

SANGER HEART & VASCULAR INSTITUTE

An inside look at outcomes and innovation



Carolinas HealthCare System
Sanger Heart & Vascular Institute

The choice for advanced cardiovascular care

For more than 50 years, Sanger Heart & Vascular Institute has delivered world-class care across a broad range of heart and vascular conditions.

Today, that commitment to patients and the breakthroughs that help them live longer continues to thrive. In this report, explore our broad range of specialties and see how our outcomes and clinical innovators place us among the nation's leaders.

Need to refer a patient? We offer life-saving care at Carolinas Medical Center, part of Carolinas HealthCare System, in Charlotte, NC, and at more than 20 other locations in North and South Carolina. We work together closely with referring physicians throughout the treatment process until we can transition each patient back for ongoing care. **Call 877-999-7484.**

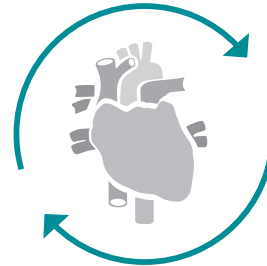
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ONE NETWORK CONNECTED BY EXCELLENCE

When it comes to comprehensive cardiac care, Sanger Heart & Vascular Institute offers the broadest range of treatments possible. From minimally invasive surgery to the latest in interventional cardiology, we care for the most complex cases – with the quality and compassion you expect from a pioneer.

TOP IN HEART TRANSPLANT Three-year survival rate



95.35%
Carolinas
Medical Center
85.22%
Nationally

Adult only, unadjusted
Scientific Registry of Transplant Recipients, published July 2017

MORE EXPERIENCE IN MORE PLACES



191,000+
total visits

Adult ambulatory cardiology
visits for 2017 (annualized)

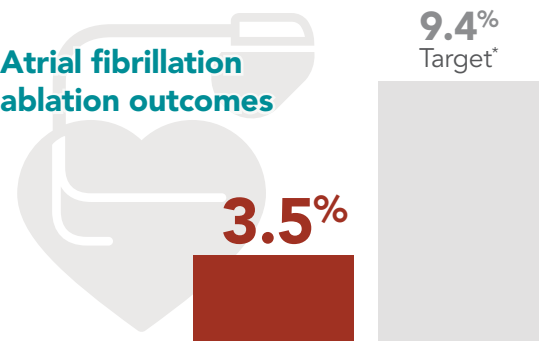
13 minutes
faster D2B

Door-to-balloon times vs.
national median
(D2B median time – non-transfers
Q2 2016–Q1 2017)

2017 Q1 ACTION Registry®

COMMITTED TO VALUE-BASED CARE

Atrial fibrillation
ablation outcomes



30-day readmission rate

Atrial Fibrillation Registry, Carolinas Medical
Center, REDCap database, 1/1/13–10/31/17
*Shah et al, Jan. 2012

PUTTING PATIENTS AND FAMILIES FIRST

91st PERCENTILE
Patient Satisfaction Score

Inpatient HCAHPS Overall, Press Ganey National Database, Sept. 2017

CARDIOTHORACIC SURGERY

One team. A unified network of hospitals.
The full spectrum of the latest surgical treatments.

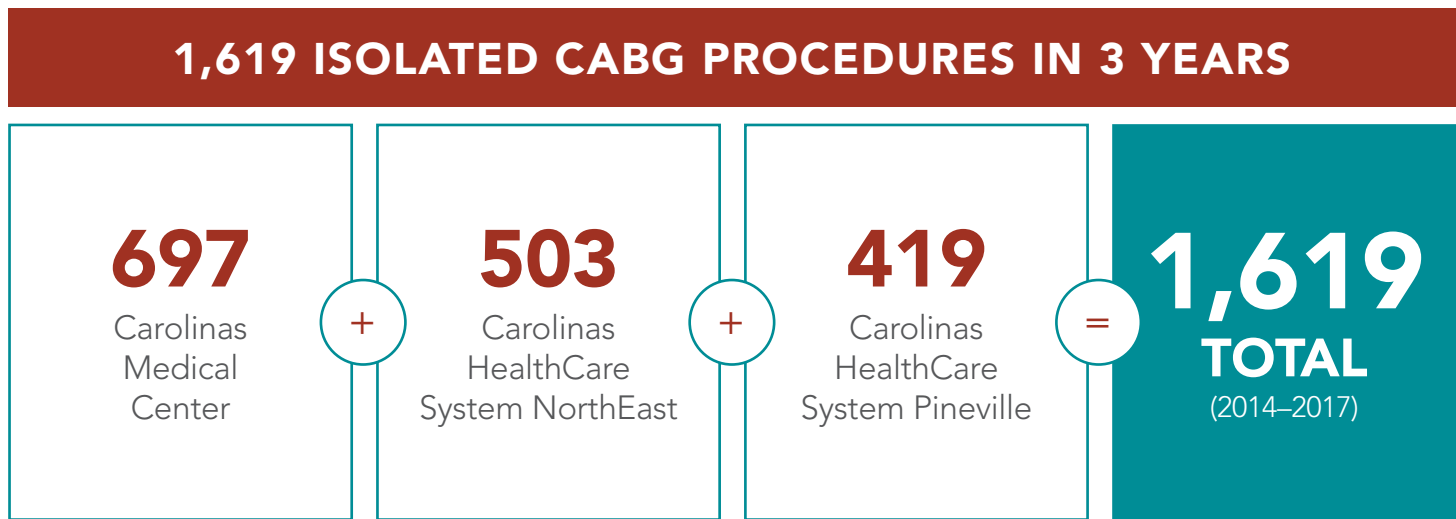
Our expertise in cardiothoracic surgery is built upon extensive capabilities and trailblazing pioneers, like Joseph T. McGinn, MD, who developed the pre-eminent technique in minimally invasive coronary artery bypass grafting (CABG). Our 30-day readmission rates for isolated CABG are consistently lower than the national benchmark.

Our dedicated thoracic surgeons bring the latest in minimally invasive and robotic approaches for a range of conditions, including pleural effusion and esophageal and tracheal cancers.

While quaternary-level-care patients are treated at Carolinas Medical Center, tertiary-level care is offered at Carolinas HealthCare System Pineville and Carolinas HealthCare System NorthEast.



EXPERIENCE WHERE IT COUNTS



Society of Thoracic Surgeons Registry, Aug. 2017

ISOLATED CABG READMISSION RATES

(Rolling-year data ending Dec. 31, 2016)



*Carolinas Medical Center, Carolinas HealthCare System NorthEast, Carolinas HealthCare System Pineville

Society of Thoracic Surgeons Registry, April 2017

AREAS OF SPECIALTY

- Minimally invasive valve surgery
- Complex thoracic aortic surgery
- Coronary artery bypass grafting (CABG)
 - Open heart surgery
 - Minimally invasive heart surgery
- Isolated valve surgery
- Cardiac transplantation and mechanical circulatory support
- Thoracic surgery
- Video-assisted thoracic surgery (VATS), including pulmonary lobectomies

ACUTE CARDIAC CARE

Speed and coordination are the hallmarks of exceptional acute cardiac care.

That's why Sanger's STEMI program is proud to be a national leader in treatment response times for patients who present with myocardial infarction symptoms. Our median door-to-balloon times for non-transfers are consistently 13 minutes faster than the national median. Plus, our nine chest pain centers help make up the region's largest chest pain network, which offers cardiac catheterization around the clock at three of our facilities.

Thousands of patients with coronary artery disease are treated by our expert cardiologists each year using the latest percutaneous coronary interventions (PCIs).

In addition, our care teams provide a supportive navigator program for our patients and families, helping them coordinate resources and transition to post-acute care.



PERFORMANCE AT THE MOST CRITICAL MOMENTS

13 minutes faster D2B

Door-to-balloon times vs. national median
(D2B median time – non-transfers Q2 2016–Q1 2017)

2017 Q1 ACTION Registry®

2,948 PCI procedures

Carolinas Medical Center, Carolinas HealthCare System NorthEast, Carolinas HealthCare System Pineville, Carolinas HealthCare System Union (April 2016–March 2017)

CathPCI Registry®, Aug. 2017



**Mission:
Lifeline®**

Gold Plus rating

**ACTION Registry®-GWTG™
Performance Achievement
Award Recipient**

Platinum rating

**CathPCI
Registry®**

4 stars out of 4

AREAS OF SPECIALTY

- Percutaneous coronary intervention
 - Acute ST elevation myocardial infarction (STEMI)
 - Acute coronary syndromes, including unstable angina and non-ST elevation myocardial infarction (NSTEMI)
 - Stable angina
- Chronic total occlusion

HEART FAILURE & TRANSPLANT

Sanger is proud to count itself among the national leaders in advanced heart failure care.

While our goal is to diagnose and treat heart failure early to prevent progression if transplantation is needed, our team of specialists offers the broadest range of advanced therapies and mechanical circulatory support available to help patients achieve best-in-class outcomes.

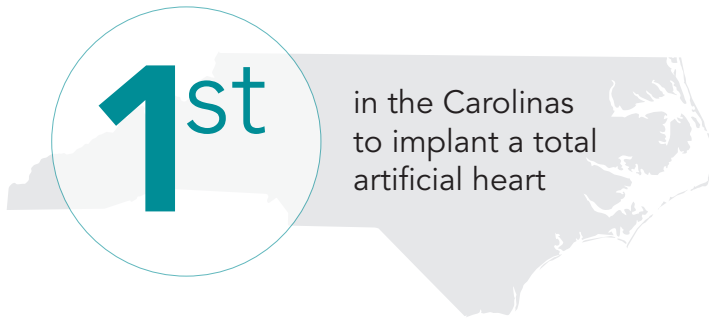
As evidence of our continued commitment to innovation, Sanger's award-winning Heart Success program has been designed to

treat even the most complex cases. Led by multidisciplinary teams of physicians, geneticists, dietitians, pharmacists, patient navigators, social workers, specially trained nurses and advanced care practitioners, we're highly experienced in managing high-risk patients. We also offer a virtual component of the Heart Success program that makes advanced care available to patients who live far from our facilities.

AREAS OF SPECIALTY

- Heart transplant
- Advanced heart failure
- Pulmonary hypertension – only facility in region to provide specialized care
- Hypertrophic cardiomyopathy – one of a few dedicated clinics nationwide
- Septal myectomy
- Ventricular assist device (VAD)
- Total artificial heart implant
- Cardio-oncology

LEADING THE WAY IN HEART FAILURE TREATMENT

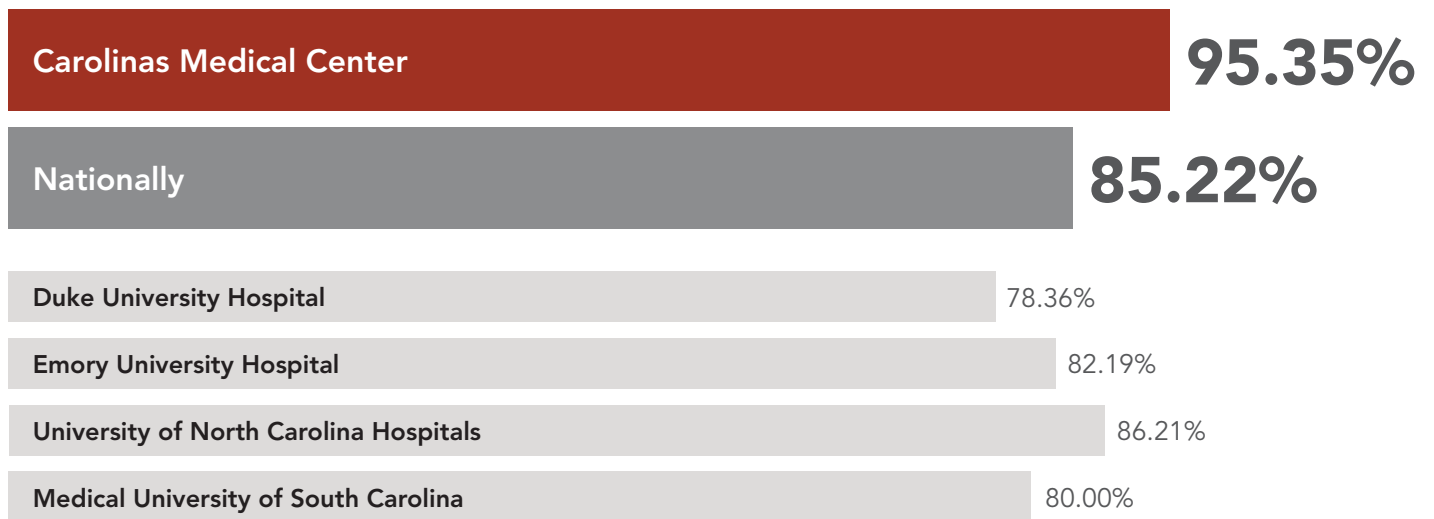


33
heart transplants

2017 (annualized)

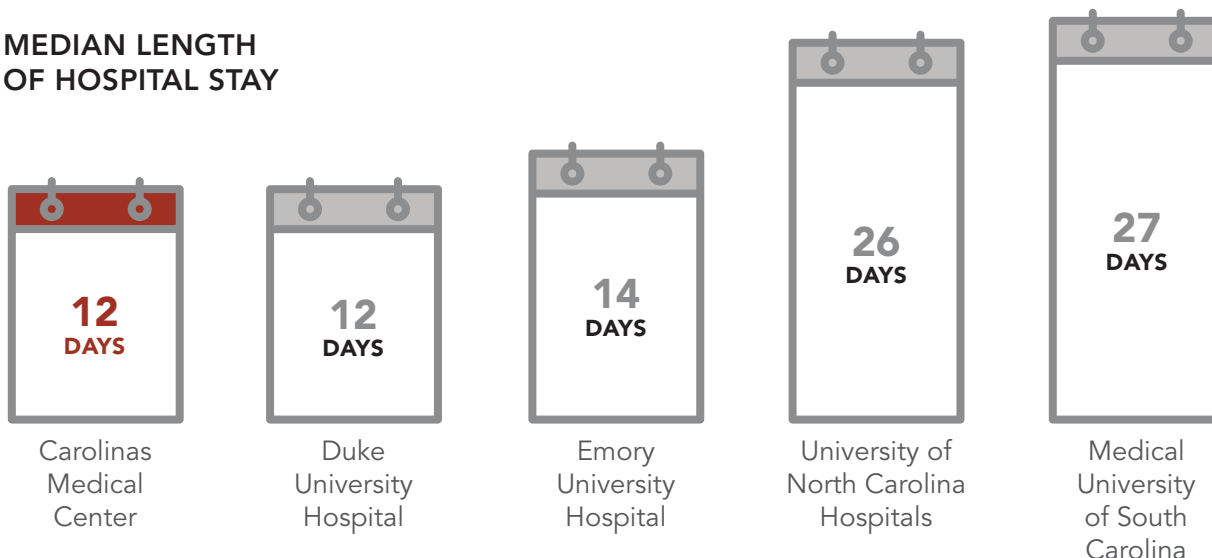
Internal data, Sept. 2017

THREE-YEAR PATIENT SURVIVAL



Unadjusted data for adult transplants from Jan 1, 2012–June 30, 2014
Scientific Registry of Transplant Recipients, published July 2017

MEDIAN LENGTH OF HOSPITAL STAY



Transplants from Jan.–Dec. 2016
Scientific Registry of Transplant Recipients, published July 2017

AORTIC & VASCULAR DISEASE

With some of the most skilled teams in the world, our aortic and vascular programs are at the forefront of delivering life-saving care.

Vascular Surgery & Medicine Program

Sanger performs more than 2,500 vascular procedures annually, making us one of the highest-volume centers in the region.

Providing complete vascular care across the continuum, our collaborative team includes more than a dozen experts who specialize in vascular imaging, vascular medicine and vascular surgery to develop the best treatment plan for each patient.

Center for Aortic Disease

Our aortic program has become an international resource for physicians looking for the most innovative care. Led by Frank R. Arko III, MD, the Sanger surgical team became the first in the world to implant a branched stent graft specifically designed for branch vessel repair of a thoracic aortic aneurysm. Dr. Arko also became the first surgeon in the Southeast to implant a thoracic stent graft for a descending thoracic aortic aneurysm. Physicians from around the world, come to Sanger – some for months at a time – to train under Dr. Arko and our aortic program.

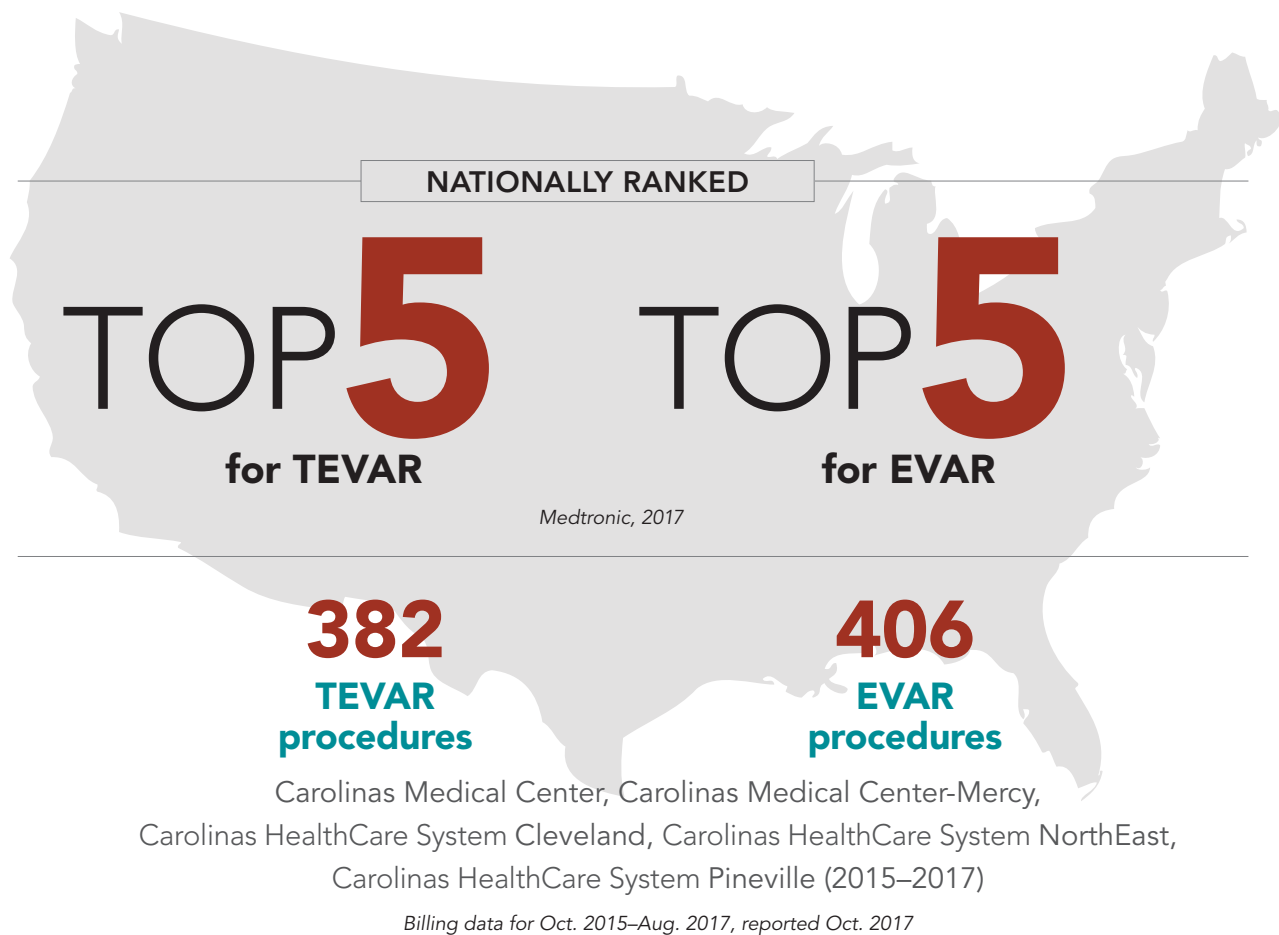
As the only center in the region that participated in both the Mona LSA and Zone Zero clinical trials – as well as helping lead research for trials such as Gore TAG and ABRE – we continue to push the boundaries with treatments that include traditional open procedures and minimally invasive endovascular repair techniques.

For patients with a ruptured abdominal aortic aneurysm or an aortic dissection, we've developed rapid-response Code Rupture and Code Dissection programs to quickly assess patients while simultaneously coordinating our medical teams to be on standby in our hybrid operating room. It's one more way we set ourselves apart in saving lives.

Limb Salvage Program

Our limb salvage program uses the latest techniques and technologies – including endovascular technology and revascularization solutions – to save limbs for patients with peripheral vascular problems or ischemia. Since we launched this program in 2012, we have saved 150 percent more limbs, often for patients who have been referred for amputation.

VOLUMES THAT GO ABOVE AND BEYOND



AREAS OF SPECIALTY

- Aortic dissection repair
- Aortic root aneurysm repair
- Thoracic endovascular aortic repair (TEVAR/EVAR)
- Abdominal aortic aneurysm repair
- Thoracoabdominal aortic aneurysm repair
- Complex aortic arch reconstruction
- Carotid endarterectomy (CEA)
- Endarterectomy
- Complex venous
 - Iliac vein angioplasty and stent
 - Saphenous vein ablation
 - Phlebectomy
 - Sclerotherapy
- Thoracic outlet surgery
- Limb salvage, including bypass and percutaneous interventions
- Code Rupture
- Code Dissection

VALVE & STRUCTURAL HEART DISEASE

Sanger's Center for Advanced Heart Valve Therapies is leading the country in treating some of the most complex structural heart and valve conditions.

As one of the first regional providers of transcatheter aortic valve replacement (TAVR) outside of clinical trials, we are committed to advancing this less invasive technology with excellent outcomes. We are currently participating in the PARTNER III trial to evaluate TAVR in low surgical risk populations, and we are the first in the world to enroll a patient in the EARLY TAVR study comparing TAVR to clinical surveillance in asymptomatic patients with severe aortic stenosis.

We are a high-volume center in transcatheter mitral valve repair since its FDA approval in 2013, and we are one of the only centers in the Southeast to perform balloon mitral valvuloplasty for mitral stenosis.

We are one of five centers nationwide to participate in the CLASP trial to assess a new technology for severe mitral regurgitation.

Sanger is one of only a few centers in the country with expertise in transcatheter closure of paravalvular leaks.

Our survival rates for TAVR and mitral valve repair beat the national average, and we often perform in the top decile in published outcomes for the STS/ACC TVT Registry™.

MAKING THE MOST OF TRANSCATHETER INNOVATIONS

TAVR

250

procedures

2017 (annualized)

1.1%

30-day observed mortality

Rolling 4-quarter data ending Q1 2017

STS/ACC TVT Registry™, July 2017

Mitral Valve

82

mitral leaflet clip procedures

2017 (annualized)

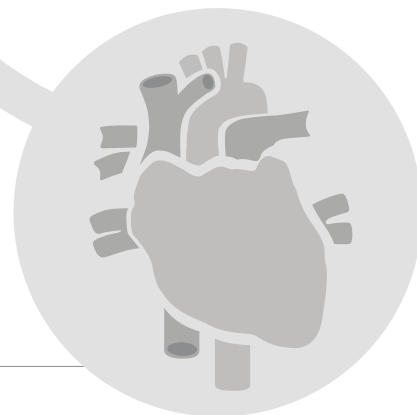
0.0%

30-day observed mortality

(unadjusted)

Rolling 4-quarter data ending Q1 2017

STS/ACC TVT Registry™, July 2017



AREAS OF SPECIALTY

- Valve surgery, including open heart and minimally invasive, to repair or replace the mitral, aortic, tricuspid or pulmonary valve
- Transcatheter aortic valve replacement (TAVR)
- Transcatheter mitral valve repair
- Transcatheter closure of paravalvular leaks
- Transcatheter closure of the left atrial appendage

ADULT CONGENITAL HEART DISEASE

For the growing population of adults with congenital heart defects, Sanger offers the region's only program specializing in adult congenital heart disease (ACHD) treatment.

Each patient works with our ACHD experts to develop a comprehensive care plan that addresses medications, lifestyle modifications and potential surgical interventions, including advanced procedures such as percutaneous pulmonary valve replacement or percutaneous closure of patent foramen ovale.

Our team has completed hundreds of ACHD-related surgeries in just the past seven years. During that time, Sanger specialists have worked with referring physicians to plan surgical and interventional treatments across a patient's complete journey from evaluation to follow-up.

Sanger is one of only a few centers in the region with expertise in congenital pulmonary valve surgery.

**GROWING IN
OUR EXPERTISE**

292 adult congenital
heart disease surgeries

Carolinas Medical Center
2010–2017

118%
increase

from 2010–2017

STS Congenital Database

AREAS OF SPECIALTY

- Percutaneous valve replacement
- Patent foramen ovale (PFO) closure
- Pulmonary valve repair/replacement
- Atrial septal defect (ASD) closure
- Tricuspid valve replacement
- Fontan revision
- Congenital pulmonary valve surgery

CARDIOVASCULAR IMAGING

Equipped with the latest technologies, our cardiac imaging specialists work hand in hand with providers across Sanger, all focused on advancing patient outcomes.

Our imaging specialists are in the operating room to evaluate the quality of a cardiac repair. They collaborate with heart failure specialists to assess left ventricular functioning or with oncologists to detect chemotherapy-related cardiac changes. For us, imaging is integral to comprehensive cardiac care.

We are one of the few heart centers in the region to offer fractional flow reserve CT (FFRCT) technology, a groundbreaking diagnostic test that enables clinicians to identify significant coronary artery disease without a diagnostic catheterization. This non-invasive technology greatly reduces unnecessary invasive testing, saving healthcare costs while improving the patient experience.

AT THE FOREFRONT OF TECHNOLOGY



225
FFRCT procedures
in 2017 (annualized)

Internal data, Oct. 2017

AREAS OF SPECIALTY

- Transthoracic and transesophageal 3D imaging
- Cardiac computed tomography angiography (CTA)
- Cardiac magnetic resonance imaging (MRI)
- Myocardial perfusion imaging for viability and ischemia
- Cardio-oncology

ELECTROPHYSIOLOGY

With one of the largest networks in the country, the Advanced Heart Rhythm Program at Sanger offers world-class arrhythmia care close to home.

Our 10 dedicated electrophysiologists treat a wide array of arrhythmias and related complications using cutting-edge technology and personalized, evidence-based care.

With five hospital implant locations and 12 device management clinics, we offer one of the largest electrophysiology networks in the country, following more than 10,500 patients using remote monitoring capabilities.

Our expertise in lead extraction and device-based heart failure diagnostics has helped make Sanger a training facility for practitioner teams from across the globe, who consult with our Cardiac Rhythm Device Management Center of Excellence on an ongoing basis.

Our dedicated Center for Atrial Fibrillation offers a vertically integrated approach to atrial fibrillation care, with a team that includes clinical cardiac electrophysiologists, cardiothoracic surgeons, imaging cardiologists, cardiac anesthesiologists, sleep medicine specialists and anticoagulation specialists. Together they help our patients achieve superior outcomes, such as ablation readmission rates that are half the national average.

CLINICAL EXCELLENCE BY THE NUMBERS

744

ICD procedures

Q2 2016–Q1 2017

ICD Registry™, Q1 2017 Report

0%

In-lab mortality for lead extraction

2013–2017

Internal data, Oct. 2017



ICD Registry™

4 stars out of 4

ATRIAL FIBRILLATION ABLATION OUTCOMES



Same-facility readmission
rate only

3.5%

30-day readmission rate

9.4%
Target*

0.43%

Total complication rate
(procedure through discharge)

5.1%
Target*

*Shah et al, Jan. 2012

Atrial Fibrillation Registry, Carolinas Medical Center,
REDCap database, 1/1/13–10/31/17

DEVICE MANAGEMENT ENCOUNTERS

43,291

Total encounters

2017 (annualized)



54%

Remote encounters

2017 (annualized)



For all cardiovascular electronic implantable devices (CEIDs): pacemakers, implantable cardioverter-defibrillators (ICDs), implantable/insertable loop recorders (ILRs) and cardiac resynchronization therapy devices (CRTs).

Internal data, Oct. 2017

AREAS OF SPECIALTY

- Ablation
 - Atrial fibrillation
 - Atrial flutter
 - Bradyarrhythmias
 - Supraventricular tachycardia
 - Ventricular tachycardia
 - Wolff-Parkinson-White syndrome
- Complex lead and device extraction
- Devices
 - Cardiac pacemakers
 - Implantable cardiac defibrillators (ICDs)
 - Cardiac resynchronization therapy (CRT-P, CRT-D)
 - Subcutaneous ICDs (SICDs)

INNOVATION, RESEARCH & CLINICAL TRIALS

At Sanger, innovation takes many forms, but they all have one central goal: to improve the treatment of cardiovascular disease.

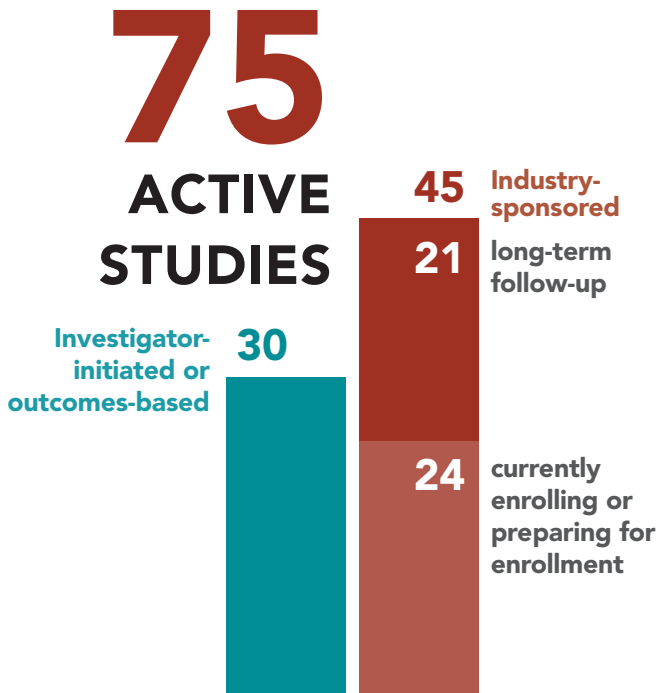
With leadership roles in top clinical trials across multiple disciplines, Sanger has broadened and deepened its research over the past decade. Many of our physicians take part in pioneering clinical studies, from the COAPT study that evaluated the first transcatheter mitral valve repair therapy device for heart failure patients with moderate to severe functional mitral regurgitation, to the PARTNER III trial that is assessing TAVR in low surgical risk populations. Our physicians also serve in leadership investigator roles for trials such as the Galactic-HF heart failure trial, the Gore TAG thoracic branch endoprosthesis

device trial, the ASSURED Gore Cardioform ASD occluder trial, and the EARLY TAVR study in which we enrolled the first patient in the world.

Innovation also comes in the shape of new protocols, such as our Heart Success program for heart failure patients that can be delivered virtually, ensuring high-quality care no matter where a patient lives. Another example is our Code PE program, a treatment algorithm developed at Sanger that offers a step-by-step guide for managing pulmonary embolism patients for optimal outcomes.



ACTIVE IN CLINICAL RESEARCH



623
enrolled research patients

Internal data, Oct. 2017

SELECTED TRIAL INVOLVEMENT

We've taken leadership roles in some of the major trials that may improve cardiovascular treatment worldwide.

- **ADVANCE** registry for fractional flow reserve CT (FFRCT)
- **ASSURED** trial for atrial septal defects
- **ASAP Too** study for WATCHMAN left atrial appendage closure
- **COAPT** transcatheter mitral valve repair in secondary MR
- **EARLY TAVR** study comparing TAVR to clinical surveillance for severe aortic stenosis
- **Galactic-HF** chronic heart failure trial
- **Gore TAG** for evaluation of thoracic branch endoprosthesis device
- **HeartMate 3** Left Ventricular Assist System (LVAS) and Continued Access study
- **Mona LSA** early feasibility study for descending thoracic aneurysms
- **PARTNER III** study of TAVR in low surgical risk populations
- **REDUCE** study for atrial septal defects (ASDs) closure (cardioform septal occluder)
- **SAPIEN 3** transcatheter heart valve study
- **Zone Zero** thoracic aortic graft trial

CONTRIBUTING TO SCIENCE



150+
publications, abstracts and presentations in 2016

Internal data, Oct. 2017

VALUE-BASED CARE

The highest caliber of cardiac care, wherever patients receive it. That's how Sanger brings greater value to healthcare.

Our broad, integrated network in the Carolinas allows us to deliver coordinated care across geographies and disciplines in a way that emphasizes quality and efficiency.

Whether we're providing virtual follow-up to a heart failure patient in one city or cardiac rehabilitation in another, all of our subspecialties work with the same processes and goals, and our facilities operate at the highest quality standards, with providers who have participated in standardized training and educational efforts. That's how we've dramatically lowered retesting and readmission rates, increased our patient satisfaction ratings and held down the cost of care.

Our navigator program supports patients and families, improving the patient experience, clinical outcomes and continuity across the care continuum.

We've instituted care pathways – for example, in acute myocardial infarction (AMI), atrial fibrillation and chest pain – that help us reduce variability in treatment and achieve more reliable outcomes. Where external benchmarks do not exist for some procedures – for example, in device management – we've developed our own internal quality measures to track our outcomes.

Overall, by keeping equipment costs under control, establishing medication protocols and stressing evidence-based practice, we've made healthcare delivery more standardized, more efficient and even more in line with patients' diverse needs.

CREATING MORE VALUE IN HEALTHCARE

0.87

Heart failure

**30-DAY
READMISSIONS**

Same-facility
observed/expected ratio

0.68

AMI

June 2016–May 2017

Premier, Sept. 2017

91st
PERCENTILE

Patient Satisfaction Score

Inpatient HCAHPS Overall

94%
TOP BOX

Likelihood to Recommend

Outpatient Satisfaction Score

Press Ganey National Database, Sept. 2017

6 **CARDIAC
REHABILITATION
FACILITIES**



95,034
total visits

2017 (annualized)

Internal data, Oct. 2017

201
virtual visits

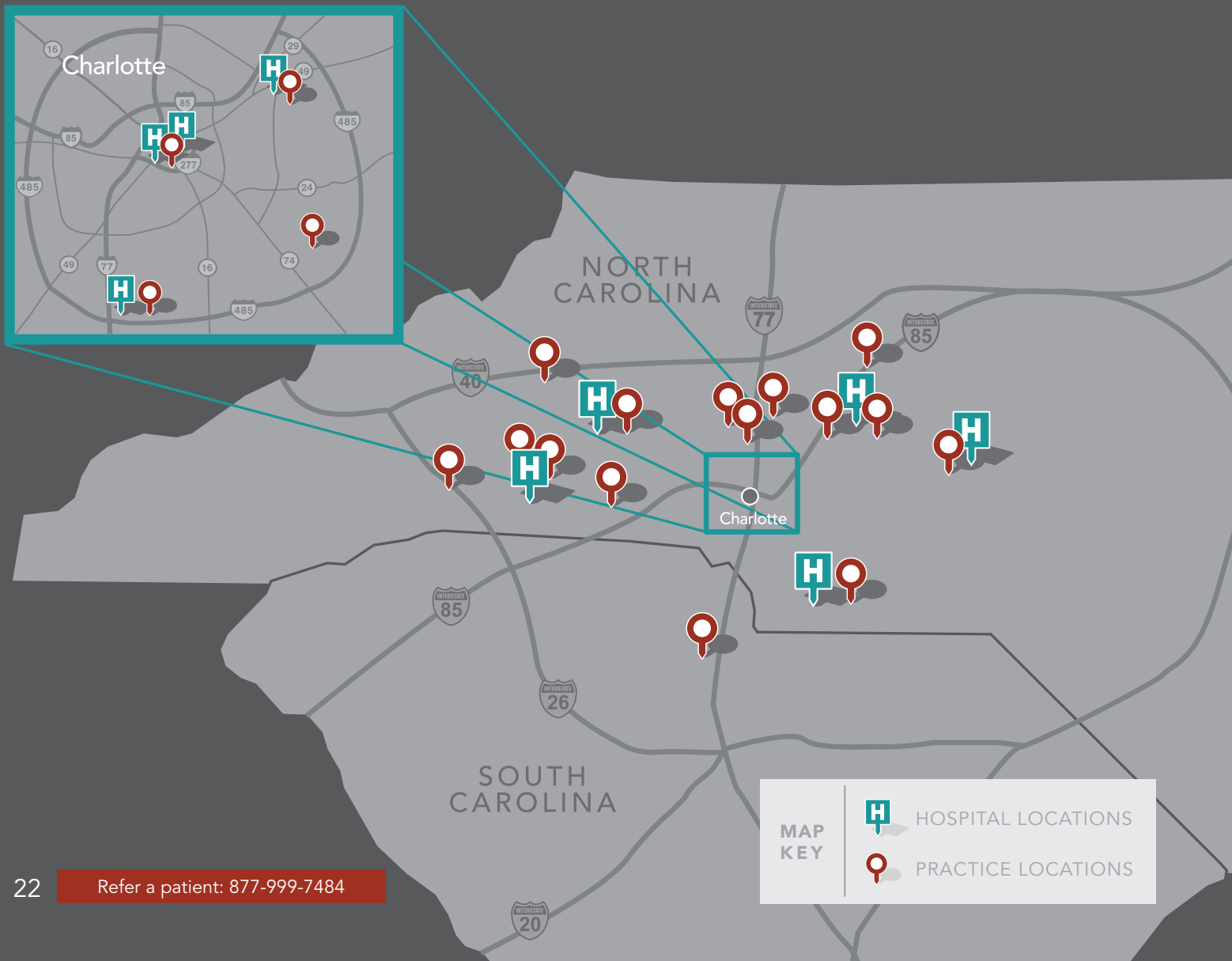
HEART SUCCESS

Internal data, Q1–Q4 2016

A NETWORK DESIGNED FOR BETTER CARE

Sanger Heart & Vascular Institute acts as one coordinated network, seamlessly delivering the specialty care your patients need.

At any one of our more than 20 locations across the Carolinas, patients receive more than just conveniently located expert care. They gain access to internationally recognized physicians, emerging technologies and life-saving research that can't be found anywhere else in the region.





MAKE A REFERRAL

Collaboration and patient-centered care are at the heart of our provider referral process.

When you refer your patients to Sanger Heart & Vascular Institute, we'll work together closely until we can transition each patient back to you for ongoing care post-treatment. And no matter where you're located – in the Carolinas or beyond – we'll find the right specialist for your most complex cases.

Our Global Patient Services program makes it easy for patients coming from all over the world. We coordinate medical appointments, travel needs and any other arrangements so patients and their families can focus on their treatment.

To make a referral to any Sanger Heart & Vascular Institute location, contact a referral coordinator at

877-999-SHVI (7484)

Our representatives are available
24 hours a day, seven days a week.



Carolinan HealthCare System
Sanger Heart & Vascular Institute

CarolinanHealthCare.org/InsideSanger

Publish Year 2018