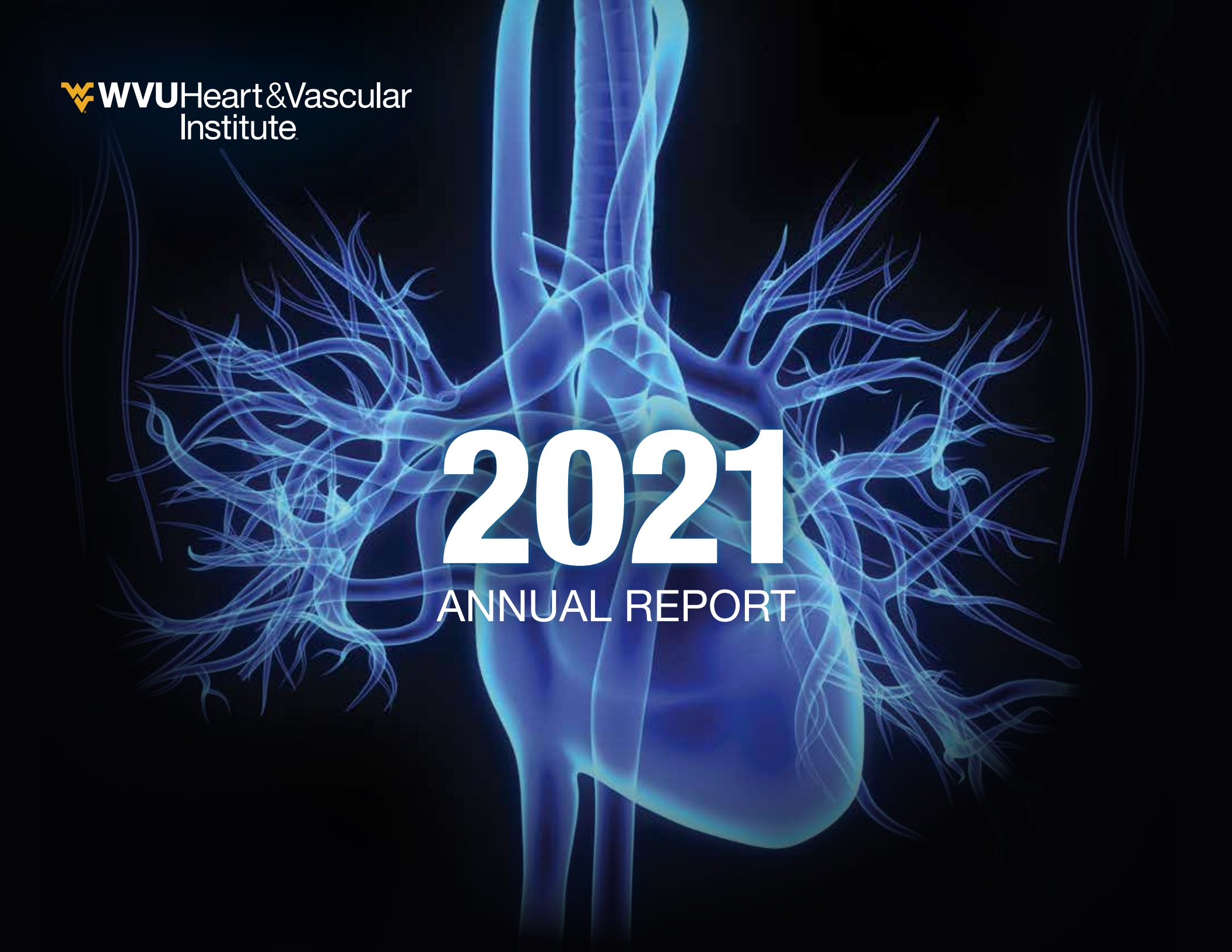
WVU Heart & Vascular Institute



2021

ANNUAL REPORT

CONTENTS

Message from the Chair

On behalf of the over 250 medical professionals and 1,300 dedicated staff who form the WVU Heart and Vascular Institute, it is my distinct privilege to share just a few of the many incredible achievements this devoted team has provided our state, region, and nation over this historic past year. Their accomplishments leave little doubt as to why WVU Medicine J.W. Ruby Memorial Hospital has been named the number one hospital in West Virginia by *U.S. News & World Report*, and why the WVU Heart and Vascular Institute, a national leader in heart, lung, and vascular care, is the state's number one ranked program for Cardiology, Heart Surgery, and Lung Surgery.

The WVU Heart and Vascular Institute has expanded from a three-hospital program in early 2017 to a dedicated cardiovascular service line that currently provides patient care in 28 locations in five states with additional locations planned for 2022. With the focused mission to provide the most advanced heart, lung, and vascular care available to all patients we serve, the WVU Heart and Vascular Institute, with its quaternary facility in Morgantown, WV, routinely cares for patients throughout West Virginia, Pennsylvania, Ohio, Maryland, and Virginia. Our teams now regularly welcome patients seeking our innovative therapies from multiple distant locations in North America, as well as from several countries around the world.

I am incredibly proud of our renowned multidisciplinary faculty who have collectively provided the state and region's leadership response to the pandemic, delivering the nation's highest survival rates following extracorporeal membrane oxygenation for COVID-19, while continuing to deliver innovative transcatheter valve therapy, robotic surgery, and transplantation. In addition to providing access to over 50 actively enrolling clinical trials, our faculty has provided academic leadership with over 700 peer-reviewed publications over the past five years, including funding from the National Institutes of Health, while inspiring teams of physicians from around the world who have come to WVU to learn our novel transcatheter and robotic techniques.

This report will outline several achievements by the WVU Heart and Vascular Institute, recognized by several organizations, including the American Heart Association, as West Virginia's number one institution focused on volume, innovation, and quality. Despite all of our innovations, our pandemic leadership, and national recognition, I remain most proud of how every member of our team cares for each patient as if they were family.

Vinay Badhwar, MD
Executive Chair

Distinctions and Recognitions

- *U.S. News & World Report* #1 in West Virginia: Cardiology, Heart Surgery, and Lung Surgery
- American Heart Association Mitral Valve Repair Center of Excellence National Reference Center
- ELSO Gold Center of Excellence for ECMO
- Three-star rating (highest) from the Society of Thoracic Surgeons for Esophageal Surgery Program
- World's first Robotic Aortic Valve Replacement Program
- IC-OS Gold Center of Excellence in Cardio-Oncology
- First in West Virginia
  - Transplant and LVAD, including First Dual Organ Transplant
  - Comprehensive Advanced Heart Failure Program
  - Center for Advanced Robotic Surgery (CARS)
  - Comprehensive Atrial Fibrillation Center
  - Comprehensive Aortic Program

HIGH PERFORMING HOSPITALS U.S.News & WORLD REPORT 2021-22
AORTIC VALVE SURGERY

HIGH PERFORMING HOSPITALS U.S.News & WORLD REPORT 2021-22
HEART FAILURE

HIGH PERFORMING HOSPITALS U.S.News & WORLD REPORT 2021-22
HEART BYPASS SURGERY

HIGH PERFORMING HOSPITALS U.S.News & WORLD REPORT 2021-22
HEART ATTACK

ELSO AWARD FOR EXCELLENCE IN LIFE SUPPORT CENTER OF EXCELLENCE GOLD

MITRAL VALVE REPAIR MITRAL FOUNDATION 2021 American Heart Association REFERENCE CENTER AWARD

THE SOCIETY OF THOMACIC SURGEONS Established 1964

2021 By the Numbers

339,581
Patient Visits

194,249
Cardiac Diagnostic Tests Performed

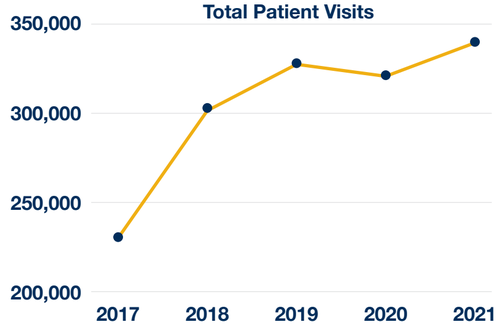
1,058
Open Heart Operations

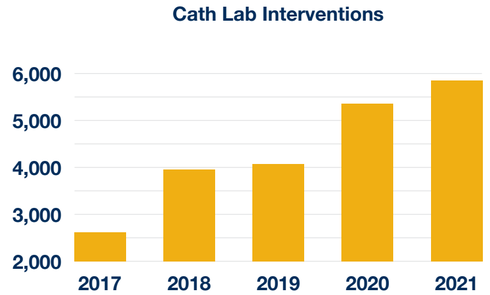
2,509
Thoracic Operations

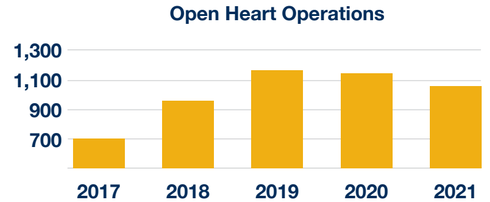
2,737
Vascular Operations

5,913
Cath Lab Procedures and Interventions

850
Electrophysiology Procedures







Division of Cardiology

Cardiologists at the WVU Heart and Vascular Institute are at the forefront of innovative therapies and technology. The WVU HVI remains a leader in the region with talented cardiologists and support staff adhering to proven protocols and standards of care to improve quality. Many patients considered too high risk elsewhere are referred to us. The WVU HVI Interventional Cardiology Program performs complex, high-risk percutaneous interventions using a variety of adjunct techniques, such as atherectomy, lithotripsy, and left ventricular assist devices, such as IABP, Impella, or ECMO. Through a statewide coordinated network, this superb team has achieved a significant reduction in stroke rates and mortality among patients with ST-elevation myocardial infarction (STEMI). “Heart attack patients across the region are provided state-of-the-art care that has resulted in a drop in cardiac mortality,” says **Bryan Raybuck, MD,** Director of the Cardiac Catheterization Laboratory.

The Section of Interventional Cardiology has several areas of expertise that include:

- Complex atherectomy
- Intravascular lithotripsy
- Alcohol septal ablation
- Chronic total occlusion treatment
- Use of transcatheter mechanical support devices to support heart function during high-risk percutaneous coronary interventions
- Coronary microvascular dysfunction detection

The WVU HVI Structural Heart Program specializes in problems with heart valves, walls, or chambers. We use the latest percutaneous catheter-based techniques to treat all forms of structural heart disease, including aortic and mitral valve disease, congenital defects, tricuspid valve regurgitation, as well as paravalvular leaks.

“At WVU HVI, patients are evaluated by a multidisciplinary care team focused on the best treatment options, the highest quality, and the best possible outcomes.”

— Ramesh Daggubati, MD
Chief, Cardiology
Director, Structural Heart Program

“We work closely with our surgical colleagues to offer the most advanced and innovative therapies to treat complex coronary and valvular heart disease, drawing also on our leadership in national clinical trials,” notes **Akram Kawsara, MD,** Associate Director of the Structural Heart Program.

The Section of Structural Cardiology regularly offers the following structural interventions:

- Transcatheter edge-to-edge mitral valve repair (MitraClip, NTR, XTR, G4)
- Transcatheter mitral valve replacement (Tendyne)
- Transcatheter aortic valve replacement (TAVR), including alternative access techniques
- Protected TAVR to avoid stroke using cerebral embolic protection
- Left atrial appendage closure (WATCHMAN, WATCHMAN FLX, and Amulet devices)
- Percutaneous balloon aortic and mitral valvuloplasty
- Multidisciplinary heart team access to novel Robotic Aortic Valve Replacement
- Transcatheter valve-in-valve therapies for degenerated mitral, aortic, and tricuspid valves
- Catheter-based closure of atrial and ventricular septal defects, pseudoaneurysms, and paravalvular leaks
- CardioMEMS device placement for patients with heart failure

WVU HVI non-invasive cardiologists quickly rose to prevailing demand and implemented new policies for cardiology imaging during COVID-19 surges. “Our research in cardiac MRI in young athletes who suffered from COVID-19 has shaped therapy across the nation,” says **Sudarshan Balla, MD,** Cardiology Fellowship Program Director. Several fellows who have graduated from our program have embarked on advanced training and stayed on to serve the population of West Virginia.

The Section of Advanced Cardiac Imaging regularly offers the following advanced diagnostic services:

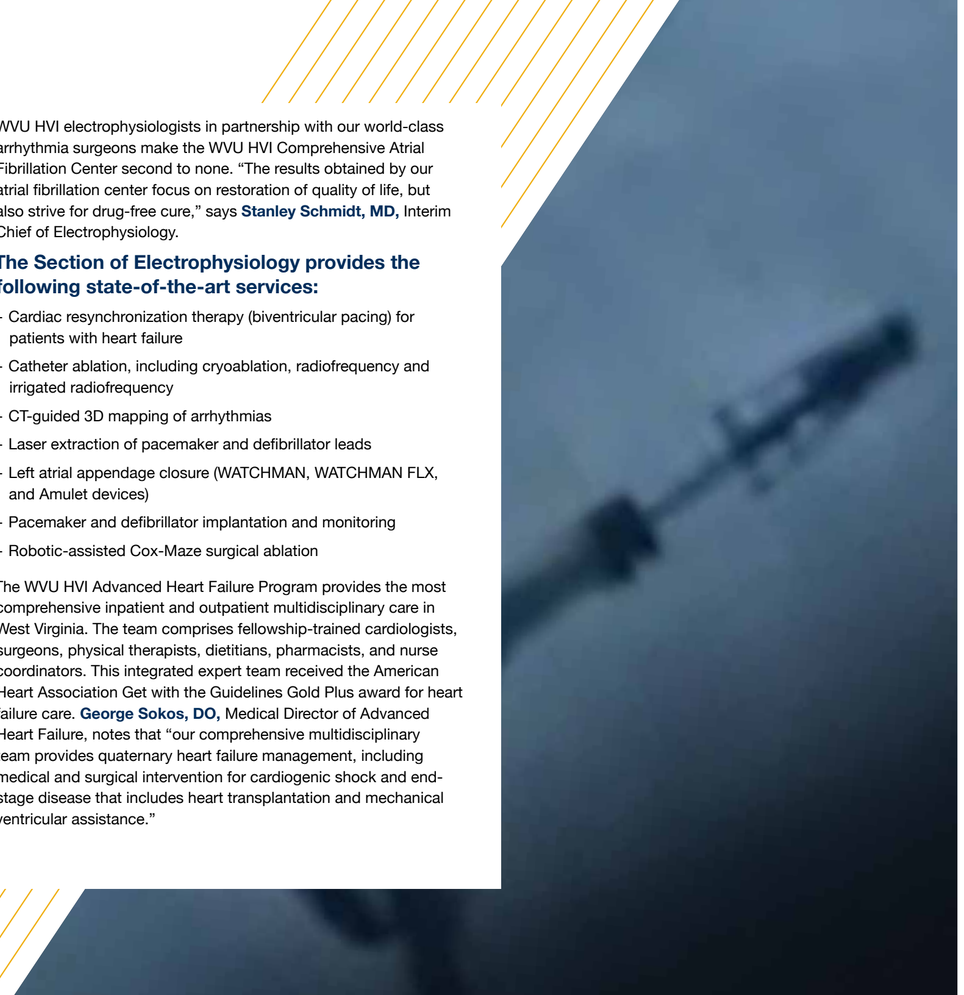
- Cardiac computed tomography (CT), including 3mensio, CT-guided fractional flow reserve for coronary blood flow, performing more than 1,200 studies annually
- Cardiac magnetic resonance imaging (MRI) for advanced quantitative perfusion mapping, tissue mapping, and quantification of four-dimensional flow is performed nearly 1,000 times annually
- Advanced echocardiography, including transesophageal echocardiography, strain echocardiography, and supine-bicycle stress echocardiography, was offered to 22,000 patients in 2021 at the Morgantown location alone – a 30 percent increase over the previous three years
- Advanced nuclear cardiology, including state of-the-art techniques for perfusion mapping, viability assessments, cardiac amyloidosis imaging, and cardiovascular inflammation imaging, was performed nearly 2,000 times in 2021
- The WVU HVI was first in the region to employ magnetocardiography (MCG) or CardioFlux, to quickly diagnose myocardial ischemia or infarction in patients with symptoms of acute coronary syndrome by imaging naturally generated magnetic fields within the heart without the use of radiation, medications, or exercise — in just 90 seconds

WVU HVI electrophysiologists in partnership with our world-class arrhythmia surgeons make the WVU HVI Comprehensive Atrial Fibrillation Center second to none. “The results obtained by our atrial fibrillation center focus on restoration of quality of life, but also strive for drug-free cure,” says **Stanley Schmidt, MD,** Interim Chief of Electrophysiology.

The Section of Electrophysiology provides the following state-of-the-art services:

- Cardiac resynchronization therapy (biventricular pacing) for patients with heart failure
- Catheter ablation, including cryoablation, radiofrequency and irrigated radiofrequency
- CT-guided 3D mapping of arrhythmias
- Laser extraction of pacemaker and defibrillator leads
- Left atrial appendage closure (WATCHMAN, WATCHMAN FLX, and Amulet devices)
- Pacemaker and defibrillator implantation and monitoring
- Robotic-assisted Cox-Maze surgical ablation

The WVU HVI Advanced Heart Failure Program provides the most comprehensive inpatient and outpatient multidisciplinary care in West Virginia. The team comprises fellowship-trained cardiologists, surgeons, physical therapists, dietitians, pharmacists, and nurse coordinators. This integrated expert team received the American Heart Association Get with the Guidelines Gold Plus award for heart failure care. **George Sokos, DO,** Medical Director of Advanced Heart Failure, notes that “our comprehensive multidisciplinary team provides quaternary heart failure management, including medical and surgical intervention for cardiogenic shock and end-stage disease that includes heart transplantation and mechanical ventricular assistance.”



The WVU HVI Advanced Heart Failure Program regularly provides the following services:

- Access to advanced heart failure therapeutics in clinical trials
- Heart transplantation management
- LVAD management as West Virginia’s only accredited LVAD program
- Temporary mechanical circulatory support for the treatment of cardiogenic shock
- Advanced Pulmonary Hypertension Program, including CTEPH
- Hypertrophic Cardiomyopathy Program
- Cardio-Oncology Program
- Multiple satellite clinics and telemedicine locations throughout West Virginia and surrounding states
- Remote CardioMEMS monitoring to quickly identify changes in pulmonary artery pressure
- Home infusions of inotropic therapy
- The state’s first-and-only site to implant the Barostim Neo — a breakthrough device using neuromodulation to improve the symptoms of patients with heart failure

The WVU HVI Cardio-Oncology Program was designated a Gold Center of Excellence, the highest possible designation, by the International Cardio-Oncology Society (IC-OS). “This national award recognizes the dedication of our team at WVU HVI to advancing specialized heart care for unique cancer patients,” **Christopher Bianco, DO**, Director of the program, said.

Through the WVU HVI Women’s Heart Program, board-certified cardiologists specialize in the diagnosis and management of heart care unique to women, including cardio-obstetrics, cardio-gynecology, and the management of peri-partum cardiomyopathy.

The WVU HVI Advanced Lipid Program was developed to serve as an advanced resource to overcome the gap between achieved and desired cholesterol levels through access to genetic testing for familial hypercholesterolemia and unique medical therapy, many of which are available through clinical trials. The program has treated more than 1,500 patients, facilitating approval of PCSK9 inhibitor therapy for more than 500 patients since the program’s recent inception. **Anthony Morise, MD,** Director of the program, notes that “advanced clinical lipidology is a key part of WVU HVI’s preventive cardiology program and an essential resource for our population in need.”

LVAD

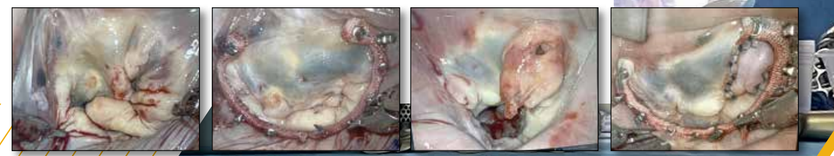
Division of Cardiac Surgery

The WVU HVI Division of Cardiac Surgery is recognized as one of the top programs in the nation and the best program in West Virginia by providing the highest quality and most advanced cardiac surgical and robotic therapies available. The Division performs more than 1,200 operations annually with unique specialization in aortic surgery, advanced heart failure therapies, and nationally recognized robotic cardiac surgery.

The WVU HVI Mitral Valve Repair Program is considered as one of the nation's best heart surgery programs for the management of mitral valve disease. The American Heart Association recognized the WVU HVI with the 2021 American Heart Association Mitral Valve Repair Reference Center Award for the second consecutive year since the award commenced in 2020. This prestigious honor is bestowed on only the highest-performing centers for volume, quality, and durability of mitral valve repair in the country. The WVU HVI program is recognized as one of the top 10 mitral programs in the United States.

The Division of Cardiac Surgery has accomplished many first operations for West Virginia, including heart transplantation, LVAD, and robotic surgery, and regularly performs the following advanced cardiac operations:

- Complex valvular reconstruction of regurgitant lesions, including mitral valve repair, tricuspid valve repair, and primary aortic valve repair facilitated by geometric ring annuloplasty or root remodeling
- Robotic mitral valve repair, tricuspid valve repair, including complex reconstruction
- Surgical treatment of atrial fibrillation, including robotic biatrial Cox-Maze operations
- Novel robotic aortic valve replacement with either mechanical or bioprostheses
- Complex aortic aneurysm repair, including hybrid arch reconstruction, debranching, and frozen elephant trunk therapy
- Coronary artery bypass grafting (CABG), including robotic minimally invasive CABG
- Surgical myectomy for hypertrophic cardiomyopathy
- Orthotopic heart transplantation
- Mechanical circulatory support, LVAD
- Congenital heart surgery from neonatal to adult congenital



The WVU HVI Robotic Cardiac Surgery Program and the WVU Center for Advanced Robotic Surgery are recognized by the Society of Thoracic Surgeons and the American Association for Thoracic Surgery as a premier destination for advanced techniques and robotic training. Multiple surgical teams have come to the WVU HVI to observe advance techniques and receive training. The WVU HVI has proctored and helped to launch several programs around the world. These include Yale University's New Haven Hospital, Harvard University's Massachusetts General Hospital, and King Faisal Medical Center in Riyadh, Saudi Arabia, to name just a few.

In 2020, the WVU HVI developed and implemented a uniquely novel approach to aortic valve replacement to be performed completely robotically. Robotic aortic valve replacement, or RAVR, is now routinely performed at the WVU HVI. While the HVI is still the most experienced RAVR program in the world, several programs in North and South America have now started to perform the procedure as an alternative to TAVR. Currently, the WVU HVI routinely performs robotic cardiac operations on multiple valves, including several concomitant operations including surgical ablation of atrial fibrillation.

The WVU HVI Aortic Valve Repair Program has pioneered new approaches to the repair of leaking aortic valves as an alternative to replacement. In 2017, the first repair cases in both tricuspid and bicuspid aortic valves in the United States were performed at the WVU HVI using a novel geometric ring annuloplasty technique. Since the program's launch at WVU, more than 1,200 operations have been performed worldwide with superb results. Primary aortic valve repair is now offered as the preferred routine option for aortic valve insufficiency at the WVU HVI.

Over the past five years, the Division of Cardiac Surgery has excelled academically with more than 250 peer-reviewed publications in top tier journals, including the *New England Journal of Medicine, Lancet, JAMA, Circulation, Journal of Thoracic and Cardiovascular Surgery,* and *Annals of Thoracic Surgery*. The Division has been recognized by receiving grant support from the National Institutes of Health National Heart, Lung, and Blood Institute. The WVU HVI is the only center in the multistate region with unique access to multiple novel clinical trials in the treatment of cardiovascular disease. These include trials to explore transcatheter or surgical repair of mitral insufficiency, transcatheter treatment of high-risk patients with mitral valve disease, optimal anticoagulation for postoperative atrial fibrillation, and multiple novel monoclonal therapies for COVID-19 through Operation Warp Speed. Our surgeons hold numerous editorial board appointments and senior national leadership responsibilities in the American Association for Thoracic Surgery and the Society of Thoracic Surgeons.

The Department of Cardiovascular and Thoracic Surgery is exceedingly proud of its CT Surgery Fellowship Program. The education of the next generation of cardiothoracic surgeons is a top priority at the WVU HVI. Since its launch in 2017, the HVI has successfully matched their top selections from across the nation every year. The CT surgery fellows are exposed to a multitude of exemplary technical and academic opportunities, and all have advanced on to excellent cardiothoracic faculty positions around the United States.

Division of Pediatric Cardiothoracic Surgery

Congenital heart disease is the most common birth defect. Many of the most serious heart lesions are fatal during infancy without intervention. Other defects may compromise quality of life and longevity. The WVU HVI Division of Pediatric Cardiothoracic Surgery and WVU Medicine Children's Heart Center offer comprehensive care for congenital heart disease from fetal life through adulthood. Some congenital cardiac defects require intervention in the first week of life, and others need intervention later in infancy. Most heart defects require long-term follow-up into the teenage years and beyond, and the Children's Heart Center has specialists to provide this lifelong care.

The WVU Medicine Children's Heart Center has dedicated specialists in the following disciplines:

- Pediatric cardiothoracic surgery
- Pediatric cardiology (including interventional cardiology, electrophysiology, fetal cardiology, adult congenital cardiology, and advanced cardiac imaging)
- Pediatric cardiac intensive care
- Pediatric cardiac anesthesiology

Some of the services offered include:

- Surgical intervention for complex congenital heart disease, including neonatal cardiac surgery such as stage 1 Norwood for single ventricles
- Transcatheter pulmonary valve implantation and PDA occlusion
- Ablation for arrhythmias
- Fetal echocardiography
- Adult congenital cardiology
- Cardiac surgery
- Cardiac MRI and cardiac CT

"The WVU HVI Division of Pediatric Cardiothoracic Surgery and the WVU Medicine Children's Heart Center serve as a destination full-service quaternary care program for congenital heart disease for the children of West Virginia and the surrounding regions."

— Christopher Mascio, MD
Chief, Pediatric Cardiothoracic Surgery
Executive Director, WVU Medicine Children's Heart Center

Division of Thoracic Surgery

The Thoracic and Esophageal Surgery Program at the WVU HVI has received critical acclaim and is ranked among the best in the nation. It is one of the few programs in the United States to receive the highest three-star rating from the Society of Thoracic Surgeons for quality and outcomes following esophagectomy. The surgeons of the Division have expertise in a variety of innovative procedures like POEM for achalasia and Zenker's diverticulum, transoral incisionless fundoplication for gastroesophageal reflux, and various robotic procedures for management of benign esophageal conditions. In addition to esophageal surgery expertise, the WVU thoracic team was named to the 2021-2022 *U.S. News & World Report's* Best Hospitals list as high performing in lung surgery. The Division services a comprehensive and high-quality thoracic oncology program emphasizing multidisciplinary and minimally invasive approaches for complex thoracic malignancies, including a robust robotic surgery program. "At the WVU HVI, we have the expertise and the technology necessary to help patients survive cancer by providing access to the most advanced therapies available," **Ghulam Abbas, MD,** Chief of Thoracic Surgery, says.

WVU HVI thoracic surgical experts offer one of the few national destinations for advanced lung and airway disorders, including complex tracheal reconstruction and extended lung resection following chemotherapy and radiation therapy, as well as options for sleeve resections to minimize the need for pneumonectomy. The Center also provides innovative options, such as hyperthermic chemoperfusion therapy and radical pleurectomy, in the treatment of mesothelioma.

The WVU HVI Division of Thoracic Surgery routinely performs advanced procedures including:

- Complex lung and airway surgery, including sleeve resection and tracheal reconstruction
- Robotic pneumonectomy, lobectomy, or segmentectomy for lung cancer
- Robotic esophagectomy
- Robotic surgery for benign esophageal conditions
- Robotic thymectomy for myasthenia gravis or thymoma
- Robotic first rib resection for thoracic outlet syndrome

Division of Vascular and Endovascular Surgery

The Division of Vascular and Endovascular Surgery provides the safest, highest quality vascular therapies available. The Division has expanded its full-time services from its quaternary flagship location in Morgantown to Wheeling, Parkersburg, and Martinsburg, WV. Additional sites of care include Keyser, Fairmont, Elkins, and Glen Dale, WV, as well as Oakland, MD, and Uniontown and Waynesburg, PA.

Through leadership in the Vascular Quality Initiative (VQI) of the Society of Vascular Surgery (SVS), the WVU HVI Division of Vascular and Endovascular Surgery facilitates the transparent statewide compilation, sharing, and analysis of de-identified information and serves as a beacon for quality outcomes. This leadership allows comparisons between programs and the development of quality improvement initiatives that continually enhance patient care. “We seek to provide evidence-based care that meets patients’ needs and continuously work to improve the treatments we offer,” **Luke Marone, MD,** Chief of Vascular and Endovascular Surgery, says. ”Our research, as well as our involvement in organizations like The Virginias Vascular Study Group, makes this possible,” notes **Samantha Minc, MD,** WVU HVI Vascular Surgeon and Co-Director of the Virginias Vascular Study Group.

The WVU HVI team also participates in a multiregional effort to improve adherence to guidelines for repairing abdominal aortic aneurysms (AAA). In the quantification of cost effectiveness, the Division contributes data in a multicenter study designed to develop and validate a tool to measure the quality of life in AAA patients. “Surveillance is often the initial treatment for people diagnosed with an abdominal aortic aneurysm,” Dr. Marone, an investigator in the study, stated. Researchers developed questions to measure the emotional impact of an AAA diagnosis to better understand how the diagnosis affects behavior. Roughly two-thirds of the 1,300 responding participants had undergone AAA repair, while one-third remained under surveillance. Researchers discovered that, in general, quality of life, measured by both emotional impact and behavior change, was lower for those under aneurysm surveillance than for patients who had undergone repair. Patients with a higher perceived rupture risk were also reported to have a deteriorating quality of life.

The HVI Division of Vascular and Endovascular Surgery has published its outcomes and research in the *European Journal of Vascular & Endovascular Surgery*, the *Journal of Vascular Surgery,* and the *Journal of Thoracic and Cardiovascular Surgery*. It has made national contributions in the mitigation of limb threatening vascular conditions in vulnerable populations. It has pioneered the use of fenestrated endografts that have revolutionized the treatment and management of patients with juxtarenal aortic aneurysms, thus decreasing the morbidity of disease and mitigating the burden of hospitalization. These procedures are now performed as a matter of routine using peripheral access alone and obviating the need for large incisions and complicated extended length of stay.

Vascular care at the WVU HVI is augmented by our world-class ICVL-certified vascular labs, which perform more than 22,000 studies annually. Our ability to provide same-day access to these studies creates ease for patients to achieve diagnosis in a noninvasive manner at the time of their initial hospital visit.

The WVU Division of Vascular and Endovascular Surgery has a clinical focus in several areas, including:

- Limb preservation for critical limb ischemia utilizing minimally invasive revascularization
- Stroke prevention in the setting of carotid stenosis utilizing transfemoral carotid stenting and traditional carotid endarterectomy, performed as part of the only comprehensive stroke care program in the region
- Treatment of complex aortic disease (thoracoabdominal aneurysm and dissection) collaborating with our cardiac surgical colleagues utilizing endovascular, hybrid, and traditional open surgical techniques

“We seek to provide evidence-based care that meets the patients’ needs and continuously work to improve the treatments we offer.”

— Luke Marone, MD
Chief, Vascular and Endovascular Surgery

Division of Cardiovascular Critical Care and ECMO Program

The WVU Heart and Vascular Institute's 28-bed Cardiovascular Intensive Care Unit (CVICU) provides care to critically ill adult cardiovascular and thoracic patients. Care is rendered in a multidisciplinary format, with providers from several specialties working in collaboration with dedicated cardiovascular critical care intensivists. The unit is staffed 24 hours a day with intensivists and advanced practice providers. The CVICU provides the highest-quality quaternary care available in West Virginia and surrounding regions in a patient-family centered model. Services provided in the CVICU include cardiopulmonary support using devices such as ventricular assist devices and extracorporeal membrane oxygenation (ECMO), along with mechanical ventilation, continuous renal replacement therapies, and a variety of other technologies to support critically ill patients with cardiac, pulmonary, and multi-organ failure. The team cares for patients with conditions ranging from myocardial infarctions, cardiac arrest, and heart failure to post-operative care and transplantation.

The CVICU and the cardiovascular critical care team had a busy year in 2021, as the unit was the premier quaternary institution leading the response to the pandemic in West Virginia. The team of intensivists, advanced practice providers, nurses, respiratory therapists, and ancillary staff worked tirelessly together to meet the challenges of the COVID-19 pandemic. In 2021, the CVICU enthusiastically embraced our motto of "we are here to help" and has continued to care for cardiovascular, thoracic, and ECMO patients; those with respiratory failure due to COVID-19; and other critically ill patients. The CVICU cared for more than 500 patients in 2021, including the care of transplant patients and the first dual organ (heart-kidney) transplant in West Virginia.

Based on case-mix index, the WVU HVI CVICU cares for the highest-acuity patients in West Virginia.

"The outstanding team in the WVU HVI CVICU considers it an honor and privilege to provide access to the highest quality critical care services to the patients and families of West Virginia,"

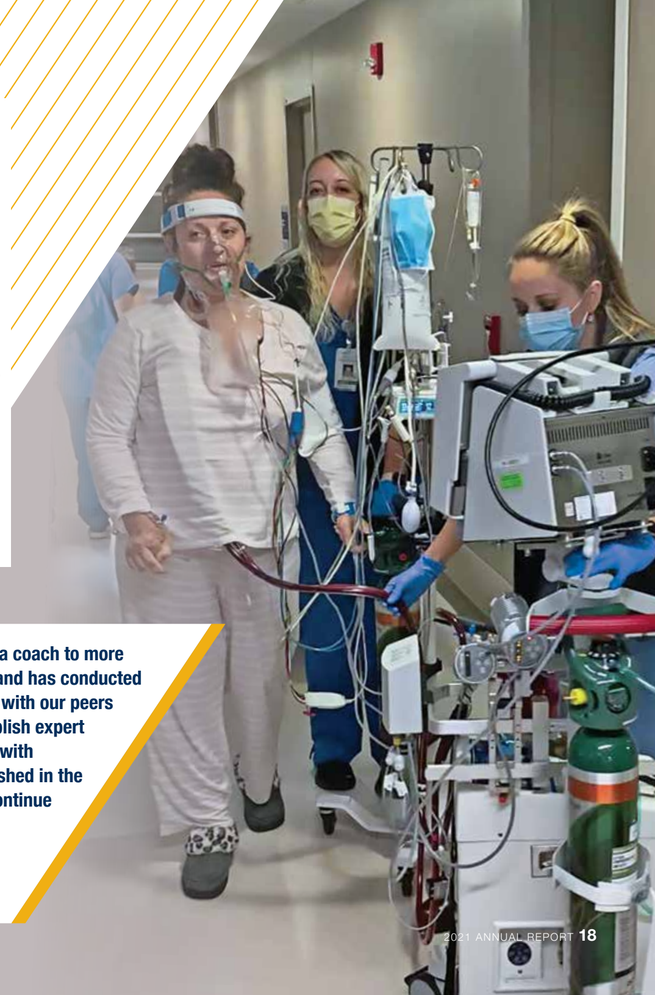
— Paul McCarthy, MD
Chief, Cardiovasular Critical Care, WVU HVI

In 2021, the Division was an active participant in clinical research. In addition to novel machine learning investigations to improve outcomes, the team participated in the ACTIV-3 trial program for COVID-19 through Operation Warp Speed and the NIH, acute kidney injury trials, and provided support for patients in cardiology and cardiac surgical trials. The Division is actively involved in education, and its faculty regularly participate in numerous educational activities. Currently, residents and fellows from several training programs rotate in the CVICU, and Division faculty regularly provide clinical peer-to-peer mentorship to hospitals throughout WVU Medicine.

The nation-leading WVU HVI ECMO program was awarded the Extracorporeal Life Support Organization (ELSO) Gold Level Center of Excellence Award for the second year in a row in recognition of exceptional commitment to evidence-based processes and quality measures, staff training, continuing education, patient satisfaction, and ongoing clinical care. The ECMO program has grown at an annual rate of 55 percent while maintaining excellent outcomes. The Program is founded on a multidisciplinary, multispecialty stakeholder alliance that has maintained a survival rate that is greater than 2.5 standard deviations above international benchmarks through the course of the global pandemic. The WVU HVI continues to be an important and life-saving destination for patients within the region. In recognition of the outstanding results, the program received a state grant to allow an expansion in capacity.

This expansion will allow the WVU HVI to offer both venovenous (VV) ECMO and venoarterial (VA) ECMO to a larger number of patients and alleviate suffering from severe cardiac or pulmonary failure secondary to:

- Cardiogenic shock
- Heart failure (bridge to transplant)
- Myocarditis
- Nonischemic cardiomyopathy
- Post-cardiotomy support
- New threats, such as e-cigarette and vaping-related lung injury (EVALI)
- Respiratory failure secondary to COVID-19



"Our multidisciplinary ECMO team is privileged to serve as a coach to more than 45 institutions around the United States and Canada and has conducted numerous webinars in this regard, sharing our experience with our peers to elevate the quality of ECMO care. We were invited to publish expert recommendations for management of severely ill patients with COVID-19 who require mechanical support. This was published in the *Journal of Cardiovascular and Thoracic Surgery*, and we continue to have the highest survival rate in the United States."

— J.W. Awori Hayanga, MD, MPH
Director, ECMO Program

Division of Research

The WVU HVI Division of Research is the academic epicenter for the faculty, residents, fellows, and their collaborators. The WVU HVI team of biostatisticians, research coordinators, and regulatory personnel support the investigators and the intricacies of more than 50 cutting-edge, sponsored clinical trials and a multitude of clinical research initiatives. This robust infrastructure has allowed the WVU HVI to offer the people of West Virginia the very latest in therapeutics. In 2021, the pandemic placed the WVU HVI at the forefront of disaster planning and mitigation. The WVU HVI is now one of a few enrolling sites for the NIH-sponsored ACTIV-3 and TESICO trials evaluating the clinical efficacy of novel monoclonal antibodies in the treatment of severe COVID-19 acute respiratory syndrome.

The WVU HVI continues to be a top contributor, and routinely leads national lists of high enrollment centers in several other cardiac trials, including the NIH NHLBI Cardiothoracic Surgery Network.

"By consolidating our research infrastructure beneath a single banner, we can optimize our efforts to achieve the best results. To date, our faculty have published over 700 articles in peer-reviewed literature and contributed to the articulation of several expert consensus documents and clinical practice guidelines."

— J.W. Awori Hayanga, MD, MPH
Medical Director, HVI Division of Research

ACTIVE CLINICAL TRIALS

ACTIV-3	**NIH**	monoclonal therapy for COVID-19
ACTIV-3B	**NIH**	therapeutics for severely ill patients with COVID-19 (TESICO)
A-DUE	**JANSSEN**	pulmonary hypertension management
ALLEVIATE AF	**MEDTRONIC**	use of LINQ sensors to monitor and treat heart failure
Balance	**IONIS**	FCS lipid therapy trial
DyeMINISH	**OSPREY**	minimization of contrast dye use
EBO5	**NIH/EDESA**	monoclonal therapy for COVID-19
FCS PR	**AKCEA**	lipid and triglyceride lowering trial
HAART	**BIOSTABLE**	geometric ring annuloplasty for aortic valve repair
ICE-AF	**ATRICURE**	surgical treatment of atrial fibrillation
I-SPY	**QUANTUM LEAP**	reduce mortality and ventilator requirements for COVID-19 patients
Lower	**AEGERION**	lipid lowering clinical trial
OPTIMAL	**NIH/NHLBI**	optimal postoperative antibiotic therapy in IVDA endocarditis
PACeS	**NIH/CTSN**	postoperative atrial fibrillation management
Proactive HF	**ENDOTRONIX**	pulmonary artery pressure monitoring for heart failure
PRIMARY	**NIH/CTSN**	percutaneous or surgical mitral valve repair
REPAIR-MR	**ABBOTT**	transcatheter vs. surgical mitral valve repair
SMART	**MEDTRONIC**	self-expanding vs. balloon-expandable TAVR
STEMI-DTU	**ABIOMED**	unloading during myocardial infarction
SUMMIT	**ABBOTT**	transcatheter mitral valve replacement vs. repair
WARRIOR	**UNIVERSITY OF FLORIDA**	Women's Ischemia Trial – reduce events in non-obstructive CAD

EDUCATION AND FELLOWSHIPS

The expertise, academic leadership, research, and mentorship of the WVU HVI faculty afford the opportunity and responsibility of several Accreditation Council for Graduate Medical Education (ACGME) fellowships and non-ACGME subspecialty fellowships offered at the WVU HVI that include:

- **Cardiac Anesthesiology Fellowship**
- **Cardiovascular Diseases (Cardiology) Fellowship**
- **Advanced cardiac imaging post-graduate fellowship**
- **Advanced cardiac imaging post-graduate fellowship**
- **Interventional Cardiology Fellowship**
- **Structural Cardiology Fellowship**
- **Cardiothoracic Surgery Fellowship**
- **Advanced minimally invasive and robotics cardiac surgery post-graduate fellowship**
- **Vascular Surgery Fellowship**
- **Cardiovascular Critical Care Fellowship ***
- **Advanced Heart Fellowship ***

***coming soon**

MAIN LOCATIONS AND FACILITIES

MAIN CAMPUS

1. **J.W. RUBY MEMORIAL HOSPITAL**
   Morgantown, WV | 877-988-4478
   Cardiology, Vascular, Thoracic, and Cardiac Surgery

CENTRAL REGION

2. **GARRETT REGIONAL MEDICAL CENTER**
   Oakland, MD | 844-424-0411
   Cardiology, Thoracic, and Vascular
3. **GRANT MEMORIAL HOSPITAL**
   Petersburg, WV | 304-257-4331
   Cardiology Telemedicine
4. **POTOMAC VALLEY HOSPITAL**
   Keyser, WV | 304-597-3790
   Cardiology and Vascular
5. **SCOTTDALE, PA**
   844-484-0300
   Cardiology
6. **UNIONTOWN HOSPITAL**
   Uniontown, PA | 724-430-5600
   Cardiology and Vascular Surgery
7. **WAYNESBURG, PA**
   855-WVU-CARE
   Cardiology and Vascular

NORTH REGION

8. **NEW MARTINSVILLE, WV**
   304-815-0050
   Cardiology
9. **MARTINS FERRY, OH**
   304-242-4800
   Cardiology
10. **REYNOLDS MEMORIAL HOSPITAL**
    Glen Dale, WV | 304-845-0100
    Cardiology, Thoracic Surgery, and Vascular Surgery
11. **ST. CLAIRSVILLE, OH**
    304-242-4800
    Cardiology
12. **WHEELING, WV**
    304-242-4800
    Cardiology
13. **WHEELING HOSPITAL**
    Wheeling, WV | 304-242-4800
    Cardiology, Vascular, Thoracic, and Cardiac Surgery
14. **TRIADELPHIA, WV**
    304-285-1996
    Cardiology, Thoracic, and Vascular Surgery

WEST REGION

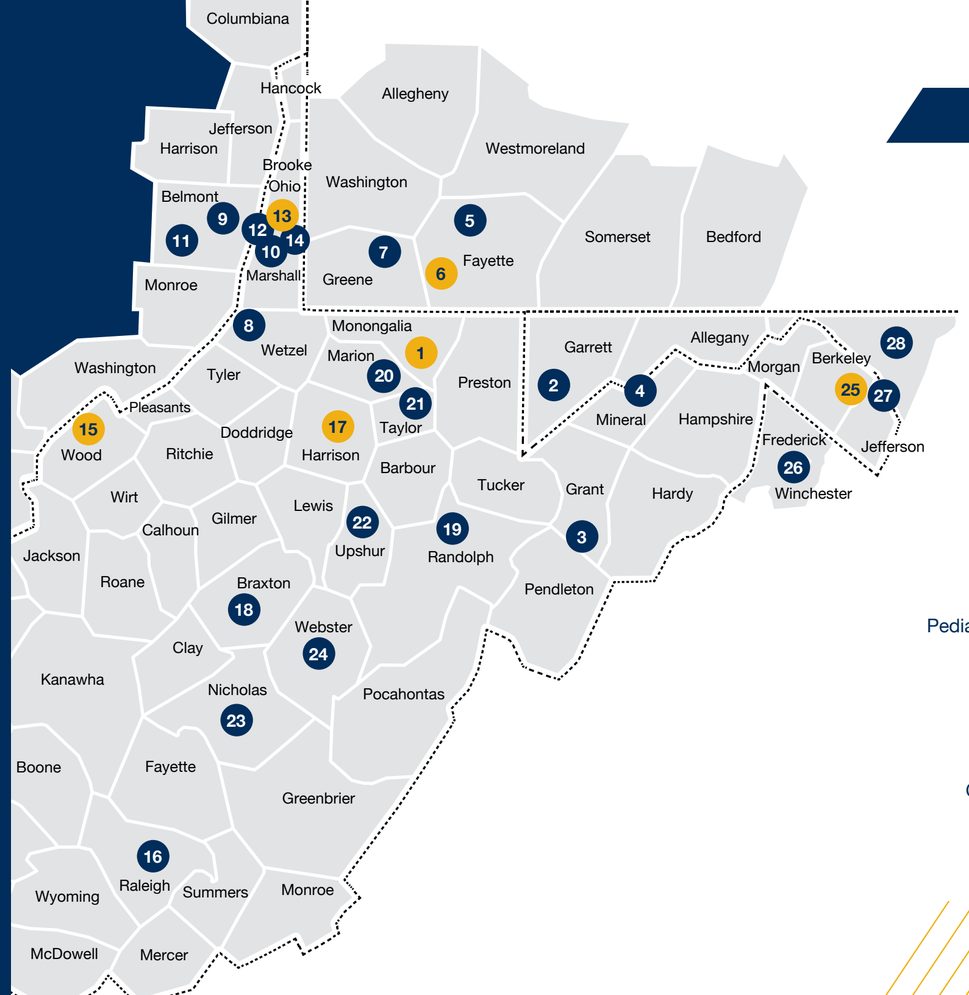
15. **CAMDEN CLARK MEDICAL CENTER**
    Parkersburg, WV | 304-424-4760
    Cardiac Surgery, Thoracic Surgery, and Vascular Surgery
16. **BECKLEY, WV**
    304-424-4760
    Cardiac Surgery

SOUTH REGION

17. **UNITED HOSPITAL CENTER**
    Bridgeport, WV | 304-842-0007
    Cardiology and Thoracic Surgery
18. **BRAXTON COUNTY MEMORIAL HOSPITAL**
    Gassaway, WV | 304-364-5156
    Cardiology
19. **DAVIS MEDICAL CENTER**
    Elkins, WV | 304-637-3897
    Cardiology, Thoracic, and Vascular
20. **FAIRMONT MEDICAL CENTER**
    Fairmont, WV | 304-974-3297
    Cardiology and Vascular
21. **PINEWOOD MEDICAL CENTER**
    Grafton, WV | 304-842-0007
    Cardiology and Vascular
22. **ST. JOSEPH'S HOSPITAL**
    Buckhannon, WV | 304-460-7979
    Cardiology
23. **SUMMERSVILLE REGIONAL MEDICAL CENTER**
    Summersville, WV | 304-872-8444
    Cardiology
24. **WEBSTER COUNTY MEMORIAL HOSPITAL**
    Webster Springs, WV | 304-847-5682
    Telecardiology

EAST REGION

25. **BERKELEY MEDICAL CENTER**
    Martinsburg, WV
    Cardiology: 304-350-3273
    Thoracic: 304-596-2861
    Cardiology, Thoracic, and Vascular Surgery
26. **WINCHESTER, VA**
    540-535-0000
    Cardiology
27. **SHEPHERDSTOWN, WV**
    304-596-2861
    Cardiology
28. **HAGERSTOWN, MD**
    304-596-2861
    Cardiology



Leadership

Vinay Badhwar, MD
Executive Chair

Frank Briggs
Vice President

Leslie Lawson
Assistant Vice President

Ramesh Daggubati, MD
Cardiology

Luke Marone, MD
Vascular Surgery

Chris Mascio, MD
Pediatric Cardiothoracic Surgery

Ghulam Abbas, MD
Thoracic Surgery

Paul McCarthy, MD
Cardiovascular Critical Care

J.W. Awori Hayanga, MD
Research

WVU Heart & Vascular Institute

1 Medical Center Drive
Morgantown, WV 26506

WVUMedicine.org/Heart
855-WVU-CARE