Inova Heart and Vascular Institute

2019 Outcomes

INOVA®
Heart and Vascular Institute

Outcomes 2019

Our mission at Inova is to provide world-class healthcare – every time, every touch – to each person in every community we have the privilege to serve.

Inova Heart and Vascular Institute is improving patient outcomes through their commitment to excellence throughout the organization. Our performance on patient safety, quality and high reliability means thousands of patients with complex heart, vascular and pulmonary disease are living longer, healthier lives.

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

Inova Heart and Vascular Institute

It is an exciting time at Inova Heart and Vascular Institute (IHVI), as we focus on excellence in clinical care, culture, research and innovation, while we continue our drive to become a top-tier cardiovascular institute.

We have reorganized our major service lines, recruited top talent from across the country and created a work culture that recognizes excellence and values trust. Under the leadership of J. Stephen Jones, MD, MBA, FACS, we have moved to a system-wide organizational structure to foster the very highest quality care. Shared decision-making and cross-disciplinary teams have resulted in substantial improvement in outcomes. We are committed to providing personalized care and the highest quality, state-of-the-art treatment to everyone we have the privilege to serve as part of our cardiovascular program.

The Heart and Vascular Service Line has seen major growth across the board, particularly in the areas of interventional cardiology, surgery and advanced heart failure. We have introduced new programs in several areas, including cardio-oncology, women's heart health and adult congenital heart disease. We have also established local heart failure clinics to better serve the needs of the community. Many other existing programs have been expanded and reorganized to provide easily accessible, quality care.

Our Protected PCI program for high-risk patients and our approach to shock treatment continue to be models of excellence on a national level. The innovative, multidisciplinary team model we implemented for the treatment of cardiogenic shock facilitates timely decision-making and intervention, which have resulted in significantly improved outcomes.

Our outstanding performance has been recognized by many measures, including *U.S. News & World Report* rankings as "High Performing" in four cardiac specialties: aortic valve surgery, heart bypass surgery, abdominal aortic aneurysm repair and heart failure. We are particularly proud of our commitment to patient safety and compassionate care. It is gratifying to see our efforts to provide an enhanced patient experience produce improved care and higher patient satisfaction.

Our faculty continues its dedication to innovation and research with 250+ publications in peer-reviewed journals in the past year, a high level of engagement and participation in major meetings and conferences throughout the world, and major growth in clinical trial enrollment. Our unique leadership training program equips physicians to advocate for quality care in the constantly evolving healthcare environment. The newly instituted fellowship training program attracted 400+ applicants, many from prestigious programs across the nation and around the world – further evidence of IHVI's increasing recognition and prominence. Thanks to generous support from Bill and Marty Dudley through the Dudley Family Foundation, we instituted an international fellowship program in cooperation with the University of Brescia in Italy.

We want to personally thank all of our patients and reaffirm our strong commitment to help everyone in our community and beyond to live stronger, healthier and more fulfilling lives. We are enormously proud of the outstanding achievements of our medical, nursing and professional staff, and look forward to even greater success in the coming years.

Christopher O'Connor, MD, MACC, FESC, FHFSA
President
Inova Heart and Vascular Institute

Heather Russell, RN, MS, FABC
Vice President & Administrator
Inova Heart and Vascular Institute

Marissa Jamarik, DNP, RN, NEA-BC
Vice President of Nursing
Inova Heart and Vascular Institute

About IHVI – 2019

163,400
Patient Visits

5
Cardiac Surgery ORs/Hybrid OR

23
Catheterization EP/IR Labs

5
Hospitals

209
Dedicated Cardiac Beds

29
Inova Cardiology, Arrhythmia, Cardiac Surgery, Thoracic Surgery and Vascular outpatient practice locations in Northern Virginia and Maryland
inova.org/IMG

12
Noninvasive cardiovascular imaging and diagnostic service locations

Patients treated from **47** states and **5** territories, countries and armed forces locations worldwide

For a complete list of awards and recognition, visit **inova.org/awards**

Inova Heart and Vascular Institute's clinical capabilities cover the full spectrum of complex cardiovascular and pulmonary care from medical evaluation and diagnostic testing to the most innovative minimally invasive surgical techniques and complex open surgeries, including heart and lung transplantation. A services grid on pages 24-25 highlights specific services available at each of Inova's hospitals.

Inova Fairfax Medical Campus

3300 Gallows Rd.
Falls Church, VA 22042

Inova Fairfax Medical Campus (IFMC), located just outside of Washington, DC, in Falls Church, Virginia, is home to IHVI's dedicated heart hospital which serves as the hub of the system's cardiac, vascular and pulmonary services.

Centers for Medicare and Medicaid Services
"5-star" Rated Hospital (Highest Level of Performance)

U.S. News and World Report Rankings 2019 – 2020
Best Regional Hospital
#1 in Washington, DC Metro Area
#3 in Virginia
High Performing for Aortic Valve Surgery
High Performing for Heart Bypass Surgery
High Performing for Heart Failure
High Performing for Abdominal Aortic Repair

The Leapfrog Group
"A" Hospital Safety Grade
3 consecutive reporting periods
Top Hospital – 2018, 2019

Healthgrades
America's 250 Best Hospitals Award™– 2017, 2018, 2019
Outstanding Patient Experience Award™ – 2019
America's 50 Best Hospitals for Cardiac Surgery Award™ – 2018, 2019
America's 100 Best Hospitals for Cardiac Care Award™ – 2018, 2019
America's 100 Best Hospitals for Critical Care Award™ -– 2018, 2019

Inova Heart and Vascular Institute Hospital Service Sites

Inova Alexandria Hospital

4320 Seminary Rd.
Alexandria, VA 22304

Centers for Medicare and Medicaid Services
"5-star" Rated Hospital

U.S. News and World Report Rankings 2019 – 2020
5 in Washington, DC Metro Area
8 in Virginia
High Performing for Heart Failure

The Leapfrog Group
"A" Hospital Safety Grade
3 consecutive reporting periods

Top General Hospital – 2019

Inova Loudoun Hospital
Schaufeld Family Heart Center

44045 Riverside Pkwy.
Leesburg, VA 20176

Centers for Medicare and Medicaid Services
"5-star" Rated Hospital (Highest Level of Performance)

U.S. News and World Report Rankings 2019 – 2020
High Performing for Heart Failure

The Leapfrog Group
"A" Hospital Safety Grade
16 consecutive reporting periods

Healthgrades
America's 250 Best Hospitals Award™ – 2018, 2019
Patient Safety Excellence Award™ – 2017, 2018, 2019

Inova Fair Oaks Hospital

3600 Joseph Siewick Dr.
Fairfax, VA 22033

Centers for Medicare and Medicaid Services
"5-star" Rated Hospital (Highest Level of Performance)

U.S. News and World Report Rankings 2019 – 2020
Best Regional Hospital
#8 in Washington, DC Metro Area
#11 in Virginia
High Performing for Abdominal Aortic Repair

The Leapfrog Group
"A" Hospital Safety Grade
15 consecutive reporting periods

Healthgrades
America's 250 Best Hospitals Award™ – 2017, 2018, 2019
Patient Safety Excellence Award™ – 2017, 2018, 2019

Inova Mount Vernon Hospital

2501 Parkers Ln.
Alexandria, VA 22306

Centers for Medicare and Medicaid Services
"5-star" Rated Hospital (Highest Level of Performance)

The Leapfrog Group
"A" Hospital Safety Grade
11 consecutive reporting periods

All Inova Hospitals

Refer a Patient:
SNAPCare Scheduling
877.634.6682 • F: 571.665.6882

Cardiology consults • Diagnostic cardiology studies
Vascular labs • Vascular consults

Cardiac and Vascular Access
One Call 24/7
Adult: 703.776.5905
Pediatric: 877.900.9543

Direct admission • Transfer • Specialized transport

Patient Experience

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

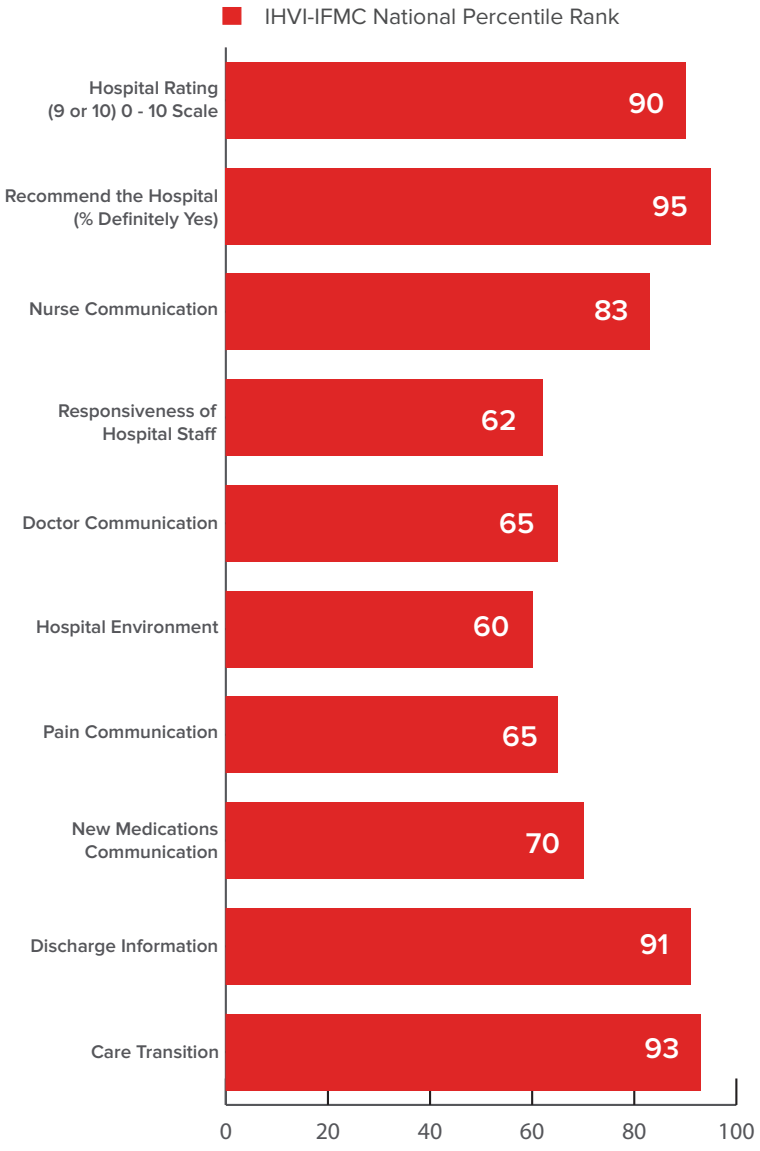
We host a monthly Patient and Family Advisory Council meeting, where a group of former patients and family members provide feedback to our administrative, nursing, patient safety and patient experience leadership.

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

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

HCAHPS

Hospital-based Care

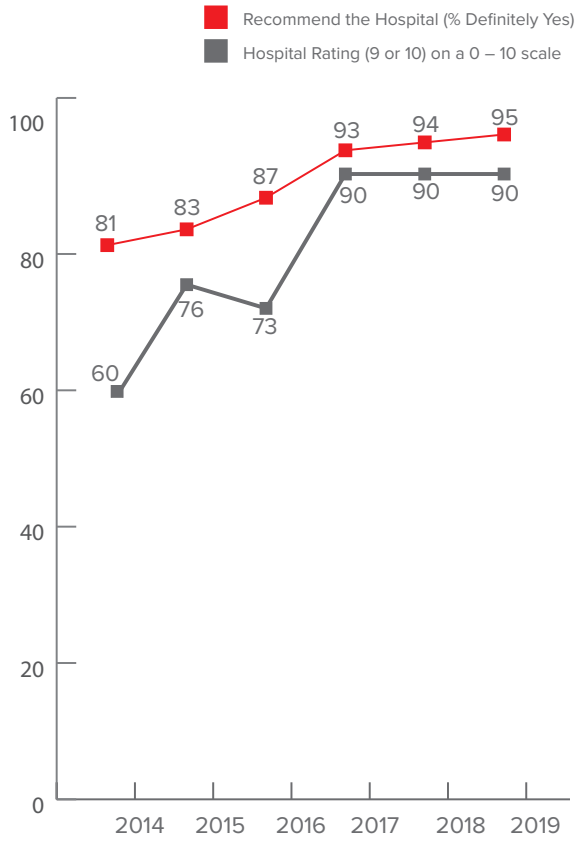


IHVI survey period showing 1/1/2019 - 10/31/2019
Benchmark period 8/1/2019 - 10/31/2019
Results from Press Ganey

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 that measures patients' perspectives of hospital care

Percentile ranking is determined from the All Press Ganey Database of Hospitals in the United States. Database contains 2,700 hospitals nationwide.

HCAHPS Percentile Rank



CG CAHPS

Inova Cardiology Outpatient Physician Offices

96% Likelihood to Recommend

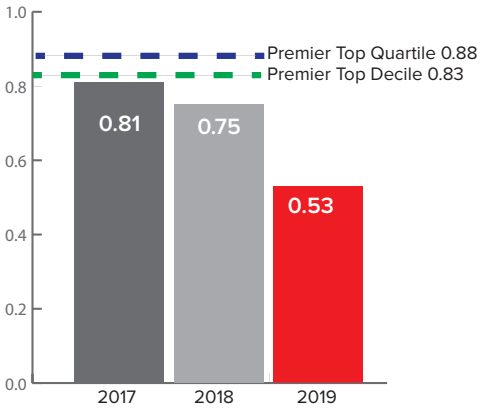
The Clinician and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) is a standard survey developed by the Agency for Healthcare Research and Quality to assess patient perceptions of care provided by physicians and medical groups in doctors' offices.

IHVI survey period: 1/01/2019 - 8/31/2019
Benchmark period 3/01/2019 - 8/31/2019
n = 4,311
Results from Press Ganey

Percentile Ranking as 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.

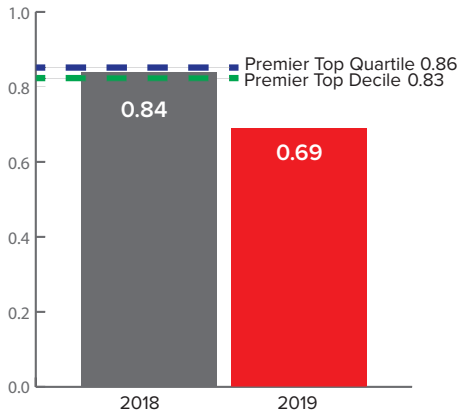
Acute Myocardial Infarction (AMI)

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



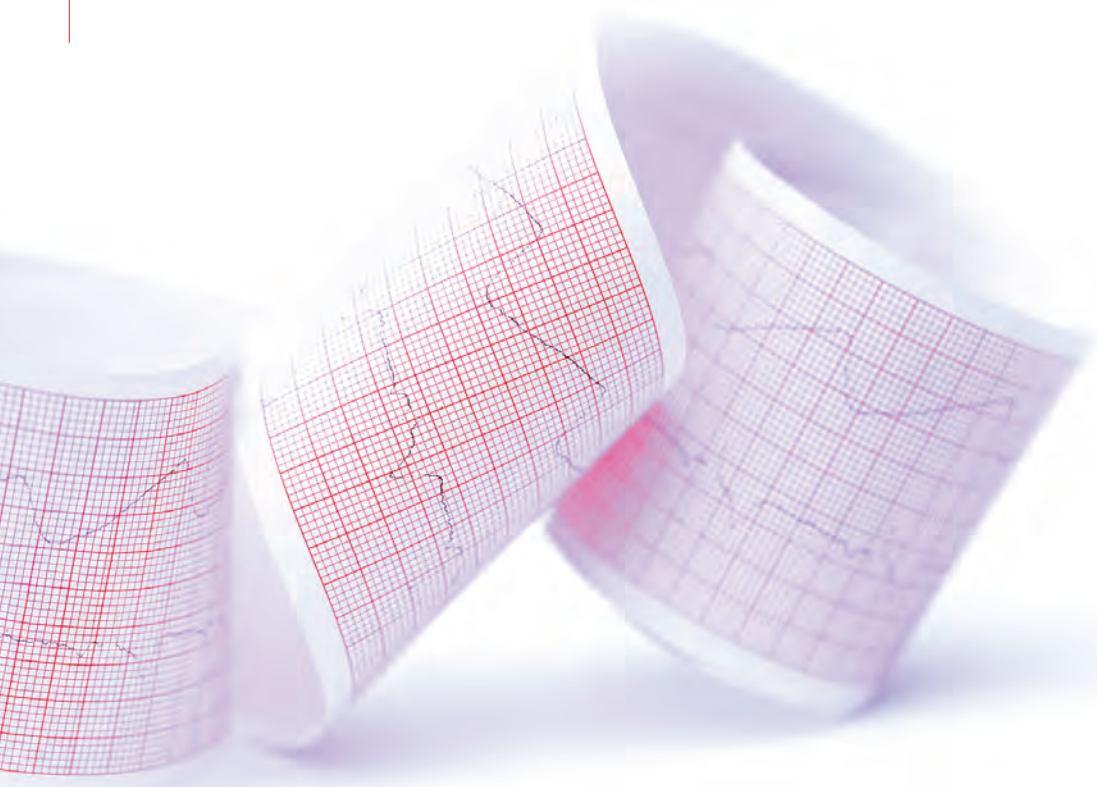
2019 = YTD July 2019

AMI Mortality Performance



2019 = YTD July 2019

Premier Healthcare Database is one of the most comprehensive electronic healthcare databases which has been utilized by the pharmaceutical and device industries, academia, healthcare insurers and healthcare policy makers for clinical, financial and outcomes analyses. (Expected mortality is based on Premier's Standard Practice Risk Methodology.)



2015 Platinum Performance Achievement Award — ACTION Registry – GWTG — NCDR

2016 Platinum Performance Achievement Award — ACTION Registry – GWTG — NCDR

2017 Platinum Performance Achievement Award — ACTION Registry — NCDR

2018 Platinum Performance Achievement Award — ACTION Registry — NCDR

2019 Platinum Performance Achievement Award — Chest Pain – MI Registry — NCDR

Diagnostic Catheterization

Diagnostic Cardiac Catheterization

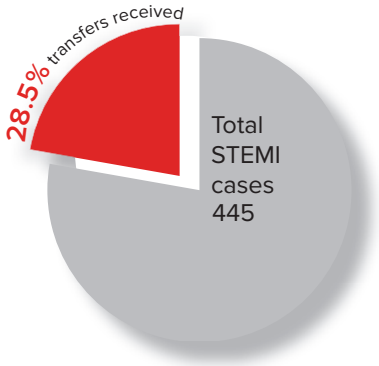
Facility	2019
IFMC	4,898
IAH	740
ILH	324
IHVI	5,962

2019 = rolling four quarters, ending Q2 2019.
IFMC 2019 annualized from year-to-date January – July data

Legend:
IFMC - Inova Fairfax Medical Campus
IAH - Inova Alexandria Hospital
ILH - Inova Loudoun Hospital, Schaufeld Family Heart Center

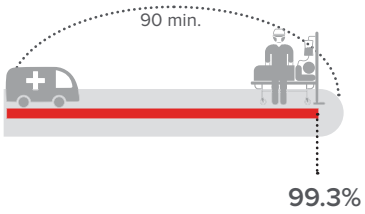
Interventional Cardiology

STEMI Volume and Transfers Received



2019 = rolling 4Q ending Q2 2019

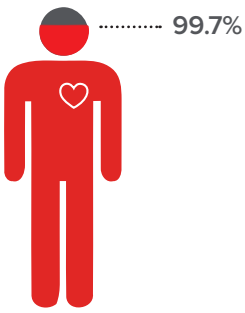
Primary PCI Door-to-Balloon Within 90 Minutes



Door-to-Balloon Time (in minutes)

2019 = rolling 4Q ending Q2 2019

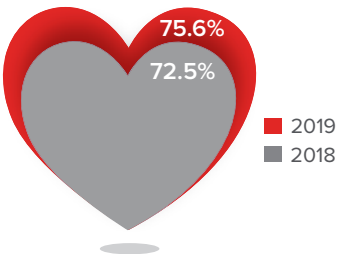
PCI Success



2019 = rolling 4Q ending Q2

IHVI PCI Volume: 1,935

Utilization of Radial Access for Catheterizations



2019 = rolling 4Q ending Q2

Electrophysiology

Ablation Volumes

	2019
SVT Ablation	553
VT (Endocardial and Epicardial) Ablation	159
AFib	584
Ablation Procedures (Total)	**1,296**

2019 annualized from YTD January – October data

Laser Device Lead Extractions: 24

Device Implant Volumes

	2018	2019
Pacemaker	747	760
ICDs	495	493
Biventricular	231	218
Dual and Single Chamber	254	259
Subcutaneous	10	16

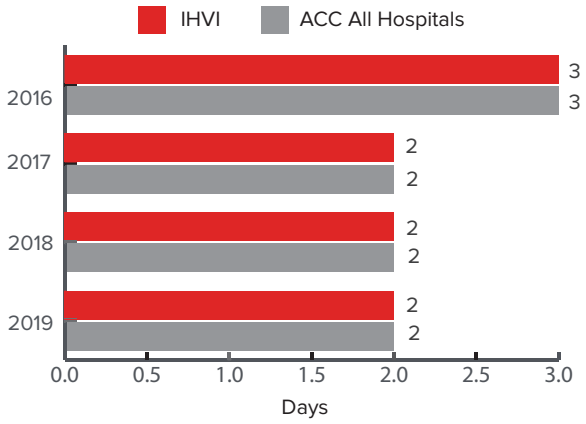
2019 = rolling 4Q, ending Q2 2019

Accredited for
- Testing and Ablation
- Device Implantation
- Chronic Lead Extraction

Refer a Patient
Inova Arrhythmia
703.289.9400

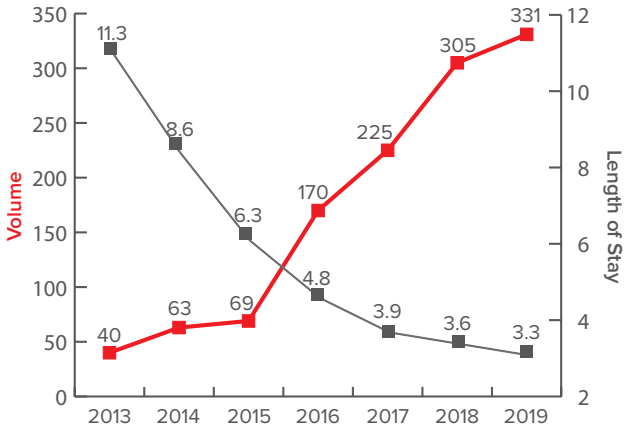
Structural Heart

TAVR Median Postprocedure Length of Stay



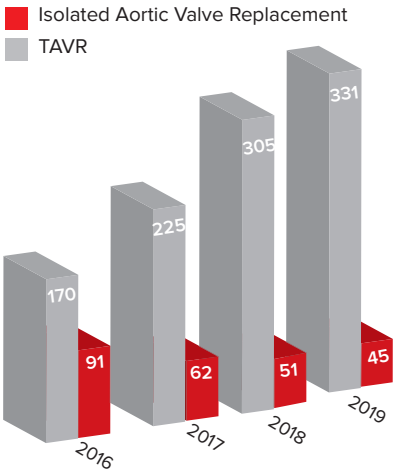
2019 = rolling 4Q, ending Q2 2019

TAVR Volume and Length of Stay



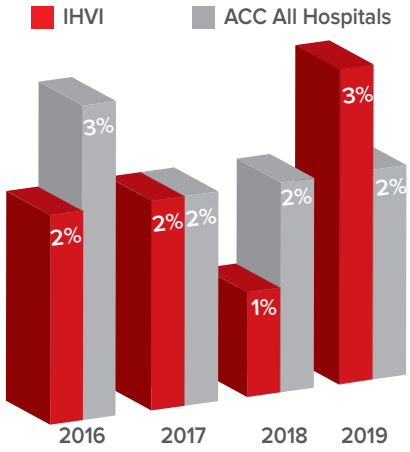
2019 = rolling 4Q, ending Q2 2019

TAVR vs. Isolated AVR



2019 = rolling 4Q, ending Q2 2019

TAVR 30-day Mortality



2019 = rolling 4Q, ending Q2 2019

IHVI PFO Closure 2019: 114

2019 annualized from YTD January – August data

Refer a Patient
valve@inova.org • 703.776.3135
inovaheart.org/structuralheart

Transcatheter Mitral Valve Repair and Replacement Procedures

With more than 4 million Americans affected, mitral valve regurgitation (MR) is a prevalent and often progressive disease. Due to the complex anatomic structure of the mitral valve and its frequent association with other comorbidities, only a small minority of patients with severe MR have undergone surgical valve repair or replacement. Fortunately, recent technical advances now offer patients newer, less invasive options. IHVI's structural heart disease team evaluates potential candidates for these procedures.

MitraClip®

In March 2019, the FDA expanded approval of the percutaneous MitraClip mitral valve repair procedure to patients with NYHA II-IV heart failure symptoms (dyspnea) associated with moderately severe to severe functional (secondary) MR and reduced left ventricular systolic function despite optimal medical therapy. Originally, MitraClip was indicated only for patients with symptomatic MR resulting from structural mitral valve disease (i.e., primary MR).

Approval of the new indication represents a paradigm shift in how heart failure patients with secondary MR will be managed, since little attention has been paid to addressing MR in these patients in the past. In the COAPT clinical trial, those who received MitraClip, in addition to optimal medical therapy, experienced a 47 percent reduction in rehospitalization for heart failure symptoms and a remarkable 38 percent reduction in mortality compared with optimal medical therapy alone.

MitraClip is implanted using a minimally invasive, catheter-based technique with access through the femoral vein in the leg. The device is guided into the left ventricle, where it grasps the two leaflets of the mitral valve, drawing them together to reduce the backflow of blood. Using transesophageal echocardiography (TEE) for guidance, the procedure allows for repositioning of the clip before its eventual release, which helps ensure the best possible result and reduction in MR.

Intrepid™ Transcatheter Mitral Valve Replacement (TMVR)

Through the APOLLO trial, Inova is able to offer a minimally invasive alternative to open-heart surgical repair for select high surgical risk patients with significant symptomatic degenerative mitral regurgitation (MR>3+) who fit the inclusion criteria for the study. IHVI surgeons and interventional cardiologists are among the most experienced in the region, offering transcatheter mitral valve-in-valve, valve-in-MAC and valve-in-ring procedures.

For both MitraClip and TMVR, patients typically visit the valve clinic once or twice before the procedure to meet the valve team, including the interventional cardiologist and heart surgeon. They also complete some cardiac imaging studies (TEE +/- cardiac CT) during their visits. Post-procedure, patients return to the valve clinic once or twice for required follow up. After that, they are returned to their primary care provider and/or local cardiologist for ongoing care. Our goal is not to interrupt the relationship and continuity of care that have been established between patients and their referring doctors.

Stroke Risk Reduction for Atrial Fibrillation Using the WATCHMAN™ Device

The WATCHMAN left atrial appendage closure procedure is indicated as an alternative to anticoagulation to reduce the risk of stroke in patients with non-valvular AFib who are not good candidates for chronic anticoagulation. This may be due to noncompliance, occupational restrictions, frequent falls, increased long-term bleeding risk or a strong preference not to take an oral anticoagulant. WATCHMAN is a permanent implant.

IHVI's structural heart disease team evaluates potential candidates. Patients need a preprocedural TEE and a consult from one of our implanting physicians. Following the WATCHMAN procedure, a TEE is repeated at 45 days, after which, anticoagulation medication can usually be stopped and replaced with dual antiplatelet therapy, and ultimately aspirin only over the long term. In rare cases, additional TEEs may be necessary at three or six months post procedure to document an adequate seal around the WATCHMAN device. These patients are referred back to their original physician for continued cardiovascular care.

WATCHMAN™ and MitraClip®

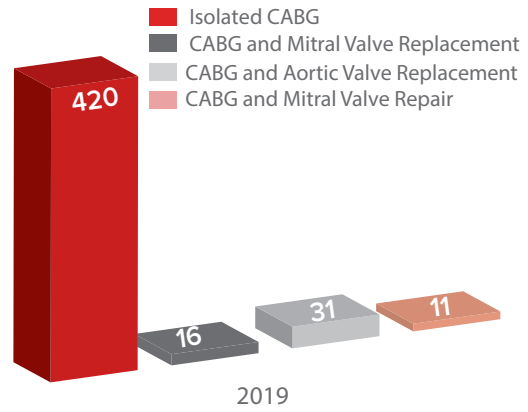
	2017	2018	2019
WATCHMAN™ Procedures	53	41	49
MitraClip® Procedures	12	18	30

2019 = YTD September data

Refer a Patient
valve@inova.org • 703.776.3135
inovaheart.org/structuralheart

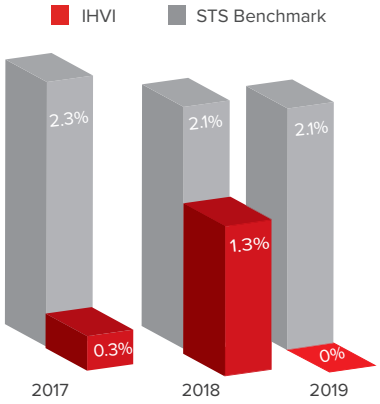
Cardiac Surgery

CABG Combined Volume



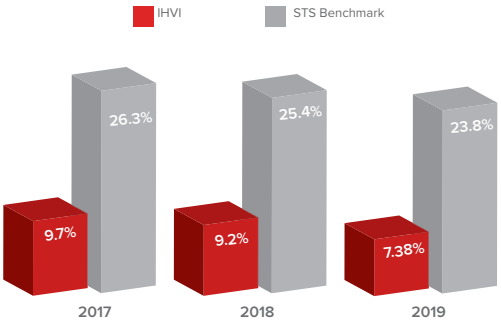
2019 = rolling 4Q, ending Q2 2019

Pure CABG Mortality



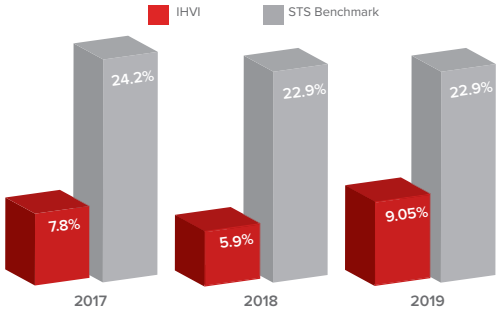
2019 = YTD January – July 2019

Post-Op Blood Products Used



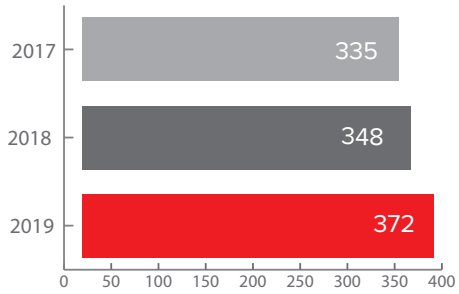
2019 = rolling 4Q, ending Q2 2019

Intra-Op Blood Products Used



2019 = rolling 4Q, ending Q2 2019

Total Surgical Valve Volumes



2019= rolling 4Q, ending Q2 2019

Isolated Surgical Valve Procedures

	2017	2018	2019
Isolated Aortic Valve Replacement	62	51	45
Isolated Mitral Valve Replacement	24	37	40
Isolated Mitral Repair	31	37	44

2019= rolling 4Q, ending Q2 2019

STS National Database™ Participant

Society of Thoracic Surgery highest rating for quality of Coronary Artery Bypass Surgery 2016, 2017, 2018, 2019

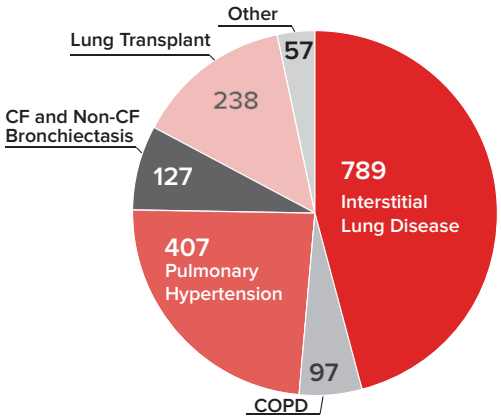
Society of Thoracic Surgery highest rating for quality of Aortic Valve Replacement + CABG 2017, 2018, 2019

Pulmonary

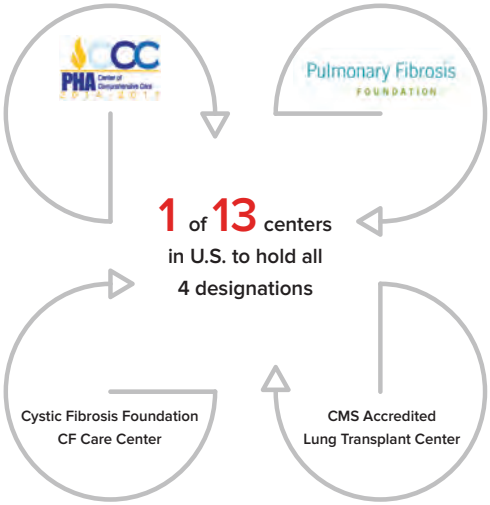
Lung Transplant Volume: 29

2019 annualized from YTD January – August data

Patients Folllowed (n = 1,715)



November 2018 - November 2019



Additional special designations:

ALPHA-1 FOUNDATION

WASOG

Lung Transplant Survival – Adult

	Observed	US Average
Adult Patient Survival (one month)	100.00%	97.78%
Adult Patient Survival (one year)	89.55%	89.55%
Adult Patient Survival (three year)	68.85%	73.13%

According to the most recent Scientific Registry for Transplant Recipients (SRTR) report, Inova's one-month and one-year survival rates are as expected.

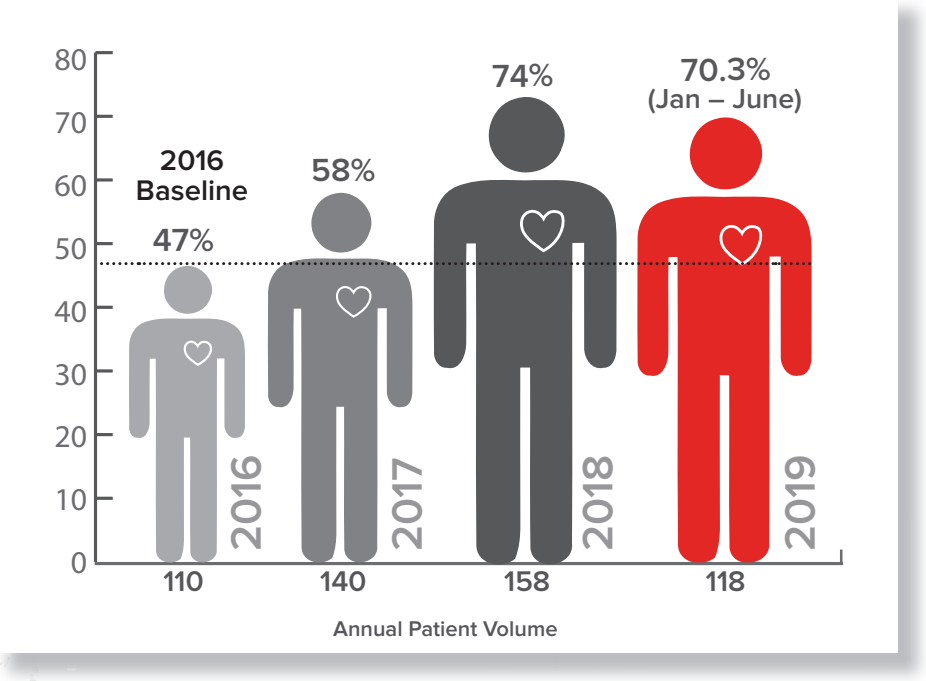
2019 = YTD January – July 2019
SRTR benchmark as of July 2019

Lung Transplant Survival 2018 – 2019

	2018			2019		
	Expected	Observed	HR Index	Expected	Observed	HR Index
Graft Survival (one year)	88.89%	91.09%	0.82	88.87%	84.15%	1.33
Patient Survival (one year)	89.81%	90.89%	0.89	90.00%	85.55%	1.33

2019 = YTD January – July 2019
SRTR benchmark as of July 2019

Refer a Patient
703.776.6168
inovalung.org



Innovative Cardiogenic Shock Team Dramatically Improves Outcomes

As the number of patients identified with cardiogenic shock increases, timely decision-making and intervention are critical to survival. Nationwide, half of all patients who experience cardiogenic shock die – a rate that has held steady for nearly two decades. At Inova Heart and Vascular Institute, a standardized, team-based approach has dramatically improved outcomes. **Just two years after deploying the Shock Team, our 30-day survival rate rose to over 70 percent**. This means more people are alive today thanks to our innovative, multidisciplinary model.

Cardiogenic shock occurs when the heart cannot pump enough blood to meet the body's needs. It typically happens after a sudden cardiac event such as a heart attack. Untreated, cardiogenic shock can quickly progress to multi-organ failure. **About one in 10 people who experience a heart attack develop cardiogenic shock, which is associated with a mortality rate exceeding 50 percent in the United States.** It is the most common reason for in-hospital mortality following a heart attack.

Deploying the Shock Team

Inova Heart and Vascular Institute's dedicated Shock Team provides timely decision-making and intervention critical to patient survival. A single phone call connects specialists from interventional cardiology, cardiovascular surgery, advanced heart failure and critical care to quickly gather information and recommend the best treatment for these critically ill patients.

Inova's cardiogenic shock protocol features:

- Rapid diagnosis
- Immediate, collaborative decision-making
- Early hemodynamic assessment and expedited initiation of mechanical circulatory support
- Minimizing vasopressor and inotrope use

Standardized Care Improves Outcomes

In our initial analysis, we found that factors such as fractured care, late detection, impaired access and practice variations contributed to high cardiogenic shock mortality rates. The opportunity was recognized to improve outcomes with timely diagnosis and utilization of a standardized algorithm across our hub-and-spoke network. Physicians at our regional centers call the cardiogenic shock line to activate the Shock Team at our hub hospital.

When the Shock Team began in January 2017, our cardiogenic shock patients' survival to 30 days post-discharge was 47 percent. Those rates swiftly increased to 58 percent by the end of 2017, and have remained at or above 70 percent.

Creating a Model of Care

Our Shock Team algorithm is both a new approach and a practical one. The critical elements for implementing a coordinated, regionalized system of care include: embracing a standardized approach, establishing a cardiogenic shock care center with a multidisciplinary Shock Team and shock care protocols ensuring fast diagnosis and intervention.

The dramatically improved survival rates achieved employing this approach for treatment of cardiogenic shock establish a validated model and new benchmark for other heart centers across the country.

Read the full manuscript of IHVI's recent JACC article at **inovaheart.org/CardiogenicShock**

Standardized Team-Based Care for Cardiogenic Shock
Behnam N. Tehrani, Alexander G. Truesdell, Matthew W. Sherwood, Shashank Desai, Henry A. Tran, Kelly C. Epps, Ramesh Singh, Mitchell Psotka, Palak Shah, Lauren B. Cooper, Carolyn Rosner, Anika Raja, Scott D. Barnett, Patricia Saulino, Christopher R. deFilippi, Paul A. Gurbel, Charles E. Murphy, Christopher M. O'Connor
Journal of the American College of Cardiology Apr 2019, 73 (13) 1659-1669; DOI: 10.1016/j.jacc.2018.12.084

Cardiac and Respiratory Failure

Impella® Volumes and Cardiogenic Shock Activations

	2017	2018	2019
Impella® Volume	93	110	82
Shock Team Activations	140	158	236

2019 annualized from YTD January – June data

ECMO 2016-2019

	2016	2017	2018	2019
Days of Support	616	740	848	936
Hours of Support	14,018	16,901	19,269	21,200

	2016	2017	2018	2019
Pediatric ECMO Runs	9	12	8	19
Adult ECMO Runs	57	68	83	85
Total ECMO Runs	66	80	91	104

2019 annualized from YTD January – September data

One in a Million

Inova's Cardiogenic Shock Team and ECMO Program Are the Reason John Harrity Is Alive Today

Imagine: You are playing a weekly pick-up basketball game with friends. You are in great shape — trim, fit and competitive. But suddenly, you're short of breath. You sit on the sideline, something you're not known to do. Your friends take notice. When they ask what's wrong, you say, "Call 911." You don't remember anything else until you wake up three weeks later in the cardiovascular intensive care unit (CICU).

John Harrity suffered a complex heart attack. The 50-year-old Washington lawyer, husband and father of two, was rushed to Inova Fairfax Hospital, where he had a second cardiac arrest. His condition deteriorated into cardiogenic shock, an often fatal condition that can quickly progress to multi-organ failure. His heart was unable to pump enough blood to meet his body's needs. Timely decision-making and intervention were critical to survival. Nationwide, half of all patients who experience cardiogenic shock die – a rate that has held steady for nearly two decades. It is the most common cause of in-hospital mortality following a heart attack.

Fortunately for John, improving those outcomes has been a major focus at Inova Heart and Vascular Institute, where a new model of care is saving lives. IHVI's multidisciplinary Shock Team unites specialists from interventional cardiology, cardiovascular surgery, advanced heart failure and critical care to quickly gather information and recommend the best treatment for these critically ill patients.

John was successfully resuscitated, and the team performed several procedures to treat his multiple emergency heart issues.

While recovering in the CICU, things again took a turn for the worse. John experienced a lung hemorrhage and acute respiratory failure. As a result, he was placed on extracorporeal membrane oxygenation (ECMO). This machine provides cardiac and respiratory support to people whose heart and lungs are unable to sustain life. It was touch and go, but eventually he started to stabilize. About two weeks later, he was weaned off ECMO.

John spent eight weeks in the CICU. He recalls having trouble with mobility and getting his strength back. With perseverance, he was soon able to walk short distances and accomplish the tasks his nurses asked him to do. Just a short time later, he was working out, gaining back weight and getting back to his fit and trim self. Four and a half months after that fateful basketball game, he returned to work.

Inova's standardized, team-based approach has dramatically improved outcomes for patients like John, with results that have garnered national attention. Only two years after deploying its Shock Team, Inova's 30-day cardiogenic shock survival rate rose to 70 percent or more, far above the national average.

"Our Shock Team algorithm is both a new approach and a practical one," says Behnam Tehrani, Medical Director of Cardiac Catheterization at IHVI's Inova Fairfax Medical Campus. "In our initial analysis, we found factors such as fractured care, late detection, impaired access and practice variations contributed to high cardiogenic shock mortality rates. By using a coordinated team approach with a standard algorithm, we became the first medical center in the country to report these amazing results."

A More Fluid Approach Transforms IHVI's Cardiac Intensive Care Unit

Advances in technology and standards of clinical practice, as well as shifts in the underlying patient population, have necessitated changes in coronary care units. The focus has transformed from rapid defibrillation and resuscitation of patients with heart attacks into providing comprehensive critical care for complex patients with cardiovascular disease and multiple comorbid conditions.

"At Inova Heart and Vascular Institute (IHVI), the Cardiac Intensive Care Unit (CICU) cardiologist's role has evolved into one that coordinates and co-manages patients in partnership with intensivists and specialized teams with focused expertise," says Shashank Sinha, MD, MSc, Medical Director, IHVI CICU. "Results are evident in significantly improved patient survival rates associated with implementation of the multidisciplinary approach and standardized protocols used by our Cardiogenic Shock Team." *(See related story on page 14.)*

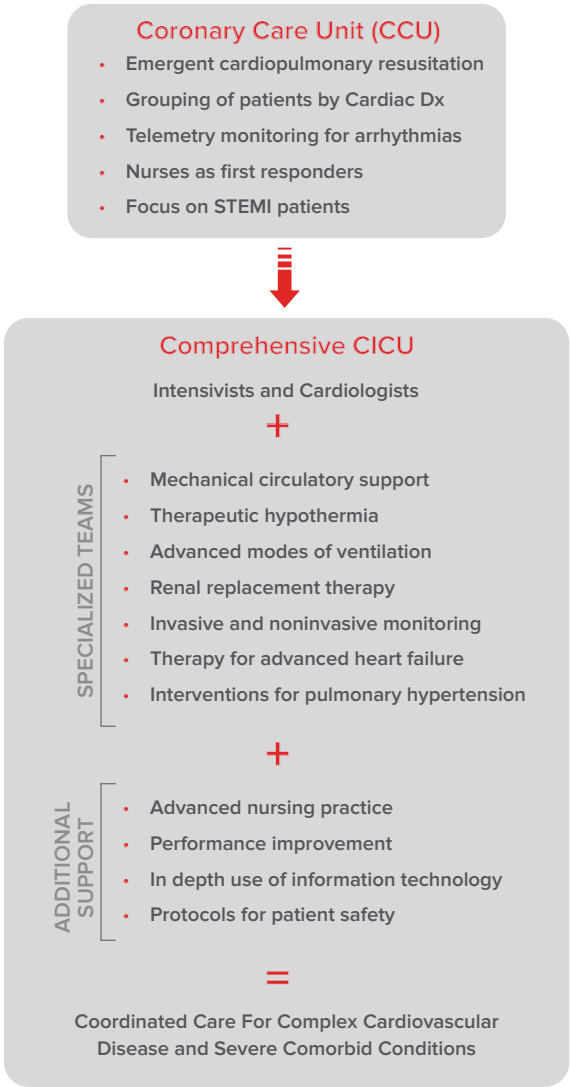
The inspiration behind this approach came, in part, from an organizational model pioneered by Bill Drayton, founder of Ashoka, a nonprofit organization focused on social entrepreneurship, who introduced the concept of a "team of teams."

In his book, *Team of Teams: New Rules of Engagement for a Complex World*, retired U.S. Army General Stanley McChrystal echoed a similar approach using a decentralized model to more effectively position the U.S. military in a world of rapid, unpredictable change and complex interdependencies.

"We've found using multidisciplinary and collaborative teams helps us be more nimble in our management of patients in the CICU," says Dr. Sinha.

Studies of clinical characteristics of cardiac patients have demonstrated a rise in primary non-cardiac diagnoses, such as sepsis, acute kidney injury, acute lung injury and infection.[1] These shifts have major implications for staffing, structure and systems for modern critical care delivery. As more data become available on the specific changes in primary non-cardiac diagnoses among increasingly elderly and complex CICU patients, IHVI will continue to proactively adjust teams and the strategic approach to address these clinical challenges.

To foster a better understanding of the longitudinal case mix and outcomes in the CICU, Inova is participating in a prospective multicenter registry of cardiac critical illness. The Critical Care Cardiology Trials Network (C3TN) involves 30 sites across North America. This broad dataset of experience will assist IHVI in developing a comprehensive understanding of trends to keep it on the forefront of diagnosis, management and treatment in cardiac critical care. Ultimately, the goal is for IHVI to participate and lead multicenter randomized controlled trials in the CICU, generating a robust, evidence-based approach to guide the redesign of cardiac critical care.



[1] Sinha SS et al Circulation Cardiovascular Quality and Outcomes 2017

Vascular

Vascular Volumes	2019
Carotid Endarterectomy	182
Carotid Artery Stent	28
Carotid Total	210
EVAR	61
TEVAR	23
Open AAA	25
Aneurysm Total	109
PVI	332
Bypass*	109
Lower Extremity Total	441

2019 = rolling 4Q, ending Q2 2019

**2019 Bypass is both Intrainguinal and Suprainguinal*

Inova's vascular surgeons are among the first in the world to demonstrate that distal venous arterialization (DVA) can be a successful intervention for patients with critical ischemia, in what otherwise have been viewed as unsalvageable, "no-option" limbs.

Novel Approaches to Vascular Surgery and Endovascular Therapy

Inova Heart and Vascular Institute is a referral center for vascular disease. Inpatients are cared for in a dedicated unit, and our team of outstanding vascular specialists offers comprehensive diagnostic and treatment options.

TransCarotid Artery Revascularization (TCAR)

Reversing Blood Flow for Stroke Protection during Carotid Artery Stenting Lowers Stroke Risk and Recovery Time

Stroke is a potential complication of carotid stenting in patients with carotid artery disease. The minimally invasive TCAR procedure uses a special neuro-protection system (NPS) during carotid artery stenting that minimizes embolic debris to provide enhanced stroke protection.

During the procedure, the vascular surgeon makes a small incision above the clavicle, providing direct access to the carotid artery. The surgeon then places a sheath in the artery and connects it to the femoral vein. This briefly reverses blood flow away from the brain, preventing clots and bits of plaque that may come loose during stenting from traveling to the brain. An NPS filter, placed near the femoral vein, traps particles outside the body while the surgeon places the stent. Because the flow reversal method does not rely on a distally placed filter to capture emboli before they reach the brain, it collects both small and large debris. Once the blockage has been treated, normal blood flow is reestablished.

Approved by the FDA in 2016, TCAR offers a smaller incision than traditional carotid endarterectomy and a lower risk of stroke than carotid stenting performed through the groin. Although carotid endarterectomy remains the gold standard, TCAR offers an alternative for higher-risk surgical patients or those for whom carotid stenting is appropriate. Anyone with symptomatic carotid disease or asymptomatic disease with more than 80 percent stenosis is considered a candidate for the procedure.

Distal Venous Arterialization for Lower Extremity

Preservation and Amputation Prevention Adds to Multifaceted Expertise in Revascularization

An increasing number of patients with critical limb ischemia (CLI) are not suited for standard distal arterial reconstruction. However, limb amputation is no longer the only option for these patients. Inova's vascular surgeons are among the first in the world to demonstrate that distal venous arterialization (DVA) can be a successful intervention for patients with critical ischemia, in what otherwise have been viewed as unsalvageable, "no-option" limbs. Inova is one of just a few institutions now performing this intricate procedure.

Advances in percutaneous endovascular techniques have greatly improved the capability to successfully treat CLI. This is true even for older patients with severe comorbidities, including diabetes, renal failure and failed prior interventions.

DVA establishes blood flow into the deep veins of the lower leg and foot to get blood to the tissues in a retrograde or "reverse" manner. Valves in the veins have to be disrupted so the blood flowing in a "reverse" direction is not stopped and can reach the tissue through the capillary bed. This can be accomplished using **a bypass technique, distal vein patch bypass (DVP), developed by Richard Neville, MD, IHVI Director of Vascular Services and Vice Chairman, Department of Surgery at Inova Fairfax Medical Campus**. In the near future, it may be done using catheter-based endovascular techniques now in an FDA-approved clinical trial. Inova will be one of the first centers in the United States to be included as part of this trial.

As limb loss has profound implications for quality of life and long-term survival, it is worth exploring DVA as an alternative, prior to amputation. Patients with ischemic rest pain, non-healing wounds or gangrene, who have been told they have limited options for revascularization and are facing amputation, are potential candidates for this procedure. The sooner they can be evaluated, the better chance there is to save the limb.

Refer A Patient
IHVI Vascular Services
703.207.7007

Heart Failure Patients Get Transplants the Same Day, Fall in Love Five Years Later

Inova heart transplant patients, who never met while receiving lifesaving care in adjoining hospital rooms, reconnected and found enduring love.

On their first date, Taylor Givens and Collin Kobelja interrupted their dinner for a medicine break. Both needed to take anti-rejection drugs to help sustain their transplanted hearts.

“It was a weirdly touching moment,” recalls Taylor, 24. “To see those parts of ourselves mirrored in someone else was really cool.”

Perhaps even more ironic is how the pair’s love story sprung from their experiences at Inova, where a heart transplant saved each of them on June 9, 2011. Rooming just yards apart at Inova Heart and Vascular Institute, they were in a race for their lives. Taylor’s heart was failing, possibly from a virus. Collin had been born with a faulty heart, and his first transplant was failing decades later. Both were at risk of dying within days if donor organs couldn’t be found.

The two clung to life while hooked up to ECMO (extracorporeal membrane oxygenation) machines that supported their heart and lung function — technology Inova has used heavily since 2010.

“When you place someone on ECMO, their heart has already died. The machine is keeping their body alive while waiting for another heart to become available,” says Shashank Desai, MD, Medical Director, Inova Heart Failure/Transplant Program. “Sadly, few people go from emergency ECMO to transplantation, due to the long wait time for organs. The fact that this happened twice in 24 hours is miraculous.”

A Chance Meeting, Five Years Later

Taylor and Collin, 17 and 22 at the time, were too sick to interact meaningfully during their hospitalizations, although their parents had met. They later connected on social media, and Taylor was aware of Collin’s subsequent move to California and his third heart transplant, which he received in 2012.

It wasn’t until June 9, 2016 — exactly five years after their Inova transplants — that sparks finally flew. Visiting the area, Collin texted Taylor to ask if their heart transplant team members were still around. Taylor, who happened to be at Inova Fairfax Hospital awaiting discharge after a tonsillectomy, told Collin to stop by her hospital room.

“Afterward, it kind of felt like both of us got struck by lightning,” Taylor says. “Looking back, we see everything that had to go wrong for us to be together.”

“I told her that we should hang out — and not in a hospital room!” says Collin, now 29. “Five days later, we met for dinner.”

Eye on the Future

Anchored by their shared experiences, the couple intends to marry one day — on a June 9, of course.

“The whole point of having a transplant is so you can live your life. Go make it as normal or not-normal as you want,” Collin says. “We’re just grateful to be alive and have a relationship where we can love each other.”

Dr. Desai says both cases exemplify the teamwork Inova clinicians value. “From opposite ends of the spectrum, these two came to the same point: needing us to buy them time to get a transplant,” he recalls. “Their story inspires our team to do what they do and keeps us going.”

Advanced Heart Failure

VAD and Heart Transplant Volumes

	2019
VAD Volume - Durable Devices	13
Heart Transplant Volume	30

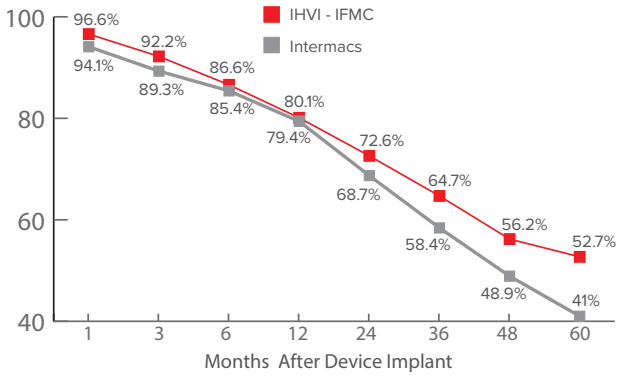
2019 annualized from YTD Sept.ember data

Heart Transplant Survival

2019	Expected	Observed	HR Index
Graft Survival (one year)	90.14%	89.53%	1.02
Patient Survival (one year)	90.14%	89.64%	1.03

SRTR Benchmark as of July 2019

Post Implant Survival



2019 = YTD September 2019
Intermacs Benchmark as of June 2016 – September 2019

The Joint Commission Gold Seal of Approval® for Ventricular Assist Device

Refer a Patient
703.776.7697 • heartfailure@inova.org
inovaheart.org/AHF

Congenital Heart Disease

Neonatal Procedures

	2019
Complex Cardiac Repairs	30
PDA Ligations – Premature Infant	5
Total	**35**

2019 annualized from YTD January – August data

Adult Congenital Heart Surgery

	2019
ASD	2
AVR	6
MVR	2
PVR	3
PAPVR	5
VSD	0
AVC (Partial, Transitional)	2
Other	18
Total	**38**

2019 annualized from YTD January – August data

Pediatric Congenital Heart Surgery

	2019
ASD	11
VSD	5
TOF	2
ASO	5
AVC (Complete, Partial)	5
PAPVR	5
TAPVR	5
COA/Hypoarch	14
Glenn/Fontan	2
Systemic Pulmonary Shunt	2
Pacer/ICD	8
PVR/RVOT Procedures	17
AVR/Supra and Sub Valvar	2
MV Repair/Replace	2
ECMO Cannulation	17
ECMO Procedures	12
PDA Ligation	5
Thoracic	5
Other STAT Category	11
Other Cardiac Non-Pump	51
Total	**186**

2019 annualized from YTD January – August data

New Cardio-Oncology Program

Patients Screened, Treated for Cardiotoxicity from Cancer Therapies

Inova Heart and Vascular Institute recently partnered with Inova Schar Cancer Institute to introduce a pilot program in cardio-oncology aimed at improving patient outcomes by avoiding cardiotoxicity from chemotherapy and radiation treatments.

The program, launched in July 2019, capitalizes on an emerging field within cardiology by examining the incidence and magnitude of side effects from cancer therapies on patients' heart function, according to co-program lead Kelly Epps, MD, MSHP, an interventional cardiologist. Dr. Epps has worked closely with Lauren Mauro, MD, co-program lead and a medical oncology and hematology specialist with a special interest in the management of all types of breast cancer, from early-stage to metastatic disease.

A total of three cardiologists and three breast oncologists are currently involved in the initiative, which focuses on breast cancer patients within Inova Health System. Current patients will be risk-stratified to determine who is most likely to benefit from cardio-oncology services.

Increasingly, research shows heightened risks for various heart conditions such as cardiomyopathy or heart failure during and after cancer treatment. In breast cancer, anthracyclines and trastuzumab have been linked to cardiotoxic effects.

"We want referring physicians to know we're partnering with oncologists to get optimal outcomes for patients with cancer, and those outcomes are reliant on optimal cardiovascular outcomes both during and after treatment," says Dr. Epps.

"Late cardiovascular effects of treatment are the second leading cause of death among cancer survivors," Epps continued. "This is relevant for long-term cancer survivorship, and we know that pre-existing cardiovascular conditions affect treatment. Optimizing therapy also helps patients complete their full course of cancer therapy. The medications they're getting are certainly lifesaving, but we want to make sure we're also optimizing their cardiovascular outcomes."

"A common misconception is that the practice of cardio-oncology may prevent patients from receiving chemotherapy, when the opposite is true," says Jennifer Shea, MD, a cardiologist with Virginia Heart, who is part of this initiative. "Our goal is to allow patients to receive their full course of chemotherapy while hopefully preventing future cardiotoxic side effects. We are excited to offer this service to the Northern Virginia community."

Extensive Protocols Developed

In the pilot phase of the program, any new breast cancer patient at Inova Schar Cancer institute will undergo cardiovascular risk stratification. The six physicians involved in the initiative have developed standardized protocols for prevention, detection and monitoring during treatment, as well as how to treat cardiotoxicity if it occurs.

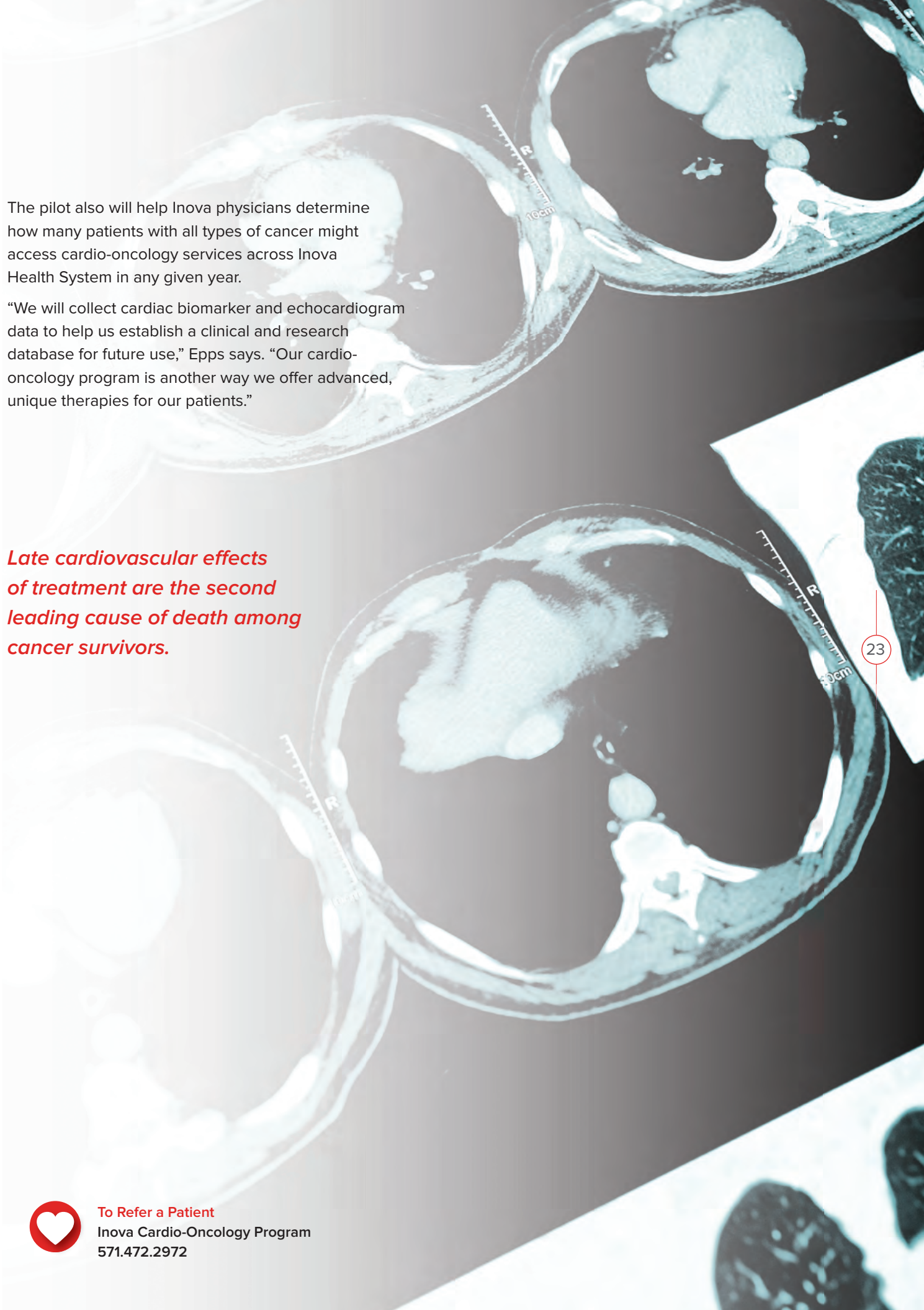
These protocols include:

- Monitoring patients using echocardiograms with strain imaging (which assesses early left ventricular dysfunction) and cardiac biomarker blood testing
- Performing preoperative cardiovascular assessment before cancer surgery
- Determining cardiotoxicity risk depending on prescribed chemotherapy and radiotherapy, altering/substituting therapies as needed
- Screening for signs of previous cardiovascular disease
- Implementing guideline-directed medical therapy for patients with pre-existing left ventricular dysfunction or cases that develop during treatment
- Discussing the importance of exercise with patients
- Initiating multidisciplinary discussions with patients' oncologists regarding monitoring and treatment

The pilot also will help Inova physicians determine how many patients with all types of cancer might access cardio-oncology services across Inova Health System in any given year.

"We will collect cardiac biomarker and echocardiogram data to help us establish a clinical and research database for future use," Epps says. "Our cardio-oncology program is another way we offer advanced, unique therapies for our patients."

Late cardiovascular effects of treatment are the second leading cause of death among cancer survivors.



To Refer a Patient
Inova Cardio-Oncology Program
571.472.2972

Inova Heart and Vascular Institute Services

Inova Heart and Vascular Institute	IFMC	IAH	IFOH	ILH	IMVH
Adult Congenital Heart Clinic	●				
Advanced Heart Failure Program	●				
Heart Transplantation Medical Management	●				
Mechanical Circulatory Support – VAD/LVAD	●				
Remote Home-based Monitoring	●				
Cardiac and Respiratory Failure	●				
Cardiogenic Shock Team	●				
Extracorporeal Membrane Oxygenation (ECMO)	●				
Impella®	●				
Pulmonary Embolism Response Team (PERT)	●	●			
Cardiac Catheterization	●	●		●	
AMI	●	●		●	
Chronic Total Occlusion Program	●				
PCI	●	●		●	
Cardiac Rehabilitation	●	●		●	●
Cardiac Rhythm Disorders/Electrophysiology	●	●		●	
AFib Ablation	●				
AV Node, SVT and VT Ablation	●	●		●	
Cryoballoon and Radiofrequency Ablation	●	●		●	
FIRM Mapping and Ablation	●				
Fluoroless EP Studies	●	●		●	
ICD	●	●		●	
Implantable Loop Recorders	●	●		●	
Pacemakers	●	●		●	
Conventional	●	●		●	*
Leadless	●	●			*
Cardio-Oncology Program	●				
Cardiac Surgery	●				
Adult Congenital Surgery	●				
AFib Surgery	●				
Aortic Surgery	●				
Heart and Lung Transplantation	●				
Minimally Invasive CABG Surgery	●				
Open and Minimally Invasive Valve Replacement Surgery and Repair	●				
Open Coronary Artery Bypass Grafting (CABG)	●				
Cardiovascular Genomics Center	●				

Inova Heart and Vascular Institute	IFMC	IAH	IFOH	ILH	IMVH
Lung Services	●				
Alpha-1 Antitrypsin Deficiency Clinical Resource Center	●				
Cystic Fibrosis Care Center	●				
Interventional Pulmonology	●				
Lung Transplantation Medical Management	●				
Pulmonary Embolism Response Team (PERT)	●	●			
Pulmonary Fibrosis Foundation Care Center	●				
Pulmonary Hypertension Comprehensive Care Center	●				
Pulmonary Rehabilitation	●	●		●	●
WASOG Sarcoidosis Clinic	●				
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 Electrophysiology	●				
Cardiac Surgery	●				
Congenital Heart Disease Program	●				
Genomics Testing and Counseling	●				
Structural Heart Disease Program	●				
PFO Closure	●				
Stroke Risk Reduction - WATCHMAN™	●				
Transcatheter Aortic Valve Replacement (TAVR)	●				
Transcatheter Mitral Valve Repair - MitraClip®	●				
Transcatheter Mitral Valve Replacement (TMVR)	●				
Thoracic Surgery	●				
Vascular Services	●	●	●	●	●
Endovascular and Open Surgical Procedures	●	●	●	●	●
Limb Preservation Program	●	●	●	●	●
Lower Limb Revascularization	●	●	●	●	●
Peripheral Arterial Disease Treatment	●	●	●	●	●
Vascular and Interventional Radiology	●	●	●	●	●
Wound Care	●	●	●	●	●

* *Emergency cases only*

** *Inpatient only*

LEGEND

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

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

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Save the Date!

April 24 – 25, 2020

2020 Cardiovascular Symposium
Falls Church Marriott Fairview Park
Falls Church, VA

September 12, 2020

Advanced Heart Failure Symposium
The Ritz-Carlton, Tysons Corner
McLean, VA

*Visit **inovaheart.org** to register and for information regarding abstract submission.*

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