

Inova Children's Hospital  
**Cardiac Outcomes Report 2019**



# Inova Children's Hospital Cardiac Outcomes Report 2019



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## A Message from Our Hospital Administrators

We are pleased to share our 2018 Inova Children’s Heart Center outcomes with the community. These outcomes are the result of the combined efforts of our team members, who have come together with a single purpose in mind – caring for children with complex cardiac conditions.

The data certainly tell a story. In this case, that story is representative of Inova’s mission and values. No matter the role – from our cardiac surgeons and physician team members, to the nurses, respiratory therapists and environmental services staff– the mission to provide world-class healthcare, every time, every touch is easy to see.

The data also tell the story of the children and, in some cases adults, for whom our teams have the privilege to care. Our teams perform more than 250 surgical cases annually, but just as no two children are alike, the care we provide is also individualized. We rely on the principles of standardization and high reliability to ensure the best possible outcomes, but we also make sure that each child and family receive an individualized approach. We personalize both to their clinical care and the way we connect with them: not just as patients, but as children, parents, families.

Finally, the data tell the story of each team member who has had the opportunity to contribute to our hospital’s results. They tell the story of the CICU nurse who stayed far past the end of her shift to sit with a scared mother after her child’s surgery. They tell the story of the physicians who spend a Sunday each September at Clemyjontri Park celebrating their former patients as they run and play. They also tell the story of our physician assistants and nurse practitioners, and the passion they have for caring for children with cardiac disease.

We hope you will see the compelling stories behind each of these numbers and graphs. They are the truest reflection of Inova Children’s Heart Center’s outcomes.



Steven Narang, MD MHCM  
*President, Inova Fairfax  
Medical Campus*



Joanna Fazio  
*Vice President & Administrator  
Inova Pediatric Service Line*

## Moving Inova Children's Heart Center to the Next Level

We are pleased to present the 2018 Inova Children's Hospital Cardiac Outcomes. Every year, our pediatric heart surgeons perform more than 250 cardiac surgeries, and our interventional cardiologists and electrophysiologists perform procedures on more than 600 patients. In addition, our multidisciplinary team of experienced cardiologists, surgeons, intensivists, anesthesiologists, nurse practitioners and nurses provides care to patients – from fragile newborns facing complex, challenging health problems, to adults with complex congenital heart disease.

Our 2019 outcomes report reflects these efforts. It demonstrates the many ways in which we provide consistently high performance in outcomes, access, value and experience for children and young adults with cardiac disease, and their families.

2019 highlights include:

- Continued increase in cardiac surgical procedures and fetal referrals throughout Virginia and Maryland
- Significant growth in the Pediatric Electrophysiology (EP) Program
- Expansion of the Adult Congenital Heart Disease Program in partnership with Inova Heart and Vascular Institute
- Creation of an aortopathy program bridging pediatric and adult cardiac specialists
- First in Virginia to close a patent ductus arteriosus (PDA) in premature babies using the new Amplatzer Piccolo® Occluder
- Enhancement of our Inherited Arrhythmia Clinic with dedicated genetics counselors and state-of-the-art clinical and research genomics
- Participation in national research studies and registries across the spectrum of cardiac care

Two of the year's biggest highlights occurred outside the traditional hospital/patient care setting.

- With the help of Inova Child Life specialists, we created a dedicated Cardiac Parent Advisory Council. This group of more than 20 parents, whose children have been touched by Inova, provides valuable insight that strengthens our heart center.
- In partnership with a California-based biotech company, we brought virtual reality to the heart center. This innovative technology renders three-dimensional images of the heart so our cardiac surgeons can plan, and essentially perform, intricate procedures before entering the operating room.

Our goal is to achieve the best possible outcome for every patient and provide long-term support for every family. Thank you for helping us advance exceptional heart care in our community and provide groundbreaking, lifesaving services to children throughout our region.



Lucas Collazo, MD  
*Chief, Pediatric Cardiac Surgery;  
Co-Director, Inova Children's  
Heart Center*



Mitchell Cohen, MD, FACC, FHRS  
*Chief, Pediatric Cardiology;  
Co-Director, Inova Children's  
Heart Center*





## Cardiac Surgery

Our cardiac surgery program provides patients with a continuum of care that spans a lifetime. We perform a wide spectrum of surgeries for congenital heart defects in neonates, infants, children, teenagers and adults. Our goal is to deliver innovative surgical care in a compassionate, family-centric environment.

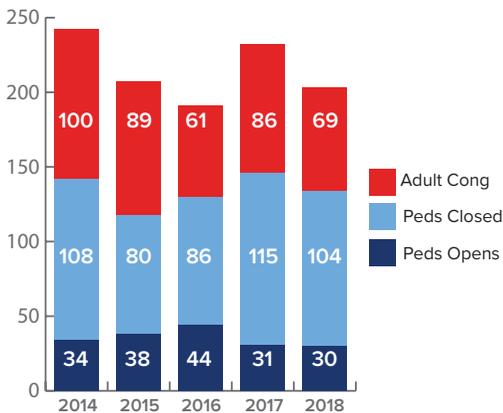
Multidisciplinary collaboration ensures the best care possible for every patient.

- Our surgical team includes two full-time pediatric cardiac surgeons experienced in all aspects of pediatric and congenital cardiac surgery, dedicated physician assistants, nurse first assistants, anesthesiologists, nurse anesthetists, perfusionists and operating room nurses.
- Following surgery, cardiac-focused intensivists and nurse practitioners care for patients in the Pediatric Cardiovascular Intensive Care Unit.
- As patients progress toward discharge, the surgical team; cardiologists; case managers; occupational; speech and physical therapists; Child Life specialists; and a dietitian coordinate and guide care.

We participate in the Society of Thoracic Surgeons (STS) Congenital Heart Surgery national database to ensure the highest quality care with results comparable to the country's leading pediatric heart centers. The ability to benchmark our performance is a powerful tool that drives our improvement efforts.

Inova Children's Heart Center has the highest rated pediatric cardiac surgical program in the Washington, DC area from the STS Database.

### Complete Caseload 2014 – 2018



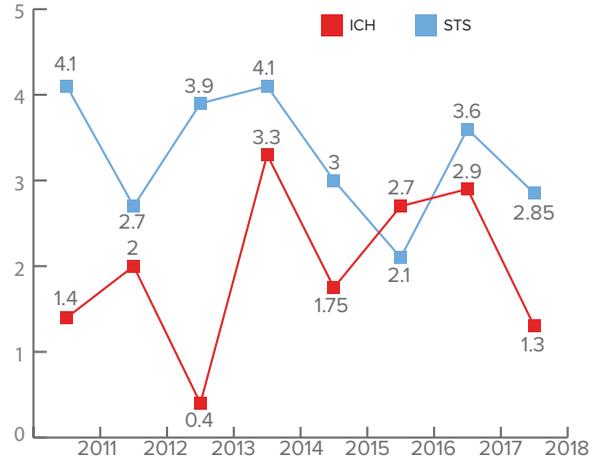
### Neonatal (<30 days) Caseload 2017 – 2018

Neonatal Patients	2017	2018
Complex cardiac repairs	24	15
PDA ligations - premature infant	19	12
<b>Total</b>	<b>43</b>	<b>27</b>

## Complete Case Mix: 2017 – 2018

Case Type	2017	2018
ASD	6	3
VSD	17	17
TOF	11	6
ASO	5	1
AVC (complete, partial)	6	8
PAPVR	1	3
TAPVR	1	2
COA/hypoarch	10	10
Glenn/Fontan	9	5
Systemic Pulm shunt	5	1
Pacer/ICD	8	3
PVR/RVOT procedures	11	15
AVR/supra and sub valvar	5	3
MV repair/replace	5	5
ECMO cannulation	11	8
ECMO procedures	12	7
PDA ligation	21	12
Thoracic	6	14
Other STAT category	10	7
Other cardiac non-pump	41	43
<b>Total</b>	<b>201</b>	<b>173</b>

## Overall Mortality Not Adjusted for Complexity



## Adult CHD (>21 years) Caseload 2012 – 2018

Adult Congenital Operation	2012	2013	2014	2015	2016	2017	2018
ASD	5	5	9	5	7	2	3
AVR	3	6	3	6	10	5	3
MVR	3	1	1	3	5	0	2
PVR	6	5	3	3	4	6	3
PAPVR	1	1	4	2	0	5	1
VSD	0	3	2	0	2	0	2
AVC-partial/transitional	3	2	1	0	2	1	0
Other	17	28	11	19	14	13	16
<b>Total</b>	<b>38</b>	<b>51</b>	<b>34</b>	<b>38</b>	<b>44</b>	<b>32</b>	<b>30</b>

## Interventional Cardiology

Our program offers a wide array of diagnostic and interventional procedures in dedicated pediatric cardiac catheterization labs. We use catheters, balloons and coils – designed uniquely for children and infants – to open, dilate or close blood vessels and heart valves.

In 2019, our interventional team performed the first-ever PDA closure of a micropreemie (800 gm) using the new Amplatzer Piccolo® device.



Amplatzer Piccolo® device

Minimally invasive procedures include:

- Closing a PDA
- Closing an atrial or ventricular septal defect
- Dilating an aortic or pulmonary valve
- Dilating a coarctation of the aorta
- Transcatheter pulmonary valve replacement (Melody and Edwards valves)
- Coiling abnormal vessels in the heart or lungs
- Balloon atrial septostomy
- Diagnostic cardiac catheterization



Jim Thompson, MD

In addition, we installed state-of-the-art Phillips imaging equipment, which delivers the clearest pictures with the lowest radiation dose possible.

To ensure that we provide high-quality care and outcomes, we participate in the IMPACT database.

### Cardiac Catheterizations in Children – First Year of Life

	< 1 month	1 to 12 months
Diagnostic	3	10
PDA closure		10
PS balloon	5	5
Recoarctation balloon		4
AS balloon	1	
BAS (in cath lab)	1	
Close ASD + close PDA		1
Coil collaterals		1
Balloon PS+LPA+RPA		1
Balloon LPA+RPA		1
Balloon PS+LPA		1
Stent atrial septum		1
Close PDA + Balloon RPA		1
Stent central shunt		1
Balloon LPA+RPA + coil collaterals		1

### Cardiac Catheterization Procedures

Age	Diagnostic	Interventional	Total
< 1 yr	13	38	51
1 - 18 yrs	29	86	115
≥ 18 yrs	29	124	153
<b>Total</b>	<b>71</b>	<b>248</b>	<b>319</b>

## Electrophysiology

Inova Children's Heart Center's electrophysiology program offers a full complement of diagnostic and treatment options for children with known or suspected heart rhythm problems. As the largest outpatient program in Northern Virginia, we perform more than 15,000 electrocardiograms and administer 1,000 ambulatory monitors annually.

Comprehensive services include:

- **Cardiac Implantable Electronic Devices.** We monitor patients with pacemakers and defibrillators via in-office checks and convenient home-based monitoring. We use the latest Bluetooth technology to follow children with implantable loop recorders.
- **Inherited Arrhythmia Clinic.** In 2017, we established the Inherited Arrhythmia Clinic that bridges both the adult and pediatric arms of Inova. With a multidisciplinary team of adult and pediatric cardiologists and genetic counselors, we are able to evaluate, manage and follow children, parents, siblings and extended family members with inherited life-threatening and rare arrhythmias, as well as cardiomyopathies.

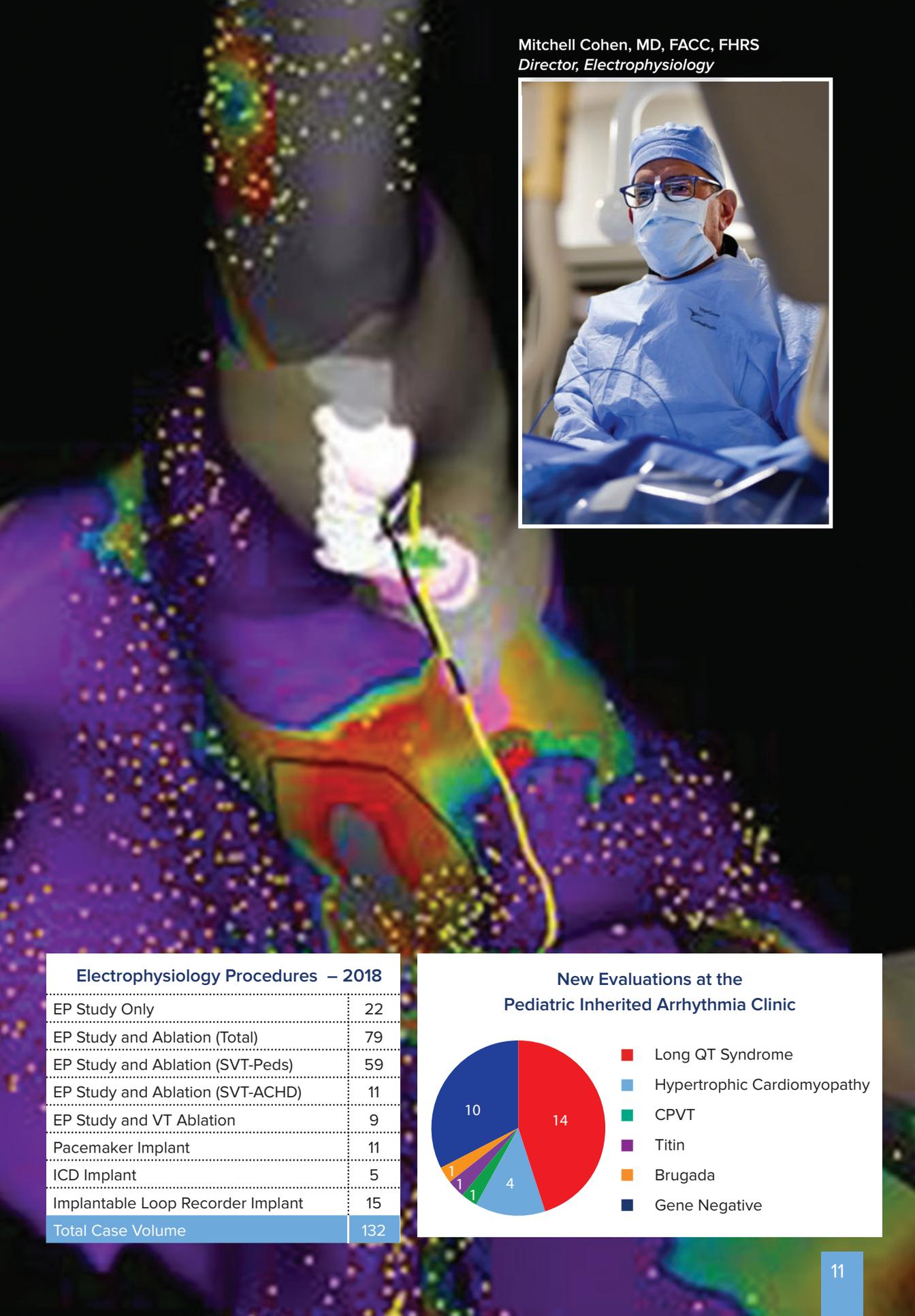
*In 2018, we evaluated 22 families with either a suspected channelopathy or nonsyndromic cardiomyopathy. With state-of-the-art whole genome and targeted sequencing, we achieved a yield of 57 percent with a pathogenic mutation. By identifying this mutation, we were able to screen more than 40 first-degree relatives within the virtually linked pediatric and adult Cardiogenetics Comprehensive Clinic.*

- **EP Procedures.** We use the latest technology, including radiofrequency energy, cryoablation and irrigated radiofrequency to treat supraventricular and ventricular arrhythmias. All ablations are performed in our newly renovated biplane electrophysiology lab. With 3D mapping, we can locate arrhythmias with minimal fluoroscopy exposure. In addition, advanced automation, impedance field flexibility and magnetic field precision significantly shorten procedure time. The latest contact-force catheters are critical in ablating patients with complex congenital heart disease to optimize effective lesions.
- **Sudden Cardiac Death Prevention Program.** We promote community awareness to identify children at risk of sudden life-threatening events. In partnership with local fire rescue services, we promote automated external defibrillator usage in the community and CPR training for high school students. We are in the early phases of an engagement with adult cardiologists in Loudoun County, VA, to educate the community about secondary prevention measures from a Good Samaritan vantage point.

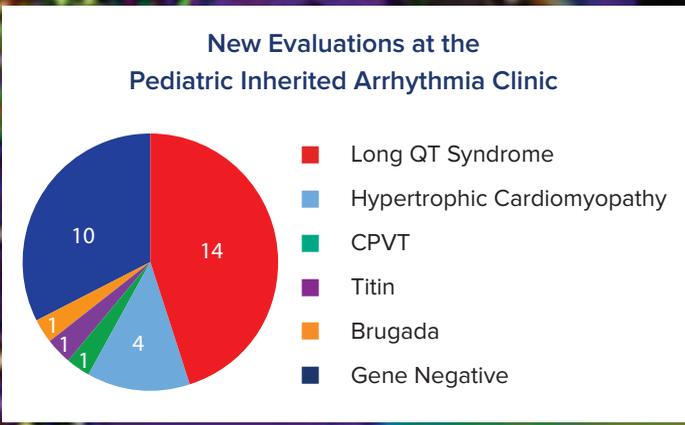
**89%** Six-month follow-up success for ablations in patients with VT

**92.8%** Six-month follow-up success for ablations in patients with WPW and all forms of SVT

**97.2%** Acute success for ablations in patients with WPW and all forms of SVT



Electrophysiology Procedures – 2018	
EP Study Only	22
EP Study and Ablation (Total)	79
EP Study and Ablation (SVT-Peds)	59
EP Study and Ablation (SVT-ACHD)	11
EP Study and VT Ablation	9
Pacemaker Implant	11
ICD Implant	5
Implantable Loop Recorder Implant	15
<b>Total Case Volume</b>	<b>132</b>



## Adult Congenital Heart Program

Thanks to advances in pediatric cardiac care over the past decades, we now have a population of adults who previously might not have survived childhood. Established in 1994, Inova's Adult Congenital Heart Disease (ACHD) Program was one of the first in the country to care for patients with congenital heart disease. Today, it provides complete continuity of care for adults with a variety of congenital heart defects, including those complicated by heart rhythm problems, heart failure and pulmonary hypertension. We partner with our colleagues in obstetrics to achieve the safest delivery plans possible for mothers with congenital heart defects and their babies.

To improve care coordination between multiple subspecialists, the ACHD Clinic is now located within the Heart Failure/Transplant Clinic, next to the Pulmonary Hypertension Clinic. Consolidating these services in one location improves access as well as the patient experience. In addition, children from birth through adolescent transition and into adulthood are cared for within one contiguous space.

A multidisciplinary team of board-certified specialists from Inova Heart and Vascular Institute and Inova Children's Heart Center collaborate to provide high-quality care for all stages of congenital heart disease. Patients have the advantage of seamless access to the collective expertise of Inova's highly skilled pediatric and adult specialists in a single location, to improve outcomes and enhance quality of life. Areas of specialization include:

- **Adult Congenital Cardiac Catheterization.** Cardiac surgeons and interventional cardiologists perform advanced procedures such as the minimally invasive transcatheter aortic valve replacement (TAVR) and catheter-based pulmonary valve replacement.
- **Adult Congenital Electrophysiology.** Electrophysiologists with specialized expertise in management of adults with congenital heart disease treat all types of arrhythmias. In 2018, we performed 16 EP procedures in adults, including catheter ablations in complex coronary heart disease such as Fontan and tetralogy of Fallot, and followed atrial switch Mustard patients. We also placed biventricular pacemakers to resynchronize the heart and improve myocardial dysfunction. All patients with arrhythmias are followed jointly by an electrophysiologist and ACHD specialists.
- **Advanced Cardiac Therapies.** Inova's end-stage heart failure program offers mechanical cardiac-assist services, including the only Joint Commission-certified ventricular assist device (VAD) program, as well as heart and lung transplantation. The Inova Pulmonary Hypertension Program was one of the first in the country accredited as a Comprehensive Care Center by the Pulmonary Hypertension Association to care for adults with congenital heart disease and pulmonary hypertension.
- **Maternal-Fetal Medicine.** Inova's high-risk obstetric specialists carefully manage women with congenital heart disease during pregnancy. The team also cares for women carrying a baby with suspected congenital heart disease that may require specialized pediatric care after birth.



*Patient with Christopher Talluto, MD  
and Carolyn Rosner, CRNP*

In 2018, our ACHD team evaluated 275 patients.

## Fetal Cardiology

Inova Children's Hospital Fetal Care Center provides a supportive team approach with prenatal consultation and pediatric care planning for pregnant women suspected of, or at risk of, carrying a fetus with a congenital heart defect.



*Fetal Care Center team*

Resources include expert evaluation and diagnosis by a board-certified pediatric cardiologist, a coordinated delivery plan and care for newborns after birth in our NICU and PCICU. Expectant mothers deliver their babies on site at Inova Women's Hospital, allowing mother and baby to remain in the same facility, close together. Delivery at Inova also ensures continuity of care by the same team that cared for the baby in utero. Our patients benefit from the combined expertise of pediatric cardiologists, cardiac surgeons, cardiac anesthesiologists, nurses and a genetic counselor working hand in hand with maternal-fetal medicine specialists and obstetricians to provide comprehensive care.

One call provides access to diagnosis, neonatal care and pediatric subspecialty care. Families also receive the emotional, educational and logistical support services they need during this critical time.

Members of our Fetal Heart Program are involved in the development of quality improvement metrics through the American College of Cardiology.

2018 Fetal ECHOCARDIOGRAMS: 1,123



## Noninvasive Cardiology

Inova Children's Heart Center offers state-of-the-art cardiac imaging to diagnose the unique medical and surgical needs of newborns, children and adults in a safe, family-friendly environment.

Our advanced procedures include:

- Fetal echocardiography to detect heart problems before birth, allowing for faster medical or surgical intervention once the baby is born
- 3D and intracardiac echocardiography for better visualization of the heart chambers and valves
- Transesophageal echocardiography (heart scan with endoscopy) to guide and facilitate surgical and catheter-based procedures

Our team of experienced certified pediatric sonographers works with cardiologists to produce comprehensive, high-quality pictures of the heart.

We monitor program quality by reviewing the correlation between preoperative imaging and surgical findings. Our echocardiography lab is accredited by the Intersocietal Accreditation Commission (formerly ICAEL).

In 2018, we performed:

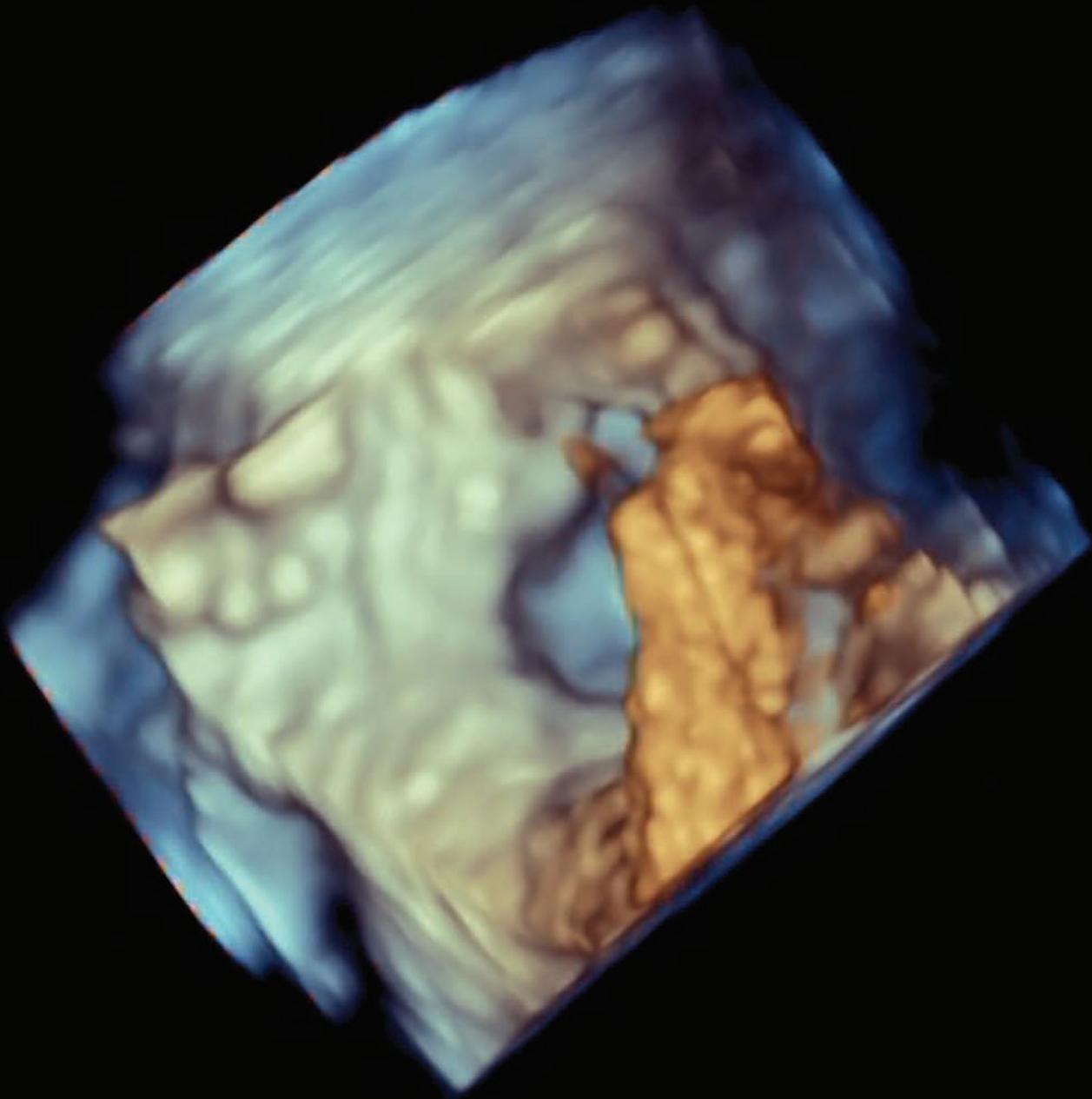
7,692 outpatient transthoracic echocardiograms

1,947 inpatient transthoracic echocardiograms

167 transesophageal echocardiograms

## Exercise Stress Lab

Exercise testing is an important diagnostic tool for children with congenital or acquired heart disease. It allows us to measure pulmonary function, the rate of perceived exertion, subjective exercise intensity and workload resistance. On average, our outpatient clinicians perform more than 400 ambulatory treadmill stress tests annually. We use exercise stress testing to assess the response to various antiarrhythmic drugs and cardiotonic medications. Exercise stress tests have proven to be valuable for ACHD follow up, as well as for patients about to undergo cardiovascular surgery.



## Ambulatory Cardiology

Our ambulatory cardiology program makes it easy for patients to receive the care they need close to home.

- Our cardiologists practice in ambulatory settings throughout Maryland and Virginia, and our team cares for infants at NICUs across the region.
- Expanded telemedicine capabilities improve access for patients who live in remote areas. Cardiologists can review clinical information such as electrocardiograms and echocardiograms, and remote rhythm monitors to develop an individualized care plan.
- Our EP program offers convenient home-based monitoring of patients with pacemakers, minimizing travel and missed work and school days.
- Many of our clinics offer exercise stress tests, as well as Holter monitoring and implantable loop recorders for evaluation of arrhythmias.

As our ambulatory program grows, we use the American College of Cardiology's Adult Congenital and Pediatric Cardiology Quality Metrics for chest pain, Kawasaki disease, infection prevention and more.

In 2018, our collective cardiologist team evaluated approximately **27,000** patients.

## Advanced Multimodal Imaging

Inova Children's Heart Center offers state-of-the-art imaging technology, including cardiac MRI and CT imaging. The Inova Fairfax MRI Center was the first location in the United States to offer comprehensive cardiac MRI with 4D flow imaging, a novel technique to evaluate flow dynamics in the heart and surrounding vasculature. It reduces scan time, so children do not need to hold their breath. It also may avoid the need for anesthesia in younger children.

In 2018, Inova Fairfax Medical Campus installed a new GE Revolution CT scanner. It allows for lower-dose imaging techniques for our pediatric patients, without anesthesia, as well as whole-heart imaging in a single beat. Although MRI is our technique of choice for congenital heart patients, CT is a valuable tool in certain circumstances.

All pediatric cardiac studies are performed and interpreted by fellowship-trained cardiac imagers and presented at our weekly multidisciplinary conference to allow a comprehensive review of the imaging.

## Intensive Care

Inova Children's Hospital offers a full range of pediatric cardiac critical care services, all housed in a family-centered, comprehensive care environment. The service is staffed around the clock by board-certified pediatric intensivists specially trained to care for critically ill children. These clinicians have extensive experience treating congenital heart disease. The ICU team includes physicians, nurses, advanced practitioners, pharmacists, respiratory therapists, and occupational and physical therapists who work together to optimize care for each precious child we serve.

In 2019, Keith Kocis, MD, a leader in the field of PCICU care, became Medical Director of the Cardiac Intensive Care Unit. Dr. Kocis' research interests have focused on streaming real-time physiologic and clinical "big data" to create advanced predictive analytics that identify rare, fatal events.

In 2018, our ICU team treated more than **1,200** critically ill children.

The PCICU provides eight beds dedicated to the care of critically ill children with heart disease. This specialty unit is staffed by cardiac intensivists, cardiologists, cardiovascular surgeons, physician assistants, nurse practitioners and nurses, all with additional training and expertise in the care of critically ill children with heart disease.

Care includes:

- Diagnostic evaluation of critically ill children with cardiac involvement
- Care of children before and after surgical repair of complex congenital cardiac defects
- Heart failure management
- Arrhythmia management

Supportive treatments include:

- Comprehensive hemodynamic monitoring
- High-frequency oscillatory ventilation
- Continuous renal replacement therapy
- Inhaled nitric oxide
- Extracorporeal membrane oxygenation (ECMO) support

Our outcomes exceed national benchmarks. However, the real strength of Inova Children's Hospital lies in our commitment to patients and families. We continually strive to provide the highest quality care and best possible outcomes. Our multidisciplinary team approach encourages open and effective communication among all clinicians. Parents are key members of the care team at all times.

## Aortopathy Program

In 2018, the Inova Cardiovascular Genomics Clinic added a program for patients with aortopathy and/or connective tissue disorders, and their families. The aortopathy program provides expert medical management, integrated care and advanced genetic services for an array of conditions, including bicuspid aortic valve, Marfan syndrome, Loeys-Dietz syndrome, familial aneurysms/dissections, aortic and arterial aneurysms, Ehlers-Danlos syndrome (vascular type) and other genetic syndromes associated with aortic aneurysms. Our team of pediatric and adult cardiology and cardiac surgery specialists uses evidence-based medical surveillance and genetic screening to guide medication management, lifestyle modifications, and catheter and surgical interventions. If needed, the Inova Cardiovascular Genomics Clinic provides multidisciplinary care coordination with experts in vascular and nonvascular specialties. Resources include personalized education, psychosocial support and documentation.

## Single Ventricle Interstage Program

The Single Ventricle Interstage Program provides comprehensive care and support for families of infants with complex conditions such as hypoplastic left heart syndrome and shunt-dependent circulation that require intervention in stages. The program bridges the gap between a child's first and second heart procedures.

Our multidisciplinary team includes two cardiologists, physician assistants, a nurse navigator, clinic nurse, speech therapist and dietitian. Because clear communication and care transition from hospital to home improve outcomes and survival, families receive extensive education to help them care for their child upon discharge, as well as home monitoring equipment to track their baby's vital signs and progress.

Patients are seen at regular intervals in our Single Ventricle Clinic. They also follow up with their primary cardiologist. In addition, our clinical nurse navigator checks in with parents every week by phone. Between appointments, parents have access to a dedicated phone line, where a clinical staff member is available to coordinate care, troubleshoot problems and discuss concerns.

To provide the highest quality care, we are part of the National Pediatric Cardiology Quality Collaborative.



## Neurodevelopmental Care

Children with complex congenital cardiac disease are at increased risk for neurodevelopmental delays and disabilities. In 2012, the American Heart Association identified those infants at greatest risk and recommended early screening and intervention to help them achieve their highest neurodevelopmental potential.

Inova Children’s Heart Center partners with our pediatric rehabilitation specialists to provide this service to our at-risk population. The Follow-Along Clinic provides developmental evaluation for infants and children who have experienced:

- Regional cerebral perfusion techniques (used for certain complex neonatal surgical procedures)
- Extracorporeal membrane oxygenation (ECMO) support
- Cardiac arrest

Our pediatric rehabilitation specialists (physical, occupational, speech and language therapists) use a standardized developmental assessment tool to determine:

- Mental abilities
- Motor skills
- Problems of weakness or tone (via neurologic screening)
- Speech skills

Recommendations are provided for:

- Home activities to promote an infant’s developmental potential
- Referral to community-based resource centers as appropriate

The clinic team works with the patients, families and primary medical providers to ensure they can manage any neurodevelopmental concerns, even after they leave the hospital.

In 2019, Inova Children’s Hospital joined the prestigious Cardiac Neurodevelopmental Outcome Collaborative (CNOC). A multicenter, multidisciplinary group of healthcare professionals, CNOC is dedicated to working together and partnering with families to optimize neurodevelopmental outcomes for children and adolescents with congenital heart disease through clinical, quality and research initiatives, to maximize quality across the lifespan.

## Pediatric Cardiac Anesthesia

At Inova Children’s Hospital, patients with congenital heart disease are cared for by a dedicated team of pediatric cardiac anesthesiologists who understand children’s unique physiology and needs. Our team of board-certified pediatric anesthesiologists and experienced CRNAs provides comprehensive care for patients anywhere anesthesia or sedation is required, including:

- Cardiac operating room
- Catheterization lab
- NICU
- Radiology and MRI
- Pediatric sedation
- General operating rooms

Patients with congenital heart disease often require sedation and anesthesia for multiple procedures, and our anesthesiologists work in collaboration with the entire cardiac team to ensure the safest outcomes.

## Nursing

Inova Children's Hospital is a 226-bed pediatric quaternary care center. The 8-bed PCICU is housed within the larger, state-of-the-art PICU. A 22-bed Pediatric Intermediate Care Unit (PIMC) is located next to the PCICU and PICU.

The PCICU provides the highest level of care for a culturally diverse population of young patients and their families, and serves as a referral unit within the hospital. The unit's scope of service ranges from birth to 21, with the majority of patients less than five years in age. Admission diagnoses include postoperative cardiac surgery, ECMO, high-frequency oscillation ventilation, continuous renal replacement therapy, vasoactive drip management and management of other life-threatening conditions, including heart failure and arrhythmias.

The PCICU is committed to a team approach with joint accountability among staff, leadership and key stakeholders. Effective communication is critical to providing high-quality care and outcomes for patients in a family-centered environment. The unit approaches staffing from a healthy work environment perspective, matching nurse skill with needs of all cardiac patients. Continuing education is provided to the cardiac nursing team, and staff are assigned to patients within their experience and expertise, with advanced support nurses caring for the most complicated cases. Cardiac patients step down to the PIMC where care continues from nurses educated in post-op management with a focus on transition to home. In the PIMC, 24-hour telemetry is provided by a centralized monitoring station with staff specializing in identification of arrhythmias.

Inova Children's Hospital is strongly committed to reducing hospital-acquired infections (HAI). The hospital has participated in the Solutions for Patient Safety (SPS) network since 2014, working to hardwire CLABSI bundle compliance and proactively address HAI reduction. Our active and comprehensive plan continues to evolve with dynamic team engagement.

The hospital's CLABSI rate is within the top 10 percent of the SPS network. The PIMC has had no HAI for more than five years.

## Child Life

At Inova Children's Hospital, we believe that meeting the psychosocial needs of children and their families is an essential component of exceptional comprehensive care. Our certified Child Life specialists partner with physicians, nurses and the entire team to craft an experience that is not only comfortable and soothing, but also promotes healthy coping and healing strategies.

For children scheduled for cardiac surgery, Inova's Child Life team provides:

- A pre-op tour that includes a hands-on developmentally appropriate description of what to expect
- Support during pre-op bloodwork, echocardiograms, cardiac catheterizations, EP procedures and other tests, as needed
- Hands-on preparation and support through admission and each step of the surgical process

In addition, Inova's Child Life specialists support children who come to the hospital for outpatient cardiac procedures.

*Nicole Johnson, Cardiac CCLS with patient*



## International Care

In 2018, our cardiac surgeons traveled to Guayaquil, Ecuador and Tripoli, Libya, where they operated on nearly 40 children with congenital heart disease and helped train local surgeons. In addition, our cardiologists participated in international missions to both Haiti and the Dominican Republic.

## Cardiac Parent Advisory Council

The Cardiac Parent Advisory Council (CPAC) was formed in 2018. Led by Jamie Gentile, Director of Child Life Services, CPAC includes parents who have had a recent experience at Inova Children's Heart Center, as well as physicians, nurses, Child Life specialists and hospital leaders. Parents are key members of the care team, and we are most successful



when we leverage their knowledge and listen to their perspectives. Now 20 parent members strong and growing, CPAC provides a wealth of insight that has strengthened the cardiac program, especially around patient education, program development and quality/safety initiatives.

## Inova in the Community

- Inova Star Kids Race was held June 2, 2019 and raised more than \$250,000 to send staff to educational conferences, assist with patient education and much more. This year there were more than 1,500 participants.
- The annual pediatric heart surgery picnic, hosted by Inova Children's Heart Center and Child Life Services welcomed more than 300 patients and family members in September 2019. This event fosters a sense of community within the pediatric cardiac program and allows time for patients and staff to reconnect.
- 2018: The Annual Inova Summit Think Tank brings together clinical leaders with inspirational speakers, including major philanthropists, corporate executives, university presidents, healthcare professionals and government leaders. Similar to the Aspen Institute, the think tank offers stakeholders an exclusive opportunity to participate in discussions about healthcare challenges, hear innovative solutions from respected thought leaders, and learn firsthand how Inova is applying its research and clinical resources to enable individuals to live longer, healthier lives. Past speakers include: CNN Chief Medical Correspondent Sanjay Gupta, MD; ABC Good Morning America Anchor Robin Roberts; Pulitzer Prize-winning author Siddhartha Mukherjee, MD; and former Second Lady of the United States, Dr. Jill Biden.





## Research

Inova Children's Hospital is actively involved with clinical research in fetal cardiology, congenital heart disease, ACHD and complex hereditary arrhythmias. With the support of two generous external grants, Inova provides CME-sponsored lectures from visiting professors throughout the year. Inova Children's Heart Center also participates in multi-institutional research to better understand the unique genetic and genomic factors within families and apply these innovative discoveries to improve health. This gives clinicians a unique opportunity to study whole genome sequencing to decode the genetic and genomic factors that contribute to congenital anomalies. Currently, our heart program is involved in research to improve understanding of the functional genomic abnormalities associated with hereditary arrhythmias such as long QT syndrome, catecholaminergic polymorphic ventricular tachycardia (CPVT), arrhythmogenic right ventricular dysplasia (ARVD) and Brugada syndrome. In addition, we have formalized a relationship with the Genetics Branch of the NIH to look at genotype to phenotype correlation from over 15,000 trios of genetic information obtained over the last few years.

## Publications

Miller RL, Diamonstein CJ, Benheim A. The importance of genetics and genetic counselors in the evaluation of patients with bicuspid aortic valve and aortopathy. *Curr Opin Cardiol*. 2019 Jan;34(1):35-40.

Talluto C. Establishing a successful transition care plan for the adolescent with congenital heart disease. *Curr Opin Cardiol*. 2018 Jan;33(1):73-77.

Karr S. Avoiding physician burnout through physical, emotional and spiritual energy. *Curr Opin Cardiol*. 2019 Jan;34(1):94-97.

Chambers Gurson S. Advances in fetal echocardiography: myocardial deformation analysis, cardiac MRI and three-dimensional printing. *Curr Opin Cardiol*. 2019 Jan;34(1).

Balaji S, DiLorenzo MP, Fish FA, Etheridge SP, Aziz PF, Russell MW, Cohen MI, et al. Risk Factors for Lethal Arrhythmic Events in Children and Adolescents with Hypertrophic Cardiomyopathy and an Implantable Cardioverter Defibrillator: An International Multi-Center Study. *Heart Rhythm*. 2019 Apr 23.

Saarel EV, Law I, Berul CI, Ackerman MJ, Kanter RJ, Sanatani S, Cohen MI, et al. Safety of Sports for Young Patients with Implantable Cardioverter-Defibrillators. *Circulation Arrhythmia Electrophysiol*. 2018 Nov;11(11)

Cohen MI. Frequent premature ventricular beats in healthy children: when to ignore and when to treat? *Curr Opin Cardiol*. 2019 Jan;34(1):65-72.

Garvey EM, Papez AL, Notrica DM, Egan JC, Molitor M, Cohen MI, van Leeuwen K.. Thoracoscopic Cardiac Sympathetic Denervation: Adjunct Therapy for Secondary Prevention of Life-Threatening Ventricular Arrhythmias in Children. *J Laparoendosc Adv Surg Tech A*. 2018 Nov; 28(11):1387-1392.

Etheridge SP, Escudero CA, Blaufox AD, Law IH, Dechert-Crooks BE, Stephenson EA, Dubin AM, Cohen MI, Sanatani S. Life-Threatening Event Risk in Children with Wolff-Parkinson-White Syndrome: A Multicenter International Study. *JACC Clin Electrophysiol*. 2018 Apr;4(4):433-444.

Dechert BE, LaPage, Cohen MI. Suspicion and Persistence: A Case of Pediatric Brugada Syndrome. *Pediatrics* 2019.

Dzelebdzic S, Tawfik SS, Collazo LR, Shorofsky M, Benheim AE, Ansong AK, Karr SS. Diagnosis and Management of Fontan Failure Secondary to Aortopulmonary Artery Fistula. *Journal Of Structural Heart Disease*, April 2019, Volume 5, Issue 2:38-42.

## Meet Our Team



### Cardiology

Mitchell Cohen, MD  
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Hassan Abdallah, MD  
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Alan Benheim, MD  
Patrick Callahan, MD  
Sarah Chambers Gurson, MD  
Amir Dangol, MD  
Jared Hershenson, MD  
Sharon Karr, MD  
William Kirby, MD  
Jennifer Lindsey, MD  
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Keyur Mehta, MD  
Jennifer O'Neil, MD  
Jin Park, MD  
Jaheedah Roane, MD  
Harish Rudra, DO  
Christopher Talluto, MD  
Sherif Tawfik, MD  
Kalpana Thammineni, MD  
Jim Thompson, MD

### Cardiac Surgery

Lucas Collazo, MD  
*Chief, Cardiac Surgery*  
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Glenn Bailey, PA  
Mechelle Fleischer, PA

### Adult Congenital Heart Disease

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Lucas Collazo, MD  
Pat Nayak, MD  
Carolyn Rosner, CRNP  
Sherif Tawfik, MD  
Mark Tannenbaum, MD

### Cardiovascular Anesthesiology

Benjamin Cramer, MD  
Ahmed Elrefai, MD  
Erin Foley, MD  
James Konigsberg, MD  
Jennifer Maher, MD  
Robert Mesrobian, MD

### Electrophysiology

Mitchell Cohen, MD

### Inherited Cardiac Conditions Clinic

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Palak Shah, MD  
*Co-Director, Adult (IHVI)*  
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Ryan Hartman, MS, CGC  
Rebecca Miller, MS, CGC

### Interventional Cardiology

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Jim Thompson, MD

### Noninvasive Imaging

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Alan Benheim, MD  
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Sarah Chambers Gurson, MD  
Jared Hershenson, MD  
William Kirby, MD  
Jennifer Lindsey, MD  
Ramiro Lizano, MD  
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Jin Park, MD  
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### **Intensive Care**

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Keith Kocis, MD  
*Medical Director, Pediatric CICU*  
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Nina Censoplano, MD  
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Cynthia Gibson, MD  
Peter Grundl, MD  
Jeremy Lamkin, MD  
William Stotz, MD  
Mahsheed Taeb, MD

### **Nursing Leadership**

Ashley Virts, *Vice President, Pediatric Service Line*  
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Gail Green, RN, *Clinical Director PICU/CICU*  
Deidre Griffith-Ball, RN, *Clinical Director IMC*  
Cecilia Harris, *Clinical Director NICU*  
Kecia Penn, *Clinical Director NICU*  
Kristine Lewis RN3, BSN, MS, CCRN  
*Single Ventricle Nurse Navigator*

### **Advanced Nurse Practitioners**

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Penny Drake, CRNP  
Kelly Feran, CRNP  
Louis Seay, CRNP  
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### **Genetic Counselors**

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### **Fetal Care Team**

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### **Single Ventricle Care Team**

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### **Cardiac Research**

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Lorna Richards, *Pediatric Research Manager*  
Erica Christian, *Clinical Research Coordinator*

### **Child Life Services**

Jamie Gentile, *Director*  
Nicole Johnson, Cardiac CCLS

### **Multimodal Imaging**

Melany B. Atkins, MD  
Edmund D. Hong, MD

### **Administration**

Steve Narang, MD, MHCM  
*President, Inova Fairfax Medical Campus*  
Christopher O'Connor, MD  
*President, Heart and Vascular Service Line*  
David Ascher, MD, MBA,  
*Chairman, Pediatrics*  
Joanna Fazio, *Vice President,*  
*Pediatric Service Line*  
Megan Hindenburg  
*Program Coordinator*

## Giving to Inova

Inova Children's Heart Center is nationally recognized and is one of the largest, most successful programs in the Washington, DC, metro area. With more than 28 dedicated pediatric cardiologists and advanced practitioners, our program provides a continuum of care from the fetus to young adult, all within the same family-centered children's hospital. Philanthropy has empowered the program to grow with an increase in cardiac surgical procedures, advancements in our fetal heart program, the creation of a dedicated electrophysiology program and ongoing growth of our adult congenital heart program in collaboration with the Inova Heart and Vascular Institute. Inova relies on community support to provide excellent care close to home.

If you would like to support the Inova Children's Heart Center, contact *Kirstin McArthur*, Director of Leadership Giving, at 703.776.6081 or [kirstin.mcarthur@inova.org](mailto:kirstin.mcarthur@inova.org)



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