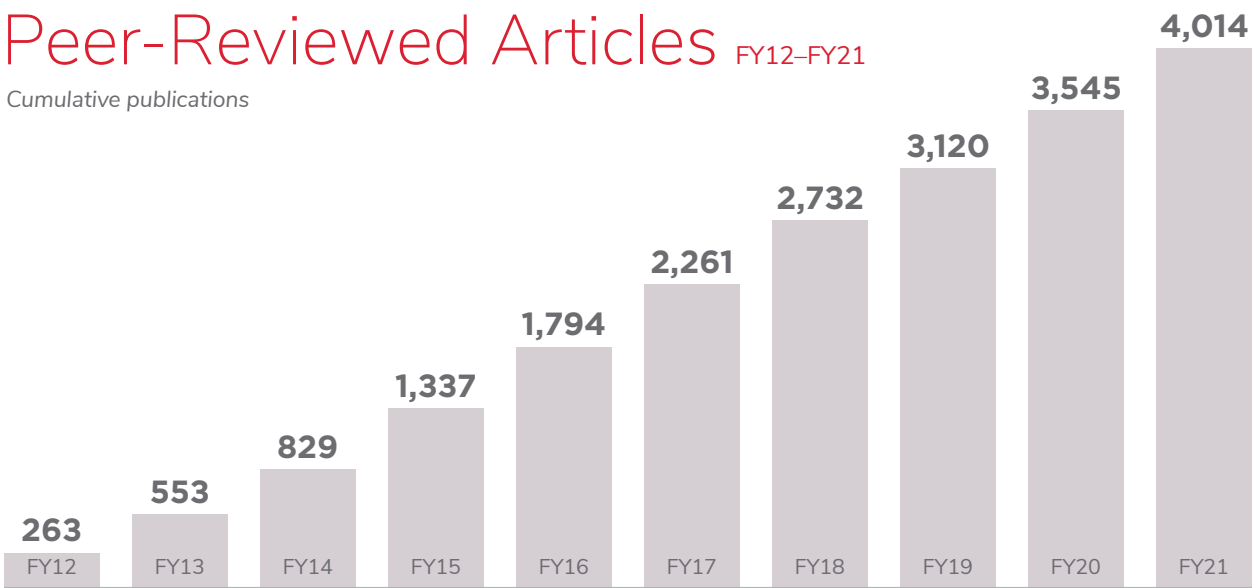
Operations	FY17–21
Heart and Lung Transplantation, and Mechanical Circulatory Support	
Heart Transplants (single and multi-organ)	602
Lung Transplants (single and double)	131
Ventricular Assist Devices and Total Artificial Hearts	427
Extracorporeal Membrane Oxygenation	378
Robotic Cardiac Surgery	
Mitral Valve Repair	486
Coronary Revascularization (stand-alone and hybrid)	145
Valvular Heart Surgery	
Mitral Valve Reconstruction (repair and replacements)	1,018
Aortic Valve Reconstruction (repair, valve sparing and replacements)	1,114
TAVR	3,000
Aorta, Coronary and Other Cardiac Surgery	
Thoracic Aortic Open and Endovascular Surgery	822
Coronary Revascularization	1,201
Surgical Endocardial Ablation (concomitant and stand-alone)	948
Other (congenital, septal myectomy, pericardiectomy)	199

>1,000

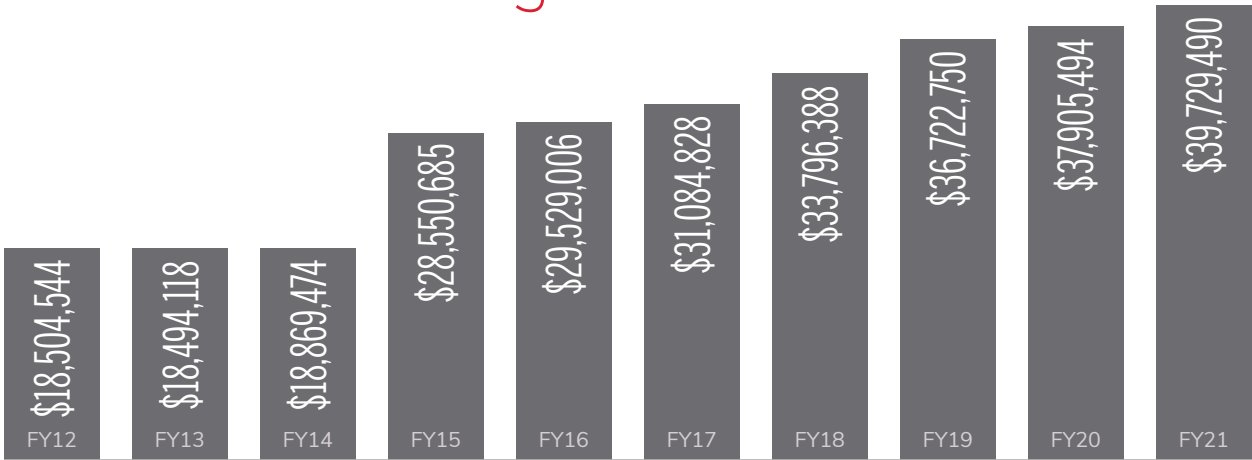
robotic mitral repairs performed to date,
with >99% repair rate

Peer-Reviewed Articles FY12–FY21

Cumulative publications



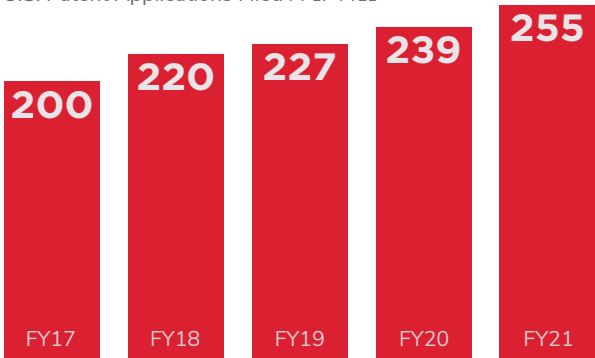
Research Funding FY12–FY21



Intellectual Property

Intellectual Property	FY21
U.S. Patent Applications Filed	255
U.S. Patents Issued	60
International Patent Applications Filed	184
International Patents Issued	63
Copyright Registrations	12

U.S. Patent Applications Filed FY 17–FY21



1,165 donors supported the Smidt Heart Institute in FY21

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Professor, Biomedical Sciences

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Director of Atherosclerosis Prevention and Management Center
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Contact Us

If you have a patient you would like to refer to one of our programs, please contact us at **310-423-3300** or visit cedars-sinai.org/heart. Our physicians will work with you to understand the unique needs of your patient and develop the best treatment plan, and will be available for additional consultations and procedures as needed.

Aortic Disease **310-423-3851**

The Aortic program is an interdisciplinary team that detects and treats the full range of diseases that affect the artery and provides access to groundbreaking surgical techniques and leading-edge clinical trials.

Barbra Streisand Women's Heart Center **310-423-9680**

The Barbra Streisand Women's Heart Center plays a leading role in identifying female-pattern heart disease, developing diagnostic tools and advancing specialized care for women.

California Heart Center **310-248-8300**

The center, affiliated with the Cedars-Sinai Smidt Heart Institute, offers the full spectrum of cardiology care, including cardiac evaluation, heart failure management, interventional cardiology, nuclear cardiology, echocardiography and hypertension management.

Cardio-Oncology **310-423-2726**

Cardiologists diagnose and treat heart disease in patients who are undergoing cancer treatment or who are cancer survivors.

Cardiogenetics **310-423-2726**

The Cardiogenetics program provides a multidisciplinary approach for the treatment of patients and families afflicted with familial cardiac conditions. Patients are evaluated by a cardiologist who specializes in these conditions, together with a cardiac genetic counselor, to help clarify the patient's diagnosis, create a personalized management of care plan based on genetic test results and provide a risk assessment for other family members afflicted with these conditions.

Cardiovascular Surgery **310-423-3851**

Our cardiac surgeons are national leaders in robotic, minimally invasive and complex cardiac surgery.

Congenital Heart Program **310-423-1153**

The Congenital Heart program offers state-of-the-art treatment for congenital heart patients from birth through their entire adult life.

Electrophysiology **310-248-6679**

The Clinical Electrophysiology program provides state-of-the-art technology in patients with abnormal heart rhythms (cardiac arrhythmias and atrial fibrillation).

General & Preventive Cardiology **310-423-2726**

The General and Preventive Cardiology program provides patients access to medical professionals nationally recognized for their skills in the detection, prevention and treatment of heart disease.

Heart Failure and Cardiomyopathy **310-423-2077**

As the anchor of the Advanced Heart Disease program at the Smidt Heart

Institute, the specialized Heart Failure program provides a comprehensive assessment and treatment plan for people with congestive heart failure and all types of heart muscle disease (cardiomyopathy).

Heart Transplant **310-423-5460**

For the past several years, Cedars-Sinai has led the nation in the number of adult heart transplants completed. The program offers advanced options in cardiac support devices, surgical techniques and anti-rejection technologies.

Hypertension **310-423-2726**

The Hypertension program takes a multispecialty approach to the evaluation and management of patients with complex hypertension. The program has been identified by the American Society of Hypertension as a certified Hypertension Center of Excellence.

Interventional Cardiology **310-423-3977**

The Interventional Cardiology program uses innovative nonsurgical techniques for treating coronary and valvular heart disease.

Lipid Disorders **310-423-2726**

Cardiologists provide a full range of diagnostics and treatments for patients with cholesterol and triglyceride disorders.

Mechanical Circulatory Support **310-423-7338**

The program provides complete care for patients with heart failure. Mechanical devices that help the heart pump blood can save the lives of patients awaiting a transplant. For others, they are a permanent treatment.

Preventive and Rehabilitative Cardiac Center **310-423-9660**

The center gives cardiology patients tools to improve their health and fitness. Services include monitored exercise programs, nutrition advice and stress management.

Regenerative Medicine **310-423-1231**

The Regenerative Medicine program is composed of a multidisciplinary team of physicians and allied health professionals who provide the largest worldwide experience in cardiac stem cell therapy, including more than 10 different cell types and methods of delivery.

Valvular Heart Disease **Interventional: 310-423-3977** **Surgical: 310-423-3851**

The valve team, comprised of highly specialized interventional cardiologists and cardiac surgeons, is at the forefront of providing novel, minimally invasive procedures to repair and replace heart valves. We offer a full spectrum of innovative procedures, ranging from completely percutaneous approaches to minimally invasive and traditional open-heart surgery. Treatment plans are individually tailored to the patient's condition to ensure the best possible outcome.

Vascular Surgery **310-423-5400**

The Vascular Surgery program provides expert diagnosis and management of all arterial and venous disorders and offers a full spectrum of advanced open, endovascular and hybrid procedures.