We are pleased to provide for your review the third edition of Novant Health’s Cardiology and Cardiovascular Surgery Outcomes book. This publication demonstrates clinical performance at Novant Health Heart & Vascular Institute’s tertiary facilities in 2014. It underscores our continued prioritization and commitment to using data analytics to provide transparent clinical quality, benchmarked internally across our facilities and externally within our peer group organizations. It also highlights our leading-edge medical research, which remains at the forefront of our strategic imperatives.

Consistent with Novant Health’s system readiness plan for population health management, our efforts at creating high-quality outcomes and responsible cost containment remain prioritized. Our physicians, nurses, caregivers and administrative leadership are culturally aligned in our commitment to provide high consumer value. “Value” is defined as best quality delivered at the best price, within an empathetic and nurturing environment of a positive patient and family experience. We create this by consistently implementing processes to achieve standardization of clinical and operational inputs and outputs at all Novant Health facilities that provide a cardiovascular product. By so doing, we are positioned as our region’s industry leader in the population management of cardiovascular disease.

The 2014 outcomes booklet is again published in collaboration with Cleveland Clinic, with whom we have been an affiliate since September 2011. This relationship continues to demonstrate a joint organizational partnership of similar values, as well as our unrelenting commitment to achieve best-in-class clinical outcomes metrics in cardiovascular medicine and surgery.

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Measuring and understanding outcomes of medical treatments promotes quality improvement. Created by the Cleveland Clinic, this Outcomes book is designed for the physician audience and contains a summary of surgical and medical treatments, with data on patient volumes and outcomes and a review of new technologies and innovations.
We are proud to present 2014 outcomes from the cardiology and cardiovascular surgery program at Novant Health Heart & Vascular Institute, which has an ongoing collaborative relationship with Cleveland Clinic’s Heart & Vascular Institute to promote best practices and optimal quality in cardiovascular caregiving.

This overview of outcomes, volumes and quality metrics reflects some of the fruits of that collaboration, which involves members of the Novant Health Heart & Vascular Institute team ranging from physicians and other healthcare providers to administrative personnel. It refers to national benchmarks established by the American College of Cardiology and Society of Thoracic Surgeons and stems from our commitment to give every patient the best possible outcome and experience. We believe that transparency around clinical outcomes is essential to improving quality and efficiency as we all continue to move toward ever more value-based care delivery.

Cleveland Clinic’s Heart & Vascular Institute is gratified by the success of our collaborations with partners like Novant Health Heart & Vascular Institute. Our goal is to develop relationships with providers nationwide to enhance the quality and value of cardiovascular care in our communities. We welcome your comments and feedback, and we thank you for your interest.

Lars G. Svensson, MD, PhD
Chairman, Sydell and Arnold Miller Family Heart & Vascular Institute
Cleveland Clinic
Novant Health is on a journey to transform the patient experience so that its patients can focus on what really matters – getting better and staying healthy. As one of the nation’s top not-for-profit integrated health systems, the Novant Health network consists of more than 1,200 physicians and 25,000 team members who make healthcare remarkable at nearly 500 locations, including 13 medical centers.

Novant Health is working to make healthcare simpler and more convenient for the communities it serves in North Carolina, Virginia, South Carolina and Georgia, providing unparalleled access through technology and points of care that are seamlessly integrated into one system.

It strives to bring its mission, vision and values to life by delivering the most remarkable patient experience, in every dimension, every time. Here are just some of the ways Novant Health is making a difference:

- Maintaining an active community health outreach program.
- Demonstrating superior outcomes for many health conditions as indicated by Novant Health’s state and national quality scores.
- Creating innovative programs that address important health issues. Many of its programs and services are recognized nationally.
- Transforming patient care at the bedside.
- Believing in its role as a good corporate citizen, working with community agencies and organizations to make its communities better places to live and work.

In 2012, Novant Health partnered with the Cleveland Clinic at its flagship facilities – Novant Health Forsyth Medical Center and Novant Health Presbyterian Medical Center. Accredited by The Joint Commission and members of the American Hospital Association, Forsyth Medical Center and Presbyterian Medical Center provide remarkable care not only through sophisticated, high-tech diagnostic, surgical and therapeutic care, but through a warm and compassionate staff, as well. Both facilities show their commitment to the leading edge of medicine by investing resources into new technology, programs and services for their hospitals and their communities.
**Novant Health Forsyth Medical Center**

As one of the largest medical centers in the state, Forsyth Medical Center has more than 92,000 annual visits to its emergency department. Coupled with Novant Health Medical Park Hospital, a 22-bed surgical facility located nearby, close to 28,000 surgical procedures, including 4,300 general surgery cases, 7,700 orthopedic and neurological procedures, and 1,350 cardiac and vascular surgeries, were performed at the Forsyth medical campus in 2014.

**Novant Health Presbyterian Medical Center**

Founded in 1903, Presbyterian Medical Center provides leading-edge health services ranging from prevention and early detection to advanced treatments in cancer, stroke and heart disease and routinely receives more than 90,000 emergency department visits each year. Combined with nearby Novant Health Charlotte Orthopedic Hospital, Presbyterian Medical Center performs more than 29,000 surgical procedures a year, including 4,200 general surgery cases, 8,300 orthopedic and neurological procedures, and 1,000 cardiac and vascular surgeries in 2014.
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ACCOMPLISHMENTS

**Structural heart care:** The valve intervention teams at Novant Health Presbyterian Medical Center and Novant Health Forsyth Medical Center provide interdisciplinary collaboration among cardiovascular surgery, adult cardiovascular medicine, advanced cardiovascular imaging, cardiac anesthesia and primary care to triage patients regarding need for medical, transcatheter or surgical valve interventions. In 2014, we implemented our transcatheter mitral valve repair program using the MitraClip device. We continue to provide contemporary options for transcatheter aortic valve replacement and remain established as a regional leader for the provision of nonsurgical treatment options for high or prohibitive surgical risk patients with advanced valve dysfunction.

**Heart failure care:** In 2014, both Presbyterian Medical Center and Forsyth Medical Center received advanced certification in advanced heart failure (HF) by The Joint Commission. The significant public health and economic burdens associated with heart failure management continue to challenge healthcare providers and health systems nationwide. At Novant Health, creating an infrastructure of HF clinics across markets has enabled a standardized approach to improving patient throughput for timely optimization of therapy. Standardizing the process across facilities with a laser focus on efficiently managing patients through the continuum of acute and post-acute care transitions is geared toward reducing avoidable admissions. Systemwide cardiovascular service line data analytics have highlighted areas of best practice and demonstrated areas with improvement opportunities. Utilization of remote monitoring of thoracic impedance has enabled prediction of clinical decline, proactive initiation of rescue therapy resulting in improvement of patient symptomatology, and reduction in unnecessary admissions and patient mortality.

**Percutaneous coronary intervention (PCI) care:** Novant Health Heart & Vascular Institute (NHHVI) continues to achieve or exceed national benchmarks for best practice in the management of acute myocardial infarction (AMI) interventions. Door-to-balloon time at our tertiary facilities in 2014 was a mean of 52 minutes, performing favorably against the 50th percentile national average of 60 minutes. With 47 minutes and 49 minutes in Q1 and Q3, respectively, we met or performed better than the 2014 90th percentile national average of 49 minutes.

Extending beyond our systemwide adoption of radial artery diagnostic heart catheterizations, NHHVI cardiologists have successfully piloted and implemented same-day discharge of radial percutaneous intervention patients with the intent to standardize this practice through algorithm directed indications of care. Our interventional cardiologists have developed protocols to enable implementation of appropriate use criteria for elective PCI, and to guide the utilization of percutaneous left ventricular assist modalities in the management of complex high-risk intervention patients.
In 2014, Forsyth Medical Center and Presbyterian Medical Center received the highest ranking as Mission: Lifeline STEMI, receiving Center Gold Plus Performance Achieving Hospitals from the American Heart Association, while Novant Health Matthews Medical Center and Novant Health Rowan Medical Center received Silver Performance Achieving Hospitals. Novant Health Huntersville Medical Center received the Gold Performance Achievement Award, which is the highest award given to STEMI referral hospitals. Forsyth Medical Center, Presbyterian Medical Center and Matthews Medical Center received the Action Registry-GWTG Platinum Performance Achievement Award by the National Cardiovascular Data Registry. The award recognizes ACTION Registry-GWTG Premier participating hospitals that have sustained performance measure score composites of 90 percent or higher in the treatment of AMI for eight consecutive quarters through the fourth quarter 2014.

Arrhythmia care: Disease management of HF in 2014 resulted in exponential growth in device implantation for cardiac resynchronization therapies and impedance monitoring, and in ablative therapies for ventricular arrhythmias at both Presbyterian Medical Center and Forsyth Medical Center. The atrial fibrillation clinics saw programmatic growth in 2014 with a 24 percent increase in procedural numbers related to atrial fibrillation ablations.

Cardiovascular surgery care: The heart surgeons at NHHVI have recognized expertise in high-risk valve surgery and continue to exceed national averages in the surgical repair of myxomatous mitral valves. NHHVI cardiac surgeons provide second opinions for high-risk valve surgery and continue to be an important component of the institute’s percutaneous transcatheter aortic valve program. Our vascular surgery team continues to perform high-risk, complex open surgical and endovascular repair of aortic arch dissections and aneurysms.
2014 SURGICAL OUTCOMES

Novant Health total cases = 6,100

Novant Health Forsyth Medical Center total cases = 3,381
Total surgery cases = 1,974
Total cardiology cases = 1,407

Novant Health Presbyterian Medical Center total cases = 2,719
Total surgery cases = 1,611
Total cardiology cases = 1,108

Surgery cases include cardiac, thoracic, vascular, and pacer procedures
Cardiology cases include CathPCI and ICD procedures
Source: Administrative case volumes
Novant Health Case Distribution

- **31%** Cath PCI
- **21%** Vascular
- **7%** Thoracic
- **10%** ICD
- **17%** Cardiac
- **14%** Pacemaker

Forsyth Medical Center

- **31%** Cath PCI
- **19%** Vascular
- **7%** Thoracic
- **18%** Cardiac
- **15%** Pacemaker
- **14%** Other

Presbyterian Medical Center

- **30%** Cath PCI
- **23%** Vascular
- **8%** Thoracic
- **15%** Cardiac
- **10%** ICD
- **14%** Pacemaker

Novant Health Cardiac Case Distribution

- **50%** CABG
- **14%** Valve
- **8%** CABG & Valve
- **28%** Other

Forsyth Medical Center

- **57%** CABG
- **8%** CABG & Valve
- **10%** Valve
- **25%** Other

Presbyterian Medical Center

- **38%** CABG
- **7%** CABG & Valve
- **20%** Valve
- **35%** Other

Source: Administrative case volumes

CABG = coronary artery bypass graft
ICD = implantable cardioverter defibrillator

*Other includes complex procedures such as aortic aneurysms, double valve procedures, etc.

Source: Society of Thoracic Surgeons (STS) National Adult Cardiac Surgery Database, 2014
2014 ISOLATED CORONARY ARTERY BYPASS GRAFT OUTCOMES

Risk-Adjusted Operative Mortality

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Forsyth</th>
<th>Presbyterian</th>
<th>STS Benchmark</th>
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<tbody>
<tr>
<td>CABG</td>
<td>0.68</td>
<td>0.60</td>
<td>n/a</td>
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<tr>
<td>Aortic Valve Replacement</td>
<td>0.72</td>
<td>0.98</td>
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<tr>
<td>Aortic Valve Replacement + CABG</td>
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<tr>
<td>Mitral Valve Replacement</td>
<td>0.00</td>
<td>0.00</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Source: STS Harvest Report period ending 12/31/2014

Cardiac Presentation on Admission

Source: STS Harvest Report period ending 12/31/2014
Age Distribution – Age ≥ 65 years old
Novant Health treats a large number of elderly patients. Advanced age and associated medical conditions are known risk factors that can adversely affect cardiac surgical outcomes.

Source: STS Harvest Report period ending 12/31/2014
CABG Risk Factors

Although advanced age and female gender are known risks factors affecting outcomes, other factors may also have an adverse effect. Patient risk factors are shown here.

### Forsyth Medical Center

- Dyslipidemia
- Hypertension
- Chronic Lung Disease*
- Diabetes Mellitus
- Left Main Disease (>50 Stenosis)
- Congestive Heart Failure
- Cerebrovascular Disease
- Family History of CAD
- Peripheral Arterial Disease
- Immunosuppressive Treatment
- Dialysis-Dependent

### Presbyterian Medical Center

- Dyslipidemia
- Hypertension
- Left Main Disease (>50 Stenosis)
- Diabetes Mellitus
- Chronic Lung Disease*
- Cerebrovascular Disease
- Peripheral Arterial Disease
- Congestive Heart Failure
- Family History of CAD
- Dialysis-Dependent
- Immunosuppressive Treatment

Source: STS Harvest Report period ending 12/31/2014

*Chronic Lung Disease contains Mild, Moderate and Severe CAD = coronary artery disease
Internal Mammary Artery Used

Arterial grafts are known for their excellent long-term patency and are the conduits of choice for coronary revascularization. In 2014, 100 percent of patients undergoing primary isolated revascularization procedures received at least one arterial graft.

On-Pump Coronary Bypass Surgery

Forsyth Medical Center

Presbyterian Medical Center

Source: STS Harvest Report period ending 12/31/2014

Cardiology and Cardiovascular Surgery/Novant Health | 15
2014 ISOLATED CORONARY ARTERY BYPASS GRAFT OUTCOMES

Perioperative Medications

[Bar chart illustrating the percentage of patients receiving various medications such as Preoperative Beta Blockers, Aspirin, Beta Blockers, and Lipid-Lowering Agents.]

Risk-Adjusted Postoperative Complications

[Bar chart showing the percentage of patients experiencing complications such as Prolonged Ventilation, Any Reoperation (NQF Definition), Renal Failure, Permanent Stroke, and Deep Sternal Infection/Mediastinitis.]

Source: STS Harvest Report period ending 12/31/2014
2014 VALVE SURGERY OUTCOMES

Novant Health Valve Case Distribution

37% AVR
22% AVR & CABG
12% MVR & CABG
29% MVR

Forsyth Medical Center

31% AVR
25% AVR & CABG
19% MVR & CABG
25% MVR

Presbyterian Medical Center

43% AVR
5% MVR & CABG
20% AVR & CABG
32% MVR

MVR = mitral valve replacement/repair
AVR = aortic valve replacement
Source: Society of Thoracic Surgeons (STS) National Adult Cardiac Surgery Database, 2014
Kristian Kellogg thought he’d done everything right.

He ate a Mediterranean diet. He participated in mud runs, CrossFit and fitness boot camps. On weekends, you could find the Charlotte husband and father playing hard on the soccer field.

It was at one of those weekend soccer games in June 2014 that Kris, now 46, suddenly started feeling tired and lightheaded. His wife went to get him a glass of water. That’s when Kris fell face forward onto the gravel-covered ground. After a few moments in and out of consciousness, Kris’ eyes rolled back into his head and his heart stopped.

One of Kris’ soccer teammates that day was a Novant Health doctor, Keith Anderson, MD. Anderson administered CPR with the help of other players until EMS personnel arrived – quick action which almost certainly saved Kris from brain damage. It took three shocks with an AED to restore Kris’ pulse and then the ambulance sped him to the Novant Health Presbyterian Medical Center emergency room.

There, Kris underwent surgery to open what turned to be a total blockage of the left anterior descending artery and received two stents. He awoke from a medically induced coma several days later and began his journey back to health.

“For us, Novant Health was an unbelievable experience,” Kris said. “In the hospital, everything from the quality of the environment to quality of care to the support staff nurses … gave me a lot of confidence. It’s not just that they saved my life, but we had a great experience, with people who would stay beyond their shift to stay with me.”

After what Kris said was a smooth handoff to rehab, he continued to make progress and is back to an active lifestyle. Kris said his message to others is to stay educated about heart health.

“People need to listen to their bodies and take action,” he said. “A lot of the education I got came from the doctors, especially at the Novant Health Heart & Vascular Institute. They were critical in getting me back physically and mentally.”

As a result of the heart care he received, the Kellogg family switched their family healthcare to Novant Health. “My cardiology team here in Charlotte was amazing,” he said. “I feel like I got the very best of the best.”
Terry Lewis, age 59, knew all too well how hereditary heart disease can devastate a family. His two younger brothers died in their sleep around age 40 because of cardiovascular disease. And both his mother and sister had successful triple bypass heart surgeries.

Knowing his odds were not in his favor, Terry had a full nuclear stress test after his second brother’s death and was much relieved when he was given a clean bill of health. His blood pressure and cholesterol were under control, and he considered himself in good shape.

With that great news, Terry decided it was time to pursue a lifelong dream and set out to hike the Appalachian Trail. After completing the second leg of a 75-mile hike on the trail on April 20, 2014, Terry returned home to Winston-Salem, North Carolina, tired and ready for a good night of sleep. However, around midnight, his wife, Lesa, noticed something strange. “I was making a sound that she hadn’t heard before,” Terry said. “When she couldn’t awaken me, Lesa dialed 911.”

The 911 dispatch operator calmly coached Lesa on how to perform CPR until the emergency services team arrived. After Terry’s heart stopped five times, he was rushed into emergency cardiac catheterization.

Terry was eventually diagnosed with ventricular tachycardia. Then he learned that a 90 percent blockage in five arteries meant he needed a quintuple heart bypass surgery as well as a pacemaker-defibrillator to address any future problems with his irregular heartbeat. Exactly one week after he coded five times, Terry was discharged and sent home.

“What I now realize is it takes a team to care for a person in cardiac arrest,” said Terry. “Many individuals were involved in saving my life that night, including my lovely wife, Lesa; Stephanie Speer, the 911 operator; the first responders; the ER doctors and nurses, my surgeons and all of the cardiac-related medical staff.” He’s grateful that the teams at both Novant Health Forsyth Medical Center and Novant Health Heart & Vascular Institute provided him with world-class care using the latest technology when his life depended on it.

A devotedly religious man, Terry feels a higher power was looking after him that day. He thanks God for the many miracles that give him another opportunity to enjoy life with his wife and watch their grandchildren grow up. “I’m very fortunate to have a loving wife, a great family, friends, neighbors, a church family and Novant Health, who helped me get through this life-threatening experience,” Terry said. “I am blessed.”
2014 INTERVENTIONAL CARDIOLOGY OUTCOMES

Cardiac Catheterization Laboratory Procedures

**Forsyth Medical Center**

![Bar chart showing number of procedures for Diagnostic and Interventional Procedures at Forsyth Medical Center.]

**Presbyterian Medical Center**

![Bar chart showing number of procedures for Diagnostic and Interventional Procedures at Presbyterian Medical Center.]

PCI Risk-Adjusted Mortality

![Bar chart showing PCI Risk-Adjusted Mortality for Forsyth and Presbyterian Medical Centers, with Forsyth exceeding the ACC 50th Percentile.]

Source: Novant Health Clinical Improvement

Source: NCDR CathPCI Outcomes Report 4Q 2014
Risk Factors among Patients Undergoing PCI Procedure

Discharge Medications after PCI Procedure

Source: NCDR CathPCI Outcomes Report 4Q 2014
2014 INTERVENTIONAL CARDIOLOGY OUTCOMES

Post Procedure PCI Complications

Composite: Death, Emergency CABG, Stroke or Repeat Target Vessel Revascularization
Heart Failure
New Requirement for Dialysis
CVA/Stroke
Cardiac Tamponade

Source: NCDR CathPCI Outcomes Report 4Q 2014

Door to Balloon Times (Percentage of STEMI Patients within 90 Minutes)

Source: NCDR CathPCI Outcomes Report 4Q 2014
2014 ELECTROPHYSIOLOGY OUTCOMES

Novant Health Electrophysiology Distribution

- 33% Pacemakers
- 30% Ablations
- 10% EP Study
- 27% ICD

Forsyth Medical Center

- 31% Pacemakers
- 30% Ablations
- 14% EP Study
- 25% ICD

Presbyterian Medical Center

- 35% Pacemakers
- 6% EP Study
- 30% Ablations
- 29% ICD

Electrocardiogram Procedures

<table>
<thead>
<tr>
<th>Year</th>
<th>Forsyth</th>
<th>Presbyterian</th>
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<tbody>
<tr>
<td>2010</td>
<td>15,000</td>
<td>20,000</td>
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<td>2011</td>
<td>17,000</td>
<td>25,000</td>
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<tr>
<td>2014</td>
<td>45,000</td>
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</table>

Source: Novant Health Internal Report
**2014 ELECTROPHYSIOLOGY OUTCOMES**

**ICD Clinical Outcomes**

![Bar chart showing incidence of death or major adverse event, cardiac perforation, lead dislodgment, pneumothorax, TIA or stroke (CVA), myocardial infarction, and pericardial tamponade for Forsyth and Presbyterian hospitals.](image)

*TIA = transient ischemic attack*  
Source: NCDR ICD Outcomes Report 4Q 2014

**ICD Mean Length of Stay**

![Line chart showing mean length of stay for Forsyth and Presbyterian hospitals from 1Q 2013 to 4Q 2014.](image)

Source: NCDR ICD Outcomes Report 4Q 2013
In order to achieve superior clinical outcomes, Novant Health uses multiple metrics to assess best practice in patients with heart failure. The information below displays compliance performance at Novant Health.

### Forsyth Medical Center

- **Anticoagulation for Atrial Fibrillation or Atrial Flutter**
- **DVT Prophylaxis**
- **Influenza Vaccination During Flu Season**
- **Pneumococcal Vaccination**
- **ACEI/ARB at Discharge**
- **Evidence-Based Specific Beta Blockers**
- **Measure LV Function**
- **Discharge Instructions**

### Presbyterian Medical Center

- **Anticoagulation for Atrial Fibrillation or Atrial Flutter**
- **DVT Prophylaxis**
- **Influenza Vaccination During Flu Season**
- **Pneumococcal Vaccination**
- **ACEI/ARB at Discharge**
- **Evidence-Based Specific Beta Blockers**
- **Measure LV Function**
- **Discharge Instructions**

DVT = deep vein thrombosis  
ACEI = angiotensin converting enzyme inhibitor  
ArB = angiotensin receptor blocker  
LV = left ventricular
PROACT: The purpose of the study is to show that various patient groups with the On-X valve can be maintained safely on lower doses of Coumadin or on antiplatelet drugs only rather than the standard dose of Coumadin and aspirin. Presently the American College of Cardiology and the American Heart Association along with the American College of Chest Physicians recommend including aspirin with the Coumadin dose.

Absorb III Trial: The objective of this trial is to evaluate the safety and effectiveness of the Absorb Bioresorbable Vascular Scaffold (BVS) compared to the XIENCE stent in the treatment of subjects with ischemic heart disease caused by up to two denovo native coronary artery lesions in separate epicardial vessels.

Endomax Trial: The primary objective of this study is to demonstrate that anticoagulation with bivalirudin results in fewer major bleeding complications compared with unfractionated heparin in subjects undergoing peripheral endovascular interventions.

S-ICD PAS: The primary purpose of the S-ICD Post Approval Study is to document long-term safety and effectiveness outcomes associated with the implantation of the SQ-RX pulse generator and Q-TRAK electrode in a commercial clinical setting.
SILVER – AMI: This study focuses its research on older persons who are admitted to the hospital with a heart attack. Patients will be interviewed in the hospital and again six months later. The researchers will also collect detailed medical record information to understand the effect of heart attacks on older individuals. The goal of the study is to help older people in the future make well-informed decisions about their healthcare during a heart attack.

RESPOND CRT Trial: The objective of this study is to assess the safety and effectiveness of the automatic atrioventricular delay and interventricular delay optimization algorithm used in the PARADYM RF SONR Cardiac Resynchronization Therapy with Defibrillation (CRT-D) device (model 9770) in combination with the SonRtip Lead, which includes a SonR sensor in the tip of the atrial pacing lead, and compatible programming software. This study will evaluate the effectiveness of the automatic optimization algorithm in increasing the rate of patients responding to the therapy as compared to an echocardiographic optimization method. This study will also evaluate the safety and effectiveness of the SonRtip atrial pacing lead.
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