SAMUEL AND JEAN
FRANKEL CARDIOVASCULAR CENTER
MICHIGAN MEDICINE

FRANKEL CARDIOVASCULAR CENTER
2007 10 years 2017
UNIVERSITY OF MICHIGAN

2017 ACTIVITY AND OUTCOMES REPORT

2016 DATA

VOTED NO. 1 IN MICHIGAN AND NO. 10 IN THE COUNTRY

Michigan Medicine's Frankel Cardiovascular Center was recognized among the best in the nation by U.S. News & World Report for 2017-2018, ranking No. 1 in Michigan and No. 10 in the country.

The magazine ranks hospitals on a number of factors including patient safety, clinical resources, quality of care, family centeredness and staff professionalism. Some specialty rankings are also based on hospital reputation, which is determined by surveying over 125,000 physicians across the country.

Overall, the academic medical center of the University of Michigan ranks 6 in the U.S., and among the nation's best in 15 medical and surgical specialties. Read more here: **michmed.org/QRA1Y.**

MAGNET AWARD OF EXCELLENCE

Michigan Medicine was honored with the Magnet Award, presented by the American Nurses Credentialing Center. Only 6 percent of U.S. hospitals earn this honor, given to organizations that meet rigorous standards for quality patient care, nursing excellence and innovations in professional nursing practice.

This recognition supports Michigan Medicine's commitment to carrying out our mission of constantly improving each patient's experience, safety and satisfaction. And it firmly establishes Michigan Medicine as a worldwide leader in advancing nursing standards, practice and empowerment – attributes that help attract and retain top talent from around the world.

2016 BY THE NUMBERS

INPATIENT DISCHARGES	6,088
CLINIC VISITS	66,191
CATH LAB CASES	4,443
EP LAB CASES	2,040
ADULT SURGICAL VOLUME	2,533

CONTENTS

A digital version of the U-M Frankel CVC 2017 Activity and Outcomes Report is available at **umhealth.me/CVC-Outcomes**.

LEFT TO RIGHT: Thomas W. Wakefield, M.D., Kim A. Eagle, M.D., Stephanie Diccion-MacDonald, M.S., R.N., Linda R. Larin, M.B.A., David J. Pinsky, M.D., and Richard L. Prager, M.D.

From the Frankel CVC Leadership

Dear Colleagues,

We are proud to present the 2017 University of Michigan Samuel and Jean Frankel Cardiovascular Center Activity and Outcomes Report. This report chronicles our recent research advances and tracks our clinical performance metrics. Moreover, it showcases the programs and teams that allow us to continue shaping the future of cardiovascular medicine.

Our place. This year marks the 10th anniversary of opening the doors of the Frankel Cardiovascular Center. The Frankel CVC serves as home to the clinical, research and educational efforts detailed in this report. However, our enterprise extends far beyond its walls as we care for patients at multiple locations throughout the state.

Our patients. When patients entrust us with their care, their stories become part of our story. Within these pages are a few recent success stories, including how a relationship between two health systems proved to be lifesaving for a patient with a deadly type of aneurysm, how an emergency thoracic endovascular aortic repair (TEVAR) saved the life of an 83-year old equestrian with a severe aortic injury, and how transcatheter aortic valve replacement (TAVR) – a minimally invasive procedure U-M doctors have performed more than 1,000 times – allowed a 16-year-old (the youngest U-M TAVR patient ever) to get back to swimming, bike riding and more.

Our people. The impressive outcomes reported here reflect the contributions and passion of more than 200 clinical faculty. Additionally the Frankel CVC has over 100 basic science faculty, many of whom have a dual clinical focus, and thousands of dedicated staff members, each committed to fulfilling our mission of making the U-M Frankel CVC the best academic heart and vascular center in the world.

Our partners. You, too, play an essential role in our ongoing success. Collaborations with community-based colleagues like you make it possible to enroll and monitor patients participating in advanced scientific clinical trials and to share best practices through provider consortiums and continuing medical education.

On behalf of the faculty and staff of the Frankel Cardiovascular Center, the thousands of patients and families we care for each year, and the millions who will benefit from the advances pioneered here, we thank you for being part of our team.

Coronary Heart Disease

COLLABORATIVE CARE FOR HEART DISEASE

Coronary heart disease is the leading cause of death for both men and women in the United States. The Frankel CVC's collaborative approach includes the patient in determining the most appropriate therapy for his or her coronary artery disease.

Surgical Options

Our faculty is renowned for their expertise in a wide variety of innovative services. Even with the declining number of cardiac surgical cases nationwide, our procedure volume continues to grow. Our surgeons perform standard on-pump coronary bypass as well as beating heart, off-pump bypass, with arterial conduits routinely used.

Angioplasty and Stenting

The Advanced Interventional Cardiology Program offers patients comprehensive and individualized care. Our skilled team of interventional cardiologists uses the latest technologies available for angioplasty and stenting. For acute myocardial infarction patients, our time from door to intervention is well below the national goal of 90 minutes, thanks to a team approach that utilizes in-house staff.

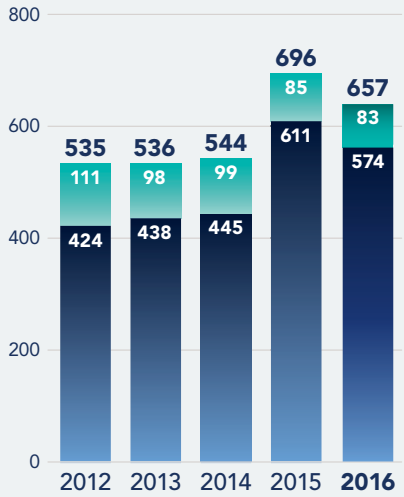
Multiple assist devices may be implanted to maintain blood supply to the heart tissue during high-risk angioplasty and as a bridge to ventricular assist device (VAD) or cardiac transplantation, including the TandemHeart™ Percutaneous Ventricular Assist Device, Impella® 2.5 and 5.0 catheters and extracorporeal membrane oxygenation (ECMO). In fact, ECMO was invented at U-M and we continue to be leaders in this advanced, lifesaving technology.

CTO Expertise

Our expertise extends to innovative methods for treating chronic total occlusion (CTO). While traditional treatment for CTO has been coronary artery bypass grafting (CABG) performed during open-heart surgery, new, advanced technologies have enabled the Frankel CVC to offer minimally invasive methods of treatment.

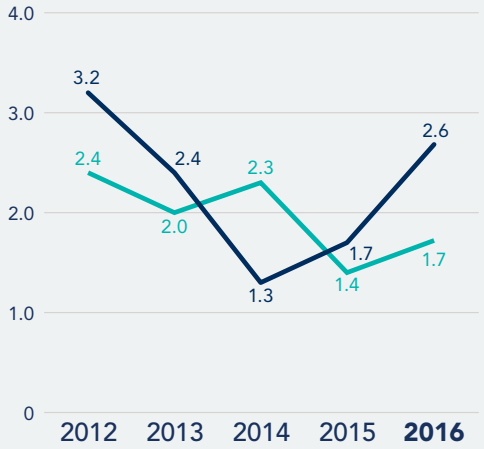
One such method is CTO PCI (percutaneous coronary intervention), a procedure performed by experienced interventional cardiologists with specialized training in advanced methods to treat CTO blockages. Only 1-2 percent of cardiac interventionalists in the U.S. can perform the full range of CTO PCI. During the procedure, a small mesh tube is placed in narrow or blocked arteries to widen and support the walls of the arteries and restore blood flow.

PCI Volume



■ PCI ■ PCI for STEMI

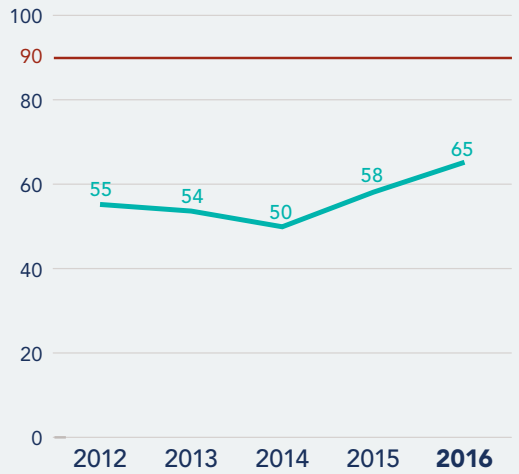
PCI Mortality (%)



■ Observed Mortality ■ BMC2 Expected Mortality

Source: BMC2 Registry

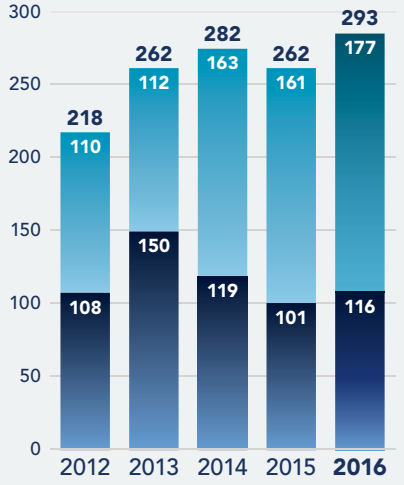
Median Door-to-Balloon Time
(in minutes)



■ CVC ■ National Goal

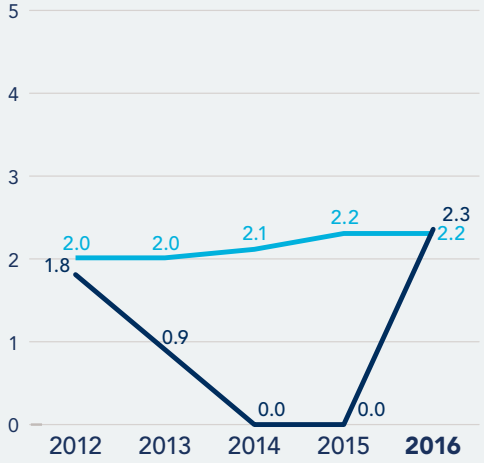
National goal is 90 minutes or less

CABG Volume



■ CABG procedures ■ Isolated CABG

Isolated CABG Mortality (%)

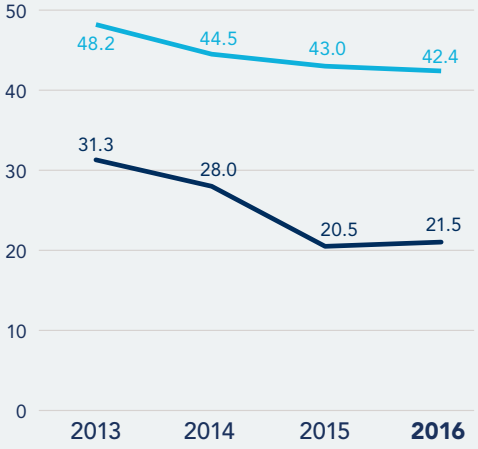


■ Isolated CABG Observed Operative Mortality

■ STS Unadjusted Operative Mortality

Source: STS National Database

Isolated CABG Blood Usage (%)



■ Any blood during hospitalization

■ STS Average

Source: STS National Database

Structural Heart and Valve Disease

UNRIVALED EXPERTISE IN STRUCTURAL HEART/VALVE DISORDERS

The Frankel CVC's Structural Heart Program features a multidisciplinary team of cardiologists, cardiac surgeons and radiologists working together to provide innovative treatments to patients with valve and structural heart disorders.

Our services include all possible treatment options for valve and structural heart disorders. We specialize in managing the most complex cases and offer patients expert care through:

- Comprehensive management of aortic, mitral and tricuspid valve disease
- Prevention of atrial appendage embolic events with surgical occlusion, percutaneous atrial appendage occlusion and percutaneous trans-pericardial occlusion, combined with optimal anticoagulation strategies
- Patent foramen ovale (PFO) and atrial septal defect (ASD) closures
- Paravalvular leak closures

Valve Disease

All treatment options – including both standard and emerging technologies – are available to treat dysfunction at all heart valve positions. Frankel CVC doctors are pioneering the future of valve dysfunction treatment, building on traditional surgical approaches with an expanding minimally invasive program and new transcatheter therapies. U-M treats more patients with valvular heart disease than anywhere else in the state and is a national leader in treating this disease.

The U-M Frankel CVC Robert and Ann Aikens Hybrid Suite solidifies our ongoing commitment to the future of cardiovascular care, employing the most innovative radiological and surgical techniques that make advanced hybrid procedures possible. The Suite is the first in the U.S. to employ the Siemens ARTIS pheno, a new robotic C-arm angiography system that improves flexibility in the OR, reduces radiation, maintains an uninterrupted sterile airflow and has antimicrobial surfaces. Read more about the Hybrid Suite at **michmed.org/QpXLL**.

Valve Disease

INNOVATIONS IN OPTIMAL VALVE INTERVENTIONS

Aortic Valve Disease

Open Approach

Historically, open surgical aortic valve replacement (SAVR) has been the standard treatment for severe aortic stenosis. For more than 25 years, the Frankel CVC has been a leader in aortic valve replacement in both volume and outcomes.

The Frankel CVC is one of only a few sites in the nation to conduct the TRANSFORM clinical trial for the INTUITY valve system developed by Edwards Lifesciences. This trial offers a potentially significant advancement in valve replacement surgery because it allows the surgeon to implant the valve with only three sutures, substantially decreasing the time required for the surgical intervention.

Transcatheter Approach

Transcatheter aortic valve replacement (TAVR) is a minimally invasive, catheter-based procedure to replace the aortic valve in patients with severe aortic stenosis. It is an alternative to SAVR. Originally developed for intermediate- and high-risk patients who were not candidates for an open-heart procedure, TAVR is now available to low-risk patients.

Michigan Medicine is one of the only health systems in the region to offer the full spectrum of valve options available through clinical trials as well as FDA-approved devices. U-M is also one of only two health systems in Michigan invited to participate in a clinical trial offering TAVR for low-risk patients.

Our interventional cardiologists and cardiac surgeons work together to seamlessly deliver these TAVR devices through a variety of access points, including: femoral, transapical, direct aortic or subclavian arteries.

TAVR technology is also being used to restore the function of failing bioprosthetic valves and may be the best valve replacement option for high-risk patients. The procedure is often referred to as “valve-in-valve.”

The U-M team is also breaking new ground in the treatment of bicuspid aortic valve (BAV) disease. Our surgeons are some of the most experienced in the world in treating patients with BAV disease. U-M has established a Bicuspid Aortic Valve registry to study patients and identify the genetic causes and long-term effects of this common congenital disease.

Our multidisciplinary approach enables us to offer additional surgical and transcatheter options for patients with complex aortic valve conditions, including:

- Valve-sparing operations on the aortic root
- Treatment of paravalvular leaks
- Placement of stentless aortic valves
- Hypothermic circulatory arrest procedures

Aortic Valve Distribution	2013	2014	2015	2016
REPLACEMENT	382	345	345	378
TAVR	127	164	200	186
AV REPAIR OR RESUSPENSION	51	43	44	44
VALVE SPARING	36	32	19	13

CLINICAL TRIALS

FROST
Assess whether intraoperative intercostal cryoanalgesia using the cyroICE probe provides better pain relief as compared to current pain management in patients undergoing unilateral thoracotomy cardiac procedures.

COAPT
Confirm the safety and effectiveness of the MitraClip® System for the treatment of moderate-to-severe or severe functional mitral regurgitation (FMR) in symptomatic heart failure patients.

Medtronic TAVR Low Risk Study
Obtain data on the safety and effectiveness of the Medtronic CoreValve System and Evolut R System on patients with aortic stenosis who are considered low risk for SAVR.

Evaluate the Benefit of Concurrent Tricuspid Valve Repair During Mitral Surgery
Determine whether repairing a tricuspid valve in patients with mild to moderate tricuspid regurgitation at the time of planned mitral valve surgery would improve patient heart health.

ReChord
Determine if NeoChord DS1000 System, which delivers sutures to the mitral valve, is safe and effective to reduce mitral regurgitation when compared with open surgical repair.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Teen Overcomes the Odds

Sixteen years ago, John-Daniel Johnson was a preemie missing two of the left chambers of his heart. His life would depend on multiple operations.

Born with hypoplastic left heart syndrome, a congenital heart defect, the newborn underwent a series of three successful surgeries at the University of Michigan, the last of which took place when he was 18 months old.

However, last year, it was discovered that John-Daniel's aortic valve was leaking. The adult and pediatric specialists at U-M decided he might be a candidate for a minimally invasive TAVR, or transcatheter aortic valve replacement, procedure. Doctors at the Frankel CVC have performed more than 1,000 TAVR procedures, but this was the first of its kind conducted on someone John-Daniel's age at the U-M Frankel CVC.

Today, the North Carolina teenager is back in full swing, swimming and riding bikes after his successful outcome.

Read more about John-Daniel's story at **michmed.org/Qvxyj.**

Valve Disease

INNOVATIONS IN OPTIMAL VALVE INTERVENTIONS (CONTINUED)

Mitral Valve Disease

Open Approach

The Mitral Valve Clinic at the Frankel CVC is one of the largest practices in the country focused on mitral valve repair. Our team's extensive experience in the operating room is a direct result of high procedure volume, which translates into better outcomes for patients. Our Mitral Valve Clinic is also a leader in the treatment of mitral regurgitation associated with heart failure from both dilated and ischemic cardiomyopathies.

While open-heart surgery is the traditional method of mitral valve repair and replacement, our team also performs complex open surgical repair or replacement of the mitral valve using smaller incisions (two to three inches) between the ribs on the patient's right side to gain access to the heart. This type of procedure has the potential to shorten a patient's recovery time and hospital stay.

Transcatheter Approach

Our cardiac surgeons and interventional cardiologists work together to offer eligible patients the latest minimally invasive surgical and endovascular options for mitral valve repair and replacement. A variety of techniques and devices can be used to repair or replace the mitral valve without opening up the heart, including:

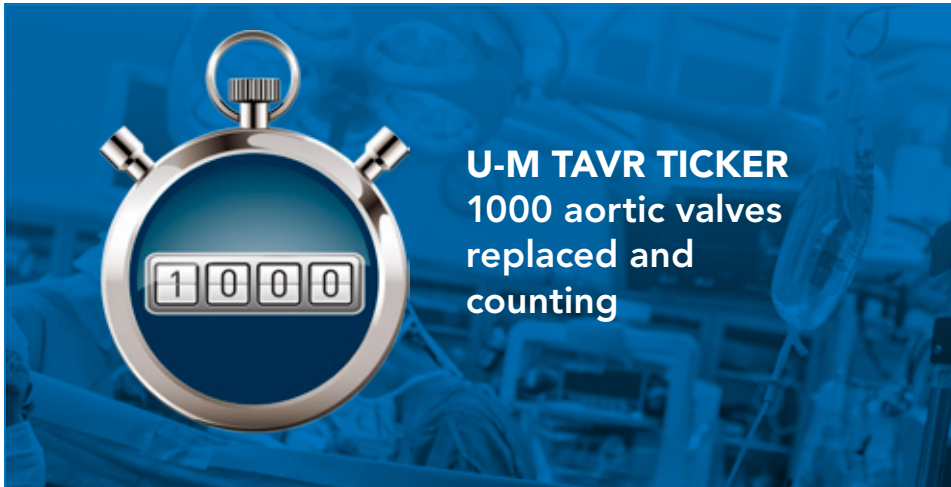
- The commercially available MitraClip® device is indicated for high-risk patients with degenerative mitral regurgitation.
- Valvuloplasty, a technique to treat mitral valve stenosis, involves using a thin catheter with a balloon tip to stretch or open the mitral valve.
- Valve-in-valve transcatheter technology is being used to restore the function of failing bioprosthetic mitral valves.
- Transcatheter mitral valve replacement (MVR) has emerged as an exciting new frontier in the minimally invasive treatment of severe mitral regurgitation in patients at high risk for surgery.
- The NeoChord mitral valve repair system enables minimally invasive implantation of artificial chordae using a catheter-based approach to treat mitral regurgitation.

Tricuspid Valve Disease

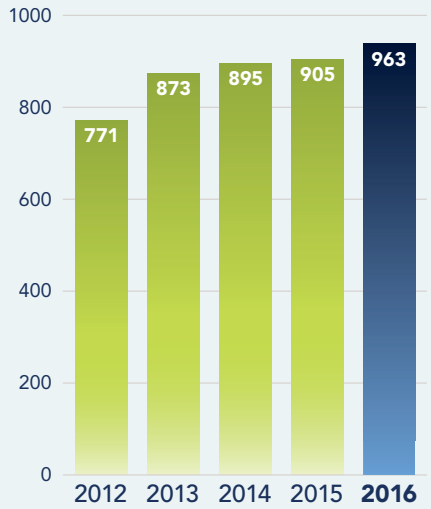
Treatment for tricuspid valve disease varies depending on a patient's condition. As symptoms progress, treatment may include certain medications such as diuretics, which promote urination and the release of excess fluids, and vasodilators, which help open blood vessels. If a patient's condition is severe, surgery to repair or replace the damaged valve may be required. Valve-in-valve transcatheter technology is also being used to restore the function of failing bioprosthetic tricuspid valves.

Types of tricuspid valve disease include:

- Tricuspid regurgitation
- Tricuspid stenosis
- Tricuspid atresia
- Ebstein's anomaly

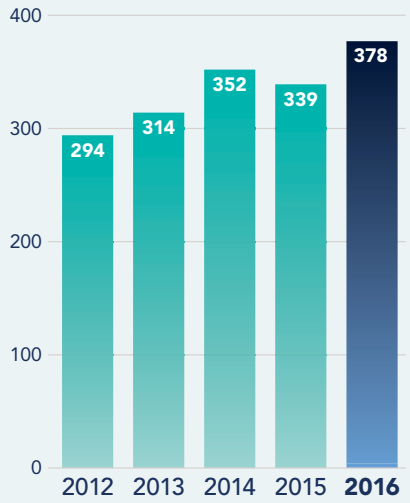


Valve Volume

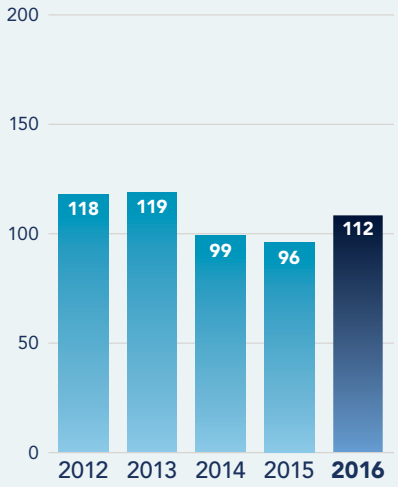


5 Year Average Mortality 2.3%

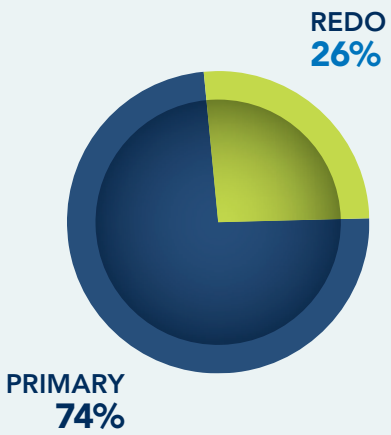
Mitral Valve Volume



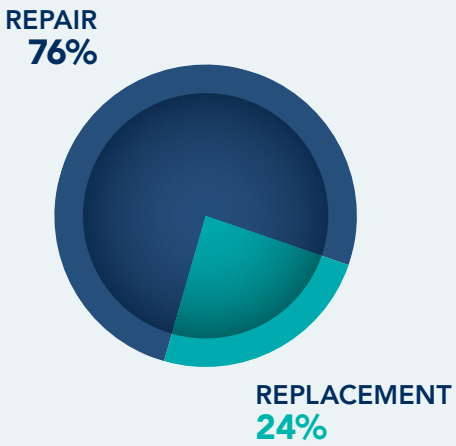
Isolated Aortic Valve Volume



Primary vs. Redo Valve 2016

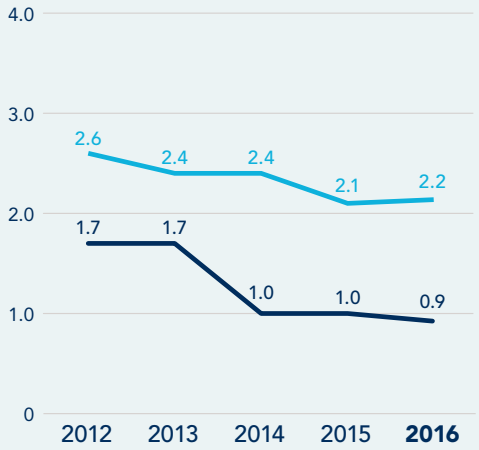


Mitral Valve Repair vs. Replacement 2016



Five-year mitral valve repair rate for degenerative mitral valve disease is 99.8%.

Isolated Aortic Valve Mortality (%)



■ Observed Operative Mortality
■ STS Unadjusted Operative Mortality

Source: STS National Database

Aortic Disease

LEADERS IN COMPLEX CARE

As leading providers of complete care for all types of aortic disease, the Multidisciplinary Aortic Program (MAP) at the Frankel CVC brings together experts from cardiac surgery, vascular surgery, interventional cardiology, interventional radiology and diagnostic radiology to formulate the best comprehensive plan for each patient. Our mortality rates are among the lowest in the country, despite a high volume of complex cases.

Specialists at the Frankel CVC provide treatment and therapy – from management and medical therapies to minimally invasive and open surgical repairs – for all types of aortic-disease-related conditions, including:

- Ascending and arch aneurysms
- Descending thoracic aortic aneurysms (DTAA)
- Abdominal aortic aneurysms (AAA)
- Thoracoabdominal aortic aneurysms (TAAA)
- Iliac artery aneurysms
- Aortic dissection

MAP faculty are prolific researchers, leading numerous novel initiatives specific to aortic disease. Current platforms include FDA-regulated trials, NIH-funded trials, Department of Defense contracts and investigator-initiated projects.

Inherited Aortic Disease

The Frankel CVC's MAP has expertise in treating complex aortic disease patients, particularly those with the following conditions:

- Connective tissue disorders such as Marfan Syndrome, Ehlers-Danlos Syndrome and Loeys-Dietz Syndrome
- Bicuspid aortic valve disease
- Suspected familial aortic/arterial disease
- Arteriosclerotic aortic disease

Comprehensive workup and care for these complex patients includes access to genetic testing and counseling as well as to experts from other relevant specialties such as high-risk obstetrics, orthopaedics and ophthalmology.

Fenestrated and Branched Endograft Technology

New technology involving minimally invasive endovascular stent graft repair allows more patients to be treated for complex aortic disease. Fenestrated endograft technologies are covered stents with holes (called fenestrations) that correspond to the position of the major arteries branching out from the aorta. Branched endografts have smaller branch extensions that funnel into critical branches, preserving flow.

Historically, treatment of aortic aneurysms involving major branch vessels required an open surgical procedure. But Frankel CVC providers can now treat patients with minimally invasive fenestrated and branched endografts in the abdominal aorta and the aortic arch.

All Aortic Surgical Volume	2013	2014	2015	2016
ASCENDING/ARCH WITH OR WITHOUT AVR	214	205	192	198
DESCENDING THORACIC AORTIC ANEURYSM	21	19	27	29
THORACIC ENDOVASCULAR REPAIR	57	49	46	48
OPEN ABDOMINAL AORTIC ANEURYSM	45	60	54	49
ENDOVASCULAR ABDOMINAL AORTIC ANEURYSM	60	68	79	74

TEVAR Saved the Life of One Unstoppable Equestrian

Myra Fleming was a healthy 83-year-old out for a trail ride when her horse suddenly began to gallop without warning. Fleming was thrown from the horse and landed on the side of the trail.

"I couldn't move at first, and wondered if I had broken my neck," she says.

Luckily for Fleming, a runner passing by stopped to help. Fleming remembers almost nothing of the two months that followed. She was taken to a local hospital near her home in Ortonville, Michigan, where doctors discovered a severe injury to her aorta caused by the fall.

Because of the nature of her injury, Fleming was referred to the U-M Frankel CVC, where doctors discovered her proximal descending thoracic aorta had torn, and she was bleeding into her mediastinum.

A decision was made to perform emergency thoracic endovascular aortic repair (TEVAR), which has emerged as a minimally invasive and safer alternative to conventional open surgical repair for patients with traumatic aortic injury.

In Myra's case, this was especially true given her advanced age and the extent of bleeding that had occurred from the injury. The accident and surgery haven't sidelined the patient entirely. Fleming, a grandmother of five, says she's feeling stronger every day.

Read more about Myra's story at **michmed.org/E5WaZ.**

Aortic Disease

LEADERS IN COMPLEX CARE (CONTINUED)

Ongoing clinical trials and approved usage of these devices include:

- Medtronic EVO Low Profile Thoracic Endograft
- RelayPRO Thoracic Stent Graft system
- Branched Arch Endograft Technology (GORE® TAG® Thoracic Branch Endoprosthesis Device)
- Zenith® Fenestrated AAA Endovascular Graft for aneurysms extending to the kidney area
- GORE® Excluder Iliac Branch Endoprosthesis (IBE) for aneurysms extending into the pelvic arteries

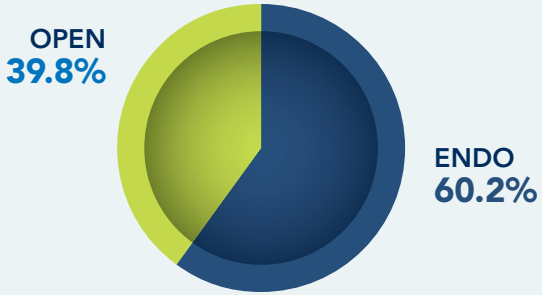
EVAR and TEVAR

Endovascular aortic repair (EVAR) and thoracic endovascular aortic repair (TEVAR) have emerged as true alternatives to conventional surgery for many patients suffering from aneurysmal disease of the aorta. These are lifesaving minimally invasive options for some patients who are not optimal candidates for traditional open repair. These procedures can shorten hospital stays and recovery periods. With more than two decades of experience in performing EVAR and TEVAR procedures, our surgical team can provide comprehensive care to all aortic patients.

In addition, as clinical trials with lower profile versions of grafts are released, we often have access to these grafts for study in approved patients.

Aortic Dissection Operative Mortality	2015	2016
ACUTE TYPE A	4.8%	5.3%
ACUTE TYPE B	0.0%	0.0%

Abdominal Aortic Aneurysm Treatment 2016



CLINICAL TRIALS

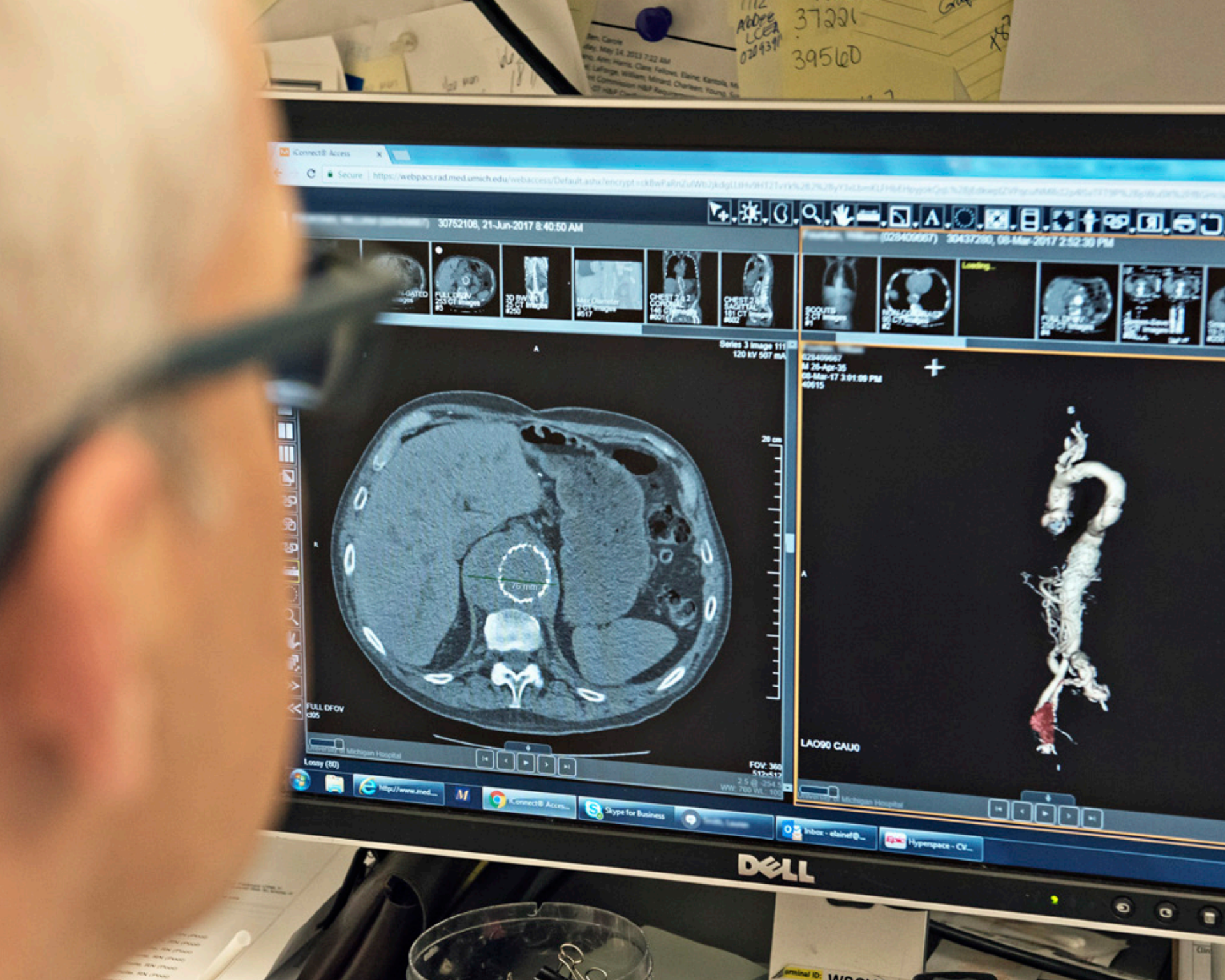
Medtronic Valiant® EVO

Investigate the safety and effectiveness of the Valiant EVO Thoracic Stent Graft System in subjects with a descending thoracic aortic aneurysm who are candidates for endovascular repair.

GORE® TAG® Thoracic Branch Endoprosthesis

Evaluate the GORE TAG in the treatment of lesions of the aortic arch and descending thoracic aorta.

For more information or to view additional trials, visit **UMHealthResearch.org.**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Cardiac Arrhythmia

ADVANCES IN ARRHYTHMIA THERAPY

Volume by Procedure	2014	2015	2016
PACEMAKERS	294	305	316
ICDS	389	388	411
RADIOFREQUENCY ABLATIONS	954	971	1023
CARDIOVERSIONS	591	655	725
TILT TABLE TESTS	116	136	136
CIED* EXTRACTIONS	111	81	152

*Cardiac Implantable Electronic Device

The Cardiac Arrhythmia Service at the Frankel CVC is a high-volume tertiary referral center for the management of complex arrhythmias, including atrial fibrillation, supraventricular and ventricular tachycardia, atrial flutter, premature ventricular contractions (PVCs) and Wolff-Parkinson-White (WPW) syndrome. We also specialize in the care of patients with complex device conditions, such as malfunction of devices and leads, infected devices and extraction of leads and devices.

Each year our dedicated electrophysiologists perform approximately 1,200 ablations and more than 700 device procedures, including pacemakers, ICDs and biventricular pacing devices. We are one of only a few centers in the country with this level of volume and experience. We are also at the forefront of implanting MRI-compatible pacemakers, ICDs and subcutaneous ICDs and are pioneering the use of "leadless" pacer technology, one of the most remarkable pacing advances of the last decade.

Leaders in the Field

Our team of cardiologists is one of the first in the state to implant the **Medtronic PLC Micra™ Transcatheter Pacing System (TPS)** in a patient. The TPS is the world's smallest pacemaker, delivered percutaneously via a minimally invasive approach directly into the right ventricle without the use of leads. The inch-long device uses small prongs to attach directly to the heart, where it delivers electrical pulses that help the heart beat more regularly. Avoidance of leads can overcome issues of inadequate vascular access, thereby providing novel pacing options for some of our most complex patients.

Our team is also one of the first in the nation to use the FDA-approved **WATCHMAN™ Left Atrial Appendage Closure Device**, an alternative to blood thinners to prevent stroke in patients with non-valvular atrial fibrillation.

Catheter Ablation Gets AFib Patient Back in the Race

James Montie, M.D., loves the sport of rowing – a passion he discovered as a high school student and resurrected 25 years ago.

An emeritus professor in the U-M Department of Urology, Dr. Montie began competing in distinguished races. He noticed he was losing steam toward the end of a few competitions in 2011 and decided to find out if it could be something serious.

Dr. Montie was referred to U-M Frankel CVC electrophysiologist Hakan Oral, M.D., who recommended catheter ablation, a minimally invasive technique used to treat atrial fibrillation without the need for major surgery.

Today, Dr. Montie is a champion rower in his age group, winning the 2016 Henley Masters Regatta in England and the 2017 U.S. Rowing Masters National Championship in Tennessee. He's happy to be back in the race, saying: "If not for the ablation, I would have been stuck on the sidelines."

Read more about Dr. Montie's story at **michmed.org/Qy27k.**

Cardiac Arrhythmia

ADVANCES IN ARRHYTHMIA THERAPY (CONTINUED)

The WATCHMAN™ closes off the left atrial appendage where blood clots tend to develop, eliminating the need for long-term anticoagulation medication. Our team of specialists evaluates patients to determine their eligibility for the device.

In addition to catheter ablations and device procedures, we provide cardiac resynchronization in patients with heart failure.

Research

On the research front, in partnership with the U-M Center for Arrhythmia Research, we are working to create new technologies to facilitate the mapping of complex arrhythmias such as atrial fibrillation and ventricular tachycardia. Our combined efforts are moving the field forward in our understanding and treatment of the most challenging and prevalent heart rhythm conditions.

CLINICAL TRIALS

CorMatrix® CanGaroo ECM® Envelope

Obtain additional information on this envelope, or 'pouch,' to hold the cardiac implantable electronic device (CIED) prior to implantation to create a stable environment and provide a barrier between the CIED and soft tissue from the leads.

Protamine for Heparin Reversal after Catheter Ablation of AFib

Evaluate the safety and efficacy of rapid anticoagulation reversal with protamine sulfate versus routine care in patients undergoing catheter-based ablation of AFib.

STOP AF First

Determine the safety and effectiveness of the Arctic Front Advance® Cardiac CryoAblation Catheter for the treatment of recurrent symptomatic paroxysmal atrial fibrillation.

QP ExCELs

Collect data regarding the long-term safety of the BIOTRONIK Sentus QP lead, a non-investigational lead used with the BIOTRONIK CRT-D device.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Anticoagulation Service

AN ANTICOAGULATION CENTER OF EXCELLENCE

The University of Michigan Anticoagulation Service is recognized as an "Anticoagulation Center of Excellence," illustrating our strong commitment to providing the highest level of patient care and making our service one of fewer than 100 out of 3,000 nationally to receive this distinction. The Centers of Excellence program was created by the Anticoagulation Forum, the leading organization of healthcare professionals working to improve the quality of care for patients taking anticoagulant medications.

The U-M Anticoagulation Service is a collaboration of physicians, nurses and pharmacists who monitor and manage anticoagulant therapy for our patients with thrombosis or other disorders that increase the likelihood of blood clots. These include atrial fibrillation, venous thromboembolism, cardiovascular disease and stroke.

The Frankel Cardiovascular Center offers and supports a variety of anticoagulation treatment options, including the use of long-standing anticoagulants such as Coumadin (warfarin) and heparin as well as newer direct oral anticoagulants (DOACs) such as Dabigatran (Pradaxa) (considered the first real alternative to warfarin), Rivaroxaban (Xarelto) and Apixaban (Eliquis), among others.

Our experienced team believes that selecting an anticoagulant requires weighing individual patient factors to determine the most appropriate choice. As a support service to the Frankel CVC clinical faculty, U-M's Anticoagulation Service works to:

- Reduce the number of potential anticoagulant issues: gastrointestinal bleeding, cerebrovascular accident, transient ischemic attack, pulmonary embolism and intracranial bleed.
- Enable patients to assume greater responsibility for their care through health education about the safe use of anticoagulants, the physical signs and symptoms of bleeding and the importance of laboratory monitoring.
- Improve patient adherence to their prescribed regimens.
- Manage transitions and interruptions in anticoagulant care.

Safety Measures

Regardless of the anticoagulation option selected, anticoagulation management services at the Frankel CVC ensure specialized care for *all* patients on anticoagulation therapy, not just those on warfarin. All anticoagulant patients are offered comprehensive monitoring and management services as well as education. Our knowledgeable staff is available by phone to discuss any concerns or problems related to a patient's medication.

INFORMATION TOOLKIT FOR DOCTORS AND PATIENTS

U-M is a part of the Michigan Anticoagulation Quality Improvement Initiative (MAQI²), a consortium of anticoagulation clinics and experts from across the state committed to improving the quality of anticoagulation care. One of the MAQI² efforts is to provide comprehensive information about anticoagulant therapy via an Anticoagulation Toolkit designed to assist providers and patients with comprehensive, continually updated information about anticoagulation care and anticoagulant selection.

We encourage you to use this up-to-date resource about anticoagulation therapy, and share it with your patients. Visit **anticoagulationtoolkit.org** where you will find separate links to information for providers and patients, along with a free patient toolkit mobile app.

Heart Failure

HIGH-VOLUME EXPERTISE IN HEART FAILURE THERAPIES

The Heart Failure Program at the Frankel CVC focuses on the complex management of advanced heart failure, circulatory support and heart transplantation. Our team has extensive, high-volume experience in the treatment of patients with acute and chronic heart failure. We partner with referring physicians to help these patients survive and thrive with a better quality of life.

Heart Failure Management

Our team of physicians, nurses, pharmacists, social workers and advanced practice providers ensures safe, collaborative, patient-centered care. For patients managed outside the hospital, this experienced team monitors, supports and optimizes the care of patients with heart failure and complex medical illness. Patients are seen in ambulatory clinics at the Cardiovascular Center in Ann Arbor, and also in satellite clinics in Livonia, Canton, Northville and Domino's Farms locations.

Our team employs dedicated heart failure trained nurses to provide disease-specific education and telemanagement services to reduce the likelihood of hospital admission. The team is experienced in the evaluation of patients with advanced heart failure and is adept at identifying patients whose care is appropriately addressed with advanced therapies, such as heart transplantation and mechanical circulatory support. The team also provides expert management of patients with a variety of heart muscle conditions, including hereditary cardiomyopathy, valvular cardiomyopathy, myocarditis, cardiac sarcoidosis, muscular dystrophy and infiltrative heart disease.

U-M Center for Circulatory Support

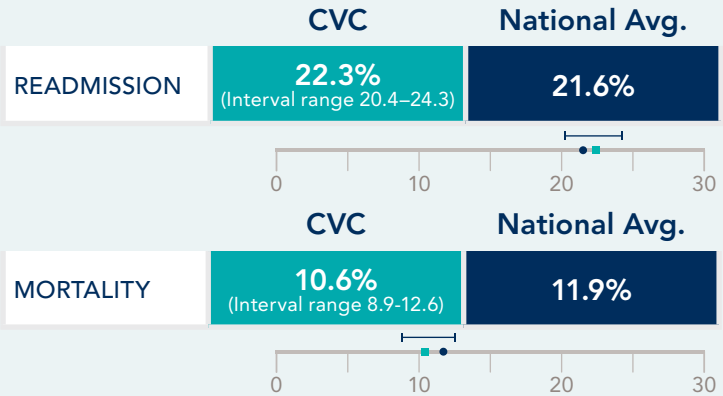
The U-M Center for Circulatory Support is one of only a few programs worldwide with access to many investigational and FDA-approved ventricular assist devices (VADs), including St. Jude Corporation's HeartMate II® and HeartMate III®, HeartWare HVAD® and SynCardia Total Artificial Heart, which provide circulatory support for patients with advanced heart failure or cardiogenic shock. With more than 20 years of experience, our VAD Program specialists work closely with referring physicians in the evaluation and selection of the most appropriate treatment and device based on each patient's needs. Find out more at **med.umich.edu/cardiac-surgery/patient/adult/ccs/**.

U-M cardiac surgeons have implanted 15 SynCardia total artificial hearts to date. The total artificial heart is often used when end-stage heart failure affects both sides of the heart and other more common heart-supporting devices are inadequate to keep patients alive. A 14-pound Freedom® Driver powers the total artificial heart with precisely calibrated pulses of air. The U-M Frankel Cardiovascular Center is the only Michigan heart program to send patients home with the wearable technology.

Our VAD Program earned the Gold Seal of Approval® for health care quality in 2008, and was one of the first centers to be awarded Disease-Specific Care Certification for Advanced Ventricular Assist Devices by The Joint Commission. We have received recertification from The Joint Commission every two years, most recently in March 2016.

The U-M CVC team of palliative care specialists also offers comprehensive support for patients and their families with ventricular assist devices by assisting them with complex decision-making, advanced care planning and symptom management.

Heart Failure Outcomes Measures



Source: Hospital Compare, Data Reflect Medicare HF Discharges
July 1, 2013 – June 30, 2016

The Complexities of HFpEF

Heart failure with preserved ejection fraction (HFpEF) is a complex illness that can be caused by multiple factors. The condition, in which the heart muscle pumps blood normally but still doesn't meet the body's requirements, is becoming more widespread as the country's population ages and the associated risk factors become more common.

Ingeborg Ludeking knows this all too well. Atrial fibrillation, pulmonary hypertension, an enlarged heart and sleep apnea were among the conditions on a long list of health concerns for the 78-year-old when she came to the U-M Frankel CVC. A heart catherization in 2015 confirmed Ingeborg's HFpEF diagnosis.

Because no patient is the same, information from diagnostic tests such as echocardiography, heart catheterization, stress testing and cardiac MRI is often used to design the best treatment plan for each patient.

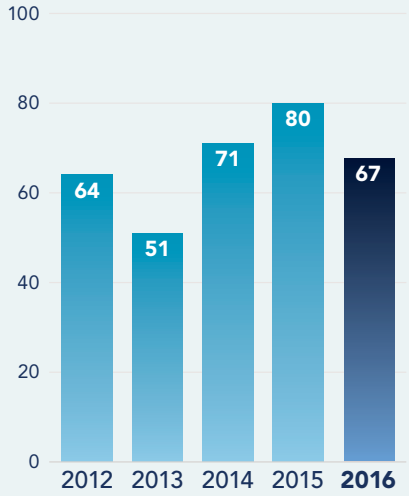
Ingeborg was treated with diuretics to reduce the fluid affecting her heart and lungs, beta-blockers to keep her heart rate stable and blood thinners to prevent stroke. Her treatment protocol has proved successful.

Read more about Ingeborg's story at **michmed.org/EXArp.**

Heart Failure

HIGH-VOLUME EXPERTISE IN HEART FAILURE THERAPIES (CONTINUED)

Long-Term Ventricular Assist Device Implant Volume



HFpEF Clinic

Specialists in the Frankel CVC Heart Failure with Preserved Ejection Fraction (HFpEF) Clinic evaluate a patient's HFpEF phenotype using data from history, physical examination, comorbidities, echocardiography, right heart catheterization, biomarkers and other laboratory data. This allows us to predict which therapies are most likely to benefit a patient with HFpEF. For all patients, we prioritize adequate blood pressure control and optimization of intravascular volume and evaluate for the presence of other cardiac and non-cardiac diseases that could contribute to a patient's symptoms. We promote lifestyle modification through our nurse educators, as exercise and dietary interventions can improve exercise capacity and quality of life. We also lead a number of research initiatives aimed at understanding why HFpEF develops and worsens, and we participate in a broad range of clinical treatment trials.

Extracorporeal Life Support (ECLS)

U-M is the world leader in ECLS, which was pioneered at the University. Our team has the most extracorporeal membrane oxygenation (ECMO) experience in the world and is capable of instituting ECMO within minutes or, under special circumstances, traveling to referring institutions to initiate ECMO for a safer transport to our center.

Patients can be supported on ECMO for days, weeks or even months, giving the heart and lungs time to recover or until an implantable replacement or transplant becomes available.

CLINICAL TRIALS

MOMENTUM III
Compare the HeartMate III to the HeartMate II in patients who are not responding to other medicines or treatments for advanced heart failure.

U-M Advanced Heart Failure Tele-Monitoring and Flexible Diuretic Project
Research the effects of a home tele-monitoring system and a flexible diuretic treatment plan among high-risk heart failure patients and reduce the risk of hospital admission for heart failure patients.

REDUCE LAP-HF II:
Evaluate the clinical efficacy and safety of the InterAtrial Shunt Device© System II for HFpEF and HFmrEF patients with elevated left atrial pressure who remain symptomatic despite standard guideline-directed medical therapy.

LIFE (Entresto™ In Advanced Heart Failure)
Obtain more information on the benefits and risks of Entresto in patients with advanced heart failure; compare Entresto with Valsartan.

Outcomes AlloMap Registry (OAR) study/sub study
Collect data on heart transplant patients and observe the clinical long-term management/outcomes of heart transplant recipients with the regular use of AlloMap testing, which helps determine the risk of rejection at the time of testing.

Home Treatment of Heart Failure Patients with Intravenous Diuretics
Outline a system to support the safe administration of intravenous diuretics in patients with volume overload due to heart failure in the home.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Heart Failure

HIGH-VOLUME EXPERTISE IN HEART FAILURE THERAPIES (CONTINUED)

Cardiac Transplant Program

The U-M Frankel CVC is the leading cardiac transplant center in Michigan, performing an average of 30 adult cardiac transplants each year. The Cardiac Transplant Program team has performed more than 1,000 heart transplants since 1984. Our transplant team includes multidisciplinary specialists with extensive experience in managing the complexities of transplant patients, including:

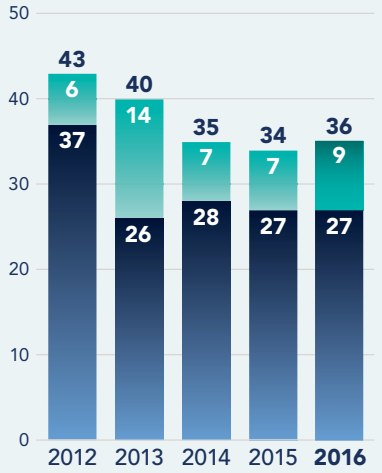
- Adult cardiac transplant surgeons
- Heart failure and transplant cardiologists with advanced training in transplantation
- Advanced circulatory support
- Cardiac critical care
- Nutritionists
- Social workers

Our team works closely with faculty who specialize in congenital heart disease, inherited cardiomyopathies and transplant infectious diseases to provide each patient with seamless, comprehensive care. We are also affiliated with MidMichigan Health. Headquartered in Midland, MidMichigan Health operates hospitals in Midland, Alma, Alpena and Gladwin, and outpatient locations throughout the center of the state.

Heart Transplant Survival	Observed	Expected
30 DAY	93.7%	98.6%
1 YEAR	91.6%	92.0%
3 YEAR	88.9%	85.1%

30 Day data and 1 Year data for 7/13 – 12/15
3 Year data for 1/11 – 6/13
Source: Scientific Registry of Transplant Recipients

Heart Transplant Volume



Adult Pediatric Includes 11 multi-organ transplants

VAD Brings Hope to Patient Awaiting Heart Transplant

In April 2015, while on the job as a security guard, Eddie Craig recalls feeling run down and short of breath. Later in his shift, fellow workers suggested he go home to rest. Instead, Eddie drove to a hospital emergency room near his home in Detroit.

Diagnosed with pneumonia, he was admitted to the hospital for treatment. When his symptoms didn't improve, additional tests revealed congestive heart failure due to nonischemic dilated cardiomyopathy.

Doctors referred him to the U-M Frankel CVC, where his life-threatening cardiomyopathy was confirmed. The cardiology team evaluated him and determined he was a candidate for a ventricular assist device (VAD).

"My only hope was for a ventricular assist device," Eddie says of his VAD, which was implanted in February 2016. He has learned to live with the device, despite the fear and uncertainty he initially felt.

"The U-M team did a wonderful job explaining my VAD, so I was confident that I could manage it after leaving the hospital," he says.

"At first, I was depressed because of my new reliance on the device, but as time went on I appreciated that it was keeping me alive. I know I made the right choice," he says, adding that he is hopeful a heart transplant is in his future. Until then, he is grateful for this second chance at life.

Read more about Eddie's story at **michmed.org/e4oaY.**

Cardio-Oncology

COORDINATED CARE FOR CANCER AND HEART PATIENTS

As cancer survivorship rates increase, there is a need to better understand how cancer therapies can affect the heart during and after treatment. Nearly 30 percent of survivors now have a cardiac issue as a result of their cancer therapy. Our goal is to predict those at risk and tailor heart-protective therapies and treatment plans that enable survivors to live long and productive lives.

The Cardio-Oncology Clinic is a multidisciplinary partnership between the Frankel CVC and the Comprehensive Cancer Center. As one of a few institutions in the country to offer this level of coordinated care, we team with oncologists to treat cancer patients and survivors who develop cardiac problems, as well as cardiac patients who are diagnosed with cancer.

Through the Cardio-Oncology Clinic, cardiologists and oncologists collaborate to improve quality of life for patients and eliminate barriers to effective treatment by:

- Working with patients who are diagnosed with a heart problem prior to cancer treatment.
- Preventing heart disease in patients who require chemotherapy or radiation therapy and are thereby at increased risk for heart disease.
- Closely monitoring patients who are receiving potentially cardiotoxic cancer treatments.
- Treating cardiac problems related to cancer therapy so patients can resume treatment as soon as possible.
- Using echocardiographic strain imaging to screen patients who are at high risk for heart disease due to cardiotoxic drugs.
- Following up with pediatric and adult cancer survivors – patients at higher risk than the general population for developing heart disease later in life.

Cardiotoxicity

Oncologists and cardiologists at the U-M Cardio-Oncology Clinic evaluate patients at risk for heart disease or those who have developed cardiotoxicity as a result of cancer treatment. Without interrupting treatment, they work to identify and address cardiovascular risks and reduce the toxic effects of cancer therapies on the heart. Cardio-oncology research includes efforts to better understand the mechanisms of cardiotoxicity at the cellular level, and participation in new chemotherapeutic drug studies aimed at minimizing the cardiotoxicity of future cancer drugs.

Cardiac Tumor Program

Recently launched as a multi-center effort, the U-M Cardiac Tumor Program brings together experts from around the country via monthly video conference to coordinate care and better understand the genetics of heart tumors. This multidisciplinary review board takes an individualized approach to determining whether surgery, chemotherapy, radiation or other therapies will yield the best patient outcome.

Through the Cardio-Oncology Clinic, cardiologists and oncologists collaborate to improve quality of life for patients and eliminate barriers to effective treatment.

Vascular Disease

EXCELLENCE IN ADULT AND PEDIATRIC VASCULAR SURGICAL CARE

At the Frankel CVC, we are focused on providing the best patient care experience. Our standard of excellence ensures the best possible vascular surgery outcomes, from initial clinic visits through subsequent follow-up appointments.

We participate in both the Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2) statewide collaborative and the Vascular Quality Initiative (VQI) to allow us to benchmark and improve outcomes.

Our surgeons specialize in open vascular surgery and the use of minimally invasive endovascular procedures for a wide range of vascular conditions, including:

- Abdominal aortic aneurysm
- Carotid artery disease
- Mesenteric artery disease
- Peripheral arterial disease
- Renal artery disease
- Thoracic and thoracoabdominal aortic aneurysm
- Thoracic outlet syndrome
- Venous thromboembolism (complicated)
- Varicose veins
- Venous insufficiency
- Vertebral artery disease

Pediatric Vascular Surgery Program

The pediatric vascular surgery program at U-M has been caring for children with a variety of surgical vascular conditions for more than four decades. We remain the country's preferred destination for children in need of surgical management of occlusive or aneurysmal diseases of the abdominal aorta and its branches. A multidisciplinary team is led by vascular surgeons and includes specialists in interventional radiology, pediatric nephrology, intensive care and anesthesia, as well as nurses and social workers with broad knowledge of pediatric renovascular hypertension and childhood abdominal aortic coarctation. Our patients come from the world over, including Western Europe, the Middle East and many major children's hospitals in Canada and across the United States.

Vascular Disease

LEADING-EDGE TREATMENTS IN INTERVENTIONAL RADIOLOGICAL CARE

The multidisciplinary Interventional Radiology Program at the Frankel CVC is a leading and innovative partner in the diagnosis and treatment of vascular disease, using cutting-edge diagnostic and minimally invasive, image-guided procedures to improve patient outcomes and reduce hospital stays.

We specialize in treating:

- Aortic aneurysms and dissections
- Arteriovenous malformations
- Carotid artery disease
- Inferior vena cava filter placement and management
- Massive and sub-massive pulmonary embolism
- Percutaneous transcatheter angioplasty
- Peripheral arterial disease and peripheral vascular disease
- Renal artery stenosis/secondary hypertension
- Varicose and spider veins
- Vascular malformations
- Vascular occlusive disease (recanalization and stenting)
- Venous thrombosis (acute and chronic)
- Pelvic congestion syndrome and varicoceles

CLINICAL TRIALS

CREST II

Compare the treatment of asymptomatic carotid stenosis in two trials. One involves optimal medical management versus optimal medical management plus stenting. The other involves optimal medical management versus optimal medical management plus carotid endarterectomy.

Medtronic Endurant® EVO

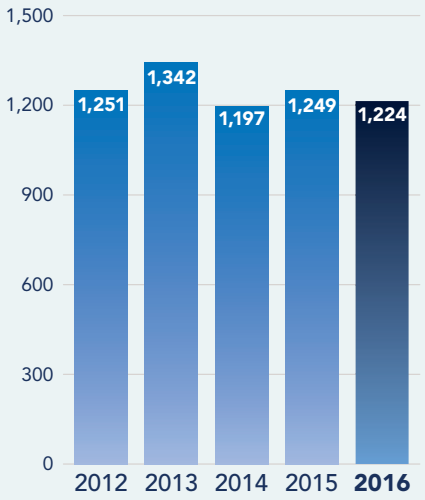
Demonstrate that the Endurant® Evo AAA stent graft system is safe and effective for the treatment of abdominal aortic aneurysms.

RelayPro® Thoracic Stent-Graft

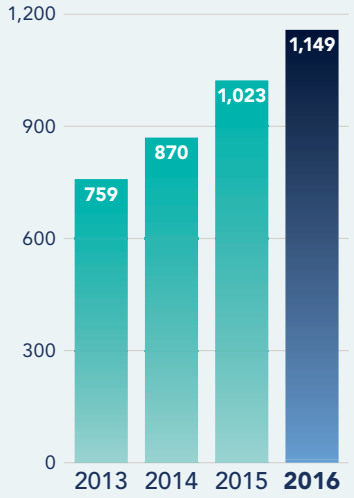
Assess and evaluate safety and performance data on the RelayPro Thoracic Stent-Graft. Patients in this study must have a thoracic aortic aneurysm or penetrating atherosclerotic ulcer.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Vascular Surgery Volume



Vascular and Interventional Radiology Volume



INNOVATIVE DVT TREATMENT

DVT is now being treated for the first time ever using a selectin inhibitor that targets inflammation. Led by Thomas Wakefield, M.D. (vascular surgery), and Sumi Sood, M.D. (hematology), of the Frankel CVC, the team received NIH funding through the National Heart, Lung and Blood Institute's Vascular Interventions/Innovations and Therapeutic Advances (VITA) program.

Venous TOS Treatment Keeps Mom of Three in the Game

Kristin Dood didn't think much about the swelling in her left arm. Just a bug bite, she thought, hoping an anti-histamine would relieve the swelling. The next morning, she awoke to an arm that had turned blue and had nearly doubled in size. Later that day, she felt the swelling moving up to her neck.

"That's when I knew I needed to get to the University of Michigan emergency room," says the 41-year-old Canton, Michigan, resident.

Initial tests revealed blood clots in Kristin's arm had moved to her lungs. She was admitted to the hospital, where a CT scan and MRI confirmed venous thoracic outlet syndrome (VTOS).

Treatment for VTOS is based on a patient's symptoms, says U-M Frankel CVC vascular surgeon Chandu Vemuri, M.D. "If a patient presents with an acute blood clot, the clot is dissolved, the diagnosis confirmed and the patient is put on systemic anticoagulation." Surgery is then scheduled with the timing based on the results of the venogram.

Surgery involves a complete thoracic outlet decompression, which includes removal of the first rib, anterior scalene muscle, middle scalene muscle, subclavius muscle, scar tissue around the jugular, innominate and subclavian vein and possible direct intervention on the vein.

Kristin underwent a procedure to remove her existing clots and was placed on blood thinners. Two weeks later, she underwent a complete thoracic outlet decompression. Kristin recently began physical therapy and is expected to achieve 100-percent usage of her arm.

Read more about Kristin's story at **michmed.org/eZA0o.**

Venous Health

COMPREHENSIVE CARE FOR VENOUS DISEASE

The Venous Health Program at the Frankel CVC is a multidisciplinary, large-volume clinic that provides care for the entire spectrum of venous disease. Specialists from vascular surgery, vascular medicine and interventional radiology collaborate to establish uniform treatment recommendations and care plans.

The spectrum of venous disease involves treatment for conditions ranging from superficial venous disease, including spider vein injection, to treatment of reflux with minimally invasive endovenous therapy and removal of varicose veins. We also provide comprehensive treatment of deep venous disease, including May-Thurner syndrome and venous thromboembolism.

Our team consists of highly trained experts with years of experience in treating all varieties of venous conditions, regardless of complexity. We participate in the Society for Vascular Surgery Vascular Quality Initiative Varicose Vein Registry (VQI VVR), allowing tracking of results of superficial vein treatments.

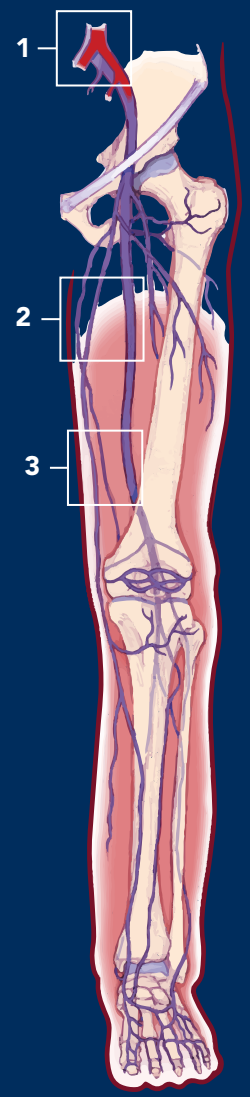
Innovative treatments include:

- **Sclerotherapy** for the treatment of spider telangiectatic veins.
- **Radiofrequency ablations/laser ablations and tumescentless ablations** for superficial venous reflux.
- **Phlebectomies** using Trivex® technique (available at very few sites in the country) for the removal of large and extensive varicose veins.
- **Pharmacomechanical thrombolysis** for a more aggressive treatment of iliofemoral venous thrombosis.
- **Recanalization of central veins** to treat significant chronic venous insufficiency or obstruction.

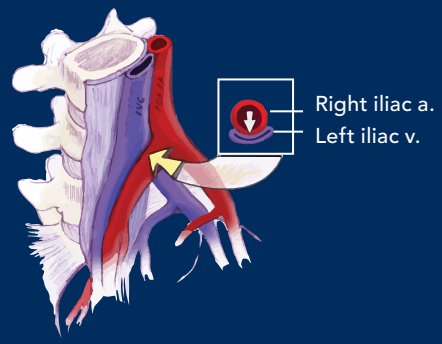
We also offer consultative and educational programs for referring physicians, especially those who are some distance from Ann Arbor, to help them manage venous disease patients locally.

The Frankel CVC is dedicated to exploring new treatments, medical therapies and delivery of care options that improve the lives of patients living with venous disease.

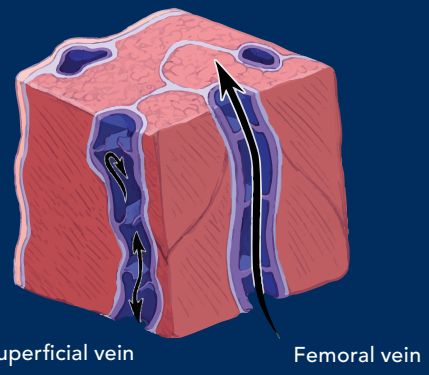
Clinic Volume	2013	2014	2015	2016
FRANKEL CVC	803	832	849	1,134



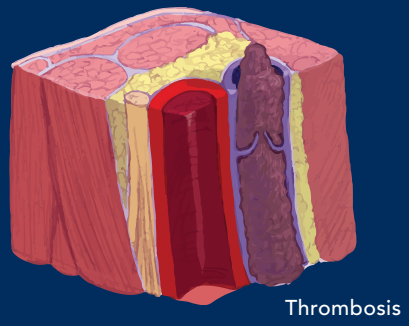
1 May-Thurner Syndrome



2 Venous Insufficiency



3 Deep Vein Thrombosis



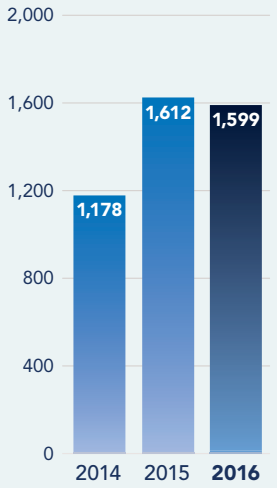
Peripheral Arterial Disease

COMPREHENSIVE PATIENT CARE

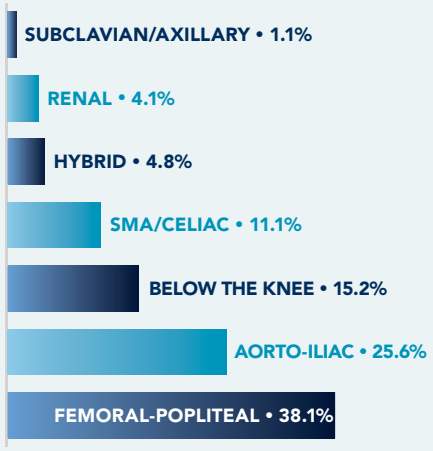
The Peripheral Arterial Disease Program at the Frankel CVC brings together a strong team of experts from interventional cardiology, interventional radiology, cardiovascular medicine, vascular medicine and vascular surgery all in one location.

Any patient with PAD can be seen in our clinic, from mild cases to limb-threatening, disabling conditions. Our team meets regularly to discuss individual cases and develop optimal management strategies for every patient. We also work closely with podiatry and diabetes specialists to prevent amputations where possible. Few other centers offer such a complete PAD treatment program.

Clinic Volume



Percutaneous Peripheral Arterial Procedures 2016

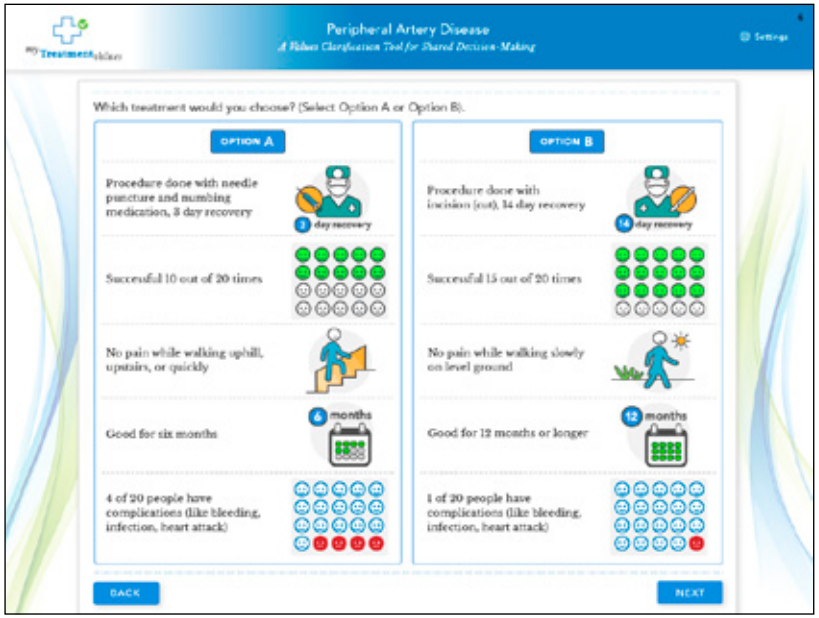


Collaborative Approach

Our coordination of a standardized outpatient experience, as well as increased access to wound care and pain management services, ensures the best care. Collaboration across physician specialties and coordination of quality improvement efforts translate into optimal revascularization strategies, fewer procedural complications and improved guideline-recommended medical therapy.

In addition, our PAD program provides:

- Comprehensive testing in an Intersocietal Accreditation Commission (IAC) vascular lab.
- Immediate access to all patients with any degree of PAD, from mild to severe.
- State-of-the-art angiographic equipment with access and expertise in multiple minimally invasive endorevascularization modalities.
- Hybrid endovascular operating rooms for combined operative and minimally invasive procedures.
- Expertise in limb-sparing and limb-salvaging operative and endovascular procedures.
- Same-day evaluations, including imaging.
- Treatment interventions, including complicated angioplasty, stenting, endarterectomy, atherectomy and bypass graft surgery.
- Exercise rehabilitation, smoking cessation program, dietary counseling and prosthetics services.
- Consultative and educational programs for referring physicians.



App Helps PAD Patients Choose Their Care Plan

U-M associate professor of surgery Matthew Corriere, M.D., who specializes in peripheral artery disease, has designed a patient-friendly app that serves as a values clarification tool to give patients a bigger role in the treatment decision-making process.

Corriere, who served as co-author for the American Heart Association's 2016 PAD guidelines, is piloting the My Treatment Values app in select PAD patients.

"Patients tell us they want input in their care," says Corriere. "A tool like ours provides a platform to elicit their opinions, quantify them and then apply this information to help design a treatment plan consistent with their values – whether that's an aspirin regimen, a stent or bypass surgery or another option."

The U-M PAD team hopes to bring the app into the clinical environment to help PAD providers everywhere enhance their patient-centered care.

Read more about the PAD app here: **michmed.org/Mldk3.**

CLINICAL TRIALS

Physical Activity Daily – Internet-Based Walking Program for Patients With PAD

Compare the effectiveness of different modes for PAD walking rehabilitation programs and test the effectiveness of an Internet-based walking program to enhance long-term adherence to regular physical activity.

BEST

Evaluate open versus endovascular treatment in patients with critical limb ischemia.

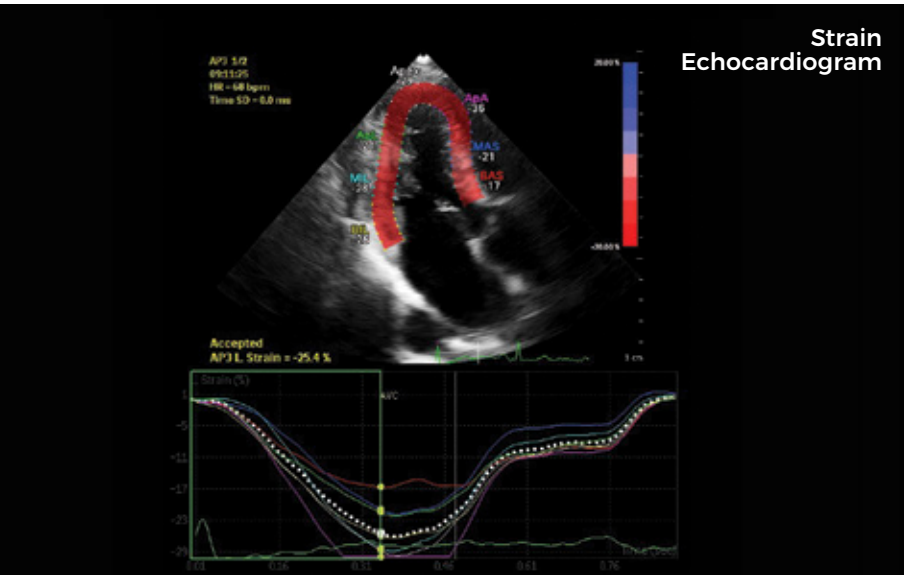
Facilitated Sharing Treatment Decision Making for Peripheral Artery Disease

Integrate our shared decision tool into clinical encounters between patients and providers to identify changes needed to overcome implementation barriers.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Cardiovascular Imaging

UNPARALLELED EXPERTISE IN CARDIOVASCULAR IMAGING



Strain Echocardiogram

Cardiovascular imaging services available at the Frankel CVC rival those at any top laboratory or center in the country. Our faculty, staff and technologists maximize our research facilities to bring state-of-the-art equipment and techniques into the clinic. Our team is able to serve large volumes of patients and provide unparalleled levels of detail, including imaging of complex and less common diseases. We collaborate with specialists throughout U-M and beyond to ensure the most effective diagnosis, analysis and treatment for patients.

Our Services Include:

Cardiac MR

The high-resolution images obtained with cardiac MR enable us to skillfully demonstrate cardiovascular anatomy, make extremely accurate measurements of cardiac function and identify areas of cardiac scar, important steps in planning advanced cardiac procedures. These techniques make possible the evaluation and diagnosis of many cardiac diseases that are difficult to identify with any other non-invasive test.

Cardiac and Vascular CT

Our advanced CT scanners use powerful computer processing techniques to acquire images with the lowest possible radiation dose and the highest possible image quality. In partnership with our advanced image processing laboratory, we are able to routinely generate three-dimensional models to aid in diagnosis and treatment decisions.

CLINICAL TRIALS

MR Multi-Echo Dixon Imaging and Signatures of Obesity Phenotypes

Develop a method of MRI scanning to look at epicardial fat and its influence on cardiovascular disease.

Normal Distribution of Rb-82, Nitrogen-13 Ammonia and F-18 FDG

Evaluate the normal cardiac distribution of Rb-82, N-13 ammonia and F-18 FDG to develop normal databases for the computer analysis of both studies.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Diagnostic Vascular Unit

The U-M Diagnostic Vascular Unit (DVU) provides a full spectrum of arterial and venous examinations, including ultrasound, Doppler and plethysmography-based studies. The DVU services both the outpatient and inpatient areas of U-M. Accreditation by the Intersocietal Accreditation Commission is current and has been ongoing since 1993. Locations for DVU imaging include the University Hospital, Frankel CVC, Domino's Farms, Briarwood, Northville and Taubman Center.

Echocardiography

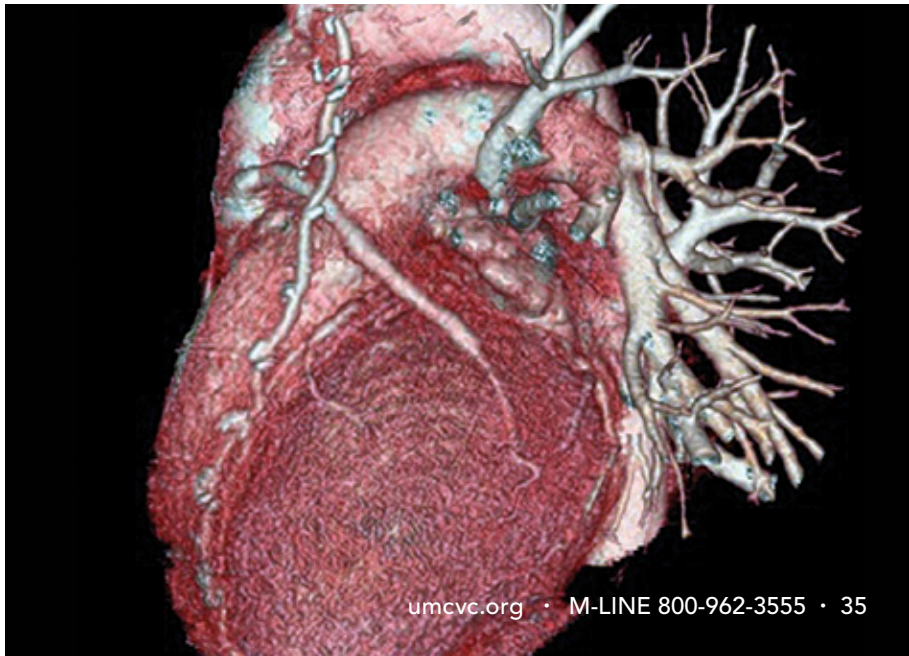
Our Echocardiography laboratories perform all types of conventional and advanced echocardiograms, including:

- 2-D
- 3-D transesophageal
- Stress
- Multidimensional strain imaging

Nuclear Cardiology

The Frankel CVC Nuclear Cardiology laboratory and PET imaging center are fully equipped with advanced SPECT/CT and PET/CT imaging systems. In addition to looking at cardiac vitality and perfusion, we use novel approaches to detect myocarditis and cardiac sarcoidosis and to image infected prosthetic material such as pacer leads and valves.

Cardiovascular Imaging Volume	2015	2016
2-D AND 3-D ECHO	23,096	25,913
STRESS ECHO	3,576	3,303
TRANSESOPHAGEAL ECHO	2,187	2,436
CT	14,235	14,993
NUCLEAR CARDIAC IMAGING	3,254	3,485
CARDIAC MR	5,206	5,660
DIAGNOSTIC VASCULAR STUDIES	28,508	30,429



Inherited Cardiomyopathies

ADVANCED TREATMENT FOR PATIENTS AND FAMILIES

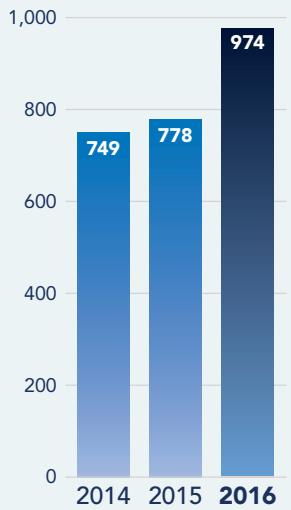
The Inherited Cardiomyopathy Clinic at the Frankel CVC is one of only 29 in the country specializing in the treatment of inherited cardiomyopathies, including hypertrophic cardiomyopathy (HCM), dilated cardiomyopathy (DCM), arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) and left ventricular noncompaction (LVNC).

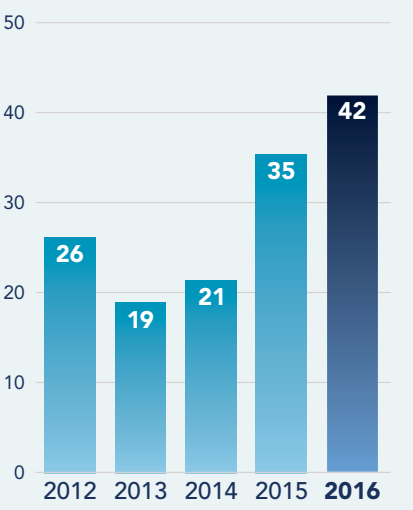
Our pediatric and adult clinicians work closely with one another, along with specialists in electrophysiology, heart failure and radiology, to provide the most comprehensive care to patients and families living with these diseases.

Serving a large volume of patients through our clinic, we offer the latest knowledge and treatment recommendations, including:

- Expert consultation
- State-of-the-art imaging, including echocardiography and cardiac MRI
- Cardiopulmonary stress testing
- Genetic testing and counseling for individuals and families
- Medical therapies
- Electrophysiology and surgical procedures

Our physicians treat entire families and coordinate care between adult and pediatric clinics so that family members can be seen on the same day. Our team also includes skilled nurses, genetic counselors and researchers.





CLINICAL TRIALS

Exercise in Genetic Cardiovascular Conditions (LIVE-HCM/LQT)

Determine how lifestyle and exercise impact the well-being of individuals with hypertrophic cardiomyopathy and long QT syndrome.

Safety of Tafamidis in Subjects with Transthyretin Cardiomyopathy

Evaluate the safety of oral daily dosing of 20 mg or 80 mg tafamidis meglumine in subjects with transthyretin genetic variants or wild-type transthyretin resulting in amyloid cardiomyopathy.

SHaRe (Sarcomeric Human Cardiomyopathy Registry)

Build a community of cardiovascular geneticists and research-based cardiologists to support the development of novel therapies for patients with heritable heart disease.

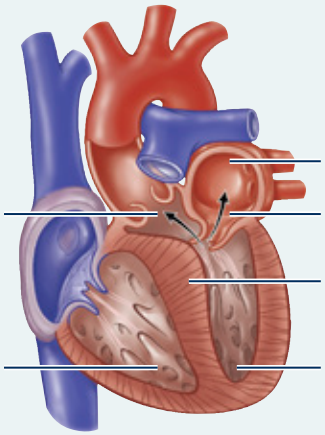
VANISH (Valsartan for Attenuating Disease Evolution in Early Sarcomeric HCM)

Evaluate the safety and effectiveness of Valsartan in early hypertrophic cardiomyopathy by assessing many domains that reflect myocardial structure, function and biochemistry.

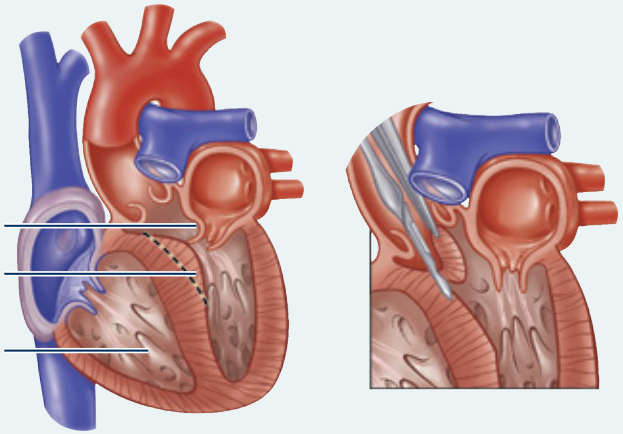
For more information or to view additional trials, visit **UMHealthResearch.org.**

The U-M Frankel CVC reported 0% operative and 30-day mortality for HCM myectomy in 2016.

Hypertrophic Obstructive Cardiomyopathy



Septal Myectomy



Genetic Counseling and Testing

A FULL SPECTRUM OF RESOURCES FOR INHERITED HEART CONDITIONS

The University of Michigan Frankel Cardiovascular Center offers comprehensive genetic counseling and testing for individuals diagnosed with inherited heart conditions.

The U-M Cardiovascular Genetic Counseling and Testing program works hand in hand with a multidisciplinary Frankel CVC team made up of specialists in a variety of areas, including:

- Cardiomyopathy
- Arrhythmia
- Aortic disease (aneurysms and dissections)
- Heart failure
- Early-onset coronary artery disease (familial hyperlipidemia)

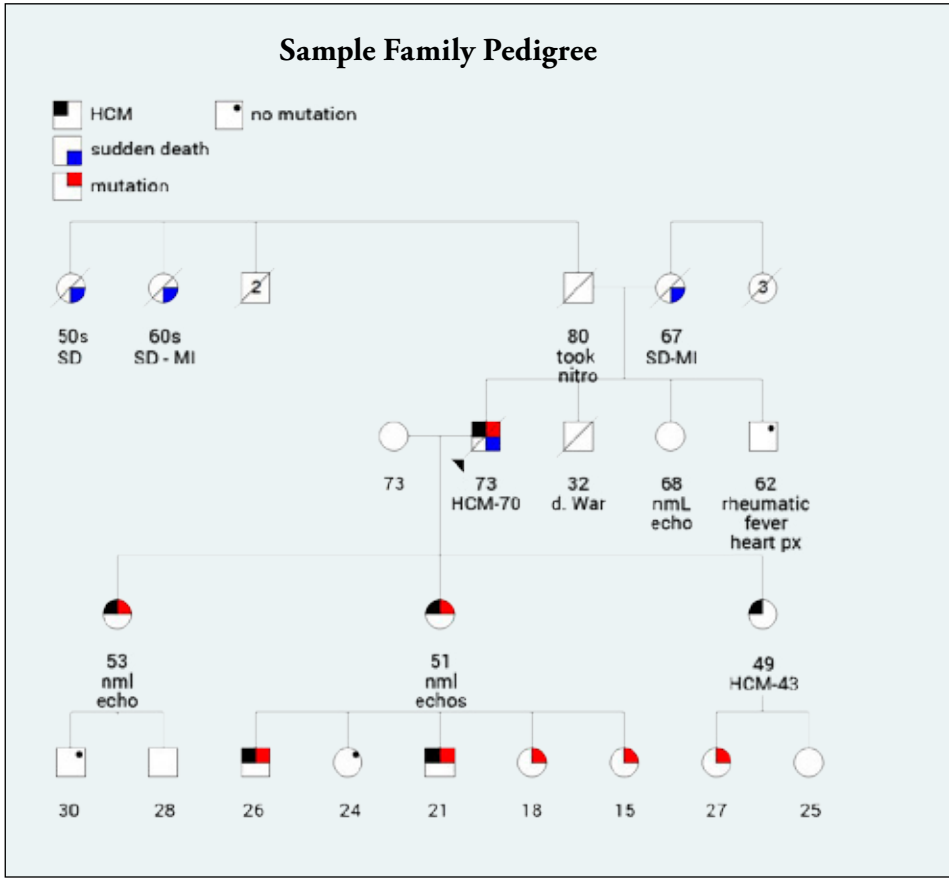
Counseling

Genetic counselors at U-M help individuals work through the emotional aspects of their diagnosis and prepare them for genetic testing, including how the testing might impact the patient and his or her family. Genetic counseling also helps families explore their family health history to assess risks for a heart condition that may run in the family.

Consultation with a genetic counselor is offered to all patients diagnosed with a possible genetic heart condition. These are in-person appointments, generally 30-60 minutes in length, and can be coordinated with a patient's other cardiology appointments.

Genetic counselors are also available to help referring physicians recognize signs of a patient's potential genetic heart disorder, such as:

- Sudden cardiac arrest.
- Family history of sudden cardiac death, unexplained death at a young age or death by an unexplained accident or drowning.
- Heart failure at a young age (under 50).
- Palpitations or an abnormal heart rhythm at a young age.
- Fainting, blackouts or seizures that could not be treated with typical seizure medications.
- More than one relative with the same type of heart disease.



Testing

Genetic testing is available for a number of hereditary heart conditions, including cardiomyopathies such as hypertrophic cardiomyopathy and arrhythmogenic cardiomyopathy, arrhythmia conditions such as long QT syndrome and Brugada syndrome, amyloidosis, aortic aneurysms and dissections and familial hyperlipidemia.

Our team of experienced, board-certified genetic counselors is available to assist clinicians throughout the testing process to:

- Review patient cases that may benefit from genetic testing.
- Differentiate between genetic tests to select the one that is most suitable for the patient.
- Assist in interpreting results.
- Provide result-specific background regarding variants, genes and conditions.
- Evaluate, discuss and provide information for at-risk family members who can also be tested and followed though the program.
- Identify gene-specific information, including relevant literature and studies, published management guidelines and patient resources.

CLINICAL TRIALS

CHIP (Cardiovascular Health Improvement Project)

Establish a biorepository of DNA, plasma, serum and aortic tissue samples as well as an extensive clinical database of medical and family history information.

Bicuspid Aortic Valve and Ascending Aortic Aneurysm Registry

Gather information on patients with BAVs to better understand and assess patterns of aortic dilatation, responses to medical therapy based on serial imaging and the potential for genetic markers.

For more information or to view additional trials, visit **UMHealthResearch.org.**

Stroke

MULTIDISCIPLINARY EXPERTISE

The University of Michigan Comprehensive Stroke Center includes an expanded, specially trained, multidisciplinary team of experts in emergency medicine, vascular surgery, cardiology, neurology, neurosurgery, neurocritical care, neurointerventional radiology, internal medicine and physical medicine and rehabilitation. The Center offers patients the highest level of comprehensive stroke care, from reducing the risk of stroke to the most advanced stroke treatments. The team includes eight board-certified vascular neurologists who are active in national stroke guideline development and offer a depth of knowledge about all types of stroke.

Emergency Stroke Care

Our emergency response services, including Survival Flight, bring patients to our hospital quickly and safely. Our tPA delivery timing surpasses the standards outlined in the American Stroke Association "Get With The Guidelines®" program, a testament to our well-trained and efficient emergency room staff. When a patient is not a candidate for IV tPA, he or she is evaluated and treated by a specially-trained neurovascular team in our neurointerventional radiology suite – the only one of its kind in the area.

Inpatient Stroke Care

Stroke patients are cared for in our dedicated Stroke Unit and Neuro-Intensive Care Unit, which have been shown to decrease complications and improve survival and functional outcomes following stroke. Patients receive personalized guidelines for the best recovery strategies upon discharge.

Preventive Stroke Care

The Stroke Clinic provides screening and preventive care to high-risk patients. We work with patients to diagnose and treat conditions that increase risk for stroke. Our location in the Frankel CVC promotes collaboration with cardiologists and vascular surgeons. Together, we put the best stroke prevention plan into action for each patient, which may range from lifestyle changes to the most sophisticated testing and treatment in an effort to decrease stroke risk.

Cutting-edge Treatment

For ischemic stroke patients, our team is highly experienced in thrombectomy, also known as clot retrieval. This surgical method of ensnaring and removing debilitating blood clots with technology known as a stent retriever has helped stroke patients recover more quickly and more fully.

Inserted through an artery (typically in the groin), the collapsed stent can be expanded from inside a catheter once routed up to the brain's blocked blood vessel. A wire-like cage then "traps" the clot and removes it from the body.

Stroke Rehabilitation

In 2017, U-M Comprehensive Stroke Center became the first medical center in Michigan to achieve Joint Commission certification for both our Comprehensive Stroke Center and our Stroke Rehabilitation Program. Our stroke rehabilitation unit provides patients a multidisciplinary team of rehabilitation physicians, nurses and therapists, with a goal of maximizing functional abilities after stroke.

Volumes	2014	2015	2016
ACUTE ISCHEMIC STROKE	331	421	410
TRANSIENT ISCHEMIC ATTACKS (TIA)	84	86	91

Procedural Volumes	2014	2015	2016
IV tPA	38	44	41
MECHANICAL THROMBECTOMY	23	22	49

Brain Aneurysm Patient Benefits from Collaborative Efforts

Merrill Harvitt, 71, suffered a debilitating headache that landed him in the Munson Healthcare emergency room in Traverse City, Michigan. The cause: a neurovascular bleed, or brain aneurysm.

Munson Healthcare on-call neurosurgeon Thomas Schermerhorn, M.D., consulted with Michigan Medicine neurosurgeon Aditya Pandey, M.D., and was able to relieve the pressure from Merrill's head by removing part of his scull and implanting it in his abdomen to keep the tissue viable.

The patient was airlifted via Survival Flight to U-M where a dural arteriovenous fistula was identified. The potentially deadly type of aneurysm was further complicated by its location on the major artery going to Merrill's eye. The team performed an open surgery to successfully excise the abnormal segment, with no danger of harming the patient's eyesight.

The relationship between Munson Healthcare and Michigan Medicine proved to be lifesaving for the patient.

Read more about Merill's story at **michmed.org/Q2YBx.**

Stroke

MULTIDISCIPLINARY EXPERTISE (CONTINUED)

Our Commitment to Excellence

The U-M Comprehensive Stroke Center is accredited as such by The Joint Commission. Team members of the Stroke Center helped in authoring as well as participating in the American Stroke Association "Get With The Guidelines®" Quality Initiative. We have repeatedly been designated as an American Heart Association Gold Plus and Target Stroke Honor Roll hospital, the highest stroke quality designations. These awards recognize hospitals that provide consistently excellent care following evidence-based guidelines. The AHA has recognized the quality of stroke care provided at U-M since 2005.

American Heart Association
American Stroke Association
CERTIFICATION
Meets standards for
Comprehensive Stroke Center

Stroke Indicator	MI Benchmark	National Benchmark	2016
VENOUS THROMBOEMBOLISM PROPHYLAXIS BY END OF HOSPITAL DAY 2 (STK-1)	97.1%	97.3%	99.4%
DISCHARGED ON ANTITHROMBOTIC THERAPY (STK-2)	98.8%	98.5%	100%
ANTICOAGULATION THERAPY FOR ATRIAL FIBRILLATION/ FLUTTER (STK-3)	93.3%	96.3%	100%
THROMBOLYTIC THERAPY (STK-4)	80.6%	88.2%	100%
ANTITHROMBOTIC THERAPY BY END OF HOSPITAL DAY 2 (STK-5)	96.8%	97.3%	98.4%
SMOKING CESSATION	95.1%	97.7%	100%
DISCHARGED ON STATIN MEDICATION (STK-6)	96.2%	96.7%	100%

Pulmonary Hypertension

UNSURPASSED EXPERTISE IN DIAGNOSIS AND TREATMENT

The Pulmonary Hypertension Program at the Frankel CVC is the largest and most experienced program in the state, and one of the largest in the country. The program was also one of the first in the country (and the first in the state) to be accredited as a Center of Comprehensive Care (CCC) through the Pulmonary Hypertension Association's Pulmonary Hypertension Care Centers (PHCC) program.

While often under-recognized, pulmonary hypertension diagnosis and treatment are complex and require highly specialized expertise. Our team of physicians, nurse clinicians, research coordinators and support staff offers a comprehensive, single resource for the care and treatment of patients who live with various types of this challenging and difficult-to-diagnose disease, including:

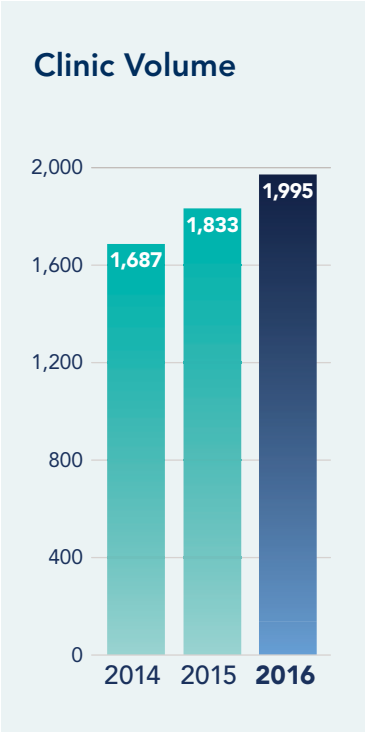
- **Pulmonary hypertension (PH)**, an elevation in the pressure in the arteries of the lungs, may be caused by an underlying disease such as congenital heart disease, left heart disease, blood clots in the lungs or rheumatologic disease, as well as other factors.
- **Pulmonary arterial hypertension (PAH)**, a disease of the blood vessels of the lungs, which become thick and narrow, causing elevation in pressure.
- **Chronic thromboembolic pulmonary hypertension (CTEPH)**, pulmonary hypertension associated with chronic thromboembolic obstruction. The disease is often present without any known history of pulmonary embolism.

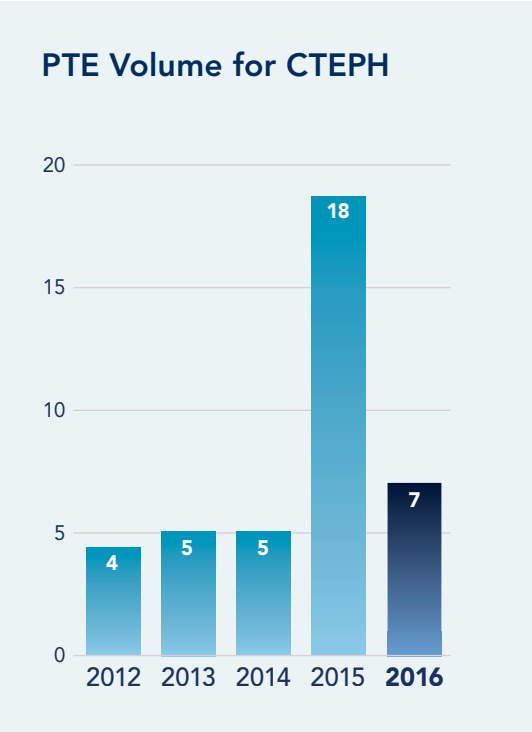
Treatment for Pulmonary Arterial Hypertension

Because each patient's PAH is different, there are more than a dozen FDA-approved and several investigational treatment protocols. We use high-dose calcium channel blocker therapy in select patients who demonstrate pulmonary vasodilator reserve to inhaled nitric oxide. We have extensive experience with all current FDA-approved treatments.

Treatment for Chronic Thromboembolic Pulmonary Hypertension

The U-M cardiac surgery team offers pulmonary thrombo-endarterectomy (PTE) as a treatment option for CTEPH patients. During this extremely complex procedure, the surgeon removes chronic organized thrombus from the pulmonary arteries in both lungs via a sternal incision.





Pulmonary Hypertension

UNSURPASSED EXPERTISE IN DIAGNOSIS AND TREATMENT (CONTINUED)

Hypothermic circulatory arrest (brief cessation of all circulation under deep systemic cooling) is typically required during PTE. The Frankel CVC is currently the only institution in the state, and one of only a few in the region, to offer PTE therapy. We have observed highly successful outcomes, resulting in many patients' pulmonary pressures returning to normal, thus significantly improving their quality of life.

Partnership with Scleroderma Clinic

Early diagnosis of pulmonary arterial hypertension is key for scleroderma patients. The Pulmonary Hypertension Program regularly partners with U-M's Scleroderma Clinic to investigate new and better screening techniques and treatments for systemic sclerosis-associated PAH. Some of our current projects include:

- A study on the novel, evidence-based DETECT algorithm for diagnosing PAH at earlier stages
- Phase II multi-center Rituximab trial
- Metabolomics screening

Pulmonary Hypertension Breakthrough Initiative

The University of Michigan serves as the Data Coordinating Center for the PHBI, a network of multidisciplinary, collaborative transplant and research centers that distributes stored clinical specimens and relevant data to researchers and for use in groundbreaking research to better understand the molecular basis of pulmonary arterial hypertension. Funding for this important network has been extended via a large NIH grant.

CLINICAL TRIALS

TROPHY-1

Clinical evaluation of the Therapeutic Intra-Vascular Ultrasound (TIVUS™) System for pulmonary artery denervation in patients with pulmonary hypertension.

Novel Screening Strategies for Scleroderma-Associated Pulmonary Arterial Hypertension

Examine whether tests performed during exercise improve the ability to detect early pulmonary hypertension and attempt to identify genes responsible for the development of PH.

SPHERE

Observational research study that follows patients who have either started therapy with the prescription medication Uptravi or have been receiving therapy with Uptravi, which may help slow the progression of PAH and lower the patient's risk of being hospitalized.

For more information or to view additional trials, visit **UMHealthResearch.org**.

Treating PH Requires an Extensive Approach

Cara Lister remembers the day in 2013 when she first felt something wasn't quite right.

"I was walking to my car and became very short of breath," she says. Thinking it was asthma, Cara made an appointment with her doctor, anticipating that an inhaler would be the solution.

Armed with the inhaler, she continued with her busy life in Battle Creek, Michigan. Then, one day, after nearly passing out, she was taken to the emergency room where she was diagnosed with pulmonary hypertension.

Cara, who also had high blood pressure and diabetes, was referred to the U-M Frankel CVC. Extensive testing, including a pulmonary function test, a ventilation perfusion scan and an echocardiogram, confirmed the PH diagnosis.

A heart catheterization and medication have helped improve Cara's health. She currently takes IV medications to keep the arteries in her lungs open and to stop fluid from building up around her heart and lungs. Cara also relies on supplemental oxygen, which means, "Everything needs to be planned in advance," she says, adding that those compromises are a small price to pay for her improving health.

Read more about Cara's story at **michmed.org/EzlR7.**

Women's Heart Disease

A LIFESPAN OF CARE FOR WOMEN'S HEART DISEASE

The Women's Heart Program at the Frankel CVC is a vibrant research and clinical venue focused on prevention, diagnosis and treatment of heart disease in women across the lifespan, from childbearing years through menopause and beyond. We offer a comprehensive program with cardiac rehabilitation, stress management, nutrition and exercise counseling, and many testing modalities all in the same building.

Our multidisciplinary team is comprised of experts who specialize in women's heart health, including physicians, nutritionists and exercise physiologists. We coordinate cardiovascular care for women and act as a central point of contact for patients, other cardiovascular specialists within the Frankel CVC and referring physicians.

Conditions that arise during pregnancy, such as gestational diabetes, preeclampsia and gestational hypertension, are associated with increased risk of cardiovascular disease later in life. With this knowledge, we are able to provide preventive care earlier to these women in an effort to reduce the burden of cardiovascular disease as they age.

Pregnancy can also lead to complications for women with underlying heart disease and can even lead to a condition called peripartum cardiomyopathy. Our multidisciplinary team includes obstetricians, anesthesiologists and cardiologists with expertise in pregnancy, congenital disease, electrical abnormalities and heart failure. We provide preconception counseling and cardiac monitoring during pregnancy and the early postpartum period. We also work with local providers to maintain ongoing continuity of care.

As we learn more about how cardiovascular disease presents differently in women than in men, we are expanding our knowledge and expertise in providing preventive care earlier in the lives of women, most notably during pregnancy.

Survival Starts with Self-Awareness

Erin Sargent is healthy and happy to be alive. The mother of two young children experienced daily fatigue and fever shortly after the delivery of her son more than six years ago, but her doctors couldn't make a diagnosis. After enduring months of symptoms, Erin was ultimately diagnosed with infective endocarditis and was referred to the U-M Frankel CVC for treatment. Here, it was discovered she was born with a bicuspid aortic valve, predisposing her to heart valve infection.

Despite a regimen of antibiotics, Erin's infection worsened and led to life-threatening complications. A sudden, severe headache resulted in a diagnosis of subarachnoid hemorrhage, or bleeding around her brain. Bacteria had destroyed her aortic valve and caused bits of the infection to travel to her brain, resulting in the bleed.

U-M cardiac surgery team performed emergency open-heart surgery and replaced her bicuspid aortic valve with a bioprosthetic valve.

Erin says she felt "10 times better" just two weeks after surgery and has steadily improved.

Read more about Erin's story at **michmed.org/E1vqR.**

Adult Congenital Heart Disease

FOCUSED ON PATIENT QUALITY OF LIFE

The Adult Congenital Heart Disease Program provides expert care to adult patients living with congenital heart disease, conditions present since childhood. Our multidisciplinary team of congenital heart disease specialists treats the full spectrum of these inherited conditions with extensive experience in imaging, electrophysiology, interventional catheterization and cardiac surgery, while our expert clinical nurse coordinators oversee patient care between visits. Our goal is to provide expert, collaborative and patient-centered care for adults with congenital heart disease.

Our board-certified adult congenital cardiologists specialize in the diagnosis, management and lifelong care for complex congenital heart disease conditions, including:

- Tetralogy of Fallot
- Transposition of the great arteries
- Single ventricle anatomy following the Fontan procedure
- Ebstein's anomaly
- Pulmonary valve abnormalities
- Septal defects (atrial, ventricular, atrioventricular)

Percutaneous interventions, among other treatments, offer patients more options for successful outcomes. U-M has performed more than 150 percutaneous pulmonary valve replacements in children and adults.

Ongoing Coordinated Care

Patients with congenital heart disease require lifelong management and care. All of our physician providers are board-certified in adult congenital cardiology in addition to internal medicine.

Our program partners with other specialists within Michigan Medicine to coordinate care across these disciplines as needed;

- High-risk obstetrics
- Heart failure and transplantation
- Cardiac surgery
- Social work
- Electrophysiology/arrhythmia
- Pulmonary hypertension
- Aortic disease/aortic surgery

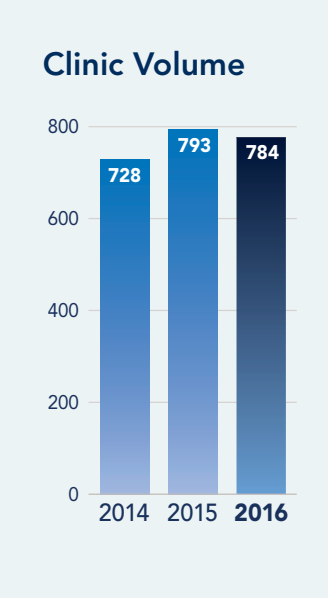
An ACHA ACHD Accredited Comprehensive Care Center

The U-M Frankel CVC Adult Congenital Heart Disease Program was recently accredited by the Adult Congenital Heart Association as a Comprehensive Care Center. The ACHA is dedicated to improving the quality of life and extending the lives of adults with congenital heart disease. The accreditation recognizes the Frankel CVC as a foremost leader in the field and a provider of the highest quality of care for ACHD patients.

Statewide Clinics

The Adult Congenital Heart Disease Program participates in comprehensive pediatric and adult congenital cardiology clinics for families throughout the state of Michigan, including:

- Ann Arbor
- Kalamazoo
- Lansing
- Marquette
- Petoskey
- Traverse City



Preventive Cardiology

PROMOTING LIFESTYLE MODIFICATIONS FOR PATIENTS

In keeping with the Frankel CVC's mission to deliver holistic cardiovascular care, one of our most important efforts is to prevent coronary and other vascular diseases with early detection, risk stratification and evidence-based interventions and treatments. Through our Coronary Risk Assessment, Lipid Management, Metabolic Fitness and Cardiac Rehabilitation programs, we can provide patients with a level of care and resources not commonly available at other institutions.

Our Preventive Care team includes physicians, nurse practitioners, nutritionists and exercise physiologists who specialize in the management of heart and vascular disease, hypertension, lipids, metabolic syndrome, nutrition and exercise. Together, they actively participate in patient care, research and education. The team has published a number of manuscripts with research emphasis on air pollution, lipids, cardiac rehabilitation, hypertension and lifestyle interventions.

Lipid Management – This multidisciplinary service determines why the lipids (cholesterol, HDL, triglycerides) are abnormal, performs an individual assessment of heart attack and stroke risk and develops a lifestyle and, when necessary, drug treatment plan to reduce the risk of heart and vascular disease for patients.

Hypertension – Our hypertension experts use both traditional and innovative approaches to ensure patients have the most effective treatment plan to control all types of hypertension, including rare forms.

Metabolic Fitness – Our team of cardiovascular experts is focused on helping patients manage and reverse metabolic syndrome, which reduces the risk of diabetes and heart disease.

Cardiac Rehabilitation – A multidisciplinary group of specialists empowers patients by providing them with information about diet, exercise and relaxation techniques for an overall improved lifestyle. Patients benefit from the expertise of dedicated dietitians, exercise physiologists, yoga instructors, nurse practitioners and cardiologists. More than 320 new patients completed 9,200 visits last year. Approximately 60 percent of referred patients that live within 45 miles began cardiac rehabilitation. We refer patients outside this radius to rehab centers in closer proximity to their homes.

Enhanced External Counter Pulsation (EECP) – This non-invasive treatment helps lower the number and intensity of angina episodes via external inflatable cuffs that are applied around the lower legs, upper legs and buttocks. The inflation and deflation of the cuffs is timed to the cardiac cycle by continuous telemetry ECG monitoring. The program features seven weeks of continuous treatments, which require daily one-hour visits, Monday through Friday.

THE BRIDGE CLINIC

Within seven to 14 days of being discharged from the hospital, U-M patients meet with mid-level or advanced practice providers at one of our Bridge Clinics. There they receive additional education about their diagnosis and planned treatment, including an assessment of recommended follow-up care, cardiovascular resources and future cardiologist appointments. Our data has shown that patients who participate in the Bridge Clinic are at lower risk for hospital readmission or emergency room visits.

Hypertension

EXPERT CARE IN BLOOD PRESSURE MANAGEMENT

The U-M Comprehensive Hypertension Center, designated as such by the American Society of Hypertension, is a national leader in the treatment of hypertension. We ensure patients get the proper diagnosis and an individualized treatment program to control both rare and common forms of hypertension.

As part of Cardiovascular Disease Prevention and Rehabilitation at U-M, our hypertension experts use both traditional and more innovative approaches, and have access to highly precise measurement devices available only in a specialty center.

Beyond identifying the optimal medical regimen for each patient, our Hypertension Center employs a team of experts, including nutritionists, exercise physiologists and stress management counselors. We offer a comprehensive approach tailored for each individual involving lifestyle recommendations, alternative therapies and traditional medications as needed. Often, we can offer enrollment into clinical trials in hypertension for eligible and interested patients.

Diagnosing Hypertension

To diagnose hypertension, we perform highly accurate, specialized blood pressure monitoring and conduct urine and blood tests tailored to each patient's profile. We order an electrocardiogram or cardiac ultrasound to look for heart muscle damage or thickening. Additional testing offered only at a specialty clinic such as our Comprehensive Hypertension Center is available if needed to help identify the cause of hypertension as well as the best treatment approach.

We also offer training in proper home blood pressure monitoring as well as 24-hour ambulatory monitoring, which is increasingly recognized as the best possible method to characterize the health risks related to high blood pressure, especially during sleep.

Many patients are referred to U-M because they haven't reached their goals, have "resistant" hypertension, are intolerant to medications, have "white coat hypertension" or potentially have an underlying secondary cause of their high blood pressure.

Most often, our treatment strategy involves lifestyle changes together with an optimized medical regimen and proper home blood pressure monitoring. However, in some circumstances, catheter-based or surgical interventions may be helpful to control the hypertension. In a small number of patients, surgery is required to remove hormone-secreting tumors that cause resistant hypertension, and in some, the hypertension is cured or improved by performing an angioplasty or surgery on the arteries leading to the kidney.

CLINICAL TRIALS

Low Salt 4 Life

Study the effectiveness of the Low Salt 4 Life iPhone app to determine its influence on individuals with high blood pressure.

AMBER

Evaluate the safety and efficacy of Patiromer to enable Spironolactone use for blood pressure control in patients with resistant hypertension and chronic kidney disease.

FIGARO-DKD and FIDELIO-DKD

Evaluate the effects of an investigational medication (finerenone) when added to regular treatment for patients with type 2 diabetes and diabetic kidney disease (DKD) to examine whether this non-steroidal mineralocorticoid receptor antagonist (MRA) finerenone can decrease cardiovascular mortality and morbidity in this patient population.

For more information or to view additional trials, visit **UMHealthResearch.org**.

World-Class Research

GIVING PATIENTS ACCESS TO THE LATEST CLINICAL TRIALS/THERAPIES

The Frankel Cardiovascular Center is at the forefront of cardiovascular research, thanks to our world-class faculty, supportive infrastructure and culture of collaboration and innovation. Our goal is to generate new knowledge and make significant advances in cardiovascular research to lead the fight against cardiovascular disease.

Our commitment to basic science and research is an important differentiator that keeps us at the leading edge of science and discovery in the fight against cardiovascular disease and ensures patients have access to the hundreds of clinical research studies currently available.

The Frankel CVC recruits and retains promising scientists and clinicians who are not only successful in their fields, but who represent our mission, vision and values. The current membership total is 319 faculty.

Basic Science & Translational Research Strengths

- Arrhythmia
- Cardiac Myocyte Biology
- Cardiovascular Biomechanics
- Cardiovascular Genetics
- Tissue and Cell Regeneration
- Vascular and Thrombosis Biology

Clinical Research Strengths

- Acute and Chronic Cardiovascular Diseases
- Aging
- Aortic Disease
- Arrhythmia
- Cardiac Imaging
- Health Services and Clinical Effectiveness
- Heart Failure and LVAD
- Pulmonary Hypertension
- Stroke
- Structural Heart Disease
- Thrombosis and DVT

Clinical Trials Support Unit

The Heart Vessel Blood Clinical Trials Support Unit (HVB-CTSU) enhances performance of cardiovascular, coagulation and nonmalignant hematologic clinical trials across the lifespan, including industry-sponsored, federally-sponsored and investigator-initiated clinical trials of acute or chronic disease. Drawing from the successful clinical trials programs, which have driven both clinical business and research, meaningful synergies within the HVB-CTSU foster a culture of collaboration.

Outcomes Initiatives

- Michigan Clinical Outcomes Research and Reporting Program (M-CORRP)
- Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2) Projects
- The Society of Thoracic Surgeons
- Section of Health Services Research and Quality, Department of Cardiac Surgery Initiatives
- VQI Registries for Treatment of Varicose Veins (VVR), Open Abdominal Aortic Aneurysms (AAA) and Carotid Stenting

RESEARCH HIGHLIGHTS

Collaborative, multidisciplinary research endeavors continue to be an essential theme for Cardiovascular Research Center investigators. Here is just a sample of the collaborative projects/programs we are spearheading:

Cardiovascular Health Improvement Project (CHIP)

CHIP is a biorepository of DNA, plasma, serum and aortic tissue samples as well as an extensive clinical database of medical and family history information. For more information about CHIP please visit: **umcvc.org/cardiovascular-health-improvement-project-chip-study.**

Multidisciplinary Aortic Program (MAP)

MAP is an interdisciplinary program with over 20 faculty representatives from cardiac surgery, vascular surgery, interventional radiology, cardiac imaging, medical genetics and cardiovascular medicine. MAP faculty are conducting innovative research across a wide spectrum, including FDA-regulated trials, NIH-funded trials, Department of Defense contracts and investigator-initiated projects, all specific to aortic disease.

Michigan Biology of Cardiovascular Aging Program (MBoCA)

The MBoCA program has been established to enable multidisciplinary research to advance science on aging and cardiovascular disease under the leadership of Program Director Daniel R. Goldstein, M.D.

Center for Advanced Models for Translational Sciences and Therapeutics (CAMTraST)

This Center strives to accelerate the "bench to bedside" process in biomedical research and drug development. For more information about CAMTraST please visit: **camtrast.med.umich.edu/.**

Center for Arrhythmia Research

At the Center for Arrhythmia Research, scientists and physicians from a variety of disciplines work together to develop new methods of diagnosing and treating cardiovascular diseases, with the primary goal of preventing premature cardiac death. Already, our scientists have made major advances in understanding the molecular and cellular basis for and the fundamental mechanisms of complex, life-threatening arrhythmias and sudden cardiac death. Ultimately, we will be an international resource for the study of cardiovascular diseases, including ischemic heart disease, heart failure and sudden cardiac death.

There are currently 535 active research studies across 45 diverse divisions, departments, schools and institutions at the University of Michigan.

Quality and Safety

COMMITTED TO A TRANSPARENT, PROACTIVE LEARNING ENVIRONMENT

The U-M Frankel CVC, and Michigan Medicine as a whole, has a robust Patient Safety Reporting System that promotes reporting of any event that is not consistent with the desired normal or usual medical care of the patient. All staff members are encouraged to report any patient- or staff-related safety issue. Our reporting philosophy is one that reflects our desired focus on improving processes and developing systems to prevent future harm. Events reported through the Patient Safety Reporting System are among the topics discussed at the University Hospital/CVC Daily Safety Huddle.

Our Daily Safety Huddle is a 10-15 minute Daily Check-In that allows the hospital units and departments to coordinate on issues that affect the safe operations of the hospital. The goal is to ensure communication and problem solving about key issues among all members of the UH/CVC team. Daily Safety Huddles allow for hospital leadership to be engaged with safety concerns and ensure that they are addressed in a timely manner. Real-time problem solving also occurs immediately after huddle when individual unit or department representatives connect to discuss an issue or process-related concerns.

When leaders and staff were asked in our most recent annual survey of Safety Huddle participants (Jan 2017), 92 percent agreed or strongly agreed that Daily Check-In has resulted in safety improvement.

In addition to real-time reporting with immediate follow-up, faculty and staff at the Frankel CVC have access to retrospective quality data through participation in state and national registries and consortiums. Cross-disciplinary sharing of data through our CVC Dashboard helps us review how we are doing within the CVC, as well as compared to state and national benchmarks. Clinical leaders from within the CVC meet to review performance on a quarterly basis, providing an opportunity for leaders to discuss barriers to improvement and sharing of best practices. This discussion also leads to clinical collaboration among subspecialties.

For more information about our Quality and Safety measures, visit **uofmhealth.org/quality-safety.**

Education

PARTNERS IN CARDIOVASCULAR KNOWLEDGE

One of the main pillars of the Frankel CVC mission is education. Expanding our understanding of cardiovascular disease across the lifespan is a collaborative effort among clinicians and scientists, patients and their families. Our focus on the exploration of better treatments, disease mechanisms, genetics and myriad other factors impacting patient care supports our educational partnerships with you, our referring physicians, to improve outcomes for all.

Patient and Family Education

The Frankel CVC's Mardigian Wellness Resource Center is available to provide top-quality, reliable information about cardiovascular health in patient-friendly language. Our goal is to help patients and families understand their health conditions, make informed decisions and become active members of their health care team.

Ongoing Communication

Subscribe to our monthly e-newsletter for news on research, procedures, services and CME courses available at the Frankel CVC. Contact Physician Liaison Erika Laszlo at M-LINE **800-962-3555** or email **physicianliaisons@med.umich.edu** to sign up.

COLLEAGUE CONNECTION

Colleague Connection is an online resource for the latest in medical research, CME opportunities and news you can use in your practice. To see the latest offerings in our specialty areas – including cardiovascular – please visit **colleagueconnection.uofmhealth.org**.

CONTINUING EDUCATION

Throughout the year, the U-M Frankel CVC offers physicians, mid-level and advanced practice providers a variety of continuing medical education courses and seminars taught by our faculty.

UPCOMING COURSES:

For upcoming courses, visit **med.umich.edu/intmed/cme/calendar.htm.**

INFORMATIONAL DINNERS:

For the past year, U-M faculty have presented complimentary **informational dinners** on a variety of cardiovascular-related topics at locations throughout Michigan. This is a unique opportunity for our faculty to interact with doctors, mid-level and advanced practice providers, share their expertise and discuss various issues. Positive survey feedback from past attendees has demonstrated that these informational dinners are viewed as valuable and worthwhile. Past topics include heart failure, TAVR, stroke, hypertrophic cardiomyopathy, pulmonary hypertension and peripheral arterial disease.

U-M doctors look forward to sharing information with our referring physicians in an informal, interactive environment and welcome the opportunity to hear your thoughts on topics you'd like us to pursue in the future. Upcoming topics, based on referring physician feedback, include electrophysiology, mitral valve disease and many others.

For more information about the dates and locations of upcoming dinners, contact Erika Laszlo at **734-647-1164** or **ellaszlo@umich.edu.**

Your Resources

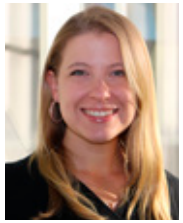
PARTNERING WITH OUR REFERRING PHYSICIANS

Research

Finding the Right Match

Our scientists and physicians are collaborating across disciplines to fulfill the Frankel CVC's mission of discovering new and better ways to prevent, diagnose and treat cardiovascular disease. As part of the robust and top-funded research environment at U-M, every clinical department and program within the Frankel CVC is actively engaged in research. Early access to expanded treatment options, from drug therapies and devices to prevention and procedures, is available to referring physicians and patients through these studies.

Cardiovascular clinical trials need all types of volunteers, from those who live with or have a family history of specific conditions, to those who are healthy. As part of our efforts to continuously improve the volunteer experience, finding the right patients for each trial is central to our research. This is why partnering with you, our referring physicians, is critically important.



Rachael Privett

Clinical Research Recruitment Coordinator

Rachael collaborates with you and your patients to find the most appropriate match available in our cardiovascular clinical trials. She also provides you with additional information about individual trials and direct patient referral.

Please contact Rachael for answers to your questions or for additional information about our research programs. Call **1-888-286-4420**, email **CVCVolunteer@med.umich.edu** or visit **UMHealthResearch.org**. Rachael welcomes your feedback to ensure the best possible service.

Patients and their families can sign up to be matched with research studies for specific health conditions through **UMHealthResearch.org**, the greater University's research community website.

Physician Liaison Program

Your Frankel CVC Connection

Communication with you, our referring physicians, is central to improving coordination of patient care. The U-M Physician Liaison Program offers personalized service to community-based physicians in Ann Arbor and throughout the region.

Erika Laszlo

Physician Liaison for the Frankel Cardiovascular Center

Erika is here to provide you with the best possible service. She is available not only for on-site visits, but also to:

- Provide information about new cardiovascular services, treatment options and clinical trials.
- Assess your needs and determine how we can best meet them.
- Share outreach opportunities from our clinical faculty.

Please contact Erika for answers to your questions or for additional information about our services. Call M-LINE **800-962-3555** or email **physicianliaisons@med.umich.edu**. Erika welcomes your feedback, which enables her to provide top-quality service that meets your needs.

Referring Physician Communications

Committed to Solid Partnerships

The U-M Frankel CVC is committed to creating a seamless communications system with you, our referring physicians. Our Attending Provider Communication Standards represents our strategic plan to ensure a solid partnership with you.

Michelle Donnelly, M.A.

Referring Physician Communication Specialist

Michelle coordinates efforts with attending physicians to provide you with efficient clinical updates regarding inpatient and outpatient care. Michelle works to:

- Identify and resolve any communication gaps and monitor systems to prevent them.
- Provide timely clinical updates regarding hospital-to-hospital transfers.
- Ensure appropriate flow of correspondence for all patients referred.

Please contact Michelle for answers to your questions or for additional information about our services. Call **734-232-4144** or email **RP_communications@med.umich.edu**. Michelle welcomes your feedback to help ensure exceptional service that meets your needs.

Patient and Family Centered Care

Improving Patient Care

The U-M Patient and Family Centered Care (PFCC) initiative works to remove the barriers between medical professionals and patients by truly valuing the concerns, opinions and voices of patients and their families. Our "Nothing about me, without me" slogan represents the guiding principle for patient-centered care throughout U-M, where PFCC programs act as forums for patients and families to share their personal experiences with faculty and staff.

Additionally, U-M has established numerous Patient and Family Advisory Councils (PFACs) throughout hospital departments, which are an integral part of our PFCC initiative.

For more information, call **734-232-4617**, email **cvc-pfcc-program@med.umich.edu** or visit **umcvc.org/patient-and-family-centered-care-program**.

M-LINE

M-LINE is a single, 24-hour, toll-free number for you, our referring physicians, and your staff seeking access to clinical services and faculty at U-M. The M-LINE staff works closely with personnel throughout U-M to provide efficient and personalized service.

To make a referral or speak with one of our specialists, contact M-LINE 24 hours a day, 7 days a week.

800-962-3555

For additional referral information, visit the Michigan Medicine Health Provider website:

med.umich.edu/umhs/health-providers

Clinical Physicians

Adult Cardiac Surgery
Steven F. Bolling, M.D.
G. Michael Deeb, M.D.
Jonathan W. Haft, M.D.
Karen M. Kim, M.D.
Francis D. Pagani, M.D., Ph.D.
Himanshu J. Patel, M.D.
Richard L. Prager, M.D.
Matthew A. Romano, M.D.
Paul C. Tang, M.D., Ph.D.
Bo Yang, M.D., Ph.D.

Adult Congenital Cardiology
Timothy B. Cotts, M.D.
Mark Norris, M.D.

Cardiovascular Anesthesiology
Matthew D. Caldwell, M.D.
Anna V. Dubovoy, M.D.
Timur Z. Dubovoy, M.D.
Neal Duggal, M.D.
Jordan Fenneman, M.D.
Ian Gannon, M.D.
Paul E. Kazanjian, M.D.
Michael Mathis, M.D.
Jesse Morrison, M.D.
Mukilan Muthiswami, M.D.
Erin E. Payne, M.D.
Stephanie Rayos, M.D.
Lauren Richey, M.D.
Jennifer Vance, M.D.
Bryant Wu, M.D.

* Emeritus Faculty

Cardiothoracic Imaging
Prachi Agarwal, M.D.
Anil Attili, M.D.
Nicole Bhave, M.D.
Nicholas Burris, M.D.
Aamer Chughtai, M.D.
Paul Cronin, M.D.
Adam Dorfman, M.D.
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Elizabeth Lee, M.D.
Jimmy C. Lu, M.D.
Venkatesh Murthy, M.D., Ph.D.
Smita Patel, M.D.
Perry Pernicano, M.D.
Leslie Quint, M.D.
Mohamed Sayyouh, M.D.
Jadranka Stojanovska, M.D.
Dharshan Vummidi, M.D.

Congenital Cardiac Surgery
Edward L. Bove, M.D.
Richard G. Ohye, M.D.
Jennifer C. Romano, M.D.
Peter Sassalos, M.D.
Ming-Sing Si, M.D.

Critical Care Faculty
Jehad I. Albataineh, M.D.
Ross Blank, M.D.
Adam Carter, M.D.
Murtaza Diwan, M.D.
Milo C. Engoren, M.D.
Lauren Faulk, M.D.
Baber Fiza, M.D.
Michael D. Maile, M.D.
Andrew Rosenberg, M.D.
Matthew Sigakis, M.D.
Brian J. Woodcock, M.D.

Echocardiography
William F. Armstrong, M.D.
David S. Bach, M.D.
Nicole M. Bhave, M.D.
Peter G. Hagan, M.D.
Adam S. Helms, M.D.
Theodore J. Kolias, M.D.
Troy M. LaBounty, M.D.
Maryse Palardy, M.D.
Sara Saberi, M.D.
Kenneth J. Tobin, D.O.
Elina Yamada, M.D.

Electrophysiology
Frank M. Bogun, M.D.
Aman Chugh, M.D.
Eugene Chung, M.D.
Thomas C. Crawford, M.D.
Ryan T. Cunnane, M.D.
Hamid Ghanbari, M.D.
Krit Jongnarangsin, M.D.
Rakesh Latchamsetty, M.D.
Fred Morady, M.D.
Hakan Oral, M.D.
Frank Pelosi Jr., M.D.
Mohammed Saeed, M.D.

General Cardiology
Geoffrey Barnes, M.D.
Mark R. Benson, M.D., Ph.D.
James B. Byrd, M.D.
Sunil K. Das, M.D.*
Melinda B. Davis, M.D.
Sharlene M. Day, M.D.
Kim A. Eagle, M.D.
Daniel T. Eitzman, M.D.
Peter M. Farrehi, M.D.
James B. Froehlich, M.D., M.P.H.
Santhi K. Ganesh, M.D.
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Elizabeth A. Jackson, M.D.
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Monika J. Leja, M.D.
Vallerie V. McLaughlin, M.D.
Venkatesh Murthy, M.D., Ph.D.
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Melvyn Rubenfire, M.D.

Marschall S. Runge, M.D., Ph.D.
Michael J. Shea, M.D.
Adam B. Stein, M.D.
Scott H. Visovatti, M.D.
Denis Weinberg, M.D.
Richard L. Weinberg, M.D., Ph.D.

Heart Failure/Transplant

Keith D. Aaronson, M.D.
Abbas Bitar, M.D.
Monica Colvin, M.D.
David Bradley Dyke, M.D.
Daniel R. Goldstein, M.D.
Reema Hasan, M.D.
Scott Hummel, M.D.
Todd M. Koelling, M.D.
Matthew Konerman, M.D.
John M. Nicklas, M.D.
Audrey H. Wu, M.D.

Hypertension

Robert D. Brook, M.D.
James B. Byrd, M.D.
Kenneth A. Jamerson, M.D.
Stevo Julius, M.D.*
Susan Steigerwalt, M.D.
Ralph Stern, M.D.*
Alan B. Weder, M.D.*

Interventional Cardiology

Eric R. Bates, M.D.
Stanley J. Chetcuti, M.D.
Claire S. Duvernoy, M.D.
P. Michael Grossman, M.D.
Hitinder S. Gurm, M.D.
Daniel S. Menees, M.D.
Brahmajee K. Nallamothu, M.D.
Nadia Sutton, M.D.
Michael Thomas, M.D.

Interventional Radiology

Jeffrey Chick, M.D.
Kyung Cho, M.D.*
Kyle Cooper, M.D.
Narasimham Dasika, M.D.
Joseph J. Gemmete, M.D.
Marcus Jarboe, MD.
Minhaj Khaja, M.D., M.B.A.
Venkataramu Krishnamurthy, M.D.
Bill Majdalany, M.D.
Wael A. Saad, M.D.
Mamadou L. Sanogo, M.D.
James J. Shields, M.D.
Ravi Srinivasa, M.D.
David M. Williams, M.D.
Sara Smolinski-Zhao, M.D.

Interventional Neuroradiology

Neeraj Chaudhary, M.D.
Joseph J. Gemmete, M.D.
Aditya S. Pandey, M.D. B.
Gregory Thompson, M.D.

Nuclear Cardiology

Richard Brown, M.D.
James Corbett, M.D.
Kirk Frey, M.D., Ph.D.
Venkatesh Murthy, M.D., Ph.D.
Morand Piert, M.D.
Richard L. Weinberg, M.D., Ph.D.

Stroke Neurology

Devin L. Brown, M.D., M.S.
James F. Burke, M.D., M.S.
Mollie McDermott, M.D.
Lewis B. Morgenstern, M.D.
Lesli E. Skolarus, M.D., M.S.
Michael M. Wang, M.D., Ph.D.
Darin B. Zahuranec, M.D., M.S.

Vascular Surgery

Ramon Berguer, M.D., Ph.D.*
Dawn M. Coleman, M.D.
Matthew A. Corriere, M.D.
Jonathan L. Eliason, M.D.
Katherine A. Gallagher, M.D.
Peter K. Henke, M.D.
Andrea T. Obi, M.D.
Nicholas H. Osborne, M.D., M.S.
James C. Stanley, M.D.*
Chandu Vemuri, M.D.
Thomas W. Wakefield, M.D.

Locations

1 Frankel Cardiovascular Center
1500 E. Medical Center Drive
Ann Arbor, MI 48109

2 Domino's Farms
4000 Ave Maria Drive
Lobby A, Suite 1300
Ann Arbor, MI 48106

3 Briarwood Health Associates
325 Briarwood Circle, Building 5
Ann Arbor, MI 48108

4 Brighton Health Center
8001 Challis Road
Brighton, MI 48116

5 Canton Health Center
1051 N. Canton Center Road
Canton, MI 48187

6 Chelsea Health Center
14700 E. Old US 12
Chelsea, MI 48118

7 Northville Health Center
39901 Traditions Drive
Northville, MI 48168

8 West Ann Arbor Health Center
380 Parkland Plaza
Ann Arbor, MI 48103

Additional Locations in Michigan

Grand Rapids
Mercy Health Physician Partners
Electrophysiology Clinic
Cardiothoracic Surgery
310 Lafayette SE, Suite 310
Grand Rapids, MI 49503

Midland
MidMichigan Health
Advanced Heart Failure Clinic
4011 Orchard Drive, Suite 1002
Midland, MI 48640

Muskegon
Mercy Health Physician Partners
Electrophysiology Clinic
1212 E. Sherman Blvd, Suite 2
Muskegon, MI 49444

Cardiothoracic Surgery
1560 E. Sherman Blvd., Suite 309
Muskegon, MI 49444

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Executive Vice President for Medical Affairs, Dean, University of Michigan Medical School, CEO, Michigan Medicine

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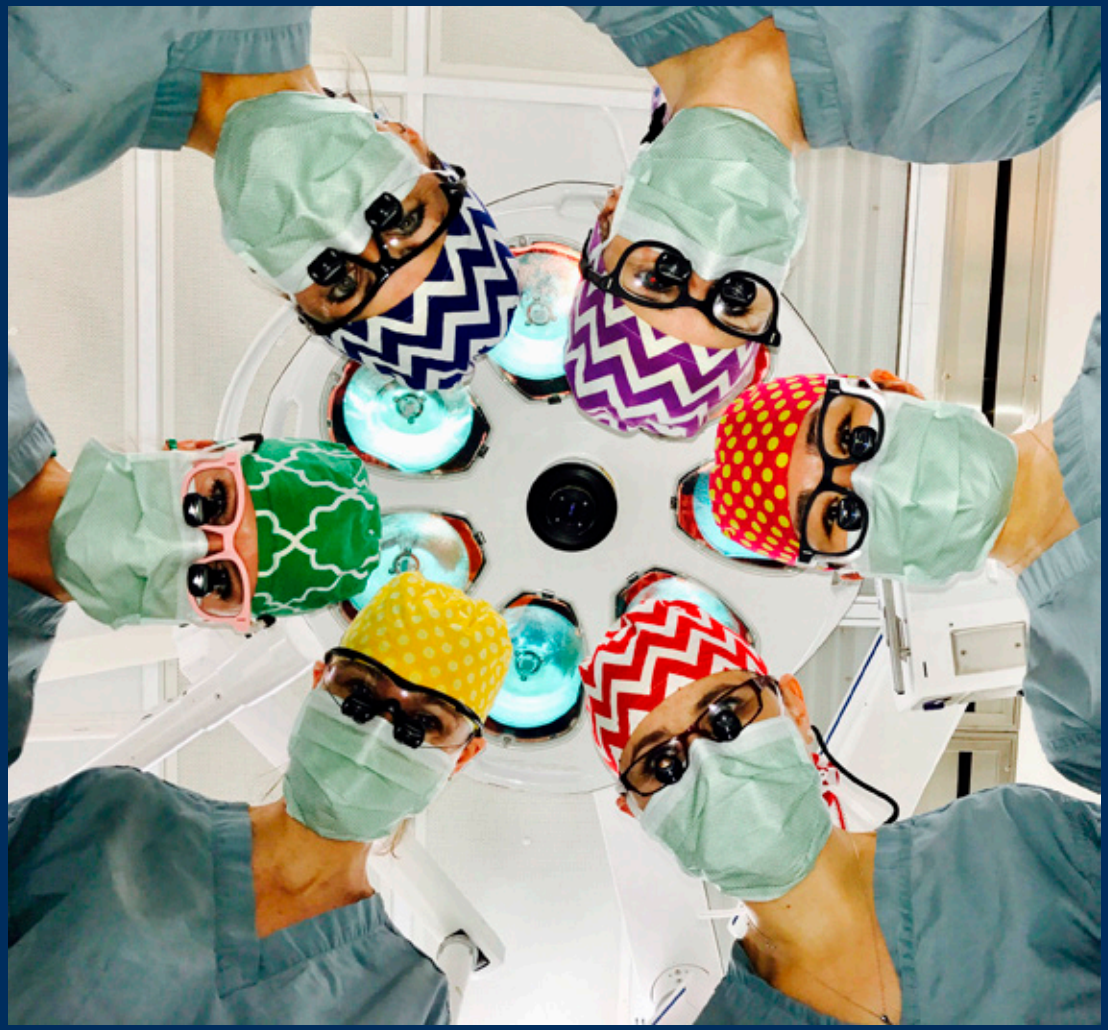
Dean, School of Nursing

The Regents of the University of Michigan

10/2017/10K



Female vascular surgeons at the Frankel Cardiovascular Center re-create the now iconic New Yorker cover to raise awareness of women in medicine.

SAMUEL AND JEAN
FRANKEL CARDIOVASCULAR CENTER
MICHIGAN MEDICINE

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