

Healing Young Hearts

today, tomorrow and beyond



MUSC's Children's Heart Center is the recipient of the Society of Thoracic Surgeons 3-star rating for Congenital Heart Surgery Public Reporting in Spring 2016 – denoting the highest category of quality and awarded to only 8 out of 117 members nationally.



Changing What's Possible

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Dear Colleague:

At MUSC Children's Health Heart Center our mission is to provide the highest level of care to every child. Physicians at our Heart Center fulfill this mission by using the latest technology, providing comprehensive and compassionate family-centered care, and engaging in innovative research.

Our Heart Center has consistently been named one of the top pediatric heart centers in the country by *U.S. News and World Report*. Our 99%, 30-day survival rate following complex cardiac surgery ranks us among the best centers in the world and in the top group of U.S. News-ranked elite centers. Our use of advanced imaging and interventional techniques to optimize planning and treatment, and our use of the latest minimally invasive catheter procedures to complement, postpone or even prevent cardiac surgery, clearly demonstrate our total commitment to superior care through individualized attention and advanced technology.

Significant and ongoing research efforts through the Charles P. Darby Children's Research Institute enhance our ability to provide the highest level of care to children by translating laboratory advances to the bedside, by developing new technologies, and by testing new care paradigms through clinical trials. As one of the elite group of 5 cardiac programs in North America with continuous participation in the prestigious Pediatric Heart Network since its inception in 2001, our goal is to continue improving patient care and outcomes.

As we look to the future and realize what is possible for the future of comprehensive pediatric care, we will continue to work towards outstanding results for our patients and yours.

For more information about our services or to refer a patient, call the MUSC MEDULINE at 800-922-5250 or 843-876-CARD (2273).

Sincerely,



Andrew M. Atz, M.D.
Director, Division of Pediatric Cardiology



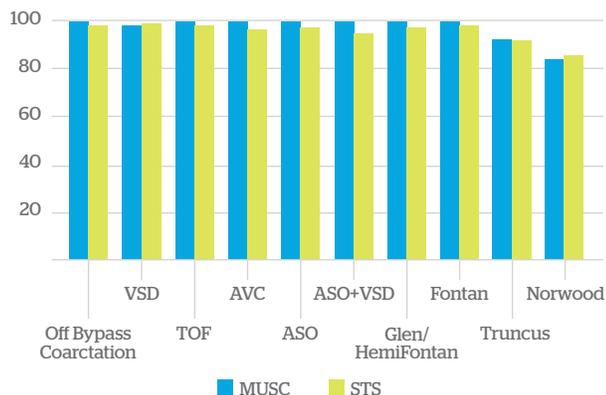
Advanced Technology, Individualized Care, Innovative Approach to Cardiothoracic Surgery

Under the leadership of Dr. Scott Bradley, the MUSC Children's Health Heart Center provides the full range of pediatric surgical procedures for acquired and congenital cardiac disorders. Our specialists perform more than 400 surgeries a year, treating children from birth through adulthood.



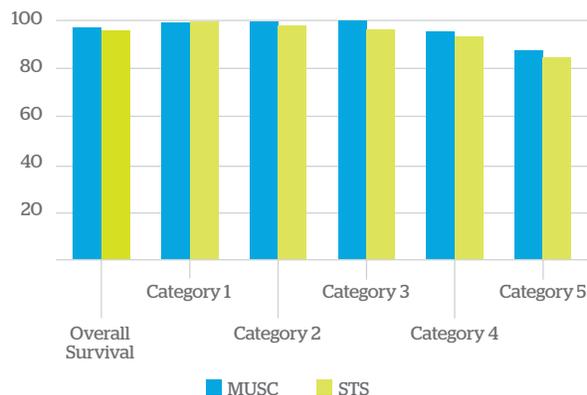
As the only comprehensive cardiac surgery program in South Carolina, and with an overall 30-day survival rate of 99%, MUSC Children's Health ranks among the best congenital cardiac programs in the world. We have also been awarded the 3-star rating for Congenital Heart Surgery Public Reporting by the Society of Thoracic Surgeons in Spring 2016 – denoting the highest category of quality. This 3-star rating was awarded to only 8 of 117 member hospitals nationally.

Survival rate % by procedure 2012-2015 (↑ is better)



MUSC's hospital survival rate by procedure is **BETTER** than the Society of Thoracic Surgeons aggregate data.

Survival rate % by severity 2012-2015 (↑ is better)



MUSC'S hospital survival rate by risk factor is **BETTER** than the Society of Thoracic Surgeons aggregate data. STAT category 1 = patients with the lowest chance of mortality. STAT category 5 = patients with the highest.

Cardiothoracic Anesthesia: Dedicated team of 7 pediatric cardiothoracic anesthesiologists and CRNAs

Our Services:

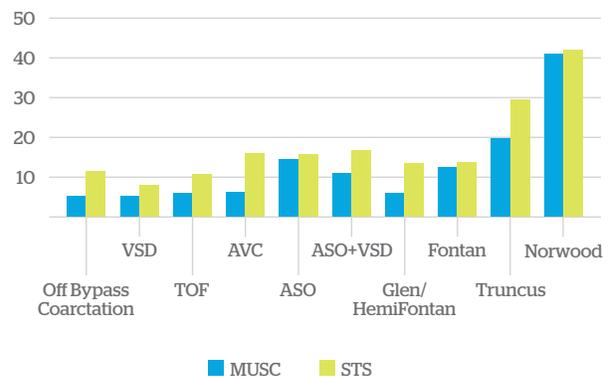
- Pre-surgical evaluation and consultation
- Individualized comprehensive management during surgery
- Anesthetic care of children undergoing cardiac catheterizations, electrophysiology studies, echocardiograms and other advanced cardiac imaging studies
- Anesthetic management of children with congenital heart defects undergoing non-cardiac surgery, including coordination of multidisciplinary providers



2016 – the Year in Review – Achievements

- A 99% 30-day survival rate for all surgical procedures from 2012-2016
- To date, our one-year survival rate after slide tracheoplasty is 100%.
- Postoperative Length of Stay (LOS) days is shorter (better) than STS averages for all benchmark operations from 2012-2015

Postoperative LOS days 2012-2015 (↓ is better)



The MUSC postoperative LOS is shorter than the Society of Thoracic Surgeons data.



Heart Failure and Transplantation

Our Medical and Surgical Management:

- ABO-incompatible heart transplantation for infants
- Diagnosis and treatment of antibody mediated rejection
- Heart transplantation when necessary for all congenital cardiac defects
- A multi-disciplinary team with expertise in desensitization techniques for highly sensitized patients
- Minimally invasive implantation of automatic implantable cardioverter defibrillator (AICD) in infants and small children
- Outpatient intravenous medication administration until donor heart is available
- Access to extracorporeal membrane oxygenator and ventricular assist device until a donor heart is available
- Use of mechanical circulatory support devices to stabilize and bridge high-risk patients to transplant (Berlin Heart®, Thoratec PediMag®, HeartWare®)

Interventional Cardiac Catheterization: A leader in novel imaging guided interventions

Our Program:

- Two pediatric cardiac catheterization labs
- Two dedicated pediatric interventional cardiologists
- More than 600 cardiac catheterizations each year
- Outstanding outcomes
- Active participants in the first national registry for congenital cardiac catheterizations laboratories
- Member of IMPACT registry-an American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR)

Common Interventions:

- High-pressure balloon angioplasty
- Cutting balloon angioplasty
- Balloon expandable stenting to address blood vessel narrowings, including pulmonary artery stenoses, aortic coarctation, and systemic venous stenosis

- Hybrid interventions
- Device closure of septal defects, mechanical perivalvar leaks, and abnormal vessel patency
- Catheter deployed pulmonary valve placement

Our Research:

- The MAGIC national intervention database
- The Congenital Cardiovascular Interventional Study Consortium
- Post Market FDA trial for the Amplatzer Duct Occluder II device
- Post market FDA trial for the Amplatzer Septal Occluder device and Ventricular Septal Occluder device
- PARC study for covered stent placement in the pulmonary position



Echocardiography Laboratory: Continuous accreditation by the Intersocietal Accreditation Commission (IAC)

One of a select group of Pediatric Echocardiography Laboratories with continuous accreditation by the Intersocietal Accreditation Commission (IAC).

Our Program:

- Performs more than 8,000 echocardiograms annually
- Utilizes state-of-the-art methods to evaluate structural heart disease including 3-D

echocardiography and strain for quantitative analysis of ventricular function

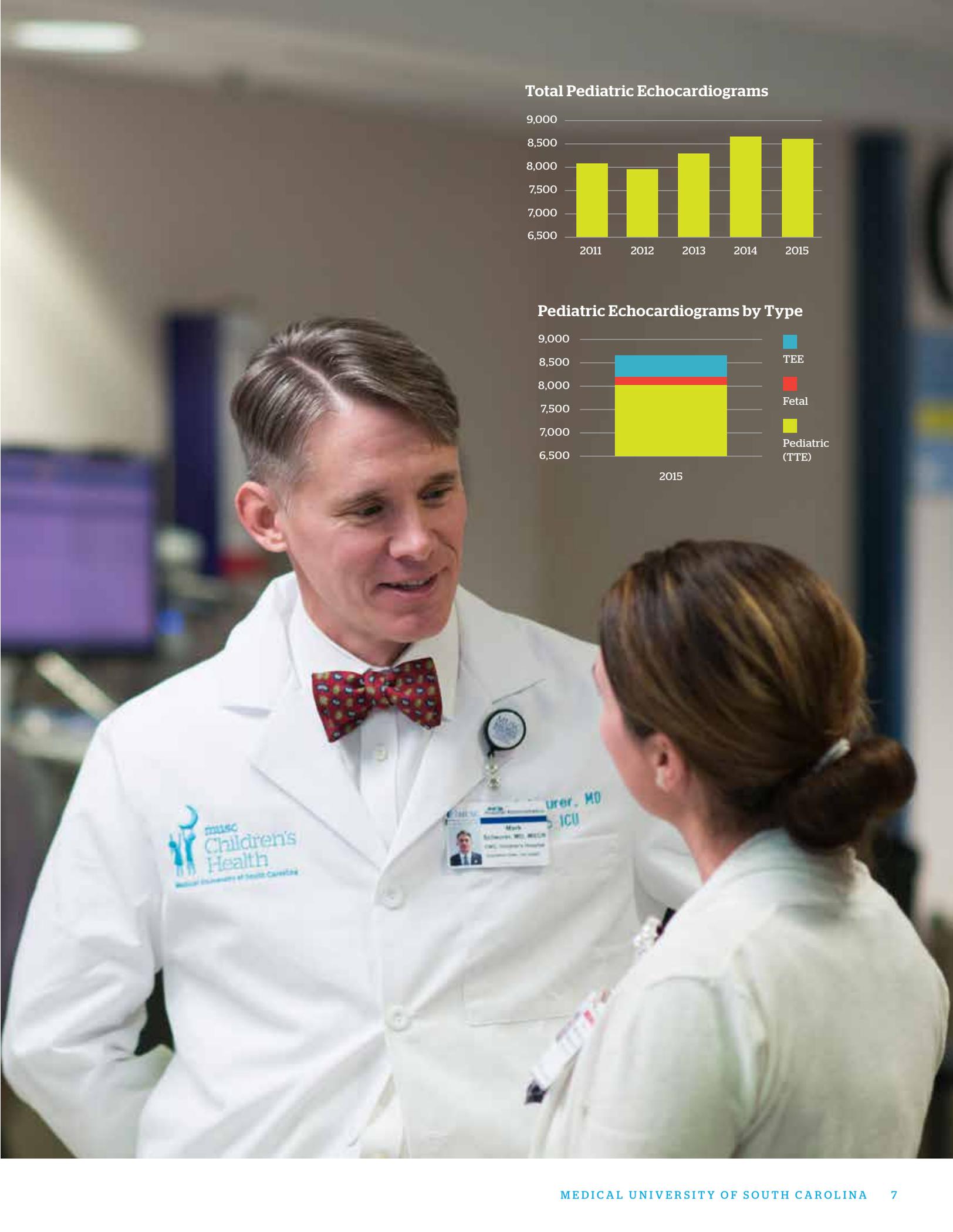
- Provides sedation services as needed for younger children, or those with developmental disabilities
- Performs trans-esophageal echocardiograms and trans-catheter interventions

Advanced Cardiac Imaging: State of the art programs in both cardiac computed tomography(CT) and cardiac magnetic resonance imaging(cMRI) for a tailored and individualized management strategy

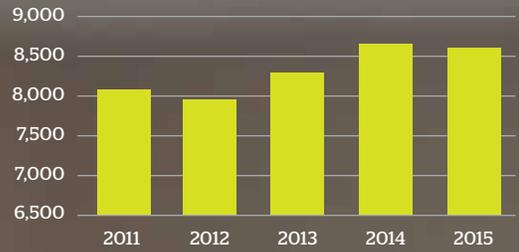
Our Features:

- Collaborative approach with the MUSC Department of Radiology
- Most advanced scanners in the industry, designed with patient comfort and safety in mind
 - › A wide tube design minimizes claustrophobia, reducing the need for sedation or anesthesia
 - › Equipped with headphones, reducing patient stress and anxiety
- Advanced image processing software for image processing is utilized, allowing construction of 3D images of cardiovascular anatomy
- Involved in ground-breaking research into imaging protocols
- Currently involved in projects evaluating techniques to minimize radiation exposure in children undergoing these studies.

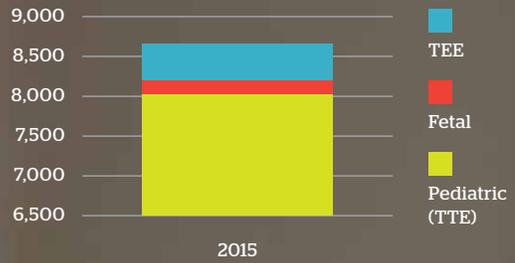




Total Pediatric Echocardiograms



Pediatric Echocardiograms by Type



Fetal Cardiology: Collaborate with a statewide network of physicians to ensure best possible level of care for mother and baby

Our Program:

- Includes obstetricians, maternal-fetal medicine experts, pediatric cardiologists, surgeons and others
- Physicians provide care in the MUSC Advanced Fetal Care Center, which includes a partnership between MUSC Maternal-Fetal Medicine and the pediatric subspecialty teams
- This includes comprehensive diagnosis, coordinated and multidisciplinary care, and maternal-fetal treatment for pregnant women with a fetal congenital anomaly
- Our physicians also determines timing and mode of delivery to reduce medical and emotional stress for mother and baby, and collaborate with local physicians to schedule delivery at MUSC Health
- We also develop a post-delivery plan for the baby and maternal follow-up

Regardless of where the mother lives, our goal is to have the mothers of babies with critical heart disease deliver at MUSC Health in order to minimize postnatal transport and resulting medical and emotional stress for mother and baby.

The Pediatric Cardiac Intensive Care Unit (PCICU) and Cardiac Step-Down Unit

The Pediatric Cardiac Intensive Care Unit

- An intensive care unit that is dedicated exclusively to pediatric and congenital heart care
- A 14 bed state-of-the-art area designed to care for complex medical and surgical patients from newborns to adults
- Equipped to provide the highest complexity of therapies including the employment of mechanical cardiac support with extracorporeal membrane oxygenation and ventricular assist devices.
- Multidisciplinary team with a specific cardiac focus and includes specialized nurses, respiratory therapists, pharmacists, clinical assistants, clinical nutritionists, occupational, physical and speech therapist, as well as specifically trained physicians in pediatric cardiology and critical care medicine
- Dedicated waiting room for families with a child in the PCICU, complete with computers with Internet access, televisions, a private

consultation room and a private lactation room for breastfeeding mothers, staffed by a guest relations specialist who assists families with lodging, transportation and other needs

- Our environment promotes a culture of safety and consistently demonstrates hospital acquired infection rates well below the national average.

The Pediatric Cardiac Step Down Unit

- The pediatric cardiac step down unit provides highly specialized patient care for children not requiring an ICU
- Features 14 private rooms with in-room sleeping available for family members
- The team is comprised of specialists from many disciplines that have a specific pediatric cardiac focus
- Our environment promotes a culture of safety and consistently demonstrates hospital acquired infection rates well below the national average.



Single Ventricle Care

Despite dramatic improvements in survival and outcomes, children with single ventricle heart defects remain at higher risk for lifelong morbidities including poor growth, neurodevelopmental delays, multi-organ dysfunction, myocardial failure, and shortened lifespans.

Our Goal: To provide comprehensive and multidisciplinary care to meet the evolving lifelong needs of children with single ventricle heart defects.

Interstage Monitoring Program

Our Goal: To prevent life-threatening events and improve growth between the newborn and second stage operations in infants with single ventricle heart defects.

Our Team:

- Pediatric cardiologist
- Pediatric nurse practitioner
- Dietician



Cardiac Neurodevelopment Program

Our Goal: To provide multidisciplinary care for high-risk pediatric cardiac patients who are vulnerable to the following:

- Growth failure
- Laryngeal and swallowing dysfunction
- Neurodevelopmental delays
- Gastrointestinal complications
- Progressive myocardial failure

Our Team:

- Pediatric cardiologist
- Developmental-behavioral pediatrician
- Pediatric nurse practitioner
- Pediatric occupational therapist
- Pediatric speech therapist
- Pediatric physical therapist
- Dietician

Additional subspecialty care with pediatric surgery, otolaryngology, neurology, gastroenterology, audiology, and ophthalmology is also coordinated through the Cardiac Neurodevelopment Program.

Fontan Program

Our Goal: To meet the unique and lifelong needs of Fontan survivors

Our Team:

- Pediatric cardiologist
- Dietician
- Nurse practitioner
- Dietitian
- Hepatologist for structured liver surveillance
- Neuropsychologist for screening adolescent patients



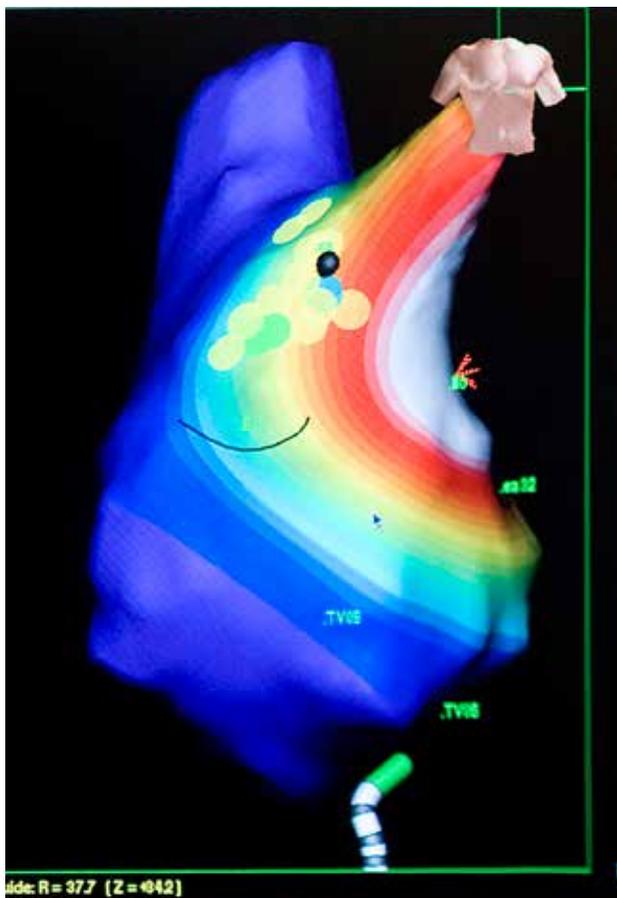
Heart Health Program

Heart Health is both the pediatric weight management program of MUSC Children's Health and the preventive cardiology service of the Children's Heart Center. A family-centered and lifestyle-oriented program, Heart Health is appropriate for any child or adolescent who has abnormal weight gain and/or cardiometabolic risk factors such as dyslipidemia, elevated blood pressure, or pre-diabetes.

Our Services:

- Comprehensive, individualized weight management and cardiovascular risk factor counseling for ages two to twenty-two
- Education for patients and families on how to improve lifestyle behaviors to manage weight and improve cardiometabolic risk.

Electrophysiology and Ablation Services: Comprehensive evaluation and management of arrhythmias in the fetus, child, adolescent and adult with congenital heart disease



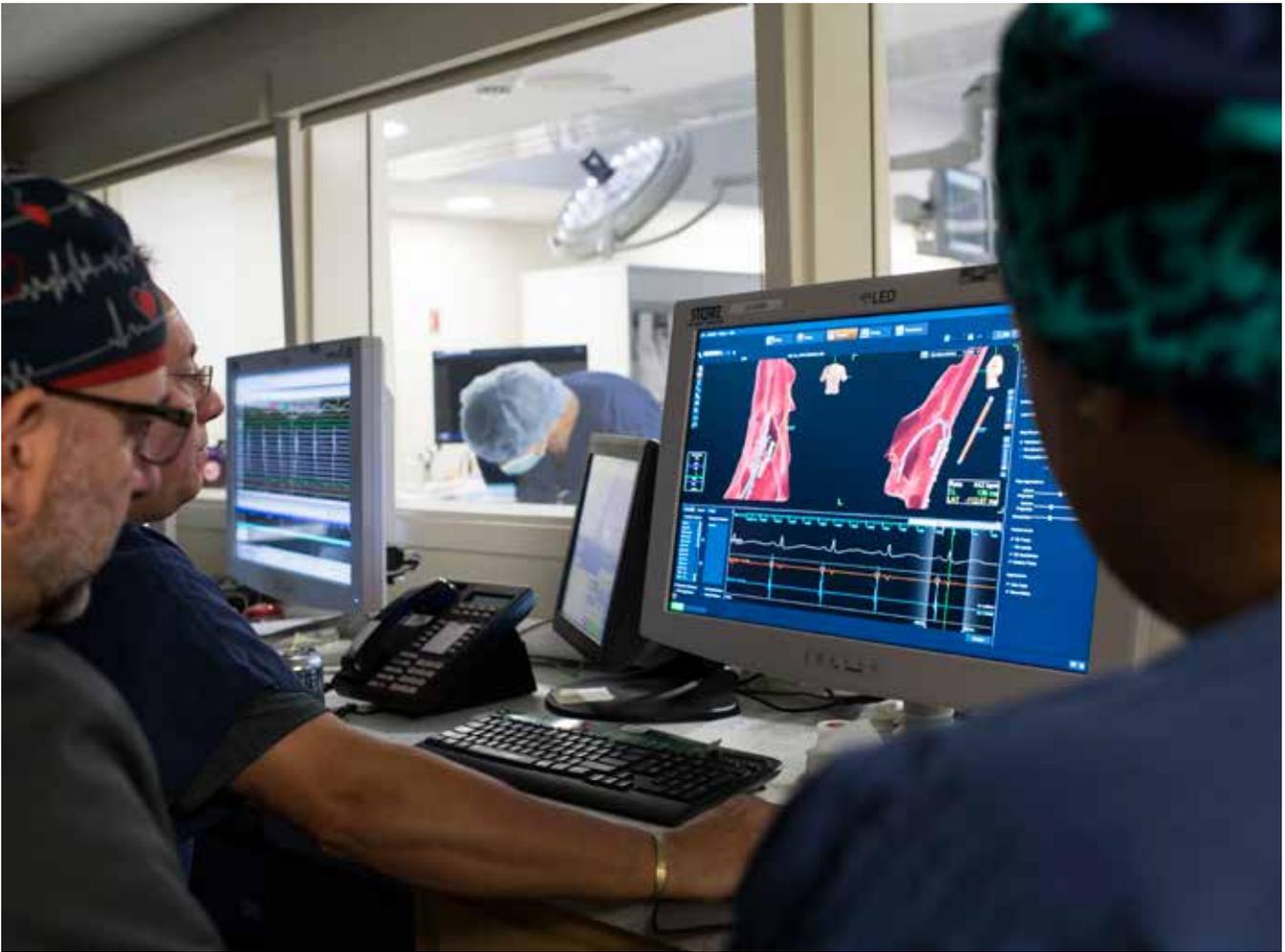
With more than 1,500 ablations performed at MUSC, we consistently achieve an overall success rate of 98%.

An all-inclusive rhythm assessment includes:

- Standard electrocardiograms
- 24 hour ambulatory Holter monitors
- Trans telephonic event monitoring
- Tilt table testing
- Transesophageal pacing studies
- Intracardiac electrophysiology studies and ablation
- Implantable loop recorder placement
- Pacemaker and defibrillator implantation

Arrhythmia Services include:

- Radiofrequency ablation
- Cryo-ablation
- 3D computerized mapping and ablation using advanced mapping systems, treating the most complex rhythm abnormalities in the most complex patients.
- Actively follow over 300 patients with implanted devices in clinic and by remote follow-up



Adult Congenital Heart Disease: A combined management team comprised of adult and pediatric cardiac specialists

Today more than 95% of the children born with congenital heart disease will survive to adulthood. These adults represent a growing population of patients who have pediatric-like heart disease but face the usual issues of adult life – education, jobs, marriage and family - requiring the expertise of specialists who understand both the complex nature of their heart condition as well as the issues faced. The evolution from primary pediatric to combined providers begins with our adolescent transition clinic. This specialized program includes

Adolescent Medicine physicians with expertise in family planning and mental health with the goals of preparing adolescents ages 11-21 years of age to assume responsibility of their health care as adults.

Our Team:

- Adult and pediatric trained cardiologists
- Adult and pediatric interventionalists
- Congenital cardiac surgeons
- Nurse practitioners



Research

History has shown that the best way to optimize patient care is to take what we learn in research labs and apply it in a way that enhances patient care. That is the vision of the Charles P. Darby Children's Research Institute (CRI). Opened in February 2005, the CRI is the largest and most comprehensive pediatric research facility in the Carolinas and one of only 15 in the country. The 121,000 sq. ft. building provides space for researchers in 14 programs, each with investigators representing multiple departments and disciplines.

Current Research Efforts:

- **9.93 Million** dollars in ongoing research support with **\$5.5 Million** from the National Institutes of Health (NIH) *2010-2015 direct cost
- Understanding the basic development of the heart with the potential for identifying methods to modify the structure of the heart for a "natural" repair
- Bioengineering of tissue structures such as vessels or valves made from a patient's own cells to use in surgical repair
- Understanding and modulating the inflammatory response to cardiopulmonary bypass
- Computational modeling and pressure volume loop analysis to better understand and manage single ventricle physiology
- Investigating intestinal function and feeding intolerance in neonates after cardiac surgery
- Studying endothelial barrier function after the Fontan operation
- Participating in the National Pediatric Cardiology Quality Improvement Collaborative
- One of the founding members of the Pediatric Cardiac Critical Care Consortium (PC4)
- Developing and testing new techniques for catheter ablation to treat heart rhythm abnormalities
- Developing and participating in numerous clinical trials at MUSC to improve our patient care and procedural outcomes

The Pediatric Heart Network (PHN): A collaboration of clinical sites and a data coordinating center

- Established in 2001 by the National Heart, Lung and Blood Institute (NHLBI) by the National Institutes of Health (NIH)
- Conducts research studies in children with congenital or acquired heart disease
- Designed to carry out clinical research so that children with heart disease can receive high-quality, evidence-based care

The major barriers to clinical studies in pediatric heart disease include small numbers of individuals with a particular congenital heart defect at any one center, differences in treatment approaches and lack of resources to provide national coordination of collaborative research. The Network approach

attempts to address these barriers by offering an effective, flexible way to study adequate numbers of patients with uncommon diseases through a common infrastructure for recruiting, monitoring, and following patients whose conditions will be characterized in a standard fashion.

Centers with experienced research teams at hospitals that specialize in the care of pediatric patients with heart disease were chosen to become part of the PHN.

The Medical University of South Carolina is one of 9 core centers in the PHN, and 1 of only 5 centers that have been a core center since its inception.

Pediatric Cardiology Fellowship Training Program: Accredited by the ACGME since 1970

We train our fellows to become the leaders of tomorrow in patient care, teaching and research, who have a strong record of academic productivity in the area of clinical research. National honors received over the years which attest to their level of excellence in research have included the following:

- Eight fellows obtained grant funding to further their careers in clinical research at MUSC: from the NIH, the American College of Cardiology, the American Heart Association, the American Society of Echocardiography, American Academy of Pediatrics, Mend a Heart Foundation and Leducq Foundation Transatlantic Network for Cardiovascular Research
- Fourteen fellows completed a Master's of Science in Clinical Research
- Seven fellows obtained grants from the NIH as part of the highly competitive NIH Loan Repayment Program, which rewards fellows who dedicate their careers to academics
- Eleven fellows were selected as finalists at Young Investigator Competitions, and were invited to present their research at national association meetings

Family-Centered Care – Comprehensive and Compassionate

Our focus on family-centered care begins with outstanding medical care and includes ongoing support, education and guidance for the entire family. From our highly qualified nursing staff, to our child life specialists, our team assists patients and families as needed.

Nursing

MUSC is an American Nurses Credentialing Center Magnet Recognized institution, which has only been achieved by 7% of U.S. healthcare organizations. This program recognizes health care organizations for quality patient care, nursing excellence and innovations in professional nursing practice. The pediatric cardiac intensive care unit, step-down unit, cardiac catheterization laboratories and same day procedure and observation units are all staffed by registered nurses with expertise in managing children with heart defects.

We have also been designated as a Baby-Friendly hospital by Baby Friendly USA. Only 14% of United States birthing hospitals have achieved this designation. This recognition means that MUSC is dedicated to promoting successful breastfeeding when mother and infant are medically stable. Additionally, when an infant is not able to breastfeed, MUSC staff will support mothers to express and store milk to be available when the infant is medically ready to feed.

Child and Family support

Our goal is to encourage emotional well-being and normal development in a healthcare setting through the use of play, education and support.

We have Child Life specialists dedicated specifically to our Children's Heart Center that provide support strategies for infants, children, and teens as well as their family and siblings. They provide pre-operative tours to all interested families, as a way of preparing older children and helping families become familiar with the hospital. In addition, they help prepare children to better understand medical procedures and experiences. Included in this program is the Child Life Atrium which serves as a safe haven where there are no invasive medical procedures or questions. This specially designed environment includes age-specific areas intended to meet the needs and interests of all children.

Additional support for the family includes:

- Chaplains available 24/7 to assist with the spiritual and emotional needs of children and their families
- Social workers and case managers to assist with financial and practical resources for families
- Interpreters available 24/7 to facilitate communication with families of all ethnic backgrounds
- Accommodations in the nearby Ronald McDonald house available for families with children in the PCICU
- Private cardiac step-down rooms with in-room sleeping availability for family members
- Convenient access to lodging, shopping, dining, historic attractions and beaches for family time away from the hospital
- Access to Carepages, an online personal tool parents can use to communicate updates on their child's status and recovery



Access to Care

Referring a Patient

To make a referral to one of our specialists at MUSC Children's Heart Center, contact MUSC's dedicated consultation telephone service, MEDULINE, at 1-800-922-5250 or (843) 876-CARD(2273) in the Charleston area. Representatives are available to assist you 24/7. They will put you in immediate contact with a cardiac specialist to assist with management prior to transport. Transportation will also be arranged. To make a referral online, visit physicianportal.muschealth.com/refer.

We work closely with all referring physicians through the Children's Heart Program of South Carolina. We understand the importance of keeping the primary cardiologists abreast of their patients' condition and will continue to work with the referring physician after treatment for any support needed to ensure the highest level of patient care.

MEDUCARE

MEDUCARE is MUSC's highly skilled and dedicated pediatric and neonatal transport team available 24/7 to transport patients from referring hospitals who need immediate medical intervention. Depending on the needs of the child, MEDUCARE arranges emergency medical transportation using its own hospital based on-site helicopter, plane or ground ambulance services. All transportation modes function as mobile intensive care units with much of the same equipment available in our PCICU. The transport team is pediatric trained and equipped to provide child-specific care during transport. It is often possible for a parent to travel with his or her child.

Insurance information

The MUSC Children's Hospital is dedicated to working with health insurance providers and other payers to offer convenient hassle-free access to our premier Children's Heart Center.

The Children's Heart Program of South Carolina

Since the inception of congenital heart surgery, all specialists caring for children with heart disease in South Carolina have worked together to coordinate care and provide the best possible outcomes to our patients. Today, more than 30 pediatric cardiologists throughout South Carolina and 2 pediatric cardiac surgeons in Charleston provide that coordinated care.

Cardiology groups are based in 4 locations – Charleston, Columbia, Greenville and Florence – with outreach clinics in cities statewide. Outstanding outcomes coupled with an individualized approach to each patient have resulted in referrals now coming from across the southeast as well as internationally. To optimize the care of the most critical patients, all of the surgical and catheterization procedures are performed in The Children's Heart Center at MUSC Children's Health in the children's hospital. This system allows for the highest level of care by specialized teams, while still assuring that most of the patient's care is delivered closer to home.

This coordinated approach is unique to our state, and we are proud to work so closely with our statewide colleagues to provide such an arrangement.



Looking to the Future

The MUSC Shawn Jenkins Children's Hospital and the Pearl Tourville Women's Pavilion project is scheduled to open in late 2019. The 250-bed facility is estimated to cost approximately \$385 million and span 625,000 square feet. This state-of-the-art



building will transform how care is delivered to children and women in the Lowcountry, seamlessly integrating children's care with obstetrical services. The planned cohesive design, prioritizes a child's need and experience and provides a greater connectivity between maternity services and newborn care. An entire floor will be dedicated to the care of children with heart problems. This cardiac floor will feature two dedicated pediatric cardiac operating suites, catheterization and electrophysiology suites, family amenities, and 100% private rooms. Our new facility will transform the skyline of Charleston and continue to change what's possible in the care for children and their families.

Imagine What's Possible

The Children's Heart Program of South Carolina

Charleston - Medical University of South Carolina

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Florence - McLeod Hospital

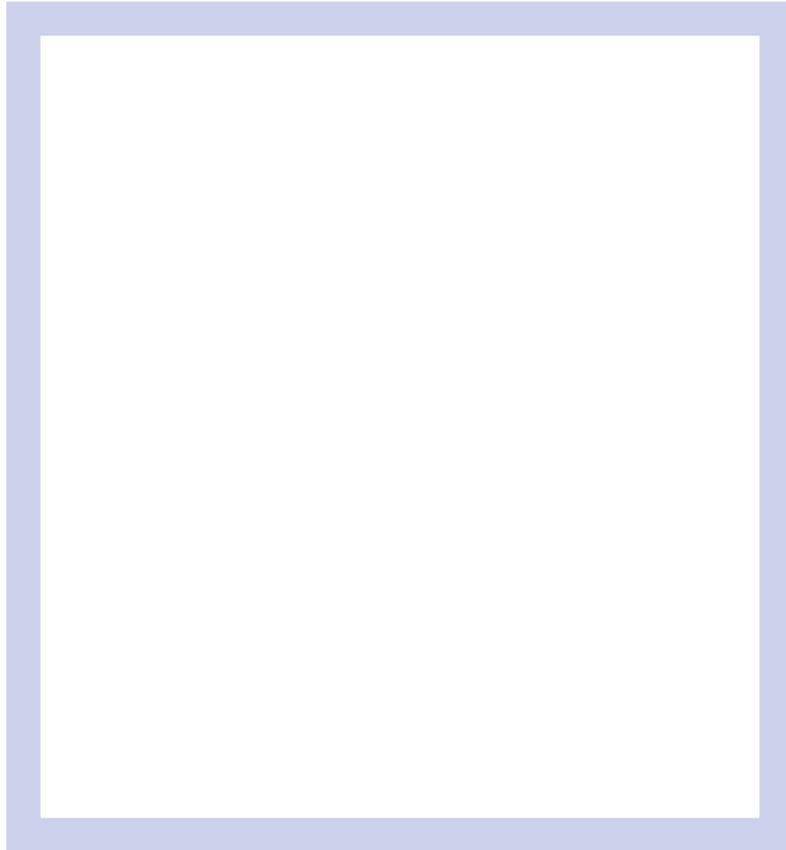
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For consultation or referral, call MUSC Meduline toll-free at 1-800-922-5250 or 843-876-CARD(2273).





Changing What's Possible

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musckids.org/heart