

INOVA HEART AND VASCULAR INSTITUTE



2022

OUTCOMES REPORT



INOVA[®]

Heart and Vascular Institute

Our Mission



Across Inova, we strive to fulfill our mission of providing world-class healthcare – every time, every touch – to each person in every community we have the privilege to serve.

Nowhere is that more evident than at Inova Heart and Vascular Institute (IHVI), where the commitment to excellence and strong teamwork continues to yield exceptional results. This drive for clinical excellence is made possible by highly skilled clinicians and other team members with a passion to create exceptional patient experiences and improve patient outcomes for those with complex heart, vascular and pulmonary diseases.

J. Stephen Jones, MD, MBA, FACS
President and CEO, Inova

Commitment to Excellence – A Focus on Multidisciplinary Care and Evidence-Based Best Practices

2022 was another challenging year in healthcare, yet IHVI continued to provide world-class care through a commitment to excellence and a focus on implementing evidence-based best practices across all Inova hospitals and sites of care.

Our patient volume and acuity remain extremely high, and that has added to the intensity and pressure to sustain positive outcomes. Fortunately, Inova places a high priority on the contributions and wellbeing of all team members. This has enhanced communication and respect among our team members and has created an environment of trust, allowing us to explore questions around effectiveness that have sparked further innovation in our care models.

Our “One Team” approach is centered around the use of integrated, multidisciplinary teams that incorporate expertise from a variety of medical specialists and practitioners. The perspective gained by using an integrated care model helps identify risk factors and address the diagnostic and treatment complexities that affect care delivery decisions.

In this year’s report, we share some of our proudest accomplishments. One of the major highlights has been the strengthening of community partnerships, with hospitals throughout the region using our care model for treating cardiogenic shock. Inova has provided a blueprint for excellence that has had an impact throughout the Washington, DC, region, nationally, and internationally.

We also showcase several recent innovations in our cardiac surgery program. These include the use of robotic-assisted, minimally invasive techniques that allow us to offer bypass surgery to patients including those who would not otherwise have been surgical candidates and our team’s expertise in using multiarterial grafts – a technique with better long-term survival rates compared with a single arterial graft.

Improvements in care delivery are also evident in our approach to managing and treating heart failure. Our urgent access clinics have reduced hospitalizations and improved care by offering timely assessment and treatment on an outpatient basis for patients with symptoms of decompensation. Our team is also piloting a clinical trial to test the effectiveness of using messages within Epic to prompt clinicians across Inova hospitals and outpatient care sites to follow best practices and use guideline-directed medical therapies for chronic heart failure patients.

We are enormously proud of the outstanding achievements of our medical, nursing and professional staff. They are second to none, and we applaud their resilience, determination and dedication to excellence.

We also wish to thank all the physicians who entrust their patients’ care to us and work in partnership with us in caring for them, as well as the patients who choose us for their care. We value your partnership as we work together to help everyone in our community and beyond live strong, healthy and fulfilling lives.



Christopher M. O’Connor, MD, MACC, FESC, FHFSA, FHFA
President
Inova Heart and Vascular Institute



Andrew Gill
Vice President and Administrator
Inova Heart and Vascular Institute



Francine Barr, DNP, RN
Vice President of Nursing
Inova Heart and Vascular Institute



Highlighting Multidisciplinary Care Teams
This symbol is used throughout the report to highlight programs utilizing multidisciplinary care teams.



About IHVI 2022

Our clinical capabilities cover the full spectrum of complex cardiovascular and advanced lung disease, from medical evaluation and diagnostic testing through the most innovative minimally invasive surgical techniques and complex open surgeries, including heart and lung transplantation.



733,390 total patient encounters

7 cardiovascular and hybrid operating rooms

25 catheterization, EP and IR labs

209 dedicated cardiac beds

5 hospitals

50+ Inova physician practice locations and specialty program sites with over **629,500** patient visits

20 noninvasive cardiac and vascular imaging and diagnostic service sites

Patients treated from **48** states and **7** territories, countries or armed forces locations worldwide



Inova Heart and Vascular Institute – Inova Fairfax Medical Campus

3300 Gallows Rd.
Falls Church, VA 22042

Located just outside of Washington, DC, in Falls Church, VA, Inova Fairfax Medical Campus is home to IHVI’s dedicated heart hospital which serves as the hub of the system’s cardiac, vascular and advanced lung disease services.

Centers for Medicare and Medicaid Services
4-star rated hospital

U.S. News and World Report 2022 – 2023
#1 in both the Washington, DC, metropolitan area and VA
High performing in abdominal aortic aneurysm repair
High performing in aortic valve surgery
High performing in chronic obstructive pulmonary disease
High performing in heart attack
High performing in heart bypass surgery
High performing in heart failure
High performing in transcatheter aortic valve replacement (TAVR)

The Leapfrog Group
“A” Hospital Safety Grade
9 consecutive reporting periods
2022 Top Hospital Award

American Nurses Credentialing Center Magnet®
recognition for nursing excellence



For a complete list of IHVI’s awards and recognition, visit inova.org/heartawards.



Inova Heart and Vascular Institute – Inova Alexandria Hospital

4320 Seminary Rd.
Alexandria, VA 22304

Centers for Medicare and Medicaid Services
4-star rated hospital

U.S. News and World Report 2022 – 2023
#5 in Washington, DC, metropolitan area
#10 in Virginia
High performing in chronic obstructive pulmonary disease
High performing in heart attack
High performing in heart failure

The Leapfrog Group
“A” Hospital Safety Grade
9 consecutive reporting periods



Inova Heart and Vascular Institute – Inova Fair Oaks Hospital

3600 Joseph Siewick Dr.
Fairfax, VA 22033

Centers for Medicare and Medicaid Services
5-star rated hospital

U.S. News and World Report 2022 – 2023
#4 in Washington, DC, metropolitan area
#8 in Virginia
High performing in abdominal aortic aneurysm repair
High performing in chronic obstructive pulmonary disease

The Leapfrog Group
“A” Hospital Safety Grade
21 consecutive reporting periods
2022 Top Hospital Award

American Nurses Credentialing Center Magnet®
recognition for nursing excellence



**Inova Heart and Vascular Institute – Inova Loudoun Hospital
Schaufeld Family Heart Center**

44045 Riverside Pkwy.
Leesburg, VA 20176

Centers for Medicare and Medicaid Services
5-star rated hospital

U.S. News and World Report 2022 – 2023
High performing in heart failure
High performing in chronic obstructive pulmonary disease

The Leapfrog Group
“A” Hospital Safety Grade
21 consecutive reporting periods
2022 Top Hospital Award

American Nurses Credentialing Center Magnet®
recognition for nursing excellence



Inova Heart and Vascular Institute – Inova Mount Vernon Hospital

2501 Parkers Ln.
Alexandria, VA 22306

Centers for Medicare and Medicaid Services
5-star rated hospital

U.S. News and World Report 2022 – 2023
High performing in chronic obstructive pulmonary disease

The Leapfrog Group
“A” Hospital Safety Grade
17 consecutive reporting periods

American Nurses Credentialing Center Magnet®
recognition for nursing excellence



+ Patient Transfers
One Call 24/7 703.776.8000
Direct Admission • Transfer • Specialized Transport



Congenital cardiac surgeon Lucas Collazo, MD

Patient Experience

An important component of being able to achieve consistently high patient experience ratings is the feedback we receive from patients and family members. We make a conscious effort to integrate their perspectives to ensure we deliver patient-centered care every time, every touch.

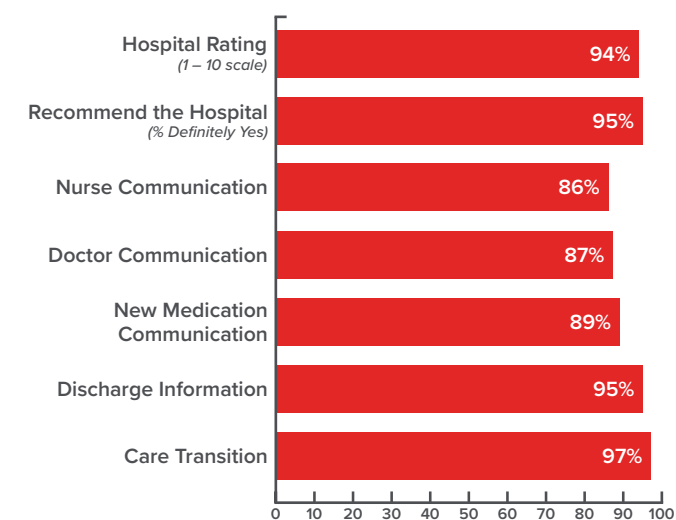
We host monthly Patient and Family Advisory Council meetings where a group of former patients and family members provide feedback to our administrative, nursing, patient safety and patient experience leadership.

There is also a data-driven continuous monitoring process for quality indicators and patient safety metrics. We examine our internal data and use national registries to provide benchmark comparisons.

As part of our monitoring process:

- Every patient care unit has specific performance metrics.
- Progress and performance are displayed to keep team members focused on results.
- Multispecialty teams of nurses, physicians, IT specialists, financial and data analysts work to monitor performance and redesign processes to improve patient care.

HCAHPS Hospital-Based Care 2022 Rankings



About the survey: The Centers for Medicare and Medicaid Services require all United States hospitals that treat Medicare patients to participate in the national Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, a standardized tool to measure patients' perspectives of hospital care.

Hospitals/units included: All surveys are from IHVI units at Inova Fairfax Medical Center (Cardstep, CCU1, PCCU, CardTelN, CardTelS, APU, 4 South, CVIC).

IHVI survey period: Returned surveys between January – November 2022
Percentile rank is determined from the All Press Ganey Database of Hospitals in the United States. Database contains ~2,400 hospitals nationwide.

96.14% Likelihood to Recommend Inova Cardiology Outpatient Physician Offices

About the survey: Press Ganey's Medical Practice Survey for use in physician office settings to measure patients' perceptions of outpatient care

Outpatient offices/clinics included: All Inova-owned practice locations

IHVI survey period: Returned surveys between January – November 2022
Percentile rank is determined by the Press Ganey Survey Vendor from the All Press Ganey Database of Care Sites in the United States. Database contains ~28,000 care sites nationwide.

IHVI Specialty Program Expansions

New at Inova Alexandria Hospital – atrial fibrillation (AFib) ablation services now available

In early 2023, Stephen Gaeta, MD, PhD, Medical Director of Inova Alexandria Hospital’s Electrophysiology Program and a team of three other electrophysiologists began performing the first AFib ablations at Inova Alexandria Hospital. While relatively low-risk catheter ablations for atrial flutter and supraventricular tachycardia have been performed at the hospital for some time, the goal has always been to add more complex procedures including AFib ablation.

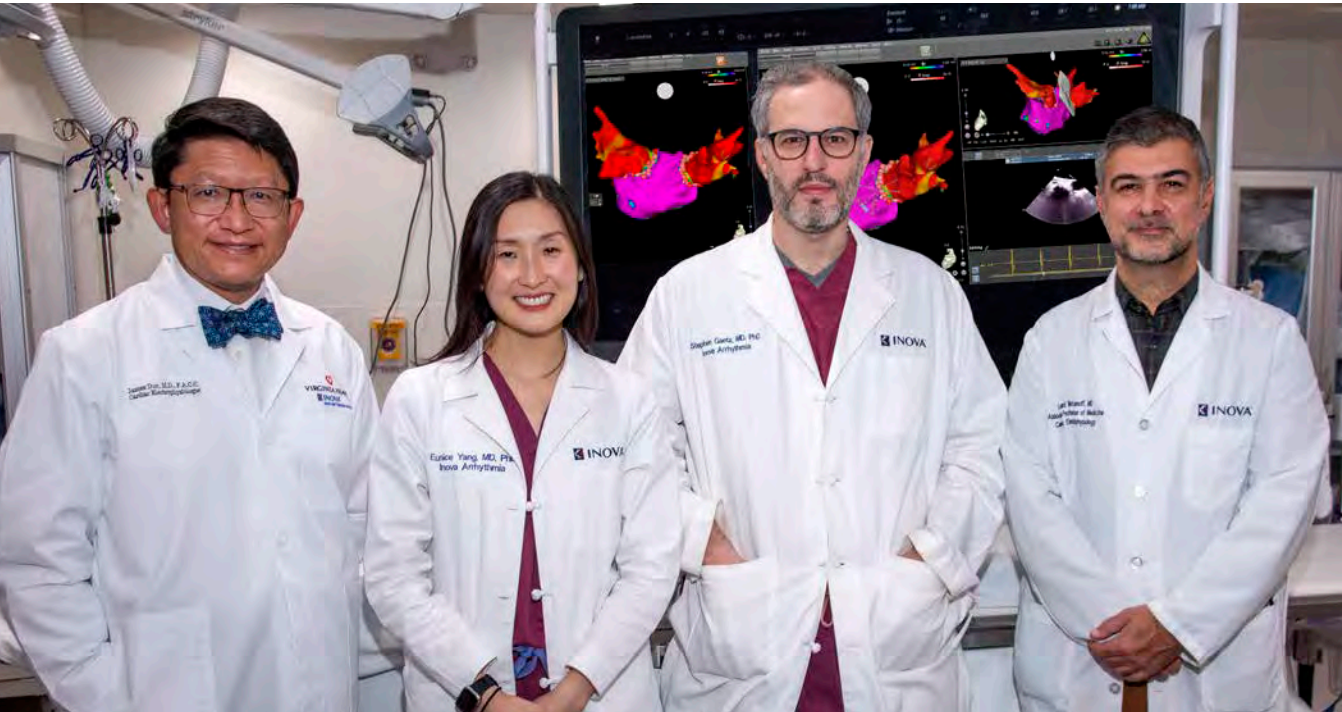
Dr. Gaeta focuses on bringing needed cardiac care to underserved areas in our region. He explained, “Alexandria

needed better access to electrophysiologists and electrophysiology procedures.” Ablation has become a first-line approach for treating most patients with AFib. The procedure reduces AFib-related symptoms, prevents hospitalizations and improves quality of life.

To successfully add AFib ablation to the electrophysiology lab’s services, Inova Alexandria Hospital upgraded to the latest equipment, conducted specialized staff training, and implemented new safety and transfer protocols aligned with Inova’s system-wide care goals. As a result, referring physicians can extend the best possible care to their AFib patients – close to home.

“We believe offering patients care for heart rhythm disease in their community will reduce health disparities across our network.”

Stephen Gaeta, MD, PhD



Some of the electrophysiologists who practice at Inova Alexandria Hospital (L to R): James Duc, MD; Eunice Yang, MD; Stephen Gaeta, MD; Leonard Ilkhanoff, MD

Inova Alexandria Hospital’s Electrophysiology Program offers:

- Ablations for AFib, atrial flutter and supraventricular tachycardia
- Full spectrum of cardiac device implants
- A team of five electrophysiologists
- Well trained, experienced staff with cross-training at other Inova institutions
- State-of-the-art electrophysiology equipment
- A fully functional lab capable of handling outpatient procedures and inpatient emergencies
- Protocols to transport patients safely and expeditiously to Inova Fairfax Medical Campus for immediate, advanced cardiac care if necessary

Electrophysiology procedures are performed Monday through Friday. To refer a patient, call 571-901-1806.

New at Inova Loudoun Hospital – advanced lung disease clinic opens

Beginning in September 2022, Inova added an advanced lung disease clinic location to its Inova Loudoun Hospital – Lansdowne campus, allowing patients to have comprehensive initial assessments and ongoing care from the same team that had been exclusively based on the Fairfax campus. More complex cases may still require follow-up care at the advanced lung disease and transplant outpatient clinic on the Inova Fairfax Medical Campus.

Steven Nathan, MD, Medical Director of Inova’s Advanced Lung Disease and Transplant Program, said, “We are delighted to bring our advanced lung disease program to Inova Loudoun Hospital.”

Inova’s highly specialized advanced lung disease and transplantation programs are nationally recognized with multiple accolades and accreditations. The care team offers expertise in: interstitial lung disease, including idiopathic pulmonary fibrosis and sarcoidosis; pulmonary hypertension, including CTEPH; cystic fibrosis; severe chronic obstructive pulmonary disease (COPD) and lung transplantation.

Learn more at [inoa.org/lung](https://www.inova.org/lung) or by calling 703-776-7939.



Advanced lung disease specialist Oksana Shlobin, MD

“We hope the additional location will help ease the burden for local patients whose lung disease makes traveling to the Inova Fairfax Medical Campus difficult.”

Steven Nathan, MD



IHVI research directors (L to R): Yihenew Abetu and Edwina Battle

Serving a highly diverse patient population reflective of national demographics positions IHVI as an ideal site for population-based protocols. “Not only do we serve a population that varies in ethnicity, gender and socioeconomic status – but we have also established a diverse care team that meets patients where they are,” said Yihenew Abetu, Director of Cardiology Research for IHVI.

IHVI has been the top-enrolling site for several cardiovascular and lung studies and has been awarded competitive federal, industry and nonprofit grants. Its researchers regularly collaborate with academic medical centers, the U.S. Food and Drug Administration (FDA), the American Heart Association, the National Institutes of Health, and the pharmaceutical and device industry, including Abbott, Medtronic and Amgen, among others.

Researchers at IHVI are also developing and validating genomic biomarkers that can inform new techniques for improving long-term outcomes for patients with advanced heart failure. Early analyses through an ongoing collaboration with the National Heart, Lung and Blood Institute and the Genomic Research Alliance for Transplantation hold great promise for developing strategies to reduce the complications of immunosuppression after transplantation.

Investigators on the advanced lung disease team are collaborating on studies to increase lung transplant availability through ex vivo perfusion, an innovative technique to rehabilitate lungs initially considered not suitable for transplantation.

Numerous ongoing studies and trials in interventional therapies, algorithms for heart failure, mechanical complications of acute myocardial infarction, suture-mediated patent foramen closure and advanced cardiac imaging have expanded patients’ treatment options, often allowing them access to exclusive and innovative therapies before they’re widely available.

Continual improvements in patient care

“As we look to the future, we plan to expand our research efforts to include patients at more Inova facilities, including Mount Vernon, Alexandria, Loudoun and Fair Oaks,” said Dr. Christopher M. O’Connor, President of IHVI.

Integral to the success of the research program is the dedication and collaboration between Inova’s clinical and research teams. “Our research nurses, coordinators and assistants work closely with the investigators who bring new trials to our patient population,” said Edwina Battle, Director of Advanced Lung Disease Research for IHVI. “We couldn’t do what we do without their dedication and hard work.”



IHVI research team

Involvement in Clinical Cardiology and Lung Disease Research Drives Care Improvements

Discovery and implementation of novel therapies through clinical research leads to improved patient care, and IHVI’s participation in research furthers Inova’s commitment to excellence. Clinical research also allows patients to have access to leading-edge treatments and facilitates the identification of even more effective therapeutics for the future.

“We strive to be both a regional and national leader in expanding treatment options and clinical care strategies that improve patient outcomes.”

Christopher M. O’Connor, MD, MACC, FESC, FHFA, FHFA

Research areas of focus

The incidence of cardiovascular disease is expected to continue to rise due to an aging population and increased prevalence of cardiovascular risk factors, underscoring the pressing need to focus on expanding treatment options. Patients with advanced lung disease continue to experience severe, disruptive symptoms with a limited number of effective treatments available.

IHVI’s robust cardiac research program focuses on several areas of great need, including advanced heart failure, structural heart disease, cardiovascular surgery, critical care, vascular disease and cardiogenic shock. For advanced lung disease, studies underway focus on interstitial lung disease, cystic fibrosis, sarcoidosis and idiopathic pulmonary fibrosis.

IHVI Adds Regional Medical Leadership Roles Focused on Assuring Best Practices

Four physicians were promoted to system-wide oversight roles in 2022 and are now involved in evaluating and overseeing safety, quality and efficiency to assure consistency in patient care. This change is part of IHVI's continued efforts to improve and sustain positive outcomes for our growing cardiovascular patient population.

"Working closely with their counterparts at other Inova facilities and across various services and medical specialties, these physician leaders are working to optimize and standardize best practices," said Dr. Christopher M. O'Connor, President of IHVI. "This coordinated approach further supports our drive to excellence across all Inova facilities."

These four physicians serve as the regional medical directors within IHVI's system-wide service line, covering cardiovascular services across all five Inova hospitals. Working together with the IHVI Senior Directors of Nursing Services, Marina Ocasio, MSN, and Sharri Robinson, MSN, this leadership team ensures a seamless system of people-centered, high reliability and high value cardiovascular care.

Regional Directors



Regional Medical Director

Saquib Chaudhri, MD, MBA, is board certified in internal medicine and has an MBA in healthcare management. He is a cardiac hospitalist and former Medical Director of the Progressive Coronary Care Unit at Inova Fairfax Medical Campus. Saquib joined Inova in 2016 and has been part of the IHVI leadership team since 2020.



Regional Cardiothoracic Surgery Director

Katherine Klein, MD, is a specialty care physician board certified in thoracic and cardiac surgery, surgical critical care, and general surgery. Prior to joining Inova in 2022, she was an Assistant Clinical Professor in Cardiothoracic Surgery and Surgical Critical Care as well as the Surgical Director of Mechanical Circulatory Support at Virginia Commonwealth University in Richmond, VA.



Regional Cardiology Director

Shashank Desai, MD, MBA, is an advanced heart failure/transplant cardiologist, Director of Inova Thoracic Transplant, and Director of IHVI Strategy and Growth. He has been at Inova since 2006.



Regional Critical Care Director

Hala Moukhachen, MD, FCCP, joined Inova in 2018. She has led the cardiac critical care team since then as the Co-Medical Director of the Cardiac ICU at Inova Fairfax Medical Campus. Prior to that, she served as the Director of Cardiopulmonary Services and Chairman of Medicine at HCA.



IHVI Senior Director of Nursing Services

Marina Ocasio, MSN, RN, CNL, NE-BC, oversees IHVI's critical care departments and procedural departments including the invasive and non-invasive cardiovascular labs, interventional radiology and ICAR. She has been with Inova since 2011 and has served in several unit leadership roles.



IHVI Senior Director of Nursing Services

Sharri Robinson, MSN, RN, RN-BC, has responsibility for overseeing five nursing units (PCCU, CVSD, CTUS, CTU4, APU) and Cardiac Rehabilitation. She holds a board certification for Cardiac Vascular Nursing and has been with Inova since 2004 and has held a variety of nursing and leadership roles.



IHVI regional medical leadership (L to R): Sharri Robinson, MSN, RN, RN-BC; Hala Moukhachen, MD; Shashank Desai, MD; and Saquib Chaudhri, MD

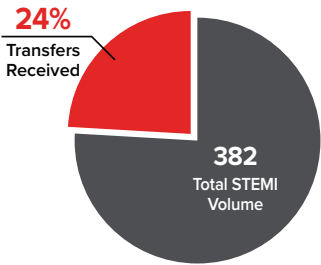


Interventional Cardiology

2022 Cardiac Catheterization and Percutaneous Coronary Intervention (PCI) Volume

Facility	Total Patients
Inova Fairfax Medical Campus	3,855
Inova Alexandria Hospital	1,085
Inova Loudoun Hospital	1,073
Q1 2022 – Q3 2022 annualized	
IHVI Total 6,013	

STEMI Volume and Transfers Received



Rolling 4Q ending Q2 2022

Acute Myocardial Infarction (AMI)

“It is notable that we continue to outperform expected mortality, even while the complexity of our patient population has significantly increased as we serve as a destination center for the most severe cases of cardiogenic shock.”

Wayne Batchelor, MD, MHS, FACC, FSCAI
System Director, Interventional Heart Program

Primary PCI Door-to-Balloon Within 90 Minutes



Rolling 4Q ending Q2 2022

IHVI Door-to-Balloon Time (in minutes)



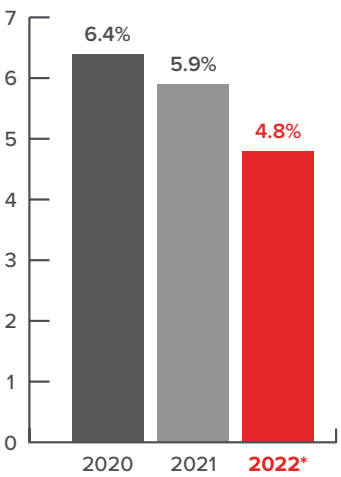
Rolling 4Q ending Q2 2022

99.23% PCI Success

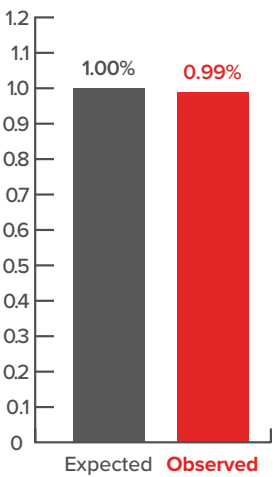


Rolling 4Q ending Q2 2022

AMI 30-Day All-Cause Risk Adjusted Readmission (Medicare 65+)

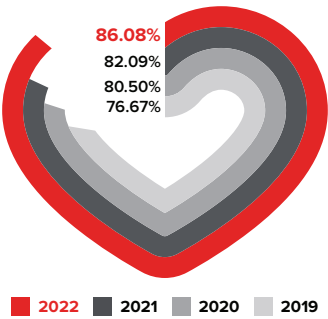


AMI Mortality Performance at IFMC



IFMC, IAH, ILH have received this award every year since 2016. The Chest Pain – MI Registry™ is the most trusted source for outcomes-based, continuous quality improvement for hospitals and health systems applying American College of Cardiology (ACC) and American Heart Association clinical guideline recommendations.

Utilization of Radial Artery Access for Catheterization

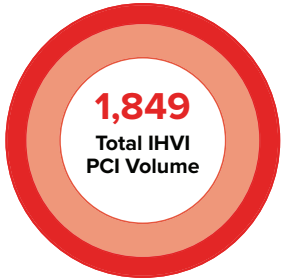


Rolling 4Q ending Q2 2022



+ Patient Transfers

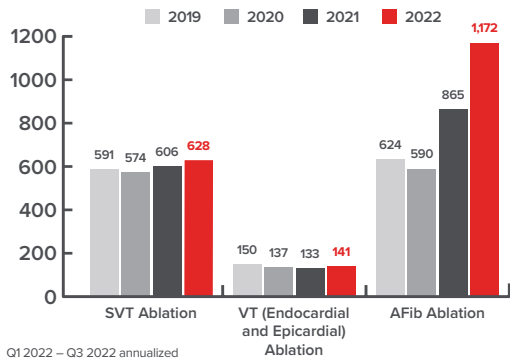
One Call 24/7 703.776.8000
Direct Admission • Transfer • Specialized Transport



Rolling 4Q ending Q2 2022

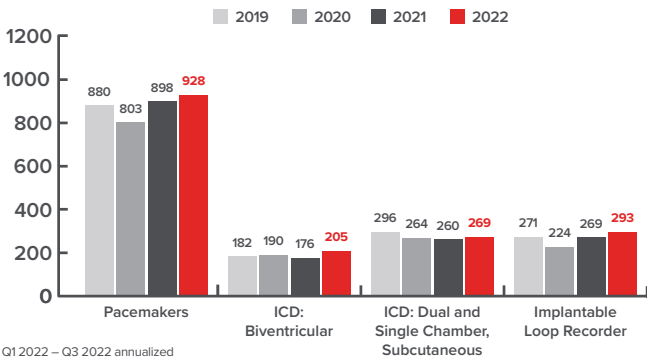
Electrophysiology

Adult and Pediatric Ablation Volume



Q1 2022 – Q3 2022 annualized

Device Implant Volume



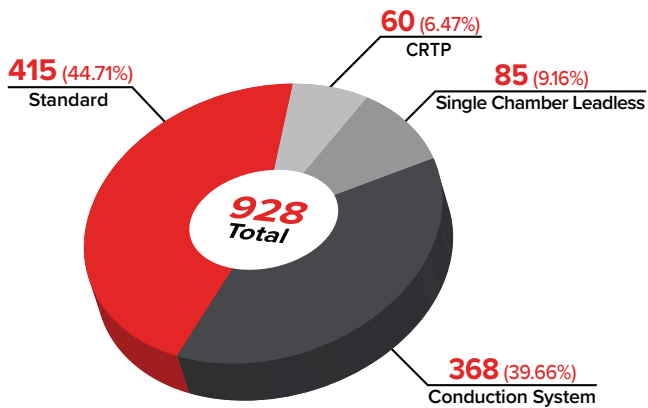
Q1 2022 – Q3 2022 annualized

Total Combined Procedure Volume

Volumes	2019	2020	2021	2022
Total Ablations	1,365	1,301	1,604	1,941
Total CIEDs	1,629	1,481	1,603	1,696
Total Procedures	2,994	2,782	3,207	3,637

Q1 2022 – Q3 2022 annualized

Pacemaker Device Implant Volume



Q1 2022 – Q3 2022 annualized

45 2022 Lead Extraction Procedures for Cardiovascular Implantable Electronic Devices (CIED)

Q1 2022 – Q3 2022 annualized

143 2022 WATCHMAN™ Left Atrial Appendage Closure Implant Procedures

Full-year data

+ Refer a Patient

Inova Arrhythmia
phone 571.472.3270
email arrhythmia@inova.org
web inova.org/arrhythmia

Inova AFib Center
phone 571.472.2342
email afib@inova.org
web inova.org/afib

Collaboration Spurs Growth in Arrhythmia Management for Adults with Congenital Heart Disease (ACHD)

Individuals with ACHD often develop arrhythmias later in life and may be particularly symptomatic as a result of their anatomy and physiology. Patients with ACHD frequently require catheter ablations or implantable devices such as pacemakers or defibrillators.

“These procedures can be challenging due to anatomical variations and multiple arrhythmic substrates,” said Brett Atwater, MD, System Director, Cardiac Electrophysiology and Electrophysiology Research.

With pediatric and adult electrophysiologists working together, IHVI’s electrophysiology team is uniquely situated to care for these complex patients. ACHD patients with complex arrhythmias have come from throughout the mid-Atlantic region to undergo these procedures, seeking the combined expertise of both an adult and a pediatric electrophysiologist in one location.

“Working together brings a unique and invaluable collective expertise to each ACHD case.”

Mitchell Cohen, MD, pediatric and adult congenital electrophysiologist
Co-Director, Inova Children’s Heart Center



Brett Atwater, MD

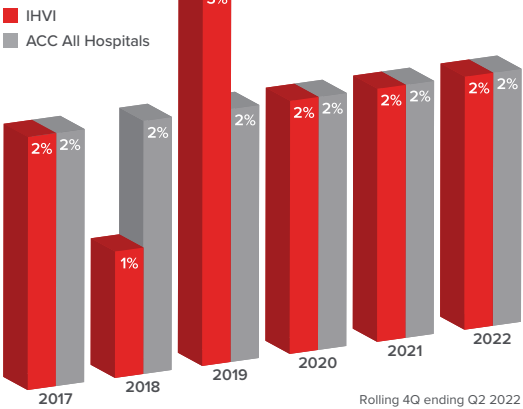


Structural Heart

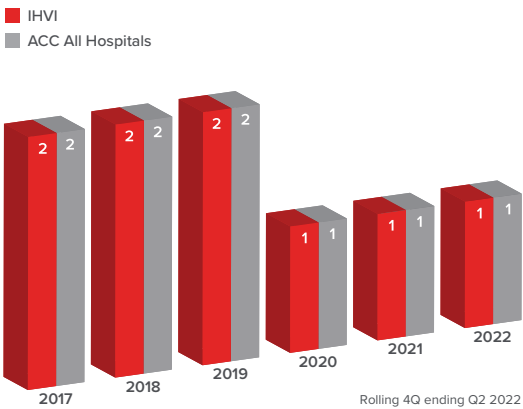
Standardized Treatment Algorithm for Heart Failure Patients with Mitral Regurgitation



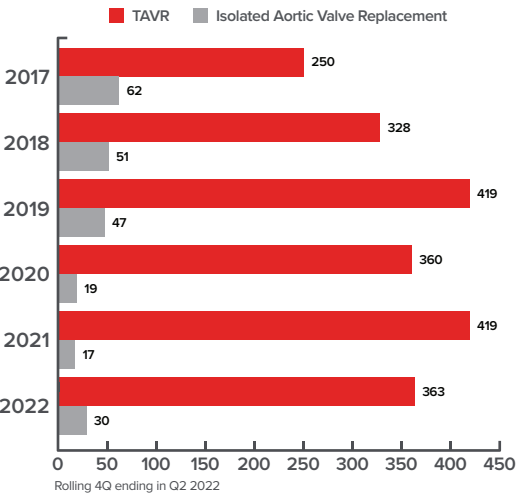
TAVR 30-Day Mortality Rate



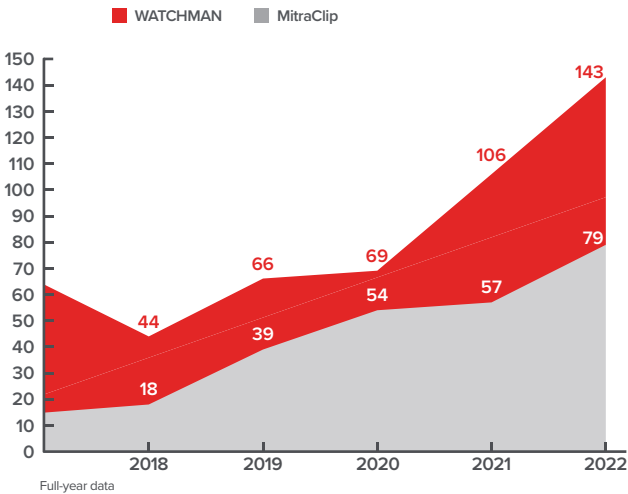
TAVR Median Postprocedure Length of Stay (Days)



TAVR vs. Isolated AVR Cases



WATCHMAN and MitraClip Procedures



Using a protocol that marries the expertise of the advanced heart failure team with the structural heart team, Inova is working to improve outcomes for patients who have mitral regurgitation related to heart failure by optimizing medical therapy and improving access to the MitraClip™ procedure. Key to its success is the role of advanced practice providers (APPs), who have been an integral part of the IHVI team for more than four decades.

The MitraClip transcatheter mitral valve repair procedure is indicated for patients with severe, symptomatic secondary mitral regurgitation who remain symptomatic while on optimal guideline directed medical therapy (GDMT). Optimal medical therapy is a key component for the appropriate selection of patients who will most benefit from MitraClip.

“We created the Inova Heart Failure Treatment Algorithm as a way to optimize care for these patients through aggressive GDMT in order to ensure they are good candidates for the MitraClip procedure,” said Kathleen Emper, FNP, one of eight APPs on Inova’s advanced heart failure team. “We work as a bridge between the heart failure and structural heart teams to identify patients who could benefit from this protocol, so they can live longer and have a better quality of life with the device.”

The protocol was developed for patients with symptomatic heart failure due to reduced ejection fraction and moderate to severe mitral regurgitation. “Our goal was to emulate the conditions of the COAPT clinical trial, which showed that use of the MitraClip, in addition to GDMT, was safe, reduced the severity of mitral regurgitation and resulted in an improved prognosis compared with medical therapy alone,” said Matthew Sherwood, MD, MHS, Co-Director of IHVI’s Structural Heart Program.

“Inova wants to lead the charge across the nation to make this a standardized practice,” according to Wayne Batchelor, MD, MHS, FACC, FSCAI, System Director of IHVI’s Interventional Heart Program. “We set out to determine if we can improve outcomes and quality of life in the real world, not just within the confines of a clinical trial, and we are already seeing great results.”

Patients referred by their cardiologists are evaluated by a heart failure APP and go through a “boot camp” that educates them about their disease, including exercise and nutrition, in addition to receiving focused titration of their medications to the highest doses they can tolerate. “We are one of the few places in the country that has created and implemented this process using APPs,” noted Carolyn Rosner, NP, Director of Innovative Programs for IHVI.



Matthew Sherwood, MD

Once the advanced heart failure team determines that the medications have been optimized, a structural heart specialist reevaluates imaging of the patient’s valve to determine if the patient is a good candidate for transcatheter edge-to-edge repair.

After the MitraClip procedure, patients return to their original cardiologist for ongoing monitoring. “In some cases, their valvular disease has improved so much they no longer need the MitraClip device,” said Dr. Sherwood. “However, the majority do need it, and we recommend the patient move forward with the procedure. Based on the results we are seeing, we now have confidence these patients will see major benefits in quality of life and reduced mortality and morbidity.”

“The core difference in our model is that APPs have a central role and are the linchpins for our success,” said Shashank Desai, MD, MBA, IHVI Director for Strategy and Growth and Director of Thoracic Transplant. “As clinicians, we are fortunate that IHVI’s leadership gives us the freedom to explore, experiment and innovate.”

“We took the best of what our heart failure and structural heart teams could contribute and combined them to optimize patient care.”

Shashank Desai, MD, MBA

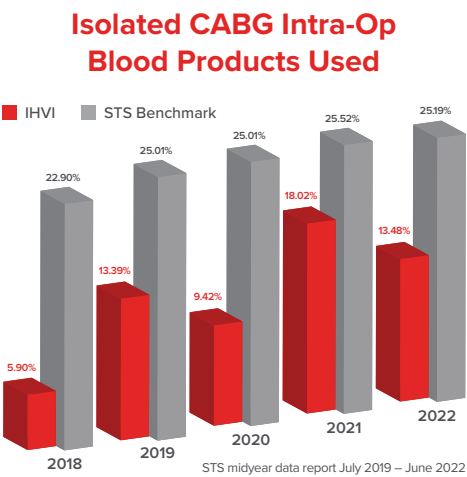
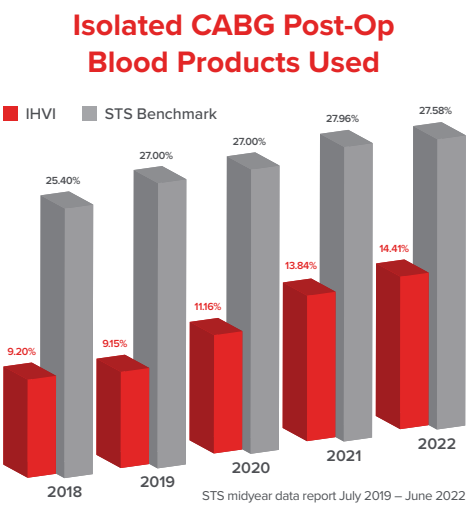
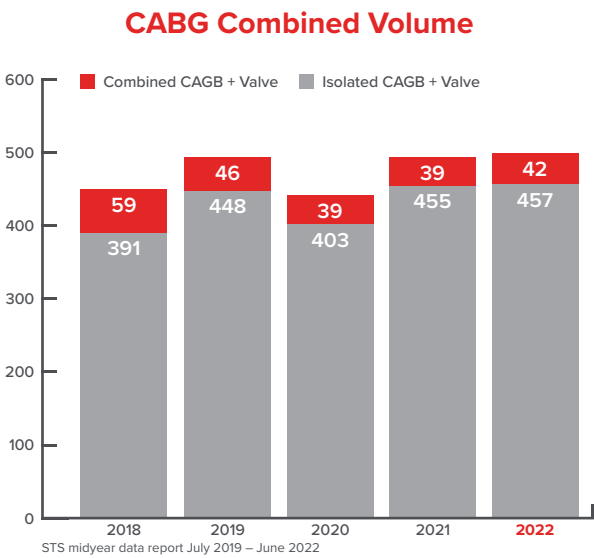
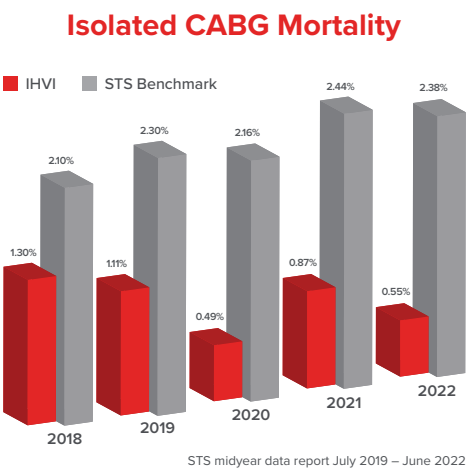
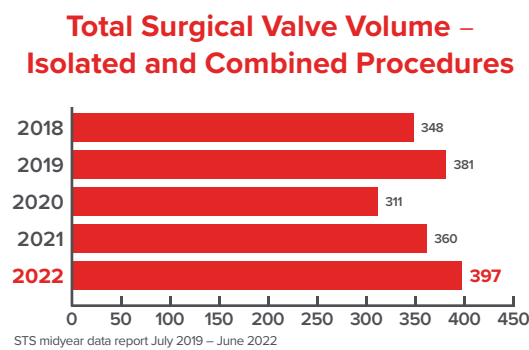
35 2022 Minimally Invasive Patent Foramen Ovale (PFO) Closures

+ Refer a Patient

phone 571.472.4669
email valve@inova.org
web inova.org/structuralheart

Cardiac Surgery

Inova Leads the Way with Innovations in Cardiac Surgery





Society of Thoracic Surgery (STS) quality ratings

Overall Composite Score January 2019 – December 2021

3 Stars | Highest Rating: Better Than Expected

CABG

Aortic Valve Replacement

STS is a national leader in healthcare transparency and accountability that has developed a comprehensive rating system for the quality of cardiac surgery care based on the overall performance of hospitals across the country for survival, complications and other measures. 2022 ratings not yet available at time of publication. Approximately 12 – 15 percent of hospitals receive a “3-Star” rating, which denotes the highest category for quality care. Further details can be found at: publicreporting.sts.org.

+ Refer a Patient

phone 571.472.4600

web inova.org/cvsurg

With our focus on clinical excellence and cutting-edge treatment, IHVI ranks among the top heart centers in the U.S. and leads the way with innovations in cardiac surgery that improve outcomes for patients.

Robotic-assisted minimally invasive heart bypass surgery

Robotic-assisted minimally invasive coronary artery bypass grafting (CABG) – or mini CABG – has been an exciting addition to Inova’s heart surgery program. While minimally invasive treatments have become routine in other types of cardiac surgery, mini CABG has been slower to be adopted, due to the technical and physical demands of the technique. Patients’ concern over the traditional invasive approach of CABG has led some to delay recommended bypass surgery or seek an alternative option using stents, even if CABG might afford a better long-term outcome.



Ramesh Singh, MD

“After a patient told me he could not undergo a sternotomy because he was the primary caretaker for his wife and could not be incapacitated for the amount of time needed for recovery, I sought out training and began offering mini CABG about five years ago,” said cardiovascular surgeon Ramesh Singh, MD, Surgical Director of Inova’s Mechanical Circulatory Support Program. “While patients were thrilled to have a minimally invasive option, it was rather challenging, and the pool of patients I could offer it to was limited. Fortunately, IHVI was willing to invest in robotic-assisted CABG, which is more precise and better for both the patient and the surgeon performing the procedure.”

The robotic-assisted procedure offers improved visualization compared to the standard minimally invasive technique and allows for greater surgical accuracy in placement of bypass grafts.

Compared to open heart surgery, patients who undergo robotic-assisted mini CABG generally experience less pain and bleeding, a smaller risk of rib fractures or serious infections, and significantly shorter recovery times.

- Currently, robotic-assisted mini CABG is indicated for:
- Patients who need single-vessel bypass
 - Patients with multiple blockages who would do well with a single-vessel left internal mammary artery to left anterior descending artery graft combined with stents in other vessels
 - Patients considered high risk for conventional open heart surgery
 - Those unwilling or unable to undergo sternotomy due to physical or social limitations

Though IHVI began offering robotic-assisted mini CABG in 2022, our specialized team has five years of experience using the standard minimally invasive surgical version of the procedure.

“For the right patient, it can make all the difference,” said Dr. Singh. “Inova is proud to count ourselves among the hospitals offering this option to patients who can benefit from it.”



Kathleen Petro, MD

Multiple arterial grafts for CABG surgery offer significant benefits

Over the last several years, Inova's cardiac surgery team has focused its efforts on improving outcomes for CABG patients through the use of multiple arterial grafts. Currently, more than 60% of our patients receive two or more arterial grafts without a concomitant increase in surgical morbidity.

For more than two decades, it has been generally accepted that patients who receive multiple arterial grafts at the time of CABG have better long-term survival rates as compared with those who receive only one arterial graft. U.S. and European guidelines strongly recommend the use of multiple arterial grafts in patients with long life expectancies.

Unfortunately, adoption of these guidelines in the U.S. has been slow and according to the STS database, only about 12% of CABG patients receive a second arterial conduit. This increases to approximately 20% for young (under 50), low-risk

patients, but even that number has remained low and has remained unchanged over the last 10 years.

Currently, more than 60% of Inova patients receive two or more arterial grafts without a concomitant increase in surgical mortality.

"There are several reasons explaining the slow adoption by the surgical community," said Inova cardiothoracic surgeon Kathleen Petro, MD. "These include concerns about postoperative complications such as poor sternal wound healing and competitive graft flow, as well as the fact that the procedure is technically more challenging, it's very time consuming and many surgeons have not been trained in the technique."

However, Dr. Petro points out Inova's cardiac surgery program has achieved and maintained the highest rating from STS for CABG surgery every year since 2016. Notably, the 3-star rating for isolated CABG includes top ratings across all the categories (composite, mortality, morbidity, use of internal mammary artery and periop meds), a result achieved by a limited number of programs nationally.

"Not every patient is a candidate for the use of multiple arterial conduits," noted Dr. Petro. "However, in terms of outcomes, the currently available evidence is compelling, with the majority of benefits seen in patients with multivessel disease, followed by those with left main vessel disease. Inova's cardiac surgery team is committed to making the procedure an integral part of our revascularization strategy discussions."

Excellence in mitral valve repair

Inova is proud to have once again received the Mitral Valve Repair Reference Center Award from the American Heart Association and the Mitral Foundation for a demonstrated record of superior clinical outcomes resulting from evidence-based, guideline-directed degenerative mitral valve repair.

"For more than thirty years, Inova has had a reputation for excellence in valve surgery," said Eric Sarin, MD, Section Chief, Adult Cardiac Surgery and Co-Director of the Structural Heart/Valve Disease Program at Inova. "As techniques and approaches have changed, we continue to lead in our ability to treat complex valve disease."



Eric Sarin, MD

Evidence-based treatment guidelines support the importance of repairing the mitral valve, as compared to replacing it with a bioprosthetic or mechanical valve. Studies have shown that repair correlates with better long-term outcomes for patients, including improved survival and fewer long-term complications within five years.

"In addition, numerous studies have shown a strong correlation between the number of cases performed by experienced mitral valve surgeons and the resulting clinical outcomes," noted Dr. Sarin. "Therefore, because of our growing volume of mitral valve repairs, we have a distinct advantage."

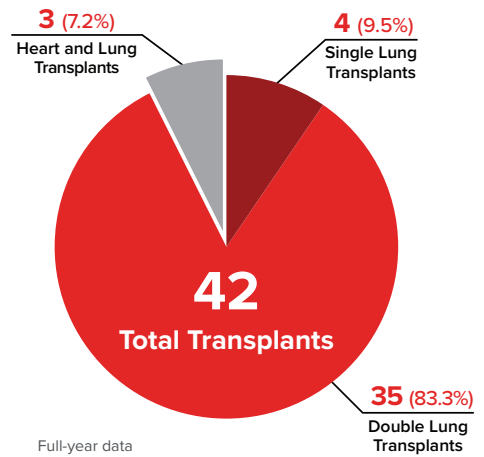
In order to qualify for the award, heart centers must perform at least 50 repair procedures per year with less than 1% mortality. Additionally, the center must demonstrate a 95%

rate of successful repairs and track the durability of the repair over time with echocardiography. IHVI is one of a select number of centers nationally to maintain this designation.

The award also recognizes the breadth of services available. In addition to open surgery, Inova has expertise in catheter-based techniques, innovative protocols for treating advanced heart failure that include the MitraClip procedure and an emphasis on multidisciplinary teams working in concert to benefit patients.

Advanced Lung Disease and Transplant Services

2022 Lung Transplant Volume + Heart and Lung Transplant Volume



2022 Unique Patients Followed

Interstitial lung disease	817
COPD	68
Pulmonary hypertension	369
Bronchiectasis	174
Lung transplant	242
Other	43
Total patients	1,713

YTD January through November 2022

92.56%

2022 IHVI's Observed Adult Lung Transplant Patient Survival (1 year)

January 2023 SRTR report

88.05%

2022 US Expected Adult Lung Transplant Patient Survival (1 year)

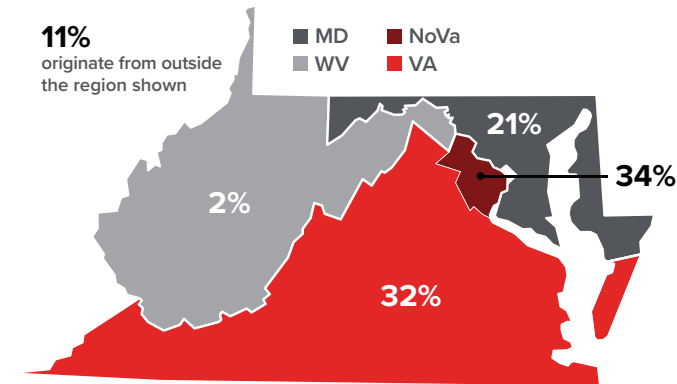
January 2023 SRTR report



Additional special designation:



Inova Lung Transplant Patient Origin



Distribution based on patients discharged by Dec. 31, 2022

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phone 703.776.7939
email ltxreferrals@inova.org
web inova.org/lung

Cardiac and Respiratory Failure



The cardiac, critical care and lung services teams at Inova Fairfax Medical Campus have been designated a Gold Level Center of Excellence by the Extracorporeal Life Support Organization for demonstrating the highest level of performance, innovation, satisfaction and quality.

Impella Implants and Cardiogenic Shock Patient Volume

	2018	2019	2020	2021	2022
Impella Volume	110	100	70	60	57
Cardiogenic Shock Volume	158	220	192	350	405

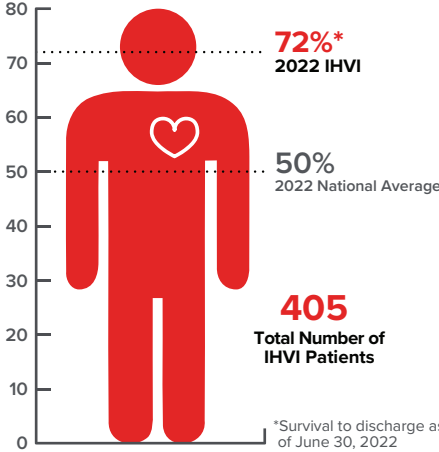
Full-year data

ECMO

	2018	2019	2020	2021	2022
Total ECMO Runs	91	113	130	157	127
Adult ECMO Runs	83	93	116	141	107
Adult Days of Support	788	908	1,442	1,526	1,227
Adult Hours of Support	17,916	20,663	33,200	35,002	28,190
Pediatric ECMO Runs	8	20	14	16	20
Pediatric Days of Support	60	139	58	201	339
Pediatric Hours of Support	1,353	3,134	1,248	4,659	7,932

Full-year data

Cardiogenic Shock Patient Survival Rates



+ Patient Transfers

One Call 24/7 703.776.8000
Direct Admission • Transfer • Specialized Transport

Complex Course of Treatment Showcases IHVI's Team Approach

With treatment and services from cardiogenic shock to cardiac surgery, advanced heart failure, interventional cardiology, advanced cardiac imaging, nursing and case management services, IHVI has built a comprehensive care team to support critically ill patients from the time they present to the hospital, throughout their time in intensive care, to release from the hospital and beyond. The case of 64-year-old Corazon Atienza demonstrates the impact of that approach.

“This case exemplifies and personifies the evolution of IHVI and the extraordinary quaternary services that have been amassed, coordinated and are being delivered here,” said Alan Speir, MD, Director of Cardiac Surgery, Director of Extracorporeal Membrane Oxygenation (ECMO) and Senior Associate Director of IHVI. “It’s not only about ECMO, transplant, ICU nursing or surgery. It’s about the aggregate: the transformation and coordination of these previously disparate services into a coordinated entity.”

Corazon came to Inova Fairfax Medical Campus’s emergency department on Jan. 21, 2022, with worsening chest pain and shortness of breath. The emergency team suspected she was in heart failure and was having a heart attack. She was admitted, the interventional cardiology team assessed her, and she underwent evaluation for possible angioplasty and stenting. Unfortunately, she was found to have complicated and advanced coronary artery disease and significant heart dysfunction.

Corazon remained hospitalized while undergoing evaluation for a left ventricular assist device (LVAD) and heart transplant. On Feb. 4, she suffered a cardiac arrest requiring resuscitation and was placed on venoarterial (VA) ECMO emergently. “The complexity of our patients is growing significantly, and we’re privileged to coordinate and provide therapies for them that weren’t available a couple of decades ago,” said Carolyn Rosner, NP, Director of Innovative Programs for IHVI.



Key physicians involved in Corazon's care (L to R): Alan Speir, MD; Jessica Buchner, MD; Daniel Tang, MD

Dependent on VA ECMO for life support, Corazon was now status 1 on the heart transplant list. Just 10 days later, on Valentine’s Day, Corazon received a heart transplant and was able to be removed from ECMO support. She had a challenging recovery, including suffering another cardiac arrest, requiring additional operations and two more days on ECMO support.

She was ultimately able to go to an acute rehabilitation facility to recover fully before going home on March 21. “I owe my second chance at life to the top-notch support and the technical skills of the whole Inova team,” Corazon said.

“Corazon’s case is a great example of the extraordinary teamwork and excellence that takes place on a daily basis for us.”

Alan Speir, MD

“Inova truly has an extraordinary approach to cardiac critical care, as seen in Mrs. Atienza’s story,” said Jessica Buchner, MD, ECMO Section Chief, IHVI. “Our system offers extremely specialized treatments for complex cardiac disease performed by a talented multidisciplinary group that not only works together effectively but does so with the utmost professionalism and humanity.”

Corazon spent a total of 59 days in the hospital and was on ECMO support for 10 of them. At IHVI, she had access to every complex intervention available. “Her case was complicated, and her odds of surviving if she had been anywhere else are likely very low,” said Rosner. “She really benefited from an integrated approach across medical specialties to coordinate her care. It allowed her to survive a heart attack and end-stage heart failure, and then be eligible for a heart transplant when it became clear that her native heart had suffered too much damage.”

Today, Corazon and her husband, Pol, take long walks together – three to four miles each day. They look forward to traveling to their small farm in Florida soon and hope to go on a fishing trip to Alaska next May. “It’s a simple, but beautiful, life,” Corazon said.



Corazon Atienza with her husband, Pol

A Regionalized Network to Improve Care for Cardiogenic Shock

Cardiogenic shock is a time-sensitive and challenging condition to treat. As a result, short-term survival rates for patients with cardiogenic shock have historically been low – approximately 50% die within 30 days. It remains the most common cause of death in patients hospitalized after a heart attack or with heart failure.

Beginning in 2017, IHVI significantly improved its patient survival rates using a standardized protocol employed by a multidisciplinary team that increased survival rates to more than 70%. IHVI then focused on expanding use of its team and protocol across a regional network of hospitals. Inova’s team recently published results of its work in the October 2022 issue of *JACC: HF*, entitled “A Standardized and Regionalized Network of Care for Cardiogenic Shock.” The article demonstrates the impact of using a systems-of-care, or “hub-and-spoke,” approach to clinical management to extend these survival benefits across a larger geography.

Challenges of treating cardiogenic shock

Cardiogenic shock requires a timely and multidimensional response with input and expertise across several medical specialties. Patients in cardiogenic shock can progress to multiorgan failure, and ultimately death, within hours.

“Implementing the correct response and treatment strategy can be tricky, as the cause of cardiogenic shock is not always clear at its onset,” according to Behnam Tehrani, MD.

“Even when physicians halt the progression of multiorgan system failure, patients may require high-level treatments such as mechanical circulatory support devices to include ECMO (extracorporeal membrane oxygenation),” Dr. Tehrani continued. “And, in the event the native heart does not recover, patients may require cardiac replacement therapies such as an LVAD or heart transplantation.”

Using a hub-and-spoke model for cardiogenic shock

IHVI’s Inova Fairfax Medical Campus location serves as a central hub to manage cardiogenic shock cases from across the region. It provides a full spectrum of interventional cardiology, cardiovascular surgery, advanced heart failure and cardiac critical care capabilities, with an American Heart Association Level 1 Cardiac ICU and a multidisciplinary shock team of specialists who are on call and available around the clock.

To aid in improving outcomes across the region’s hospitals, Inova serves as a destination center, or “hub,” to more than 30 “spoke” hospitals with Level 2 and 3 capabilities. As the hub, IHVI provides 24/7 support via timely, efficient and coordinated access to its multidisciplinary cardiogenic shock team, including specialists in:

- Advanced heart failure
- Cardiovascular critical care
- Cardiac surgery
- Interventional cardiology
- Emergency medicine

“All the hospitals across this regional network are encouraged to follow a standardized protocol to identify cardiogenic shock quickly, stabilize patients, manage those they can, and transfer those who may require more advanced treatments or expertise,” Alex Truesdell, MD, said. “These spoke hospitals look to the cardiogenic shock team at IHVI for consultative guidance and support around patient management and transport decisions.”

Through this regionalized network, outcomes have improved for all patients, including those who presented first to a “spoke” hospital prior to being transferred to IHVI for care.

Improved outcomes for cardiogenic shock

Before implementing a standardized approach, Inova’s 30-day survival rates for cardiogenic shock were just below 50% – in line with the national and worldwide average. With the new protocol, survival has jumped to more than 70%. Notably, this survival rate has been maintained over the past five years, even as the volume of patients treated at IHVI for cardiogenic shock has tripled and the number and geographic distribution of transferring facilities has increased.

+ Patient Transfers

One Call 24/7 703.776.8000
Direct Admission • Transfer • Specialized Transport

Critical factors in treating cardiogenic shock

The cardiogenic shock team credits three factors with the program’s success:

Collaboration

More than half of patients with cardiogenic shock ultimately treated at Inova Fairfax Medical Campus initially present at a spoke hospital and are transferred. Spoke hospitals can access the entire cardiogenic shock team through a “one-call” approach – specialists in all relevant disciplines can be reached simultaneously, 24/7, using one point of contact.

Communication

The team welcomes consultations and phone calls from partner hospitals as often as needed to discuss ongoing treatment and possible transfer of patients. Check-ins follow the initial consultation at 8, 16 and 24 hours, and in between as needed.

Multidisciplinary approach

Uniting specialists from multiple disciplines allows for collaborative, expert decision making and a tailored approach to care. The team considers the complexity of each case, along with the patient’s health condition and health values to employ a selective strategy for optimal outcomes.



Alexander G. Truesdell, MD, is the Co-Director of IHVI’s Cardiogenic Shock Program. He is board certified in interventional cardiology and cardiovascular disease and sees patients at the Virginia Heart – Fairfax office.

Inova’s impact on cardiogenic shock outcomes

Inova’s cardiogenic shock team is advancing cardiac critical care practice and knowledge by overcoming historical care challenges and publishing its process and outcomes. The team’s work is impacting national guidelines and worldwide health protocols. The 2022 American College of Cardiology and the American Heart Association’s guidelines for the management of heart failure have cited the work performed at Inova and now provides a Class IIa recommendation for employing multidisciplinary shock teams for the care of patients with cardiogenic shock, making this approach the new standard for care in the treatment of patients with advanced cardiovascular disease.

“Treating this condition requires advanced knowledge, meticulous care and coordinated efforts among multiple specialists.”

Behnam Tehrani, MD



Behnam N. Tehrani, MD, is the Co-Director of Cardiac Catheterization Laboratories for Inova Fairfax Medical Campus and Co-Director of IHVI’s Cardiogenic Shock Program. He is board certified in interventional cardiology and cardiovascular disease and sees patients at the Inova Cardiology – Fairfax and Ashburn offices.

IHVI Celebrates 2022 Milestones



IHVI's cardiovascular OR team



IHVI's heart and lung transplant teams

58

Heart Transplants

+

39

Lung Transplants

+

3

Heart-Lung Transplants

= 100 Life Changing Procedures

Advanced Heart Failure and Transplant

Ventricular Assist Device (VAD) and Heart Transplant Volume

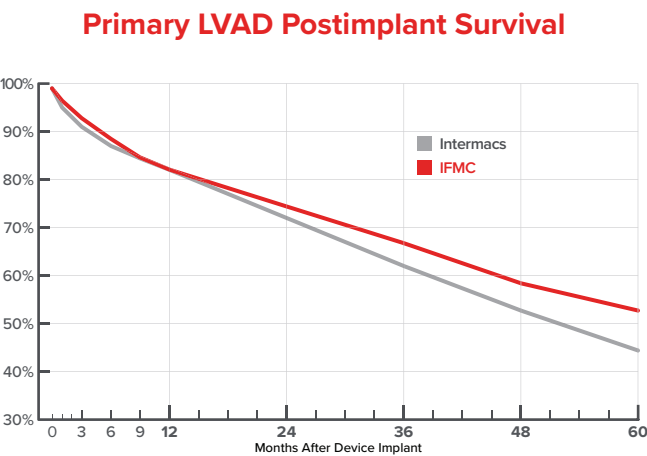
	2019	2020	2021	2022
VAD Volume – Durable Devices	19	24	23	16
Heart Transplant Volume	30	43	55	58
Heart-Lung Transplant Volume	0	1	1	3

January 2023 SRTR report

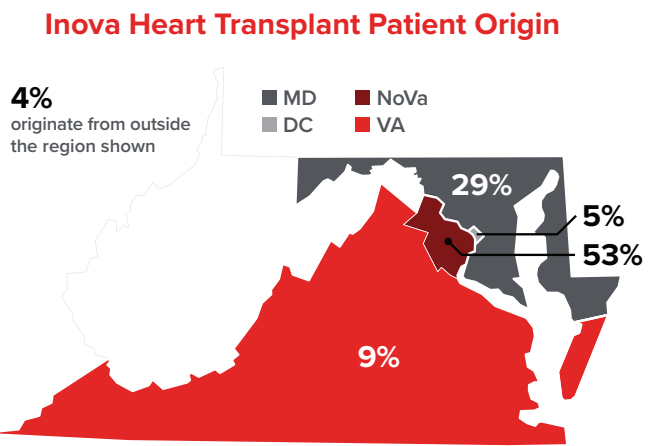
Heart Transplant Patient Survival Rates

	Expected	Observed	HR Index
One-Year Patient Survival	90.96%	92.96%	0.81%

January 2023 SRTR report



Source: Q2 2022 cumulative – primary VAD patients report from InterMACs released Sept. 30, 2022



Distribution based on patients discharged by Dec. 31, 2022

Inova's heart transplant program now ranks **9th** in the nation for volume based on a record number of procedures in 2022, including 3 combined heart-lung transplants.



The Joint Commission Seal of Approval® for VAD

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phone 703.776.6453
email heartfailure@inova.org
web inova.org/ahf

Urgent Heart Failure Outpatient Clinics – Successfully Managing Preventable Hospitalizations



Optimal management of heart failure patients requires a prompt response to symptoms indicating a deterioration in health status. Many hospitalizations for decompensated heart failure are considered preventable if patients are identified and treated in a timely manner.

Beginning in 2018, a team of heart failure cardiologists, pharmacists, APPs and RNs have worked together to design and deploy a protocol for outpatient IV diuretics for volume-overloaded heart failure patients. The result was the creation of an APP-led heart failure clinic providing patients with same-day or next-day evaluations, lab assessment and outpatient IV bolus diuretics.

The clinic operates Monday – Friday 8 a.m. – 4 p.m. at IHVI's Inova Fairfax Medical Campus location and on a limited schedule at Inova Loudoun Hospital. The team is working on expanding capacity in 2023.

“We’re pleased our new location has allowed us to expand capacity and continue to treat the majority of patients without admitting them to the hospital.”

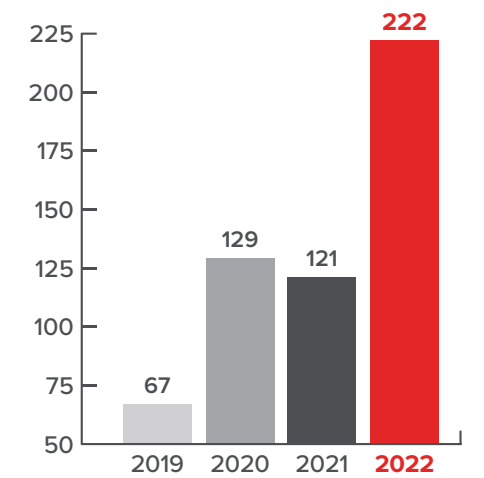
Carolyn Rosner, Director of IHVI Innovative Programs

Heart Failure Clinic Statistics

Patient Characteristics	
Median Age	74
Gender	61% male
HFpEF Dx	52%
Chronic Kidney Disease (GFR <60)	74%
Previous HF Hospitalization	71%
HF Hospitalization Within Last 6 Months	55%
Treatment	
Received IV Diuretics	95%
Thiazide Augmentation	64%
Outcomes	
Diuretic Changed at Initial Visit	48%
Discharged Home	90%
Subsequent Admission Within 30 Days	28%
30-Day Survival	94%

Based on 521 visits from 220 unique patients from Jan. 1 through mid-October 2022

Urgent Heart Failure Clinic Patient Volume



Full-year data | Inova Fairfax Medical Campus patients only

Refer a Patient

phone 703.776.2529
hours Mon. – Fri. | 8 a.m. – 4 p.m.



IHVI's advanced heart failure and transplant team

Significant Growth in Heart Transplants

IHVI is now the ninth busiest heart transplant center in the U.S. Even as the program's volume has more than doubled over the past five years, clinical outcomes remain excellent, with the one-year post-transplant survival rate at 93%.

Shashank Desai, MD, MBA, IHVI's Director for Strategy and Growth and Director of Thoracic Transplant, attributes the exponential growth to three key factors: innovations in managing patients with heart failure and cardiogenic shock so they are better candidates for transplant, partnerships with healthcare organizations and cardiology practices throughout the region that have expanded access to advanced treatment protocols, and the decision by Inova's leadership to invest resources in communities underserved by transplant services.

Hub-and-spoke model for cardiogenic shock

The expertise of the multidisciplinary cardiogenic shock team at Inova Fairfax Medical Campus is now available to more than 30 hospitals in a regional "hub-and-spoke" model (see page 28).

"By building this infrastructure and focusing on best practices, we saw survival rates skyrocket because we were able to deploy decision making and intervention in a much timelier fashion for these complex patients," said Dr. Desai. "Our use of devices like Impella® and ECMO grew, and we saw an increase in the number of patients who became eligible for transplantation as a way out of cardiogenic shock."

A partnership for advanced heart failure expertise

Inova's comprehensive approach to treatment involves an advanced heart failure and transplant program that uses proven clinical protocols, including medications and devices, as either a bridge to transplant or a therapeutic intervention to avoid transplantation for patients whose condition improves.

"One of the biggest drivers of transplant growth has been the system's collaborative approach to partnering with surrounding cardiology groups to facilitate timely identification and evaluation of patients in need of advanced therapies," said surgeon Daniel Tang, MD, Surgical Director of Inova's Cardiothoracic Transplant Program.

"Nationwide, less than 1% of symptomatic patients are actually seen by a heart failure specialist," added Dr. Desai. "Inova is trying to change that by bringing our specialists to the cardiologists and their patients."

Inova has embedded heart failure specialists in cardiology practices and locations throughout Northern Virginia, making their services more accessible.

Meeting community needs

The growth in heart transplants is also a result of Inova's commitment to identifying unmet community needs and investing resources in those communities. More than 100 cardiologists are now affiliated with our system, including dozens of highly trained interventional specialists as well as cardiac surgeons. Working collaboratively within IHVI and alongside clinicians throughout the region creates a seamless continuum of care that benefits all patients with heart disease.

This past year, the addition of another transplant surgeon, Katherine Klein, MD, further increased our program's capacity. Dr Klein also serves as IHVI's Regional Cardiothoracic Surgery Director. "I have a 360-degree perspective of each patient because I have the opportunity to do the preoperative assessment and the surgery, manage the patient in the cardiovascular surgical ICU, and collaborate with the referring cardiologist after discharge," Dr. Klein said.

IHVI Explores Electronic Alerts for Heart Failure Therapy

Physicians at IHVI are investigating a unique approach to improve care for patients with heart failure. PROMPT-HF (PRagmatic trial Of Messaging to Providers about Treatment of Heart Failure) is a clinical trial designed to test if a timely and targeted best practice advisory messaging system that alerts clinicians to guideline-indicated and FDA-approved recommendations for medical treatment of heart failure with a reduced ejection fraction (HFrEF) would lead to increased medical therapy prescriptions for heart failure.

Led by principal investigator and IHVI Heart Failure and Transplant Section Chief Mitchell Psotka, MD, PhD, the randomized, single-blind intervention is taking place in Inova outpatient clinics and five Inova hospitals through 2023. According to Dr. Psotka, "The goal of this study is to generate evidence that guides the efficient implementation of therapies to improve life and longevity for heart failure patients at Inova and to provide an excellent guideline-based standard of care for heart failure patients worldwide."

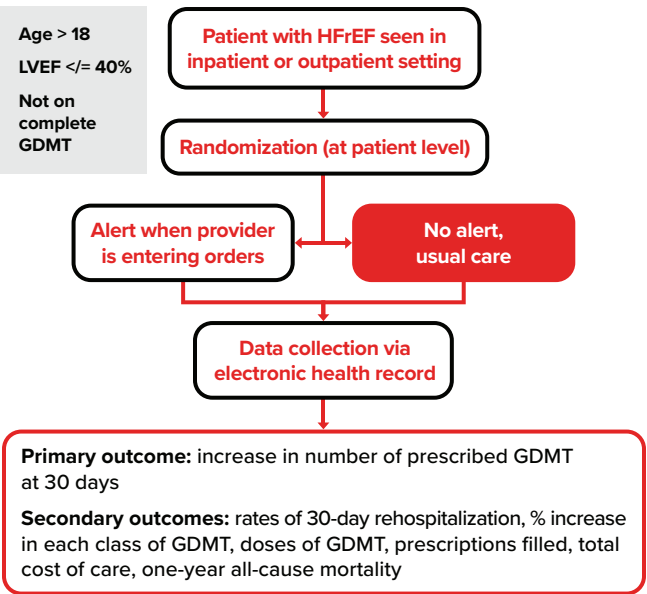
Study design

When clinicians access a heart failure patient's electronic medical record, they receive notification with recommendations for medical therapy based on the patient's characteristics. According to IHVI informaticist and Inova Cardiovascular Information System Medical Director Tina Slottow, MD, the practice of medical informatics "allows clinicians to work smarter, not harder. The PROMPT-HF study provides clinicians timely information and tools to best care for their patients by promoting seamless care through well-designed technology."

The medical record alerts are triggered by the presence of heart failure and the patient's left ventricular ejection fraction and gives the provider information and ordering options for:

- Recommended evidence-based medications that could improve the patient's care
- Monitoring and follow-up requirements for prescribing these medications

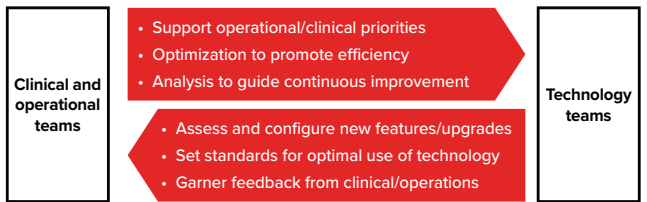
The accompanying order set was designed to simplify implementing the recommendations and maximize utilization of the best available guideline directed therapy for heart failure.



The primary outcome for the trial is the proportion of identified patients with heart failure who have an increase in the number of prescribed evidence-based therapies for HFrEF (beta-blockers, ACE-I/ARB/ARNI, MRA, SGLT2i) 30 days after randomization. Secondary outcome measures are all-cause hospitalization and all-cause mortality at 30, 90, 180 and 365 days, determined by a review of medical, hospital and billing records.

About clinical informatics at Inova

The clinical informatics team at Inova draws on a deep clinical understanding of how technology can improve patient outcomes. The team generates solutions via technology based on clinical indicators providers already use by triggering digital alerts intended to prompt earlier use of interventions and treatments for improved patient outcomes. In essence, the group uses existing computer systems to prompt clinical decision support at the point of care.





Congenital Cardiology Programs Offer Full Spectrum of Care

For more than 30 years, Inova has provided specialized care to children with congenital heart disease (CHD) through Inova Children’s Heart Center. An adult program launched in 1994 to give pediatric CHD patients a seamless transition to continue under our care. The program provides a medical home with expert care for young adults managing their CHD independently of their parents for the first time and for adults newly diagnosed with CHD or new to Inova.

“We can diagnose congenital heart disease in utero and treat the patient throughout childhood, in the teenage years and long into adulthood – from the same campus,” said Lucas Collazo, MD, Surgical Director of the ACHD Program at IHVI.

The pediatric and congenital heart surgery program recently added a third pediatric cardiac surgeon, James St. Louis, MD, FACC, FACS, who joined Inova with more than 20 years of experience and will serve as Director of Pediatric Cardiac Surgery and Co-Director of Inova Children’s Heart Center. He has specialized expertise in advanced heart failure therapies for children as well as neonatal heart differences.

“I’m excited to be part of the Inova team,” said Dr. St. Louis. “The integration and alignment of services here creates a patient-centric, family-friendly culture and demonstrates Inova’s commitment to cardiac health. I look forward to helping build on that vision to help in becoming a top program in congenital heart nationally.”

“We are uniquely positioned to care for whole families,” said Mitchell Cohen, MD, a pediatric and adult

congenital electrophysiologist and Co-Director of Inova Children’s Heart Center. “Having Inova’s Women’s Hospital and Inova L.J. Murphy Children’s Hospital in the same building represents the essence of our collaboration. If we suspect a fetus has a congenital heart defect, experienced pediatric cardiac surgeons and pediatric cardiologists are in the same tower, so mom and baby can stay in the same location and get the required cardiac care. Similarly, when we identify children or adults with heritable genetic conditions, family members can work with the same genetic counselor throughout testing. And, if they are diagnosed with a

channelopathy or cardiomyopathy, we can provide the most current treatment strategies to family members with those conditions. That’s pretty incredible.”

“Adults with CHD need different care than children with CHD, but it’s not uncommon for them to receive treatment at a pediatric facility specializing in congenital heart defects but not in the unique aspects of adult care,” said IHVI ACHD Medical Director and cardiologist Anurag Sahu, MD.

IHVI’s ACHD Program includes outpatient and inpatient services and cares for patients with simple to complex heart lesions as well as those with advanced CHD-related heart

failure. The program also cares for CHD patients with heart rhythm disorders, pulmonary vascular disease and expecting moms with CHD. In addition, the program offers procedures for complex heart rhythms, catheter-based interventional procedures including valve replacement, and, when needed, cardiac surgery for ACHD patients, including transplantation.

“One of our program’s unique offerings is structural interventions for CHD,” noted Dr. Sahu. “With our adult and pediatric interventional cardiologists working together on complex structural interventions, ACHD patients get the best possible outcomes.”

Neonatal Procedures

Complex Cardiac Repairs	13
PDA Ligations – Premature Infant	7
Total	20

YTD Jan. 1 – Dec. 15, 2022

“With fetal, pediatric and adult specialization in congenital heart disease, Inova offers a full spectrum of cardiac care to CHD patients and their families – a continuity of care that is unmatched in our region.”

Lucas Collazo, MD

Pediatric Congenital Heart Surgery

Procedure	2022
Anomalous Coronary Surgery	0
ASD	11
ASO	2
AVC (Complete, Partial)	7
AVR/Supra-Sub AS	4
COA/Hypoarch	0
COA Nonpump	4
ECMO Cannulation	19
ECMO Procedures	23
Glenn/Fontan	4
MV Repair/Replacement	1
NORWOOD/STAT 5	1
Pacer/ICD	7
PAPVR	1
PDA	9
PVR/Conduit/RVOT Procedure	4
Systemic Pulmonary Shunt	0
TAPVR	2
Thoracic Procedure	1
TOF	6
Tricuspid Valve	0
VSD	6
Other STAT Categories	6
Other Cardiac Nonpump	23

Total 141

YTD Jan. 1 – Dec. 15, 2022
ECMO procedures include any re-explorations, cannula adjustments, associated procedures and eventual decannulations.

Adult Congenital Heart Surgery

Procedure	2022
Anomalous Coronary Surgery	3
ASD	4
AVC (Complete, Partial)	0
AVR/ASAA/Sub AS	8
MVR	1
PVR	2
PAPVR	3
VSD	1
Other	14

Total 36

YTD Jan. 1 – Dec. 15, 2022

+ Refer a Patient

Adult Congenital Heart Program 703.776.3599
Pediatric Congenital Heart Program 703.776.4428
Fetal Congenital Heart Program 703.776.6371
web inova.org/chd



(L to R): Mitchell Cohen, MD; Lucas Collazo, MD; Qurratulaen Khawaja-Javaid, PA; Anurag Sahu, MD

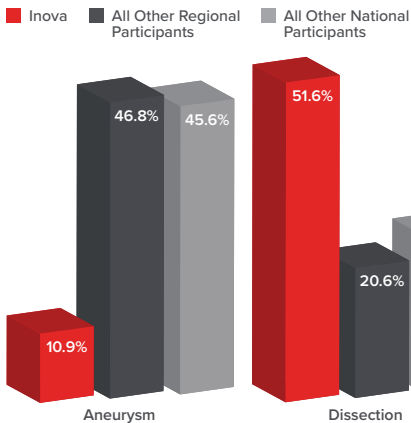
Vascular Services

Vascular Procedure Volume

Vascular Procedure	2022
Carotid	272
Carotid Endarterectomy (CEA)	231
Transcarotid Artery Revascularization (TCAR)	21
Carotid Artery Stent	20
Aortic	158
Endovascular Abdominal Aortic Aneurysm Repair (EVAR)	81
Open Abdominal Aortic Aneurysm (AAA) Repair	14
Thoracic Endovascular AAA Repair (TEVAR)	63
Lower Extremity	588
Infrainguinal Bypass	101
Peripheral Vascular Interventions (PVI)	487
Hemodialysis	332
Hemodialysis Access	332
Total Procedural Volume	1,350

Rolling 4Q ending Q3 2022, source: VQI database

TEVAR Pathology Aneurysm vs. Dissection



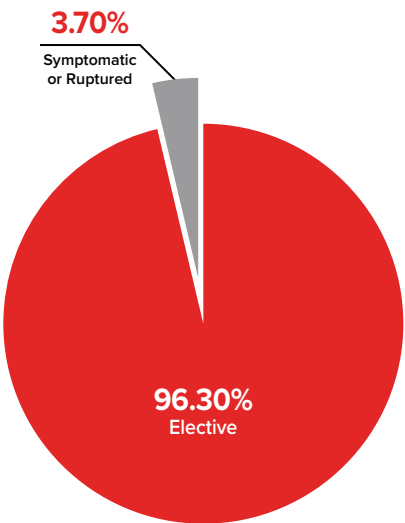
Rolling 4Q ending Q3 2022, source: VQI database

Vascular Procedure Mortality

Vascular Procedure	Inova	All Other Regional Participants	All Other National Participants
EVAR			
Death During Hospitalization	0.00%	1.10%	1.90%
TEVAR			
Death During Hospitalization	4.70%	6.40%	5.30%
CEA			
Death During Hospitalization	0.00%	0.30%	0.40%
Stroke and Death	0.00%	0.00%	0.10%
PVI			
Death During Hospitalization	0.80%	1.30%	1.30%
Infra			
Death During Hospitalization	2.00%	1.00%	1.40%
Hemodialysis Access			
Death During Hospitalization	0.00%	0.20%	0.20%

Rolling 4Q ending Q3 2022, source: VQI database

Urgency of Endovascular AAA Repair (EVAR)

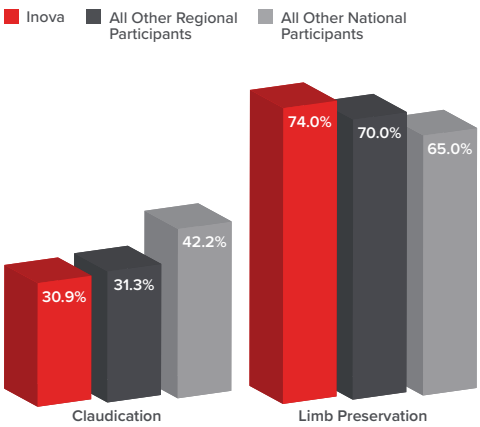


Rolling 4Q ending Q3 2022, source: VQI database



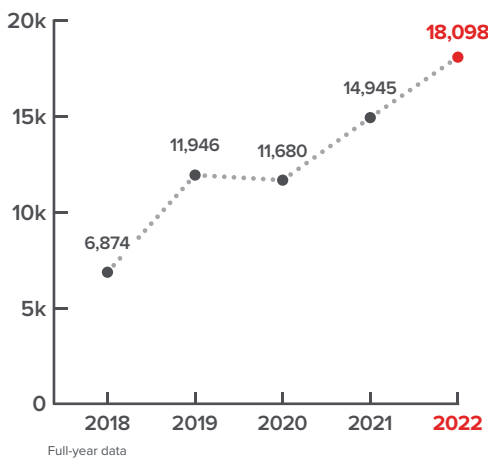
IHVI's vascular surgery hybrid OR team

Peripheral Vascular Interventions



Rolling 4Q ending Q3 2022, source: VQI database

Vascular Ultrasound Studies



Full-year data



Refer a Patient

phone 571.472.4600
email vascular@inova.org
web inovavascular.org

The Society for Vascular Surgery Vascular Quality Initiative (VQI)® is a collaboration intended to improve the quality, safety and effectiveness of vascular care. Data presented include all Inova hospital locations. Included cases are those derived from the adjudicated VQI database.



Expanding Options for Treating Complex Aortic Disease

A multidisciplinary collaborative approach combined with state-of-the-art technologies offer Inova patients access to leading-edge endovascular treatment options for complex aortic conditions.

Cardiothoracic surgeons, vascular surgeons and interventional radiologists at IHVI work together to treat complex vascular diseases and conditions. They meet regularly to discuss cases to determine the best course of treatment. Then, they work together to perform endovascular procedures using minimally invasive techniques and the latest aortic endograft devices to provide patients with a comprehensive and tailored treatment plan that achieves optimal results.

The team approach is a significant advantage. “We harness the best of our talents, working together to bring patients the most advanced, effective treatments,” said Richard Neville, MD, Chair, Inova Department of Surgery; Director, Inova Vascular Surgery; and Associate Director, IHVI.

Leading-edge devices

The aortic disease team has been involved in several pivotal clinical trials to test the most promising aortic repair technologies, including the major trials for infrarenal aortic aneurysm grafts. These advanced grafts allow treatment of aortic aneurysms below the kidneys while sparing the critical hypogastric artery. The team was also recently invited to participate in a trial to evaluate aortic repair in zone zero, the section of the aorta just beyond the aortic valve and extending to the first branch.

“Because of our active research involvement, patients have access to the newest devices and other leading-edge treatments,” said cardiothoracic surgeon Liam Ryan, MD.

In the last year, Inova became one of the first sites in the nation to offer the thoracic branch endograft outside of clinical trials. This endograft – the first such device to be FDA approved – allows for stent positioning in the device’s opening after the thoracic branch endograft is placed to allow blood to continue flowing freely to the arm.

The team also treats thoracoabdominal aneurysms with fenestrated endovascular grafts, using custom-made devices based on a patient’s own unique anatomy. Previously, this required major surgery to open the chest and abdomen, place a surgical graft, and reimplant all the critical branches that supply blood to the liver, spleen, intestines and kidneys. However, using this innovative technology, IHVI can offer an effective, minimally invasive treatment to many patients, including those who would not have been able to undergo a complex open surgery.

The future of aortic disease care

Using a multidisciplinary team-based approach employing a wide range of endovascular treatments has a direct positive impact on patients. Not only do these techniques offer more treatment options to patients with previously inoperable conditions, but they also significantly improve patient outcomes.

“At Inova, our commitment to quality ensures that we continually evaluate how we can improve our care and outcomes,” said David Spinosa, MD, Section Chief, Interventional Radiology, Inova Fairfax Medical Campus. “We actively participate in data collection and report our outcomes by sharing our data and results with both regional and national databases.”



Aortic care team (L to R): Richard Neville, MD; Dipankar Mukherjee, MD; Kendal Endicott, MD; David Spinosa, MD

Inova Wound Healing Centers and Limb Preservation

Diabetic complications, such as nonhealing wounds on the legs and feet, are one of the most significant risk factors leading to amputation. In fact, about 60% of all nontraumatic lower limb amputations are related to diabetes. Not only does limb loss significantly affect daily life, but it also increases the risk of additional health problems and may even decrease lifespan.

Estimates show that about 85% of all diabetes-related amputations can be prevented with early intervention and specialized treatment.

IHVI offers access to comprehensive, highly specialized care through the Inova Wound Healing Centers and Inova Vascular physicians for those at risk of limb loss.

Wound Care

The Inova Wound Healing Centers are staffed by a team of clinicians with advanced training in wound management.

Four locations across Northern Virginia offer convenient access to a full spectrum of specialized treatments, including:

- Compression stockings to reduce swelling
- Specialized shoes to accommodate structural foot problems
- Advanced wound dressings
- Topical antimicrobial treatments to heal damaged tissue
- Wound grafts made of synthetic materials or skin substitutes
- Negative pressure wound therapy and hyperbaric oxygen (HBO) therapy, sitting in a pressurized chamber and breathing in pure oxygen to promote faster healing
- Autologous platelet therapy, injecting a concentration of the patient’s own blood platelets into the wound to accelerate healing
- Prosthetics and rehabilitation services for patients who need an amputation

Limb Preservation

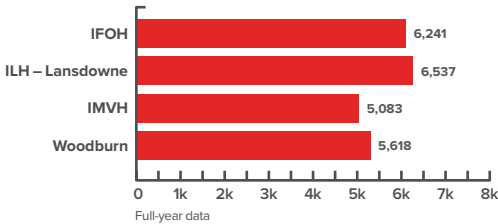
In addition to advanced wound healing services, patients at high risk for losing a limb are evaluated for vascular and endovascular procedures to help restore blood flow to limbs by a multidisciplinary team of vascular surgeons, cardiologists and interventional radiologists. The level of complexity and nature of the underlying disease determine whether follow-

up visits will continue at one of the seven Inova Vascular physician office locations or in one of the four Inova Wound Healing Centers.

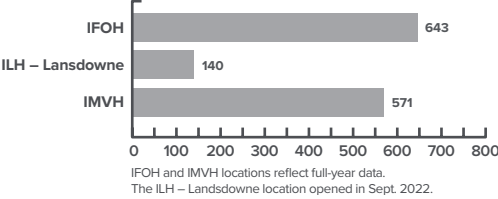
Patients are evaluated for vascular and endovascular procedures to help restore blood flow to limbs in addition to advanced wound healing services.

Most patients require weekly or biweekly follow-up visits, which can usually be done onsite at one of the Inova Wound Healing Centers. Patients return to their vascular surgeon for “remission” visits (every two, three or six months). Remission visits continue for patients whose condition has stabilized but who remain at risk for limb loss.

Inova Wound Healing Centers 2022 Patient Visits



Inova Wound Healing Centers HBO Treatment Visits



24,833 Wound Healing Total Visits

+ Refer a Patient

Inova Wound Healing Centers 703.664.8025

Coordinated Treatment Saves Patient from Double Amputation

For several years, Cynthia Martin, 54, had been working as a federal police officer in Southern Maryland. When the COVID-19 pandemic temporarily shut down most industries in March 2020, she found herself far less active than usual.

In January 2021, she noticed a sore on her left heel that wasn't going away. She tried nursing it herself with over-the-counter ointments and medicines, but nothing worked.

Over the course of 2021, Cynthia saw multiple specialists, including a podiatrist, wound care specialist and vascular surgeon. All agreed she had poor blood flow in her left leg, but they couldn't seem to find a treatment that helped. She underwent stent placement to open her blocked arteries and improve blood flow in her leg, but it wasn't long until she noticed a new sore on her other heel.

After another stenting procedure in her right leg and complications with her left stent, she was feeling defeated. "I had an angiogram with a vascular specialist, and the doctor told me he couldn't do anything," she said. "He told me the only thing we could do was amputate both legs."

Seeking options to avoid amputation

Cynthia wanted to do everything she could to avoid amputation. A second specialist recommended debridement, which could only occur if she stopped taking blood thinners, which were necessary to prevent blood clots following her stenting procedures.

Cynthia was frustrated. The sores on her heels made it nearly impossible for her to move without pain. "How am I going to get better if these doctors won't even treat me?" she wondered. In a moment of desperation, she searched online for "wound care in Virginia" and scheduled an appointment at one of the Inova Wound Healing Centers.

Cynthia met with Lonnie Fontana, PA-C, who evaluated her and agreed that her sores were likely the result of a blood flow problem and diabetes. She immediately scheduled Cynthia to be evaluated by a vascular surgeon at the Inova Vascular – Fairfax office.



Cynthia Martin

Focus on limb preservation offers hope

For patients at high risk of amputation, Inova's vascular surgeons and wound healing specialists work together to offer specialized wound treatments, endovascular procedures and vascular surgeries.

"Once I was at Inova, they said they were going to do everything they could to save my legs," Cynthia said. It gave her hope for the first time that her condition might improve.

Advanced wound treatment was initiated, and Cynthia was also seen by Dipankar Mukherjee, MD, Chief of Vascular Surgery at Inova Fairfax Hospital, who determined she needed bypass surgery in her left leg. The bypass rerouted blood flow around her blocked arteries and improved her

symptoms nearly immediately. Inova's wound specialists then worked for several months to save both of her legs. Treatments included care such as skin substitutes with living cells and a special boot to remove pressure from her foot. Cynthia's diabetic sores on the left foot healed. However, the sores on Cynthia's right foot worsened, and the team sprang into action to coordinate a timely intervention.

In April 2022, bypass surgery was performed on Cynthia's right leg and treatment using advanced wound care continued. Today, all her sores have fully healed, and she is back on her feet. Cynthia is in physical therapy to increase her strength after spending so much of the last two years immobile, and she's grateful every day that she still can walk at all.

"The wound healing and limb preservation team at Inova changed my life. If I hadn't sought their opinion, I would have lost my legs – and that would have been absolutely devastating."

Cynthia Martin

+ Refer a Patient

phone 571.472.4600
email vascular@inova.org
web inovavascular.org

IHVI Sites and Services Grid

Inova Heart and Vascular Institute	IFMC	IAH	IFOH	ILH	IMVH	OP/AMB
Adult Congenital Heart Center	•					
Advanced Heart Failure Program	•					
Heart Failure Specialist Consults	•	•		•	•	•
Heart Transplantation Medical Management	•					•
Mechanical Circulatory Support – VAD/LVAD	•					
Remote Home-Based Monitoring	•					•
Cardiac and Respiratory Failure	•					
Cardiogenic Shock Team	•					
ECMO	•					
Impella	•			•		
Pulmonary Embolism Response Team (PERT)	•	•		•		
Cardiac Catheterization	•	•		•		
AMI	•	•		•		
Complex Coronary Intervention	•	•				
PCI	•	•		•		
Cardiac Rehabilitation	•	•		•	•	
Cardiac Rhythm Disorders/Electrophysiology	•	•		•		•
AFib Ablation	•	•		•		
AFib Center	•					•
AV Node Ablation	•	•		•		
PVC and VT Ablation	•					
SVT Ablation	•	•		•		
Cryoballoon Ablation	•					
Radiofrequency Ablation	•	•		•		
FIRM Mapping and Ablation	•					
Fluoroless EP Studies	•	•		•		
ICD	•	•		•		
Implantable Loop Recorders	•	•		•		
Laser Lead Extraction	•					
Left Atrial Appendage Occlusion	•					
Pacemakers	•	•		•		
Conventional	•	•		•		
Conduction System	•	•		•		
Leadless	•	•		•		
BiV	•					
Cardio-Oncology Program						•
Cardiac Surgery	•					
Adult Congenital Surgery	•					
AFib Surgery/Convergent Therapy	•					
Aortic Surgery	•					
Heart and Lung Transplant	•					
Minimally Invasive CABG (Robotic Assisted)	•					
Open and Minimally Invasive Valve Replacement Surgery and Repair	•					
Open CABG	•					

IFMC

Inova Fairfax Medical Campus
Inova Heart and Vascular Institute
3300 Gallows Rd.
Falls Church, VA 22042

IAH

Inova Alexandria Hospital
4320 Seminary Rd.
Alexandria, VA 22304

IFOH

Inova Fair Oaks Hospital
3600 Joseph Siewick Dr.
Fairfax, VA 22033

Inova Heart and Vascular Institute	IFMC	IAH	IFOH	ILH	IMVH	OP/AMB
Cardiovascular Genomics Center	•					•
Lung Services	•	•	•	•	•	•
Alpha-1 Antitrypsin Deficiency Clinical Resource Center	•					•
Cystic Fibrosis Care Center	•					•
Interventional Pulmonology	•			•		
Lung Transplantation Medical Management	•					•
PERT	•	•		•		
Pulmonary Fibrosis Foundation Care Center	•					•
Pulmonary Hypertension Comprehensive Care Center	•					•
Pulmonary Rehabilitation	•	•		•	•	
WASOG Sarcoidosis Clinc	•					•
Noninvasive Cardiovascular Diagnostics	•	•	•	•	•	•
Cardiac MRI	•	•*				•
Cardiac Stress Testing (Nuclear Cardiology, Pharmacologic)	•	•	•	•	•	•
CT Angiography	•	•	•	•	•	•
CT Calcium Scoring	•	•		•	•	•
Echocardiography (Stress Echo)	•	•	•	•	•	•
Peripheral Vascular Ultrasound (Venous, Arterial)	•	•	•	•	•	•
Pediatric Cardiovascular Services	•					
Catheterization	•					
Cardiac EP	•					
Cardiac Surgery	•					
Congenital Heart Disease Program	•					•
Genomics Testing and Counseling	•					•
Structural Heart Disease Program	•					
PFO Closure	•					
Stroke Risk Reduction – WATCHMAN FLX	•					
TAVR	•					
Transcatheter Mitral Valve Repair – MitraClip	•					
Transcatheter Mitral Valve Replacement	•					
Transcatheter Tricuspid Valve Replacement	•					
Vascular Services	•	•	•	•	•	•
Endovascular and Open Surgical Procedures	•	•	•	•	•	
HBO Therapy			•	•	•	•
Limb Preservation	•	•	•	•	•	•
Lower Limb Revascularization	•	•	•	•	•	
Peripheral Arterial Disease Treatment	•	•	•	•	•	•
Vascular and Interventional Radiology	•	•	•	•	•	
Vascular Diagnostic Imaging	•	•	•	•	•	•
Wound Care	•	•	•	•	•	•

*Inpatient only

ILH

Inova Loudoun Hospital
Schaufeld Family Heart Center
44035 Riverside Pkwy., Suite 120
Leesburg, VA 20176

IMVH

Inova Mount Vernon Hospital
2501 Parkers Ln.
Alexandria, VA 22306

OP/AMB

Inova outpatient/ambulatory services – includes services now located at Inova Specialty Center and locations outside Inova hospitals.

Join us – in person or remotely

IHVI Advanced Heart Failure Symposium
Ritz Carlton Tysons Corner & Virtual
April 15, 2023

IHVI Grand Rounds
Second Tuesday of every month | 12:30 – 1:30 p.m.
* Free CME Accredited Program



To register for these events,
scan the QR code or visit
inova.org/hearteducation

Clinical Trials
Check for currently enrolling clinical trials at inova.org/trials

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Inova Heart and Vascular Institute

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703.776.8000

Programs and Services

Inova Arrhythmia
571.472.3270
Email: arrhythmia@inova.org
Web: inova.org/arrhythmia

Inova AFib Center
571.472.2342
Email: afib@inova.org
Web: inova.org/afib

Inova Cardiac Rehabilitation Program
Inova Alexandria Hospital
703.504.3398
Inova Fairfax Medical Campus
703.776.3635
Inova Loudoun Hospital
703.858.6674
Inova Mount Vernon Hospital
703.664.8238
Web: inova.org/cardiarehab

Inova Cardiac Surgery
571.472.4600
Web: inova.org/cvsurg

Inova Cardiology
571.472.8940

Inova Cardio-Oncology Program
571.472.2972
Web: inova.org/cardioonc

Inova Cardiovascular Genomics Program
Adult: 703.776.6453
Pediatric: 703.942.8300
Email: cvgenomics@inova.org
Web: inova.org/cvgenomics

Inova Congenital Heart Disease Program
Adult: 703.776.3599
Email: achdclinic@inova.org
Pediatric: 703.776.4428
Fetal: 703.776.6371
Web: inova.org/chd

Inova Heart Failure and Transplant
703.776.6453
Email: heartfailure@inova.org
Web: inova.org/ahf

Inova Urgent Access Heart Failure Clinics
703.776.2529

Inova Lung Services and Transplant
703.776.7939
Email: ltxreferrals@inova.org
Web: inova.org/lung

Inova Sports Cardiology Program
571.472.2900
Email: sportscardiology@inova.org
Web: inova.org/sportscardio

Inova Structural Heart Disease Program
571.472.4669
Email: valve@inova.org
Web: inova.org/structuralheart

Inova Vascular Services
571.472.4600
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