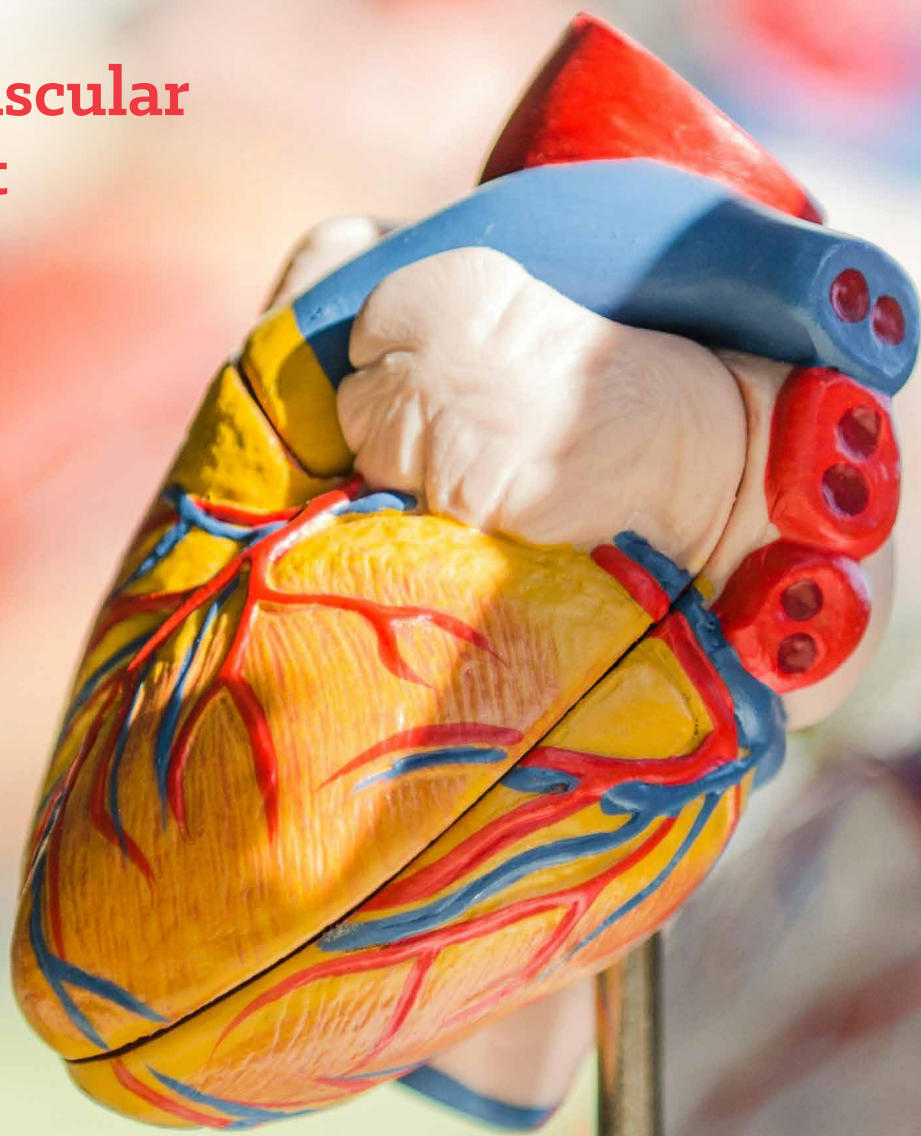


2024 Cardiovascular Impact Report



A MESSAGE FROM The President

Cleveland is home to top-performing programs for heart and vascular care.

Our team at University Hospitals Harrington Heart & Vascular Institute maintains a strong presence at the forefront of cardiovascular medicine and surgery. We have made significant strides in physician recruitment, program expansion, research innovation and market growth.

A few of our team's contributions to the field in 2024 included:

- Chairing the American Heart Association/American College of Cardiology committee on new peripheral artery disease guidelines
- Leading new guidelines on implementation of GLP-1s
- Leading a new Heart Failure Society of America scientific statement on co-morbid cognitive impairment
- Co-authoring major publications on environmental impacts in cardiovascular health
- Being first in the world to implant the Penditure™ clip using a minimally invasive approach
- Being named national principal investigator for the RESTORE study of repeat transcatheter aortic valve replacement
- Co-authoring an international statement on multimodality cardiac imaging for pericardial diseases
- Leading the successful growth of Ohio's first robotic minimally invasive cardiac surgery program

Our progress is only possible because of the unwavering dedication of our 2,000 heart and vascular professionals, spanning 18 hospitals and 47 ambulatory sites across the region.

We are grateful to serve our communities and remain steadfast in our mission: To Heal. To Teach. To Discover.

Mehdi Shishehbor, DO, MPH, PhD

**President | Angela and James Hambrick Chair in Innovation
University Hospitals Harrington Heart & Vascular Institute**



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Procedure Volume Growth
2023-2024

	2023	2024	% Growth
Cardiac Electrophysiology	6,032	6,661	10%
Cardiac Catheterization	21,995	22,812	4%
Echocardiography	74,070	80,497	9%
Vascular Lab	41,399	45,596	10%
Cardiac Surgery*	1,501	1,592	6%
Vascular Surgery*	1,975	2,324	18%

*Numbers do not include cases outside the operating room



Institute Leaders



Mehdi Shishehbor, DO, MPH, PhD
President



Eric Hess, MBA, CPA
Chief Operating Officer



Yasir Abu-Omar, MD, PhD
Chief, Division of Cardiac Surgery



Jae Cho, MD
Chief, Division of Vascular Surgery
and Endovascular Therapies



Sanjay Rajagopalan, MD, MBA
Chief Academic & Scientific Officer
Chief, Division of Cardiovascular Medicine



Ravi Ramani, MD
Chief Quality Officer
Clinical Chief, Division of
Cardiovascular Medicine

Center and Program Medical Leaders



Yasir Abu-Omar, MD, PhD
Director, Cardiothoracic Transplantation
Co-Director, Hambrick Center for Cardiac Recovery
Surgical Director, Mechanical Circulatory Support



Rakesh Arora, MD, PhD
Director, Perioperative and
Cardiac Critical Care
Director, Cardiac Surgery Research



Mauricio Arruda, MD
Director, Electrophysiology Center
Director, Atrial Fibrillation Center



Guilherme Attizzani, MD
Co-Director, Valve & Structural
Heart Disease Center



Cristian Baeza, MD
Co-Director, Aortic Disease Center



Teresa Carman, MD
Director, Vascular Medicine
Director, Anticoagulation Monitoring Service



Yulanka Castro Dominguez, MD
Associate Chief, Quality



Akram Elgendy, MD
Director, Structural Heart Imaging



Jae Cho, MD
Co-Director, Vascular Center



Yakov Elgudin, MD, PhD
Surgical Director, Lung Transplantation



James Cireddu, MD
Director, Nuclear Cardiology



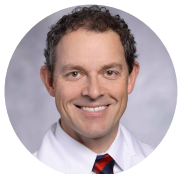
Natalie Evans, MD, MS
Co-Director, Vascular Laboratories



Bernardo Cortese, MD
Co-Director, Coronary Center



Steven Filby, MD
Co-Director, Quality, Interventional Cardiology



Justin Dunn, MD, MPH
Regional Director, Valve & Structural Heart Disease Center



Robert Gilkeson, MD
Co-Director, Cardiovascular Imaging Center

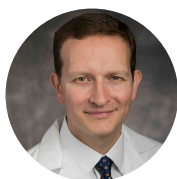


Sarah Eapen, MD
Surgical Director, ECMO Program



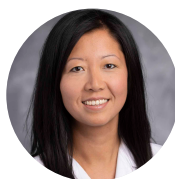
Heather Gornik, MD
Co-Director, Vascular Center
Director, Women's Cardiovascular Center
Director, Fibromuscular Dysplasia & Arterial Dissection Program

Center and Program Medical Leaders (continued)



Eiran Gorodeski, MD, MPH

Medical Director, Advanced Heart Failure
Medical Director, Heart Transplantation
Co-Director, Hambrick Center for Cardiac Recovery



Jun Li, MD

Co-Director, Vascular Center
Co-Director, Pulmonary Embolism Response Team



Shaun Harper, MD

Director, Community Cardiovascular Medicine
Co-Director, Clinical Cardiology Center



Judith Mackall, MD

Director, Center for Cardiovascular Genetics
Director, Cardiac Device Clinics
Director, Clinical Trials Unit



Karem Harth, MD

Director, Center for Comprehensive Venous Care
Co-Director, Vascular Laboratories



Colin McCloskey, MD

Medical Director, ECMO Program



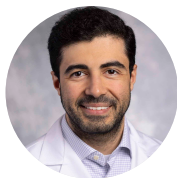
Shashank Jain, MD

Director, Lead Extraction



Raju Modi, MD

Director, Ambulatory Cardiovascular Services



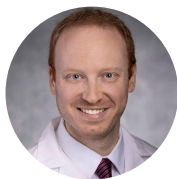
Haitham Khraishah, MD

Co-Director, Center for Integrated and Novel Approaches in Vascular-Metabolic Disease



Ian Neeland, MD

Director, Center for Cardiovascular Prevention;
Co-Director, Center for Integrated and Novel Approaches in Vascular-Metabolic Disease



Bradley Lander, MD

Director, Sports Cardiology Center
Director, Hypertrophic Cardiomyopathy Center



Charles O'Shaughnessy, MD

Co-Director, Quality, Interventional Cardiology



Ravi Ramani, MD

Co-Director, Clinical Cardiology Center



Imran Rashid, MD

Co-Director, Cardiovascular Imaging Center



Mehdi Shishehbor, DO, MPH, PhD

Director, Lorraine and Bill Doderio
Limb Preservation Center



Chad Raymond, DO

Director, Cardiovascular
& Pulmonary Rehabilitation Center



Gregory Stefano, MD

Co-Director, Quality, Interventional Cardiology



Pablo Ruda Vega, MD

Director, Cardiac Surgery Network;
Co-Director, Coronary Center



Nour Tashtish, MD, MSHI

Director, Medical Informatics



Gregory Rushing, MD

Co-Director, Valve & Structural
Heart Disease Center



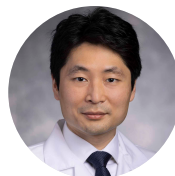
Anene Ukaigwe, MD

Director, Quality, Structural Heart



Robert Schilz, DO, PhD

Medical Director, Lung Transplantation
Co-Director, Pulmonary Embolism
Response Team



William Yoon, MD, PhD

Co-Director, Aortic Disease Center



Andres Schuster, MD

Director, Echocardiography



Michael Zacharias, DO

Associate Clinical Chief, Division
of Cardiovascular Medicine
Medical Director, Mechanical Circulatory Support



Esseim Sharma, MD

Director, Ventricular Arrhythmias Research

Regional Medical Leaders



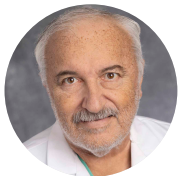
John Coletta, MD

University Hospitals St. John Medical Center



Luis Palma Dallan, MD

University Hospitals Samaritan Medical Center



Naim Farhat, MD

University Hospitals Elyria Medical Center



Gregory Stefano, MD

University Hospitals Conneaut Medical Center
University Hospitals Geauga Medical Center
University Hospitals Geneva Medical Center



Anjan Gupta, MD

University Hospitals Portage Medical Center



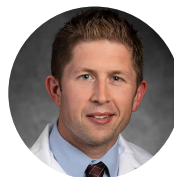
William Wolf, MD

University Hospitals Ahuja Medical Center



Raju Modi, MD

University Hospitals Parma Medical Center



Paul Zellers, DO

University Hospitals Lake
West Medical Center

Health System Leaders



Joseph Sabik, III, MD

Chair, Department of Surgery
Surgeon-in-Chief
University Hospitals Health System



Jonathan Stamler, MD

President and Co-Founder
Harrington Discovery Institute
at University Hospitals



Daniel Simon, MD

President, Academic & External Affairs
Chief Scientific Officer,
University Hospitals Health System

Residency and Fellowship Leaders



Teresa Carman, MD

Director, Vascular Medicine Fellowship



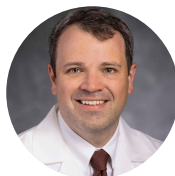
Judith Mackall, MD

Director, Clinical Cardiac
Electrophysiology Fellowship



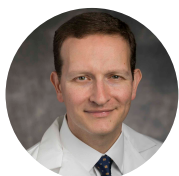
Steven Filby, MD

Director, Interventional Cardiology Fellowship
Director, Complex High-Risk Coronary
Intervention (CHIP) Fellowship



Robert Montgomery, MD

Associate Director, Advanced Heart Failure
and Transplant Cardiology Fellowship



Eiran Gorodeski, MD, MPH

Director, Advanced Heart Failure and
Transplant Cardiology Fellowship



Thomas J. O'Neill, MD

Associate Director, Cardiovascular
Medicine Fellowship



Tarek Hammad, MD

Associate Director, Interventional
Cardiology Fellowship



Gregory Rushing, MD

Associate Director, Cardiothoracic
Surgery Fellowship



Jonathan Kwong, MD

Director, Integrated Vascular Surgery Residency
Director, Vascular Surgery Fellowship



Claire Sullivan, MD

Director, Cardiovascular Medicine Fellowship



Philip Linden, MD

Director, Cardiothoracic Surgery Fellowship



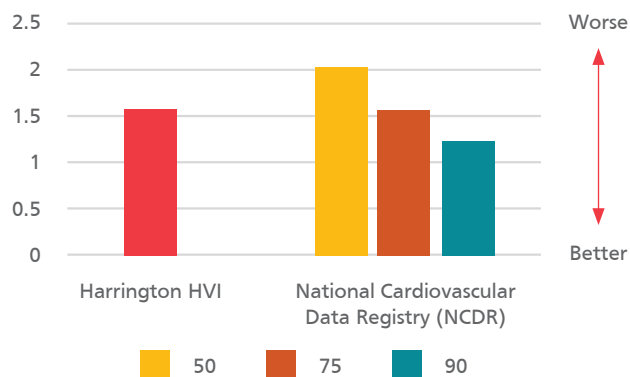
Michael Zacharias, DO

Associate Director, Advanced Heart Failure
and Transplant Cardiology Fellowship

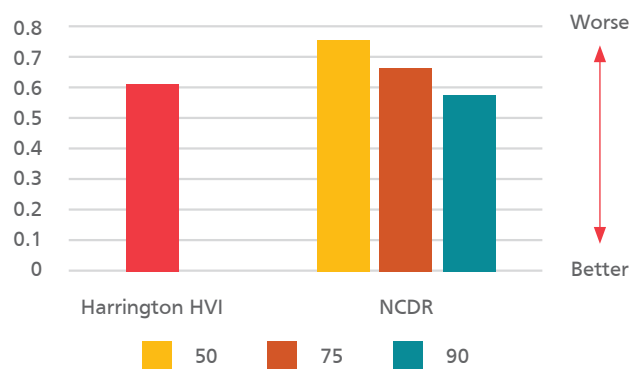
Excellence in Outcomes Across Quality Metrics

Percutaneous Coronary Intervention (PCI)

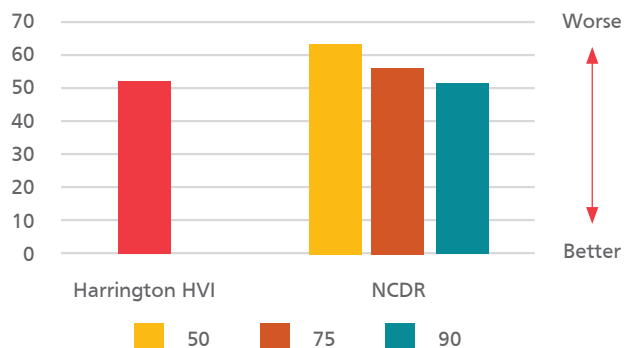
Bleeding



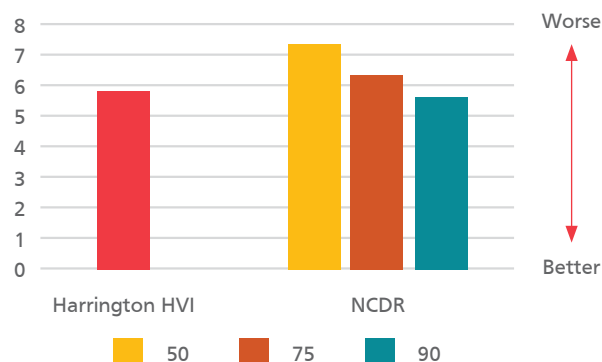
Mortality



Time to PCI (Patients with ST-Elevation Myocardial Infarction)

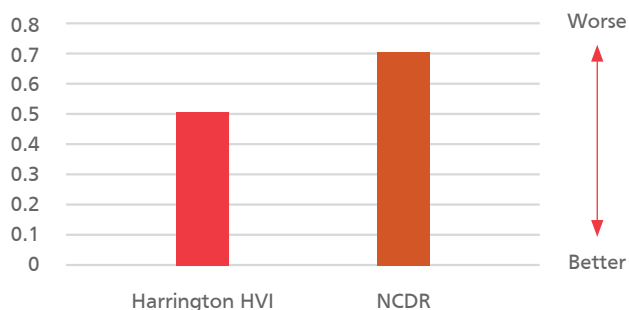


Acute Kidney Injury



Structural Heart Procedures

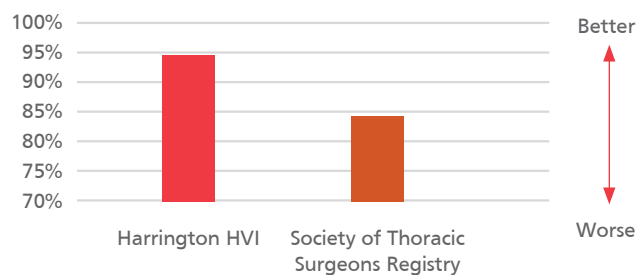
TAVR Mortality



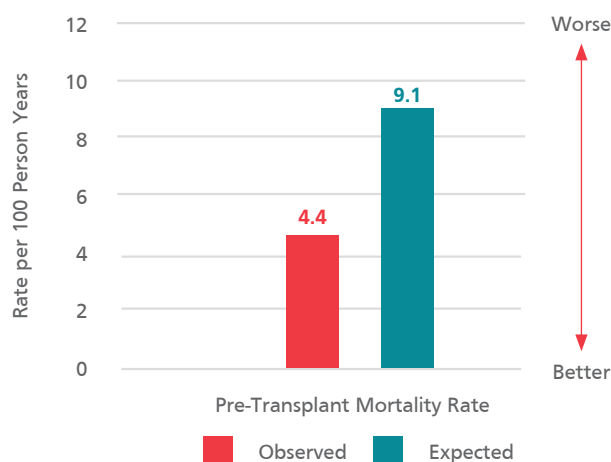
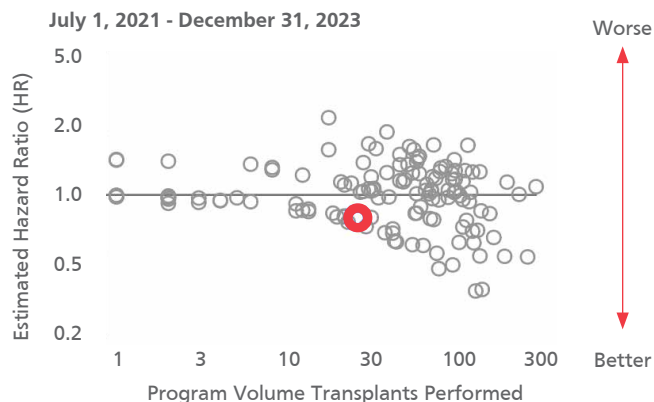
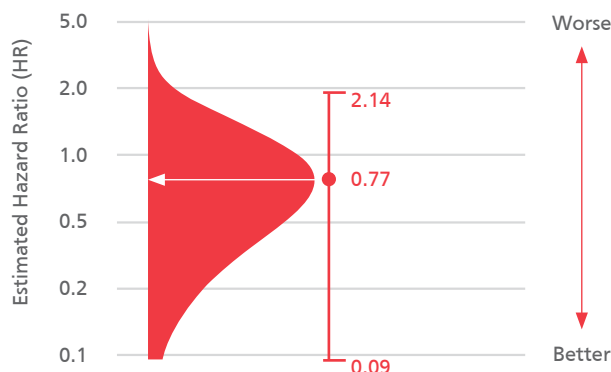
Ventricular Assist Device (VAD)

Post-VAD Implant One-Year Survival

January 1, 2023 - June 30, 2024



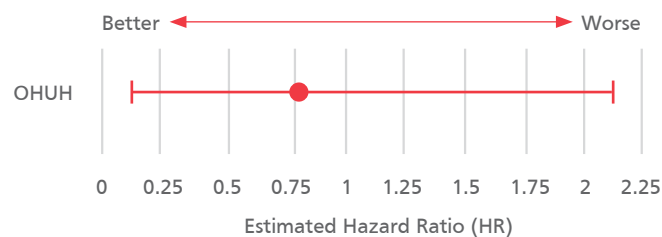
Cardiac Transplantation



Post-Transplant Outcomes

July 1, 2021 - December 31, 2023

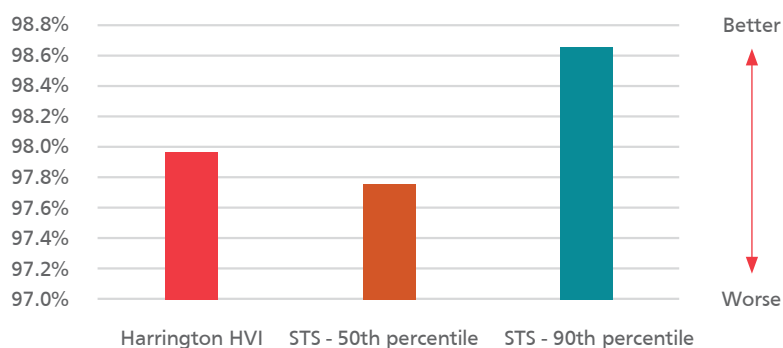
The Estimated Hazard Ratio (HR) shows whether the program has higher than expected (greater than 1.0) or lower than expected (less than 1.0) failure rates (graft failures or patient deaths).



Adult (18+) 1-year (conditional on 90-day) deceased donor patient death HR program comparison

Coronary Artery Bypass Graft (CABG) Surgery

Absence of Mortality



0 Transcatheter Mitral Valve Repair Mortality

0 Left Atrial Appendage Closure Strokes

0.8% (3 yr) and 1.9 (1 year) mortality in CABG+AVR at UH Cleveland Medical Center;
 >99th percentile 0% mortality in CABG+Mitral Valve (MV) Repair or replacement (1 year);
 >99th percentile 0% mortality in MV Repair (1 year)

Preventive Cardiology

CENTERING THE HEART IN CANCER CARE

Established in 2013, the innovative cardio-oncology collaborative between University Hospitals (UH) Harrington Heart & Vascular Institute and UH Seidman Cancer Center is providing focused care prior to, during and after cancer treatment to prevent or minimize cardiac complications. Utilizing advanced cardiac monitoring, the cardio-oncology team can treat tumors in patients who may be considered ineligible for therapy at other centers. For example, treatment with fluorouracil (5-FU) can improve survival and quality of life for patients with colorectal, breast and stomach cancers, but is closely associated with cardiotoxicity. The UH cardio-oncology team has successfully treated patients who have failed outpatient therapy with inpatient 5-FU, significantly beating the national average for safe 5-FU treatment in high-risk patients. Separately, in an ongoing clinical trial, the team is examining the correlation between chemotherapy administration in patients with biopsy-confirmed breast cancer and decreased heart function, reduced exercise tolerance and cancer-related fatigue.

+15.9%

Patient Volume in 2024

Gold
Designation



International Cardio-Oncology Society



ALIGNING SPECIALTIES TO SUPPORT CARDIOMETABOLIC HEALTH

The Center for Integrated and Novel Approaches in Vascular-Metabolic Disease (CINEMA) continues to demonstrate significant reductions in cardiovascular disease risk (CVD) among patients with prediabetes or type 2 diabetes, according to two-year data published in 2024.

Study results showed reductions in body weight, blood pressure and lipids reduced overall CVD risk by 2.4 percent, while uptake of guideline-directed cardiometabolic medications increased significantly.

In addition to providing comprehensive care, ongoing research by CINEMA investigators is building a better understanding of those risks, including environmental factors. Results from one 2024 study pinpointed the connection between air pollution and up to 20 percent or more of global type 2 diabetes cases.



Setting Standards for GLP-1 Treatment

Underpinning progress in outcomes is the increasing adoption of GLP-1 medications, with patient uptake tripling over the two-year CINEMA study. UH Harrington Heart & Vascular Institute is at the forefront of national guidelines to clarify the safe use of these weight-loss medications, including compensation for muscle-related changes associated with rapid weight loss. In one clinical trial, UH investigators and colleagues found those adaptive changes were associated with reduction in muscle fat and improvement in muscle quality. Next, the team is planning a clinical trial to better understand the effects on GLP-1s at a molecular level—which could help to better inform treatment guidelines and lifestyle modifications for CINEMA patients experiencing weight loss.

IN CARDIAC CARE FOR ATHLETES, NO SPORT – OR HEART – IS THE SAME

Whether patients are professional athletes or avid recreational exercisers, University Hospitals Harrington Heart & Vascular Institute's Sports Cardiology Center specializes in caring for known or suspected cardiac conditions in this unique population.

Conditions that may be straightforward in some circumstances can be more nuanced in athletes and highly active people. These include valve disorders, aortic dilation, hypertrophic cardiomyopathy and atrial fibrillation (Afib). Afib has a higher incidence among endurance athletes, particularly middle-aged males. For all these patients, the team takes a comprehensive approach that considers other risk factors such as alcohol, supplements, hypertension, sleep apnea, family history and medications. Understanding the complete profile of cardiac conditions in athletes often requires advanced imaging, including cardiac MRI and advanced cardiopulmonary exercise testing.

These resources help the Sports Cardiology Center team better manage cardiac conditions in professional and masters athletes as well; University Hospitals is an official healthcare provider for the Cleveland Browns, Cleveland Monsters, Cleveland Ballet and Cleveland Marathon.

The Sports Cardiology Center led a 2024 study, published in *JAMA Cardiology*, which examined ECG data from 173 Women's National Basketball Association (WNBA) players to identify cardiac changes. Though ECG changes have been previously observed in male and female athletes, there was a lack of data about women who play basketball. The study team found that 78.6 percent of WNBA players had training-related ECG findings, but they had lower rates of abnormal ECG than female professional soccer players or male NBA players. These data provide reference points for future cardiac evaluations of female basketball players.



Synchronized Diabetes and Heart Care Improves Every Aspect of Patient's Health

David Tschantz lived a healthy life with not so much as an overnight hospital stay until his late 50s. He then found himself getting more and more out of breath. Tests revealed David had a multitude of health problems including type 2 diabetes and congestive heart failure. His A1C was over 13 percent. He had high blood pressure, high cholesterol and his heart's ejection fraction measured 30 percent.



Then, in the fall of 2022, David was referred to University Hospitals (UH) Harrington Heart & Vascular Institute's Center for Integrated and Novel Approaches in Vascular-Metabolic Disease (UH CINEMA), where he was treated by a multidisciplinary team to address his overlapping conditions with one comprehensive plan.

Over the next two years, nearly every aspect of David's health improved. Now his A1C is normal, and he has no detectable diabetes. He's lost 50 pounds. His breathing has returned to normal. His ejection fraction has recovered and is now in a better range, and his heart has healed itself with no evidence of heart failure. David says he has improved his diet and is now more physically active, including participation in UH CINEMA's armchair workout classes.

"I'm back to doing things I enjoy, like building through carpentry, and I'm working with my brother," said David. "Before CINEMA I didn't have much hope of feeling good again, but now I feel as close as possible to my best, maybe even better!"

Elite Runner and Heart Attack Survivor Completes 10K Six Months Later

When 66-year-old John Zack suffered a ST-elevated myocardial infarction (STEMI) while running the Cleveland Marathon – his eighth 26.2-mile race – the "chain of survival" established by event medicine and emergency medicine at UH saved his life. After being treated in the medical tent, a cardiac catheterization, drug-eluting coronary stent and short hospital stay followed, and then John was on his way.

However, John's care at UH did not end there. Determined to maintain his status as an elite runner, he underwent a comprehensive review in the Sports Cardiology Center at UH Harrington Heart & Vascular Institute. An echocardiogram and an advanced cardiopulmonary exercise test were performed to measure various metabolic and cardiac parameters to help guide a return to competition. John was also prescribed cardiac rehabilitation, where his care team could closely monitor him as he returned to exercising at a high level.

John's results speak for themselves. After suffering a heart attack on May 19, 2024, he ran a 10K on November 16, 2024, just six months later.



Advanced Cardiovascular Imaging

STRATIFYING RISK, TARGETING PREVENTION WITH CT AND MR IMAGING

With an increasing number of applications, CT and MR protocols are being utilized not only to better pinpoint problems in the heart and arteries, but to assess cardiac risk and enhance therapeutic and surgical approaches to treat cardiac disease.

A Proven Tool for Coronary Artery Disease Prevention

Fractional flow reserve computed tomography (FFR_{CT}), a groundbreaking noninvasive diagnostic tool first used in the U.S. at University Hospitals (UH) Harrington Heart & Vascular Institute, has demonstrated significant clinical benefits in managing coronary artery disease (CAD). The institute's adoption of FFR_{CT} in 2015 marked a shift toward precision, patient-centered cardiac care. With two additional UH sites offering this imaging tool in 2024 and three more planned for 2025, FFR_{CT} is reaching more UH patients as a transformative tool for safe and accurate risk stratification with reduced downstream invasive and noninvasive testing.

Setting a New Standard for Pericardial Imaging

UH Harrington Heart & Vascular Institute cardiologists co-authored an international position statement addressing significant advancements in multimodality cardiac imaging for pericardial diseases. Published in *JACC: Cardiovascular Imaging* and endorsed by the American College of Cardiology Imaging Council and the Society of Cardiovascular Magnetic Resonance, the statement underscores the critical role of advanced imaging modalities in enhancing diagnosis, risk assessment and patient monitoring.

This collaborative effort aims to bridge educational gaps among clinicians, promoting standardized evaluation and treatment approaches—ultimately improving patient outcomes.

Defining the Future of Preventive Care

As the world's largest no-cost calcium scoring program, UH Harrington Heart & Vascular Institute cardiologists and radiology colleagues have performed more than 140,000 scans over the past 10 years to identify at-risk patients and reduce cardiovascular events at scale. Calcium score exams are completed for more than 26,000 patients each year, fueling recent research stratifying cardiovascular risk among patients with both direct cardiovascular involvement and other nonconventional cardiovascular risk factors. Additional studies characterize outcomes of interventions, such as percutaneous coronary intervention.

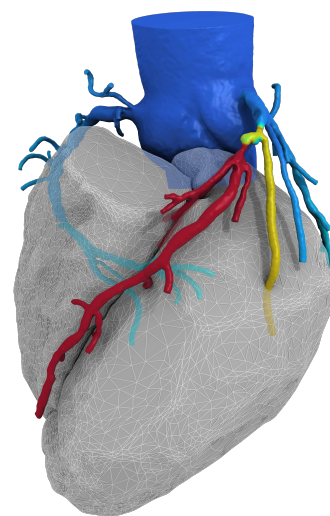
UH Harrington Heart & Vascular Institute's Center for Advanced Heart & Vascular Care serves as the core MR imaging provider for four ongoing clinical trials, securing numerous National Institutes of Health (NIH) and industry grants for the development of advanced imaging techniques. With continued collaboration among the structural heart team, a Medtronic-funded study is using exercise cardiac MRI to assess the hemodynamic and myocardial impacts of different TAVR approaches.

5%

Growth in
MR scans

60%

Growth in
FFR_{CT} Volume



SIGNIFICANT VOLUME GROWTH IN ECHOCARDIOGRAM & NUCLEAR IMAGING

The consolidation of 31 echo labs across locations, which collectively held multiple accreditations from the Intersocietal Accreditation Commission (IAC), into one system accreditation has streamlined ongoing quality efforts. All echocardiogram readers and sonographers from across locations now attend one system quality meeting and perform quarterly quality exercises. A total of 80,497 exams were performed within system-wide echocardiogram labs, an increase of 8.7 percent over 2023.

Enhancing Imaging with Artificial Intelligence (AI)

University Hospitals (UH) Harrington Heart & Vascular Institute physician researchers are studying the implementation of Ultromics' EchoGo® Heart Failure platform in the detection and management of heart failure with preserved ejection fraction (HFpEF). The AI tool has demonstrated high sensitivity and specificity in detecting HFpEF by using a single apical four-chamber echocardiographic view to surpass limitations in traditional diagnostic methods. Its use could help improve diagnostic accuracy, reduce indeterminate cases and facilitate timely intervention for patients at risk.

Separately, the team is conducting research for developing AI tools to enhance hybrid single photon emission computed tomography (SPECT) cardiac stress imaging with CT attenuation correction in collaboration with Case Western Reserve University, UH Ventures and GE. With institutional review board (IRB) approval completed, the goal of the prospective research is to develop commercially viable AI tools to enhance sensitivity and specificity of nuclear imaging.



Leading the Nation in Chest Pain Certification

UH Harrington Heart & Vascular Institute sites across 11 medical centers have achieved Advanced Chest Pain Certification (ACPC) from DNV, a globally recognized independent certification, assurance and risk management provider that sets industry standards for excellence. The institute is the first in Ohio with a DNV-endorsed ACPC and the first in the U.S. with a DNV-endorsed, system-level ACPC.

Cardiac Electrophysiology

Among the fastest growing areas of care within the institute, electrophysiology procedures – including electrophysiology studies, ablations, implantable cardiac defibrillators, pacemakers and lead extractions – have increased by 42 percent over the past five years, led by rapidly expanding services in the community. Catheter ablation procedures alone grew by 25 percent in 2024, with nearly 2,000 performed.

SINGLE PROCEDURE FOR RHYTHM CONTROL AND STROKE PREVENTION

For patients amenable to both ablation treatment and left atrial appendage closure, an FDA-approved concomitant procedure was launched in 2024, enhancing safety by eliminating the need for dual procedures and anesthesia administration. University Hospitals (UH) Harrington Heart & Vascular Institute is one of a select number of programs nationwide offering the dual procedure, with high volumes and excellent safety and outcomes.

HYBRID CATHETER APPROACH FOR AFIB

UH Harrington Heart & Vascular Institute is one of the top-enrolling sites, among 35 selected, for a study of a new catheter ablation technique for patients with paroxysmal atrial fibrillation (AFib) who failed antiarrhythmic medication. The new technique uses the THERMOCOOL SMARTTOUCH® SF Catheter with the TRUPULSE™ Generator to enable both pulse field and radiofrequency ablation via a single hybrid catheter, eliminating the need for separate catheters. Researchers are exploring whether the approach might reduce patients' AFib episodes, hospitalizations or cardioversions while simplifying the procedure.

DRIVING LEADLESS THERAPY AND EXTRAVASCULAR CARDIAC CARE

The institute's physician-scientists have long been at the forefront of investigating leadless pacemakers and implantable cardioverter-defibrillators (ICDs), most recently participating in investigational device exemption trials that helped bring to market the novel AVEIR™ VR Leadless Pacemaker and Aurora EV-ICD™ System.

Leadless devices are advancing cardiac rhythm management by simplifying implantation, improving patient comfort and reducing risks associated with transvenous leads. The Aveir system, smaller than a AAA battery, offers both single- and dual-chamber leadless pacing to treat a range of slow or abnormal heart rhythms.

Extravascular ICDs are positioned outside the vascular space to treat sudden cardiac arrest and tachycardia. They address limitations of transvenous ICDs by avoiding major intravascular and lead-related complications like venous occlusion and endocarditis, while providing safe and effective defibrillation with improved pacing capabilities.

PERSONALIZING DEVICES TO PATIENTS

Cardiac electrophysiologists at UH Harrington Heart & Vascular Institute offer the full range of leadless and extravascular pacing options, with eligibility and device selection highly personalized to each patient's specific condition with long-term outcomes in mind. Challenging vascular access or increased infection risk may point to leadless options; the extravascular approach can reduce long-term, lead-related morbidity, of particular concern for younger patients who may require multiple lifetime device revisions.

Implantable Device Improves Cardiac Function in Heart Failure Patient

When medications weren't controlling heart failure symptoms for **Lela Glass**, her care team at University Hospitals (UH) Harrington Heart & Vascular Institute decided she would be a good candidate for cardiac contractility modulation (CCM). A first of its kind, FDA-approved minimally invasive therapy, CCM improves the contraction of the heart, allowing more oxygen-rich blood to reach the body. It delivers precisely timed electrical pulses to the heart and can be used in conjunction with medications and other heart failure therapies to help the heart work better and more efficiently.

UH Harrington Heart & Vascular Institute was the first in Northeast Ohio and among the first hospitals in the U.S. to use CCM therapy, delivered by the Optimizer® system, to treat patients suffering from heart failure.

After years of negative symptoms, Lela reported feeling significantly better after implant. "Within two weeks I had a lot more energy. I wanted to be active. I wanted to exercise and work in the yard," she said. Lela, in her early 70s, continues to be monitored by her cardiologist and has a defibrillator and pacemaker, but she's living life in a way she hasn't in years.

"I was tired of being tired and I wanted my life back. Now I have it," she said.



Vascular Disease

ADVANCING CARE FOR AORTIC DISEASE

In 2024, University Hospitals (UH) Harrington Heart & Vascular Institute was accepted into the International Registry of Acute Aortic Dissection (IRAD), a consortium of 58 large referral and research centers in 13 countries evaluating the current management and outcomes of acute aortic dissections. The Aortic Disease Center convenes multidisciplinary team case discussions and offers access to next-generation treatments, which are resulting in notable patient outcomes. The team continues to expand the number of therapies available for patients with participation in prominent trials and registries, including:

Gore TOGETHER and GREAT registries, tracking outcomes for the Thoracoabdominal Multibranch Endoprosthesis (TAMBE) – the first FDA-approved, off-the-shelf, endovascular repair solution for treatment of complex aneurysmal disease involving the visceral aorta – and the Thoracic Branch Endoprosthesis (TBE), among other thoracic and abdominal endografts.

ADVANCE trial, a prospective randomized trial evaluating long-term efficacy between the Gore EXCLUDER® abdominal endoprosthesis and Medtronic Endurant™ abdominal endograft.

stAAAbile trial, a randomized controlled study evaluating the efficacy of pentagalloyl glucose compound in stabilizing and preventing the growth of small- and medium-sized abdominal aortic aneurysm.

AMDS™ Hybrid Prosthesis, in use with FDA Humanitarian Device Exemption, the world's first aortic arch remodeling device for use in treating acute DeBakey type I aortic dissection.

TRIOMPHE trial, evaluating the NEXUS® Aortic Arch Stent Graft System for endovascular treatment of aortic arch lesions, including chronic dissections, aneurysms, penetrating aortic ulcers and intramural hematoma of the thoracic aorta involving the aortic arch.

IMPROVE-AD, a National Institutes of Health (NIH) sponsored trial investigating the safety and efficacy of preemptive treatment of uncomplicated acute type B aortic dissection.



A TOP ENROLLING SITE FOR FIBROMUSCULAR DYSPLASIA AND ARTERIAL DISSECTIONS

UH Harrington Heart & Vascular Institute is among the top enrolling sites in both the North American Registry for Fibromuscular Dysplasia (FMD) and the International SCAD (iSCAD) Registry for spontaneous coronary artery dissection (SCAD). To help patients with these conditions live their best lives, the institute team also launched a support group. Managing brain aneurysms, maximizing kidney health and accessing interventional cardiovascular care are just a few of the topics addressed during 2024 virtual forums hosted by UH Harrington Heart & Vascular Institute, bringing together more than 400 individuals living with FMD and arterial dissection from across the globe. The ongoing group began with a dozen patients in a conference room at a UH community hospital, growing into a quarterly international forum convening patients and FMD experts from the field, presented in partnership with the FMD Society of America, a national patient advocacy organization.

BRINGING NATIONAL DEEP VENOUS GUIDELINES UP TO SPEED

A comprehensive report, published by University Hospitals (UH) Harrington Heart & Vascular Institute in *Seminars in Vascular Surgery*, provides pivotal guidance on the rapidly evolving field of venous disease and available therapies. The report addresses the appropriateness of care in deep venous disease of the lower extremities, inappropriate use of deep venous procedures for the lower extremities, acute thrombotic iliofemoral disease, use of intravascular ultrasound, and treatment with antithrombotics and antiplatelets. It also includes a discussion of data on thrombus-clearing devices and deep pelvic venous stenting, among other topics. While these technologies have evolved rapidly over the last decade, evidence-based guidelines have been slow to develop. This report reviews current deep venous therapies and needed work to fill gaps.

FINE-TUNING TREATMENT OF PULMONARY EMBOLISM

The Pulmonary Embolism Response Team (PERT) was launched in 2018 as a multidisciplinary group of specialists dedicated to providing rapid, real-time consultation and collaboration to better manage pulmonary embolism (PE) patients. The group consolidates expertise around PE treatment to deliver the most advanced care. Because PE is so often life-threatening, the PERT clinicians are continually seeking and implementing new ways to improve outcomes for patients. In the recently completed AVENTUS clinical trial, UH clinicians are evaluating a next generation thrombectomy system for the removal of emboli and thrombi. The multicenter, prospective, single-arm trial is exploring whether the system offers a more streamlined, efficient, precise thrombectomy solution for treating life-threatening blood clots in patients.

LEADING NEW GUIDELINES FOR PERIPHERAL ARTERY DISEASE

Generally underrecognized and undertreated compared to other cardiovascular diseases, peripheral artery disease (PAD) remains a priority for specialists at UH Harrington Heart & Vascular Institute, where experts played a pivotal role in chairing and writing new patient management guidelines. Convened by the American Heart Association and American College of Cardiology, the new 2024 PAD guidelines cover multiple clinical presentation subsets, including asymptomatic, chronic symptomatic, chronic limb-threatening ischemia and acute limb ischemia.

UH specialists also recognize that despite the availability of updated, evidence-based guidelines for PAD, disparities in disease management remain a challenge among underserved populations, who are also disproportionately impacted by the condition. In 2024, the team joined a prestigious panel of fellow experts convened by the *American Journal of Managed Care*, to examine these disparities in cardiovascular disease management.



A NATIONAL DESTINATION FOR LIMB PRESERVATION CARE

Launched with a \$5 million gift from Lorraine and Bill Dodero, the Lorraine and Bill Dodero Limb Preservation Center is creating a national destination for patients living with critical limb-threatening ischemia (CLTI), the end stage of peripheral artery disease (PAD). The center builds on the institute's growth and innovation in limb preservation and promotes further discovery of new treatments for CLTI and diabetes-associated arterial diseases.

An FDA-approved, minimally invasive procedure, LimFlow, bypasses blockages in arteries of the legs and restores blood flow, saving the legs of patients with severe vascular disease who are not candidates for traditional bypass surgery or revascularization. FDA approval followed results from the PROMISE II Multicenter Prospective Study, co-led by University Hospitals (UH) Harrington Heart & Vascular Institute, which found that the therapy enabled most patients treated to keep their leg and experience wound healing. PROMISE II study results showed 76 percent of the 105 CLTI patients treated with transcatheter

arterialization of the deep veins (TADV) using LimFlow therapy were able to keep their leg; 76 percent of patients had completely healed or healing wounds. Freedom from all-cause mortality was 87 percent at six months. UH is continuing research as a site for the extension study, PROMISE III, which will further track efficacy and safety of the approach.

AMPLIFYING BEST PRACTICES IN REVASCULARIZATION

To help clarify and communicate best practices for endovascular revascularization, UH Harrington Heart & Vascular Institute specialists convened an international panel of colleagues from the United States, Australia, Asia and Europe who treat below-the-knee (BTK) disease in CLTI. The group developed and published a needed statement in *JACC: Cardiovascular Interventions* on the essential knowledge for a BTK endovascular operator, including anatomy, recanalization techniques, challenges associated with tibial and pedal disease, and novel and anticipated devices. This document was the publication's most downloaded article in 2024.

Bill and Lorraine Dodero



UH Team Saves Leg and Life of Man Facing Amputation

Just months after cramping in his leg led to a diagnosis of peripheral artery disease, **Daniel Boynton** was delivered devastating news by his doctors in Lexington, Kentucky: His leg must be amputated. Three different doctors told Daniel, then 73, the vessels in his right leg were completely blocked. Attempts to stent the vessel in his leg were unsuccessful in Lexington. His toes started turning black.

“I had three doctors say they were going to take my leg, and then I had a couple nurses tell me they’ve come a long way with prosthetics,” Daniel recalled. “I still said no. Then I came to Cleveland. God brought the right doctor in.”

Daniel traveled six hours to Cleveland for care at University Hospitals Harrington Heart & Vascular Institute and was quickly scheduled for a minimally invasive endovascular revascularization. Patients like Daniel have traveled from more than 17 states – including Florida, California, Georgia, North Carolina, Virginia and Pennsylvania – to be treated by this team, and more than 75 percent have avoided amputation.



Complex Coronary Artery Disease

INTERNATIONAL LEADERSHIP AND INTERVENTIONS

University Hospitals (UH) Harrington Heart & Vascular Institute's Coronary Center specializes in the management of patients with complex coronary artery disease and chronic total occlusions, leading multiple clinical trials for novel cardiovascular therapies and techniques.

Among those techniques are drug-coated balloons (DCBs), now widely used in Europe for percutaneous coronary intervention. In the United States, DCBs are approved for patients requiring in-stent restenosis (ISR), and the Coronary Center team is working to advance understanding of the emerging role of DCBs in complex coronary repair.

European clinical trials demonstrate that DCBs reduce risks such as late stent thrombosis, vessel caging and stent-related restenosis. This makes them particularly useful in ISR, small vessel disease and bifurcation lesions.

Coronary Center experts contributed to the Academic Research Consortium's DCB consensus documents, which were accepted for publication in the *European Heart Journal*, gathering the most influential experts on DCBs for the first time. The team will now submit for institutional review board (IRB) approval to launch a robust scientific program of five upcoming industry-sponsored DCB trials.

FOR HIGH-RISK PATIENTS, MANY SPECIALTIES MAKE ONE TEAM

As an increasing number of high-risk patients are referred for care, the Advanced Coronary Care (ACC) program of the Coronary Center deals with complex coronary and high-risk patients (CHIP), bringing together interventional cardiologists, cardiothoracic surgeons, fellows and invited specialists throughout the UH Harrington Heart & Vascular Institute to discuss and strategize interventions. The weekly meetings provide a platform for experts to discuss individual cases and develop a shared therapeutic path for high-risk and fragile patients with coronary artery disease. Urgent cases are handled by ACC collaborators on an ad hoc basis.

Recently, the ACC implemented an expanded protocol to provide a report for each patient assessed during these meetings, shared with the referral. This is reinforcing communication between providers, aiming at improving patient care across the system. Another improvement of the Coronary Center is the development and application of a dedicated protocol for high-risk patients undergoing complex coronary interventions, by using percutaneous mechanical circulatory support with the Impella® co-axial pump. This protocol encompasses the correct patient selection, adequate pre-op assessment and follow-up after the intervention to minimize peri-procedural complications.



Valve and Structural Heart Disease

REFINING APPROACHES IN TRANSCATHETER AORTIC VALVE REPLACEMENT (TAVR)

Over the past decade, experts in the Valve and Structural Heart Disease Center have become internationally recognized for their pioneering TAVR techniques, training peers around the world. The team is involved in ongoing clinical trials examining how to improve outcomes for patients with symptoms from mild to severe. One area of research focuses on optimizing the type of implanted device used based on the patient's specific anatomy. In a randomized trial, UH physician-researchers compared a self-expanding supraannular valve with a balloon-expandable valve for patients with smaller annuli, which includes 90 percent of women who undergo TAVR. Study results published in *The New England Journal of Medicine* pointed to the self-expanding valve, already in use at University Hospitals (UH) Harrington Heart & Vascular Institute.

As the population of patients with previously placed valves ages, first-generation devices are reaching the end of their functionality. UH Harrington Heart & Vascular Institute is investigating the optimal procedure methods to remedy those failing devices as the lead of a multicenter study known as RESTORE. This first-of-its-kind study aims to enhance understanding of how to redo TAVR with the goal to address nuances involved in placing a new transcatheter valve inside a previously placed device.

WATCHMAN PROCEDURE MARKS MAJOR MILESTONE

The year 2024 marked a significant milestone as the structural heart team completed its 1,000th Watchman™ procedure for left atrial appendage closure (LAAC). This achievement highlights the center's leadership in minimally invasive solutions for atrial fibrillation, with UH Harrington Heart & Vascular Institute now recognized as the sixth-busiest center by volume among the 155 U.S. centers that perform this procedure.

The UH team pioneered the use of advanced imaging for pre-procedural planning while implementing a same-day discharge strategy to improve patient outcomes and satisfaction. With a 99.7 percent procedural success rate and zero major complications, stroke or mortality, UH Harrington Heart & Vascular Institute has earned national distinction as a Center of Excellence for LAAC. At the start of 2025, the center continues to lead the field with ongoing research, including leading a multicenter study analyzing different imaging modalities after Watchman implant, as well as hosting national and international training courses.

14% Growth in Structural and Valve Procedures

167% Increase in Transcatheter Mitral Valve Replacement Procedures

22% Increase in Patent Foramen Ovale/Atrial Septal Defect Repairs

4

publications on
TAVR efficiencies and
coronary cannula

12

publications and
a textbook on
LAAC optimization

NEW SERVICE EXPANDS TRICUSPID VALVE CARE

For patients with tricuspid valve disease, UH Harrington Heart & Vascular Institute now offers minimally invasive transcatheter edge-to-edge repair (TEER) to help involved leaflets seal correctly, reducing tricuspid regurgitation. The TEER procedure, which entails attaching a clip to the valve's leaflets via a catheter inserted through a vein in the upper thigh, has been shown to be safe and effective for patients with severe tricuspid regurgitation, leading to significant improvements in quality of life. Studies have demonstrated that TEER reduces the severity of tricuspid regurgitation and is associated with improved patient outcomes.

Cardiac Surgery

ROBOTIC ASSISTED CARDIAC SURGERY APPROACH MARKS A FIRST FOR OHIO

In 2024, University Hospitals (UH) Harrington Heart & Vascular Institute treated more than 100 patients with a robotic approach to coronary artery bypass graft (CABG) surgery. The combined expertise of the surgical team has allowed them to build a robust robotic cardiac surgery program completing eight to 10 procedures per month on average, making this one of the highest volume programs in the country. Since higher volumes result from experienced physicians, quality outcomes for patients correlate as well. UH also uses the Da Vinci robot for other heart procedures, such as valve surgery, reinforcing its role as a national leader in minimally invasive cardiac surgery.

The robotic method builds on the minimally invasive direct coronary artery bypass (MIDCAB) technique, which avoids cutting the breastbone and using a heart-lung machine. UH has maintained leadership in this area too, as the fourth highest volume program in the country.

SETTING STANDARDS FOR PERIOPERATIVE CARDIAC SURGERY CARE

Building on advancements in minimally invasive cardiac surgery, UH Harrington Heart & Vascular Institute is also at the forefront of establishing comprehensive perioperative care standards. In 2024, UH experts co-authored a Joint Consensus statement on perioperative care in cardiac surgery, in collaboration with the Enhanced Recovery After Surgery (ERAS) Cardiac Society, ERAS International Society and The Society of Thoracic Surgeons (STS).

Published in *The Annals of Thoracic Surgery*, this consensus aims to advance evidence-based, interdisciplinary care pathways that enhance patient safety and optimize surgical protocols—from preoperative preparation through recovery.

This latest version of the consensus statement reframes what perioperative care should encompass for each cardiac surgery patient, with a grading system of the level of evidence underpinning each recommendation. The updated guidelines place particular emphasis on patient engagement and shared decision-making, ensuring that the surgical care journey is patient-centric and supported by ongoing quality assessments and metrics.



8.4% Volume Growth
over Prior Year

>1,000 Cases

Highest Volume Ever at UH Cleveland Medical Center

Clinical Trial Highlight:

STICH

UH Harrington Heart & Vascular Institute is evaluating and comparing the effectiveness of percutaneous coronary intervention (PCI) against coronary artery bypass grafting (CABG) in patients with multivessel coronary artery disease and ischemic left ventricular dysfunction.

ADVANCING SURGICAL MANAGEMENT OF LEFT ATRIAL APPENDAGE

In another surgical first, University Hospitals (UH) Harrington Heart & Vascular Institute pioneered the implantation of the Penditure™ Left Atrial Appendage (LAA) Exclusion System through a minimally invasive approach during a mitral valve repair procedure. This was the first time this device and approach were used simultaneously in a human.

The Penditure system is an implantable clip designed to better match the atrial anatomy and reduce inflammation in the management of LAA problems. It is the only LAA clip that can be recaptured, repositioned and redeployed after initial deployment during a procedure, putting greater control in the hands of surgeons.

Though it is designed for placement simultaneously with cardiac surgery, just one day after the system was launched UH cardiac surgeons completed a successful case using a minimally invasive approach during a mitral valve repair.



Cardiovascular Critical Care

Created through a transformative gift from the Hambrick family, the Hambrick Center for Cardiac Recovery at University Hospitals Harrington Heart & Vascular Institute is advancing the future of care for patients recovering from heart failure, cardiac surgery and related interventions.

ONE LAST OPTION FOR SURVIVAL AFTER CARDIAC ARREST

UH Harrington Heart & Vascular Institute offers Ohio's only extracorporeal cardiopulmonary resuscitation (ECPR) program, providing a groundbreaking lifeline to cardiac arrest patients who fail to respond to standard advanced cardiac life support. The program uses extracorporeal membrane oxygenation (ECMO) to stabilize patients by temporarily supporting their heart, lungs and brain with oxygenated blood. Once stabilized, patients can undergo lifesaving interventions, such as cardiac surgery or catheterization, that would otherwise be impossible. The intervention currently targets adults ages 18 to 70 with witnessed arrests and shockable rhythms—patients most likely to benefit.

Lifesaving Results

64%

of UH patients treated with ECPR have walked out of the hospital

55%

of UH patients have a Cerebral Performance Category (CPC) score of 1 at 90 days



ECMO TEAM RECEIVES NATIONAL HONOR FOR QUALITY

The UH ECMO team has earned the Gold Level ELSO Award for Excellence in Life Support from the Extracorporeal Life Support Organization. This prestigious honor acknowledges centers that demonstrate an exceptional commitment to evidence-based protocols, team training and patient satisfaction.

First-in-Ohio Distinction for Exceptional Nursing Care

The Edna & Thomas F. Zenty Cardiac Intensive Care Unit (CICU) at UH Cleveland Medical Center earned the prestigious gold-level Beacon Award for Excellence from the American Association of Critical-Care Nurses (AACN). This CICU is the only cardiac ICU in Ohio with gold-level status. The award honors the unit's leadership, staff engagement, evidence-based care and outcomes that meet or exceed national benchmarks for delivering compassionate, high-quality care to critically ill patients.

James and Angela Hambrick



ECPR Proves Lifesaving for Cardiac Arrest Survivor

In the early morning hours, 52-year-old **Aletah Whitman** was awakened by what felt like an explosion in her left leg. She tried to stand, but lost consciousness. Aletah came to and managed to call 9-1-1 before suffering a cardiac arrest. Emergency responders broke down her door and took her to University Hospitals (UH) Cleveland Medical Center.



There, the team used extracorporeal cardiopulmonary resuscitation (ECPR), a method of cardiopulmonary resuscitation (CPR) that passed Aletah's blood through an extracorporeal membrane oxygenation (ECMO) machine to oxygenate her blood supply. UH Harrington Heart & Vascular Institute was an early adopter of ECPR, having originally launched the program in 2020, with coordination and collaboration across emergency medicine, cardiothoracic surgery, interventional cardiology and critical care.

A massive pulmonary embolism was confirmed through a CT scan, and Aletah was transported to the cardiac catheterization lab, where she received a pulmonary embolectomy to remove the blood clots in her lungs. Aletah spent four days on ECMO in the cardiothoracic intensive care unit before she regained consciousness and was removed from ECMO. She was discharged to a rehabilitation facility and eventually returned home. Less than two months after her cardiac arrest she returned to work on light duty.

“So many things had to be in place for this to go right,” she said. “I know I’m so fortunate. I just wanted to get back to the life I had. I’m so grateful to UH for the amazing care.”

Transplant Technology Preserves Donor Hearts to Save More Lives

Nick Mitchell was healthy and in his early 30s, but after catching a bug from another passenger on a plane, he sought care for symptoms of a cough and low energy. In addition to pneumonia, flu, strep throat and ear infections, caregivers also discovered Nick had an enlarged heart and an ejection fraction (EF) of only 15 to 20 percent.



Diagnosed with non-ischemic cardiomyopathy, Nick's condition gradually worsened despite regular monitoring, medications and having a defibrillator implanted. He was eventually placed on the heart transplant list.

At UH Harrington Heart & Vascular Institute, Nick benefited from an advance in heart transplantation called ex vivo organ preservation. With this technique the donor heart is perfused with blood on a machine once it has been removed from the body, keeping the heart tissue alive and beating in a box. This makes it possible to increase transportation time, enabling matching hearts to come from farther away.

Nick was discharged from the hospital about three weeks after his transplant. Before he got sick, Nick lived an active life of exercising, playing basketball and flag football, going fishing, and hanging out with friends. After months of cardiac rehabilitation and working back up to “normal,” he has returned to doing more of the things he loves.

“For the first time in years I can run and just tire myself out. I don’t feel like my heart is tired and stopping me from being active,” said Nick.

Advanced Heart Failure

HIGHLIGHTING THE HEART FAILURE- COGNITION CONNECTION

In 2024, the Heart Failure Society of America (HFSA) released a critical new scientific statement addressing the high prevalence of cognitive impairment among patients with heart failure, a condition now recognized as affecting up to 78 percent of this population. Spearheaded in part with experts from University Hospitals (UH) Harrington Heart & Vascular Institute, the statement emphasizes that cognitive decline is not an exception but a common and often overlooked reality in heart failure care. The statement details how cognitive impairment impacts key mental functions such as memory, attention, executive function and language, making routine self-care tasks significantly more difficult. The guidance provides clinicians with screening tools and practical strategies to better manage the added challenges posed by cognitive decline in heart failure patients.

UNCOVERING THE PREVALENCE OF UNDIAGNOSED HEART FAILURE

A groundbreaking study co-authored by heart failure cardiologists at UH Harrington Heart & Vascular Institute introduced a new and effective screening tool for identifying patients living with heart failure with preserved ejection fraction (HFpEF). Published in *Nature Medicine*, the HFpEF-ABA score simplifies diagnosis using just three variables—age, body mass index (BMI) and atrial fibrillation. Derived from international data, the tool promises to transform how HFpEF is detected, particularly in patients with unexplained shortness of breath—a hallmark symptom and major clinical issue. Patients flagged by the score can be promptly referred for further evaluation and timely initiation of HFpEF-specific therapies, such as SGLT-2 inhibitors and GLP-1 receptor agonists, improving patient outcomes and slowing disease progression.

DEDICATED INTENSIVE HEART FAILURE CARE

In the dedicated Heart Failure Intensive Care Unit (HFICU), patients receive a level of care available at only a few centers nationwide. The unit is designed to support patients with complex needs, providing advanced continuous hemodynamic monitoring via pulmonary arterial catheters and temporary mechanical circulatory support devices such as intra-aortic balloon pumps. For patients preparing for or recovering from heart transplantation or left ventricular assist device (LVAD) implantation, the unit offers seamless, coordinated care that spans both the pre- and post-operative periods. The HFICU also supports emotional continuity and trust—an essential component for patients managing a lifelong condition.

ADVANCES FUEL GROWTH IN AMYLOIDOSIS PROGRAM

The growth of the cardiac amyloidosis program at UH Harrington Heart & Vascular Institute reflects greater awareness of the condition, improved diagnostic tools and the emergence of targeted therapies. For AL (light-chain) amyloidosis, typically associated with underlying blood cancer, the team partners with cardio-oncology to coordinate cancer and cardiac therapies. In cases where cardiac amyloidosis affects the nervous system, the team works closely with neurology to coordinate therapies. ATTR (transthyretin mediated) amyloidosis often presents as a form of restrictive cardiomyopathy. As novel treatments such as transthyretin silencers and stabilizers are incorporated into patient care, ongoing studies pursue additional therapeutic options. UH physician-researchers are evaluating whether an injectable medication, eplontersen, can slow the progression of cardiomyopathy for people with ATTR-CM. The phase three trial is the largest and most comprehensive study conducted for this patient population.

FILLING AN UNMET NEED IN PERIPARTUM CARDIOMYOPATHY

The ReBirth trial is a clinical study investigating the potential of bromocriptine to enhance myocardial recovery in patients with newly diagnosed peripartum cardiomyopathy, a rare but serious form of heart failure that occurs during the final month of pregnancy or shortly after delivery. This randomized trial compares the use of bromocriptine – a dopamine agonist that suppresses prolactin levels – to standard heart failure therapy, to determine whether bromocriptine can improve or accelerate heart function recovery in affected women.



Targeted, Team-Based Care for Hypertrophic Cardiomyopathy

At the dedicated Hypertrophic Cardiomyopathy (HCM) Center, a multidisciplinary team navigates complex guidelines together, developing a consensus on the optimal approach. A nurse patient navigator coordinates this expansive team of cardiothoracic surgeons, heart failure specialists, electrophysiologists, geneticists, and pediatric, maternal, and sports cardiologists. In 2024, the team collectively advised on over 100 cases during their bi-monthly HCM board meeting.

Treatment options, ranging from medication to septal myectomy, have led to significant symptom improvement and a good long-term prognosis for many patients. The center's experts also advise on related issues such as the preferred septal reduction technique, potential need for ICD placement and how patients should continue with athletics following treatment.

Ongoing research is helping to inform and guide those treatment decisions. Two clinical trials underway at the center are evaluating the efficacy of myosin inhibitors, mavacamten and aficamten, to treat obstructive and non-obstructive HCM, respectively. A third study, DISCOVER-HCM, is building a registry to identify real-world treatment patterns and outcomes of patients with HCM who receive medication or other therapies for HCM, or who have failed prior treatment.

Notable Growth in Referrals and Treatment for HCM

+62% Referrals to HCM Center Team

+350% Volume of Septal
Myectomy Procedures

Heart and Lung Transplant

PRESERVING DONOR HEARTS OUTSIDE THE BODY

Transplant surgeons have long worked to find new ways to identify and preserve donor hearts. The team at University Hospitals (UH) Harrington Heart & Vascular Institute is now performing heart transplants from donors with declared circulatory death rather than declared brain death. Circulatory death donors do not meet full brain death criteria, but have suffered devastating, irreversible injuries and further care is futile. The heart is recovered after a period of asystole and perfused with blood on a machine once it has been removed from the body—keeping the heart tissue alive the heart tissue alive and beating in a box. First FDA approved for heart transplantation in 2021, the ex vivo preservation, or “heart-in-a-box” technique, makes it possible to increase transportation time, enabling matching hearts to come from farther away.

INCLUDING HEARTS FROM PATIENTS WITH INFECTIOUS DISEASE

Another donor strategy expands the landscape of viable donor hearts to include those from people infected with HIV or hepatitis C. UH Harrington Heart & Vascular Institute was an early adopter of transplantation from hepatitis C-positive donors as safety of the practice was initially reported in 2020. Since then, the utilization of these donor hearts has become more common, and approximately 10-20 percent of donor hearts transplanted at UH are from hepatitis C-positive patients. In addition, UH Harrington Heart & Vascular Institute is one of a select few centers in Ohio – and a minority of programs across the country – offering HIV-positive heart transplants to HIV-positive patients. This allows a unique ability to help this patient population, who are living longer with more therapies, and facing cardiac complications as they age.

TRANSPLANTING SENSITIZED PATIENTS

While expanding the potential sources for donor hearts, the institute’s heart transplant team is also transplanting a growing number of patients known as highly sensitized, who have a level of human leukocyte antigen antibodies greater than 50 percent. These patients, who are at risk for organ rejection, require more careful matching and additional interventions to reduce the risk of surgery and increase long-term acceptance of the donor heart. The team’s outcomes have been excellent, on par with the largest U.S. transplant programs in successfully caring for sensitized patients who may otherwise be turned away for transplant.

EXPANDING DONOR GEOGRAPHY WITH TRANSPORT INNOVATION

Adding to the program’s adoption of cutting-edge technologies in transplantation is the arrival of several innovations in organ transportation, including a more regulated and effective system for cold storage.



While donor hearts were previously transported on ice, the standard of care for several decades, hearts are now transported using temperature-controlled transportation. The advanced organ preservation device, known as SherpaPak, is specifically designed to standardize variables and better preserve the heart so it reaches its recipient in optimal condition. This has helped eliminate geographic barriers for retrieving a donor heart.

ENHANCING SURGICAL TECHNIQUES IN LUNG TRANSPLANT

The multidisciplinary lung transplant team is working to improve outcomes for patients after lung transplantation by improving surgical techniques, introducing median sternotomies and bilateral thoracotomies as alternatives to the traditional clamshell incision and offering diaphragm pacing for better post-surgical function. Ex vivo lung perfusion, an alternative to cold storage, is also helping

to optimize the lung's physiologic state before transplantation. Post-operatively, a new, noninvasive test is helping to monitor for injury in the allograft, such as infection or rejection, as an alternative to traditional bronchoscopy. Combined with early mobilization and updated immunosuppression guidelines – along with ongoing monitoring for aspiration and blood clots – these measures are helping to reduce patients' postsurgical risk.

With a comprehensive focus on both innovation and patient-centered care, University Hospitals saw 100% 1-year and 90-day conditional lung transplant survival in 2024.



Community Access

University Hospitals Harrington Heart & Vascular Institute is deeply committed to investing in the health of our communities.

Embedding the same world-class physicians, surgeons and clinical standards found at UH Cleveland Medical Center directly into our more than 40 regional sites ensures system-level protocols and seamless care across every location bearing the University Hospitals name.

Significant physical and technological investments are delivering measurable improvements in patient outcomes.

Expanding access to advanced diagnostics and complex procedures in local settings supports one UH Harrington Heart & Vascular Institute, where patients receive high-quality, personalized cardiac care in their community, no matter where they reside.

REGIONAL HIGHLIGHTS

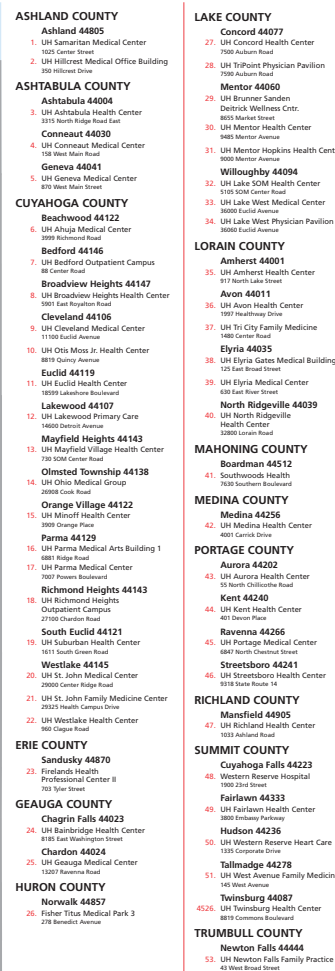
In Lorain County, patients with atrial fibrillation can now have minimally invasive left atrial appendage closure performed locally at UH Elyria Medical Center. A fully renovated cardiac catheterization lab equipped with the latest Siemens imaging technology enables a broader range of coronary and peripheral vascular procedures with improved efficiency and patient safety. The electrophysiology team also celebrated the first use of the Nitron Cryo Console Cardiac Cryoablation System in 2024, which enhances workflow and data precision during cardiac ablation procedures.

In Cuyahoga County, UH Parma Medical Center opened a new cardiac electrophysiology lab to meet the growing demand for atrial fibrillation treatment. The \$1.6 million investment brings new technology – including a 3D mapping system and fluoroscopy equipment – to the larger, updated space, enabling physicians to perform ablations and implant cardiac devices with greater precision and lower radiation exposure.

In Ashland County, a new Level II Cardiac Catheterization Lab designation at UH Samaritan Medical Center marks a significant milestone that enhances local access to emergency cardiac procedures such as diagnostic angiography and interventional treatments. This designation affirms UH Samaritan's readiness and ability to rapidly respond to acute cardiac events with timely, high-quality care, particularly for patients suffering from heart attacks who previously needed to travel longer distances for treatment.

In Portage County, the opening of a new Cardiac Catheterization & Electrophysiology lab further strengthens UH Portage Medical Center's capabilities in cardiovascular diagnostics and interventions. This state-of-the-art facility now supports expanded procedural offerings, including the treatment of coronary artery disease, arrhythmias and other cardiac conditions in a more efficient, localized setting.

In Lake County, more cardiovascular specialists have been added to the team at UH Lake West Medical Center, building on a strong foundation in cardiac care. A new \$750,000 vascular suite enables comprehensive noninvasive testing and faster, more integrated patient care. In addition to vascular procedures, the team at UH Lake West is now offering a wider range of complex cardiac surgeries, including minimally invasive bypass, advanced atrial fibrillation surgery, mitral valve repairs and aortic aneurysm repairs.



Research & Clinical Trials

As a national leader in academic medicine, University Hospitals (UH) Harrington Heart & Vascular Institute is driving discoveries through the Research and Innovation Center, which brings together clinical trials, translational research and advanced data analytics to foster breakthroughs in care.

UH physician-researchers serve on clinical oversight and study design committees, data safety and monitoring boards, and meet monthly to review prospective trials, assess enrollment, and identify new opportunities. Investigators are advancing precision medicine through biorepository initiatives and leveraging artificial intelligence (AI)-driven insights via our Cardiovascular Phenomics Core, with \$6.5 million in National Institutes of Health (NIH)-funded grants. Additionally, our Community and Environmental Innovation Core, backed by an \$18.2 million NIH grant, focuses on reducing cardiovascular disparities in underserved populations.

Clinical Trials Unit

140 Industry-sponsored Studies

3,500 Enrolled Patients

Cardiovascular Phenomics Core

4 New Grants Totaling

\$6.5

Million

Translational Science Unit

1 Start-up in Collaboration with Case Western Reserve University: Pulse AI

11

Active Trials

1,384

Total Enrolled Patients

NOVEL AI APPROACHES FOR PRECISION PREVENTION

Researchers are using AI and satellite imagery to map cardiovascular disease risk across neighborhoods, offering a transformative view into how the environment affects heart health. Surpassing the slow pace of traditional environmental health assessment methods, the team is leveraging computer vision to analyze more than 500,000 images across urban and rural areas to predict patterns in heart disease.

The research, published in the *European Heart Journal* and *JAMA Cardiology*, shows how features such as highways, recreational spaces and green cover correlate with disease prevalence.

The team trained AI models to extract thousands of visual elements from street-view and satellite imagery, then used that data to accurately predict where cardiovascular risk is highest. Their work produced striking risk maps, pinpointing Northeast Ohio neighborhoods that could benefit from targeted intervention. The project reflects growing momentum behind the idea that where people live directly shapes their health outcomes.



A NEW PARADIGM FOR RISK STRATIFICATION

By combining community outreach with advanced imaging analytics, University Hospitals (UH) Harrington Heart & Vascular Institute is setting a new standard for population-based heart health screening—one that is more predictive, more accessible and more connected to the communities it serves.

The no-cost coronary artery calcium scoring program tests individuals at risk for atherosclerotic cardiovascular disease. In partnership with Case Western Reserve University's Biomedical Engineering department, the Cardiovascular Phenomics Core has developed new, AI-driven methods to extract novel "radiomic" features from participants' non-contrast CT scans to offer even greater insights into cardiovascular health.

Recent studies from this initiative demonstrate that these AI-derived features, particularly those quantifying calcium texture and epicardial fat, can significantly enhance risk prediction over traditional evaluation methods. One major study, published in *JACC: Advances*, showed that assessments of epicardial adipose tissue using AI from routine calcium scans could independently predict cardiovascular events. Additional research, published by the team in *Scientific Reports*, leveraged radiomic features from calcium scoring CT scans to predict heart failure risk, using "calcium-omics" to forecast cardiovascular outcomes. These studies represent a shift toward more personalized, precise assessments of cardiovascular risk using information already embedded in standard imaging.

HIGHLIGHTING THE PLANET'S CONNECTION WITH CARDIAC HEALTH AND SUSTAINABILITY IN CARDIOVASCULAR PRACTICE

Air pollution leads to more deaths annually – more than half from cardiovascular disease – than all major infectious diseases combined. UH Harrington Heart & Vascular Institute is advancing understanding of the link between planetary and heart health.

Published in the *European Heart Journal* and *Circulation*, UH Harrington Heart & Vascular Institute physician-researchers and national colleagues underscore the urgency of action, laying out a host of potential solutions, including a call for the healthcare sector to do more to reduce its environmental footprint. Authors acknowledge that cardiovascular practices have a substantial environmental impact through high utilization of energy, medical devices, pharmaceuticals, transportation and waste. They propose that health systems adopt a "systems thinking" approach that recognizes the interconnectedness of environmental, societal and health-related factors. Their framework calls for reimagining how cardiovascular care is delivered to reduce the healthcare sector's environmental impact while improving health outcomes. In a landmark review published in the prestigious *Nature Cardiovascular Reviews*, investigators from UH Harrington Heart & Vascular Institute discuss motivations and frameworks for waste prevention, economics and sustainability in cardiovascular practice, and explore current challenges and future directions.

UH physician-researchers also contributed to a groundbreaking the *New England Journal of Medicine* study investigating the presence of micro- and nano-plastics in carotid artery plaques. The study found that patients with these particles in their arteries had a higher risk of serious cardiovascular events over time. While the study does not prove causation, it adds to growing concern about environmental pollutants' role in heart disease and the importance of prevention.

Residencies and Fellowships

University Hospitals (UH) Harrington Heart & Vascular Institute plays a leading role in shaping the next generation of cardiovascular specialists through robust residency and fellowship programs.

In partnership with Case Western Reserve University School of Medicine, UH Harrington Heart & Vascular Institute offers eight postdoctoral training programs, including six Accreditation Council for Graduate Medical Education (ACGME) accredited fellowships across cardiovascular disease, interventional cardiology, clinical cardiac electrophysiology, advanced heart failure and transplant, vascular surgery, and cardiac surgery. Several nonaccredited training programs in vascular medicine, advanced heart failure and advanced imaging complement the strengths of our educational offerings.

Additionally, the National Institutes of Health (NIH) funded T32 Program in Cardiovascular Disease, continually supported for over 12 years, is once again being renewed.

8 ACGME Accredited Postdoctoral Training Programs

1.5:1 Average Ratio of Full-time Physician Faculty to Residents/Fellows

50 Active Residents/Fellows

>1,000 Residency/Fellowship Alumni

>100 Publications by Residents/Fellows in 2024

Simulator Delivers Anatomy Lessons, Surgical Skill

A \$92,000 institute investment in a high-fidelity echocardiogram simulator tool now provides cardiology fellows and sonographers 24/7 access to realistic training scenarios in transthoracic and transesophageal echocardiography (TEE). Rather than learning solely on live patients, trainees can now gain confidence and competence through simulated practice using 3D technology and detailed anatomical visuals.

The simulator includes a wide range of pathologies and teaches users how to interpret diagnostic images—supporting autonomous learning even when a supervising physician is not present. It also lets users record sessions for review, helping trainees refine their skills over time. The simulator plays a key role in building foundational skills for procedures guided by echocardiography, such as transcatheter aortic valve replacement (TAVR) and MitraClip.

ENDOWED POSITIONS

Russ and Connie Lincoln Chair in Cardiovascular Innovation

APPOINTEE | Yasir Abu-Omar, MD, PhD

DONORS | Connie and Russ Lincoln, with matching funds from the James and Angela Hambrick Foundation

Alan H. Markowitz, MD, Chair for Cardiac Surgery

APPOINTEE | Rakesh Arora, MD

DONORS | Alan H. Markowitz, MD and Cathy Pollard, Henri Pell Junod, Jr. and friends

John R. Antonucci Chair in Cardiovascular Innovation

APPOINTEE | Mauricio Arruda, MD

DONORS | John M. and Marsha L. Antonucci, with matching funds from the Harrington Family Foundation

Alexander and Marianna McAfee Chair in Innovative Cardiac Interventions

APPOINTEE | Guilherme Attizzani, MD

DONORS | Estate of Alexander McAfee

Brenda and Marshall Brown Master Clinician in Vascular Innovation

APPOINTEE | Jae Cho, MD

DONORS | Brenda and Marshall B. Brown, with support from the Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Figgie Family Clinical Chair in Cardiovascular Excellence

APPOINTEE | Barry Effron, MD

DONORS | Figgie Foundation, with matching funds from the Harrington Family Foundation

Marcella “Dolly” Haugh Chair in Valvular Surgery

APPOINTEE | Yakov Elgudin, MD, PhD

DONORS | John Haugh, with matching funds from the King Family Estate

John B. Lally Family Chair in Fibromuscular Dysplasia and Vascular Medicine

APPOINTEE | Heather Gornik, MD

DONORS | John and Louise Lally Family Foundation, with support from the Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Daniel I. Simon, MD, Chair in Cardiovascular Excellence

APPOINTEE | Eiran Gorodeski, MD, MPH

DONORS | Wolf Family Foundation, a supporting foundation of the Jewish Federation of Cleveland

Heisler Family – A. Roger Tsai, MD, Master Clinician in Cardiology

APPOINTEE | Anjan Gupta, MD

DONORS | Lynn Heisler, Portage Medical Center Foundation, A. Roger Tsai, MD, with matching funds from the O’Neill Charitable Foundation

Irving B. and Virginia Spitz Master Clinician in Cardiology

APPOINTEE | Judith Mackall, MD

DONORS | Irving B. and Virginia Spitz

McCamon Family Chair in Cardiovascular Excellence

APPOINTEE | Ian Neeland, MD

DONORS | Antonucci Family Foundation, Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Herman K. Hellerstein, MD, Chair in Cardiovascular Research

APPOINTEE | Sanjay Rajagopalan, MD, MBA

DONORS | Many friends and family

Lorraine and Bill Dodero Chair in Heart Failure and Transplantation

APPOINTEE | Ravi Ramani, MD

DONORS | Sam J. Frankino Foundation

Ellery Sedgwick, Jr. Chair and Distinguished Scientist in Cardiovascular Research

APPOINTEE | Kenneth Remy, MD

DONORS | Elizabeth Sedgwick in memory of Ellery Sedgwick, Jr.

Sally and Bob Gries Distinguished Chair in Cardiac Surgery

APPOINTEE | Joseph F. Sabik, III, MD

DONORS | Sally and the late Bob Gries with support from the Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Angela and James Hambrick Chair in Innovation

APPOINTEE | Mehdi Shishehbor, DO, MPH, PhD

DONORS | James and Angela Hambrick Foundation, with matching funds from the Harrington Family Foundation and support from the Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Ernie and Patti Novak Distinguished Chair in Health Care Leadership

APPOINTEE | Daniel I. Simon, MD

DONORS | Ernest J. Novak and Patricia A. Novak, with support from Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation

Robert S. and Sylvia K. Reitman Family Foundation Distinguished Chair in Cardiovascular Innovation

APPOINTEE | Jonathan Stamler, MD

DONORS | Robert S. and Sylvia K. Reitman Family Foundation, a supporting foundation of the Jewish Federation of Cleveland

William and Eleanor Veverka Semenik Chair in Interventional Cardiology

APPOINTEE | Gregory Stefano, MD

DONORS | Eleanor Semenik, with support from the Dr. Donald J. and Ruth W. Goodman Philanthropic Fund of the Cleveland Foundation, and many friends



(left to right) Ron and Nancy Harrington, Jill Harrington, and Lydia and Ron Harrington

Ronald and Nancy Harrington and their family made a gift of \$22.6 million to support the cardiovascular program at University Hospitals in 2008.

In recognition of this extraordinary gift, the program was renamed to **University Hospitals Harrington Heart & Vascular Institute**.