



# THE NEXT FIRST<sup>™</sup>

## 2016 ANNUAL OUTCOMES REPORT





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# A LETTER FROM OUR BOARD CHAIR

*Dear Colleagues, Collaborators and Friends,*

True to its mission statement, Texas Heart Institute remains focused on cardiovascular education and research. Its goal is singular: to improve the lives of patients who struggle with heart and vascular disease. Although our home is the Texas Medical Center, our reach is global. Why? Because cardiovascular disease knows no geographic boundaries.

This past year, Texas Heart Institute researchers, scientists and physicians touched the lives of more than 7 million people who sought information from us via scientific lectures and [www.texasheart.org](http://www.texasheart.org). More than 1100 physicians practicing throughout the world were educated and mentored by leaders at THI. Numbers are impressive, but it is the continuing discovery happening deep within our Institute that drives us forward.

Across the globe, our work changes lives by changing outcomes. Advances occur in every area of need. This report will highlight accomplishments and provide updates on our studies in:

- ♥ *Regenerative medicine and stem cell therapies*
- ♥ *Surgical advancements and implantable cardiac devices*
- ♥ *Management of arrhythmias*
- ♥ *Women's cardiovascular health*
- ♥ *Community outreach and education*

We have long been recognized for the many firsts that were envisioned at and have emanated from Texas Heart Institute. We are proud of those firsts and the trailblazing impact they have had. Our work is validated each time one patient's life is improved. But our mission will be achieved when we can change the future of every patient with cardiovascular disease, wherever each may be.

Cancer is terrifying, yet cardiovascular disease remains the #1 killer of men, women and children. We are working to change that. We are resolute in our support of Texas Heart Institute's physicians and scientists. They must have the tools and resources required to discover the next first. We owe it to future patients who are depending upon us. And we do so to honor the esteemed legacy of our founder, Dr. Denton Cooley.

Our focus and resolve are as strong as they have been at any time in our proud history. We will continue to push the boundaries of discovery and partnerships while committing to new levels of accountability and performance. We will achieve goals by challenging the status quo and each other until heart disease is eradicated.

Thank you for your continued belief in Texas Heart Institute. We want to earn your support, and we honor your trust. We are proud of what we have accomplished and excited about our next first in cardiovascular discovery.

*Yours truly,*



*Eric Wade  
Chairman, Board of Trustees*



# 2016 GLOBAL INFLUENCE

Texas Heart Institute's global reach far exceeds the walls of the Denton A. Cooley Building in the Texas Medical Center. In 2016 alone, the Institute educated, collaborated with, inspired and supported scores of people in the medical community and general public across the globe.

Texas Heart Institute's global influence expanded to nearly every country, territory and dependency in the world. And this only scratches the surface of its global leadership in cardiovascular care.



**150+**  
LECTURES BY THI STAFF



**1,130+**  
PHYSICIANS TRAINED



**232** COUNTRIES,  
TERRITORIES & DEPENDENCIES



**7,042,722**  
UNIQUE WEB VISITORS



# REGENERATIVE MEDICINE & STEM CELL THERAPY RESEARCH

Several years ago, Texas Heart Institute committed a major part of its research to the field of regenerative medicine and stem cell therapy. Immense potential exists in this subspecialty which has fundamentally changed how we view people in need of care for heart and vascular diseases. Mining this potential, we are inspired to develop methods of prevention as well as to tailor individual, personalized care.

A notable strength of Institute's initiative in regenerative medicine is our heart-repair challenge. We pursue this via stem cell therapy, bioengineering, cellular reprogramming and genetic discovery. Uniquely different yet complementary, these programs have a common element: each focuses on enhancing the body's capacity to heal itself.

Uncovering and then effecting how a person's cells can be transformed from disease states to treatment properties are key goals. Ambitious, yes, but possible stepwise. We engineer healthy heart cells, enhancing the heart's ability to repair itself. We also reverse aging in the cells responsible for repair. Consequently, Institute researchers are impacting heart failure and coronary artery disease, the two cardiac conditions which threaten life most. Our efforts are enhancing survival and quality of life. And by pursuing noninvasive approaches for treatment, we can offer hope to all patients, including those for whom surgery is not a viable option.

Although there remains much to learn about its limitations and potential, regenerative medicine and stem cell therapy are encouraging. 2016 was a productive year. Unveiling the next discovery is not far.



REGENERATIVE MEDICINE & STEM CELL THERAPY RESEARCH

STEM CELL CENTER

*Emerson C. Perin, MD, PHD, FACC*

Stem cells are uniquely capable of self-renewal and regeneration. They constitute a powerful arsenal in the development of future therapies across all of medicine. Texas Heart Institute's Stem Cell Center (SCC) seeks to leverage these properties to help patients suffering from cardiovascular disease by improving treatment options and even reversing the effects of disease or damage to the heart. At the helm of this innovative department is the world-renowned physician-scientist Emerson Perin, MD, PhD, who has been a leader in cardiovascular stem cell research for more than 17 years.

Dr. Perin and the SCC team are leading multiple clinical trials through their prestigious partnership with the Cardiovascular Cell Therapy Research Network (CCTRN) funded by the National Institutes of Health and industry partners. Great progress was made in all of these trials throughout 2016, including completing enrollment in the PACE trial, which is the first ever stem cell clinical trial for patients who suffer from leg pain (intermittent claudication) caused by peripheral artery disease. Results from this trial unveiled several key insights that will not only help researchers better understand how cell therapy might work for people with occluded (blocked) arteries, but also insights that will help to improve clinical trial design overall. Cell therapy is still new, so these findings are crucial to better understanding the mechanisms that will help advance the science and ultimately lead to applicable treatments.

Other progress in the SCC's clinical trials included:

*Opening enrollment in the first ever combination cell therapy trial for patients with heart failure.*

*Enrolling the initial patient in the first stem cell trial for cancer survivors with chemotherapy-induced heart failure.*

*Publishing results from the first unique gene therapy trial for patients suffering from vascular leg wounds.*

*Forging a unique collaborative effort with M.D. Anderson Cancer Center.*


The SCC also graduated its third clinical research nurse from its Nursing Skills Core Training Program, which teaches effective planning, coordination, best practices and proper compliance for clinical trials. Perhaps most notable, the team continued to lead the first worldwide Phase III study designed to approve stem cell therapy for heart failure. A tremendous organizational undertaking, this project encompasses 33 sites in the U.S. and Canada. Texas Heart Institute remains honored to lead.


And the future? Dr. Perin plans to expand the first Phase III stem study for heart failure to 20 European sites. The expected completion date is 2019. The team also will further their work with Rice University, focusing on the potential of magnetic delivery techniques using carbon nano-particles and magnetic resonance imaging (MRI), as well as leveraging other collaborative opportunities. More discovery awaits.

“  
In 2016, we have taken significant steps toward achieving our goal of establishing regenerative medicine therapies for cardiovascular patients.  
”

 **20**  
PRESENTATIONS  
AROUND THE GLOBE

  
**7**  
PEER-REVIEWED  
PUBLICATIONS

 COMPLETED ENROLLMENT IN FIRST EVER  
**STEM CELL CLINICAL TRIAL**  
FOR PATIENTS WHO SUFFER FROM LEG PAIN  
CAUSED BY PERIPHERAL ARTERY DISEASE

 OPENED ENROLLMENT IN  
FIRST EVER COMBINATION  
**CELL THERAPY CLINICAL TRIAL**  
FOR PATIENTS WITH HEART FAILURE

ENROLLED INITIAL PATIENT IN  
FIRST STEM CELL TRIAL FOR  
CANCER SURVIVORS WITH  
CHEMOTHERAPY-INDUCED HEART FAILURE 

LEADING THE FIRST  
**PHASE III TRIAL**  
OF STEM CELL THERAPY FOR HEART FAILURE

 **11** INTERNATIONAL  
PHYSICIANS  
TRAINED IN ALL AREAS OF STEM CELL RESEARCH





## REGENERATIVE MEDICINE RESEARCH & BIOREPOSITORY

Doris A. Taylor, PhD, FAHA, FACC

Texas Heart Institute launched the Regenerative Medicine Research (RMR) department to lead the world in creating, translating, and delivering novel solutions for cardiovascular repair and regeneration. In 2016, under the direction of Doris Taylor, PhD, the RMR laboratories – which include a *Biorepository & Sample Profiling Core Laboratory (BPL)* and the *Organ Repair & Regeneration Research Laboratory (OR<sup>2</sup>)* – made great progress in furthering the science of engineering bio-artificial organs and tissues, understanding aging as a failure of stem cells, and identifying sex differences in cardiovascular disease and regenerative medicine treatments.

Dr. Taylor and her team have dedicated much effort over the last year to furthering research related to sex differences in stem cells. This work is critical to narrowing the gap in research that studies the differences in disease progression and injury response between men and women. Findings could unveil new and improved ways to treat cardiovascular diseases in men and women today and advance the development of regenerative therapies, which are still very new and require further study.

The RMR team also continued to make progress on the bio-artificial heart, focusing efforts on two key areas—developing cardiac patches that could be used to support recovery and repair after acute injury, such as a heart attack; and developing full bio-artificial hearts that could become a viable option for patients requiring heart transplant. Findings from some of this year’s studies were published in high-impact journals, like the *Journal of Circulation Research*, where the team shared viewpoints about the key role environment plays in stem cells successfully adhering to extracellular matrix and growing into new tissue, blood vessels and muscle. The results indicate that stem cells respond to their environment, which could lead to more effective study designs to test the efficacy of bio-artificial heart growth and repair.

Over the course of the year, the team published nine peer-reviewed articles, four abstracts, two textbook chapters, and contributed with other Texas Heart Institute researchers to one textbook—*Stem Cell and Gene Therapy for Cardiovascular Disease*. Additionally, Dr. Taylor gave 18 lectures at scientific meetings around the world.

Mentorship and training are important to achieving the RMR’s goal of furthering the science of regenerative medicine and research, and in 2016 the team hosted five postdoctoral trainees in the lab. The RMR also trains students at the college and high school levels, 24 of whom learned and worked in the department over the course of the year. The RMR labs are also a regular destination for tours at the Institute, hosting over 335 visitors in 2016.

Looking forward, the team will continue to focus on its bio-artificial heart and cardiac patch initiatives, while seeking expanded financial support to continue and establish new research initiatives that will lead to the next discovery about the powers of regenerative medicine.

“It’s a privilege to be at a premier heart institute, where we can embrace the cutting edge of knowledge and make new ideas a reality!”

9 PEER REVIEWED ARTICLES

4 PUBLISHED ABSTRACTS

2 TEXTBOOK CHAPTERS

1 EDITED TEXTBOOK



18 LECTURES GIVEN AROUND THE GLOBE

3 AWARDS RECOGNIZING DR. TAYLOR

NIH 5 GRANTS FUNDING WORK IN 2016

ALSO FUNDED THROUGH GRANTS FROM NASA TEXAS EMERGING TECHNOLOGY FUND & NATIONAL SCIENCE FOUNDATION



29 PEOPLE TRAINED/MENTORED IN THE LABS



335+ VISITORS TOURED THE LABS



REGENERATIVE MEDICINE & STEM CELL THERAPY RESEARCH

MOLECULAR CARDIOLOGY RESEARCH LABORATORIES

*Dr. Richard Dixon*

The year 2016 was not just a “leap year” in calendar terms, it was also a “leap year” for research at the Texas Heart Institute’s Molecular Cardiology Research Laboratories (MCRL) as the team continued to push the boundaries of how molecular biology can be leveraged to improve cardiovascular care. Led by the esteemed scientist Richard Dixon, PhD, MCRL scientists and staff published 16 original manuscripts, one book chapter and two reviews, in addition to successfully patenting and licensing new technologies. The team was also invited to present at 15 lectures and share abstracts at seven different meetings, both nationally and internationally. Lastly, the MCRL team’s expertise was highlighted by serving on six different journal editorial boards and ad-hoc reviewers for over a dozen different scientific journal publishers. In addition to sharing their research progress with the medical community, the team also made progress toward new discoveries in the lab.

Recognized by some of the world’s most prestigious nature journals, THI’s Molecular Cardiology scientists discovered a potential new way to treat peripheral artery disease by incorporating both stem cell therapy and genetic engineering. The novel therapy was able to reverse the negative effects of tissue ischemia, or an inadequate blood supply, and successfully restore both blood flow and exercise capacity close to normal levels. This work is now being developed for use in humans.

THI’s MCRL team also developed and patented small-molecule drugs that are designed to get stem cells to the right place in the body and make them stay there long enough to participate in tissue repair and regeneration. This novel technology, while being developed to treat cardiovascular issues, could also be applied to several other fields—in particular, the field of oncology.

Scientists and researchers in the MCRL also used their expertise to develop a series of nanoparticle-based imaging agents for use in detecting inflammatory plaques. Inflammation is an underlying component of cardiovascular disease, and is the primary driving force behind atherosclerotic plaque instability. When unstable plaque ruptures, stroke or heart attack can result. The MCRL team anticipates taking this newly developed technology and shepherding it into pre-clinical development and, if successful, clinical trials. Results from these trials could help prevent heart attack or stroke by targeting and treating inflammatory plaques before they lead to injury.

In addition to their time in the lab and educating medical professionals about their discoveries, Dr. Dixon and the MCRL scientists have also reached out on an international scale and instituted programs that join forces with leading academic institutions from around the world to bring exceptional students to Texas Heart Institute for training. Dr. Dixon and the rest of the team seek to expand their track record of excellence in the coming year with more innovative thinking and groundbreaking research.

“

I am extremely proud of our accomplishments this year, which build upon many years of sustained research efforts finally culminating in the production of two distinct approaches to treating peripheral arterial diseases. ”

16 ORIGINAL MANUSCRIPTS

2 REVIEWS

1 BOOK CHAPTER

15 LECTURES

7 MEETING ABSTRACTS

NIH

2 NEW GRANTS AWARDED

DISCOVERED POTENTIAL NEW WAY TO TREAT PERIPHERAL ARTERY DISEASE BY COMBINING STEM CELL THERAPY & GENETIC ENGINEERING

PATENTED SMALL-MOLECULE DRUGS DESIGNED TO DIRECT STEM CELLS

TO THE RIGHT PLACE IN THE BODY & STAY THERE TO REPAIR & REGENERATE TISSUE



REGENERATIVE MEDICINE & STEM CELL THERAPY RESEARCH

CARDIOMYOCYTE RENEWAL

*Dr. James Martin*

Director James Martin, MD, PhD, and his team in the Cardiomyocyte Renewal Laboratory (CRL) had an exciting year in 2016. The research lab, which focuses on understanding how specialized signaling pathways are connected to adult tissue development and regeneration, made meaningful progress toward their goal to obtain an in-depth understanding of these pathways. From such understanding, we hope to prevent disorders such as atrial fibrillation and calcified aortic valves.

The team's groundbreaking research studies, which are designed to decipher the molecular pathways that are active in cardiac disease states and control heart muscle regeneration, yielded significant results, including establishing a direct link between genes that regulate cardiac regeneration and cardiomyopathy. Cardiomyopathy is a collection of diverse diseases that cause the heart muscle to become enlarged, thick or rigid. Discovering this genetic link creates the possibility of directing heart repair through the growth of pre-existing heart muscle cells (cardiomyocytes).

Studies also identified a stress-response pathway that is activated after cardiac injury and is required for tissue repair. "The significance in discovering that there are genes induced upon injury that are adaptive and help the heart respond to the injury and encourage repair is far-reaching," said Dr. Martin. "While there's still much to learn, this puts us on an inside track to uncover ways to manipulate these genes and ultimately improve our ability to repair damaged hearts."

The CRL's work in 2016 yielded key biological insights into directly targeting the heart to regenerate muscle cells after injury. These findings were recognized within the medical community, garnering six publications in high-impact scientific journals and the awarding of two new grants to help support continued studies. One grant was awarded by the American Heart Association and the other by the National Institutes of Health (NIH).

Dr. Martin's studies at THI will lead to major advances in regenerative medicine. Having had a highly successful year, the lab plans to push forward in 2017 with an extension of their work to conduct translational studies aimed at promoting cardiac growth. This includes conducting molecular analysis to clearly define the targets for cardiac regeneration therapy, using molecular approaches to target cardiac regeneration pathway genes, and using gene editing technology to develop novel cardiac therapies in the future. Dr. Martin and his team will continue to make major advances in regenerative medicine, identifying new therapeutic options to promote normal regenerative capabilities in the heart.

**Dr. Martin's studies at Texas Heart Institute will lead to major advances in regenerative medicine.**

**6** PUBLICATIONS IN HIGH-IMPACT SCIENTIFIC JOURNALS

**2** GRANTS AWARDED



ESTABLISHED A DIRECT LINK BETWEEN GENES THAT REGULATE CARDIAC REGENERATION & CARDIOMYOPATHY





# SURGICAL ADVANCEMENTS & MEDICAL DEVICE RESEARCH

Texas Heart Institute has long been known for its history of firsts in cardiovascular surgery and in the development of medical devices to support the failing heart. Long before continuous quality improvement was in vogue, surgical teams at THI practiced the motto they preached—Modify, Simplify, Apply. Such refinements were common practices among surgeons, anesthesiologists and perfusionists in the operative suite, as well as among researchers in laboratories.

Dr. Cooley and his colleagues' zeal for exploration in pushing the boundaries of surgery are alive and well in the modern era. In the subsequent pages, we are proud to share milestones and summaries of their 2016 achievements.

Less invasive methods of repair and replacement, simpler recovery, and faster resumption of normal activities will always be preferred by patients and practitioners alike. Catheter-based procedures continue to improve, and conventional surgery with proven results of safety and effectiveness remains an essential element in the armamentarium against cardiovascular disease.



## SURGICAL ADVANCEMENTS &amp; MEDICAL DEVICE RESEARCH

## CARDIOVASCULAR SURGERY RESEARCH LAB

*Dr. O.H. "Bud" Frazier & Dr. Luiz Sampaio*

The Cardiovascular Surgery Research Laboratories (CVRL) at Texas Heart Institute were established in 1972 to advance the understanding and treatment of cardiovascular disease. The uniquely qualified physicians and researchers on the CVRL's staff have unequaled clinical experience, and have collaborated with government agencies and biomedical companies over the course of the department's 45-year history to conceive, design, test and apply new treatments, techniques and devices to improve patient care.

In 2016, the lab and its leaders celebrated many accomplishments and milestones, including welcoming Luiz C. Sampaio, MD, as the new co-director, joining the world-renowned O.H. Frazier, MD, to help usher in the next wave of discoveries in medical device technology.

The CVRL contributed to the advancement of pediatric ventricular assist device (VAD) research by completing pre-clinical validation studies of hemolysis (the rupturing of red blood cells) and the low-flow Jarvik Heart Infant VAD studies. This work led to approval to conduct an investigational device exemption study and clinical trials for an infant-size pump, which are expected to begin soon.

The labs also pushed forward to continue research on artificial hearts, in particular to advance the performance capabilities of the BiVACOR total artificial heart. Three experiments were performed in 2016, one of which lasted 96 days and set a new institutional record for study duration. Each of the experiments provided unique contributions to the improvement of this technology for eventual clinical implantation, taking the team a step closer to developing a viable, durable total artificial heart that can completely take over the function of a patient's failing heart.

Additional progress in 2016 included collaborations with other Texas Heart Institute research departments, such as the Electrophysiology Clinical Research & Innovations program led by Mehdi Razavi, MD, the Regenerative Medicine Research group directed by Doris Taylor, PhD, and the Stem Cell Center team led by Emerson Perin, MD, PhD. CVRL colleagues also collaborated with researchers outside of the Institute, including performing the initial study of the ECMO

Impella vs. atrial septal defect (ASD) study for the Texas Children's Hospital research group. This study could lead to future advances in the effectiveness of ASD corrective surgeries in children to patch a hole or tear in the heart's septum. And in teaming up with cutting edge start-up Corinnova, the lab tested eight new prototypes of an implantable cardiac compression device for CPR that does not contact the blood. The device is designed to treat end-stage heart failure and would create a new paradigm for heart failure treatment.

The lab's research garnered attention from multiple sources in the medical community, resulting in the documentation of their work in eight peer-reviewed articles and four published abstracts. In 2016 alone, CVRL researchers were called upon to deliver a total of 42 lectures at local, national and international scientific meetings to share the lab's innovative studies and findings.

Mentoring the next generation of great medical minds is one part of Texas Heart Institute's mission. In this pursuit, the CVRL trained four postdoctoral trainees, three college-level research students, and one graduate student from Rice University. The team also continued to train physicians and researchers to implant the Syncardia total artificial heart and to conduct transeptal punctures, which are required to gain catheter access to the left side of the heart. Lastly, educational efforts also extended to community and industry partners through 20 guided tours of the labs, with groups ranging from two to 90 visitors at a time.


In the coming year, while continuing their existing studies, CVRL directors plan to seek expanded financial support, increase the number of publications in high-impact journals, and continue the lab's ongoing participation and leadership in the scientific community. The lab is determined to push the envelope with more novel technology and further advances in cardiovascular surgery and cardiac medical devices.



**42**  
LECTURES



**8**  
PEER  
REVIEWED  
ARTICLES



**4**  
ABSTRACTS



**8**  
TRAINEES



**20+**  
TOURS OF  
THE LAB



## AORTIC SURGERY

*Dr. Joseph Coselli*

The aorta is the main artery responsible for delivering blood to your brain, your muscles and the rest of your body, so it is safe to say that caring for the aorta is a critical component of cardiovascular care. When a problem with the aorta occurs, the heart and the entire body's blood supply can be jeopardized.

Joseph Coselli, MD, and his team at Texas Heart Institute's Aortic Surgery Research Department have dedicated their careers to uncovering new and innovative ways to repair damaged aortas, and in 2016 they continued to make meaningful progress. Their research was heavily documented in medical journals with 28 articles published, and Dr. Coselli delivered 43 presentations, nearly half of which were at international conferences, to help educate the medical community about the advancements being made.

In addition to sharing learning and progress through these external forums, the Aortic Surgery Research team's life-changing work was recognized through the awarding of three new National Institutes of Health (NIH) grants in 2016. These grants will help to fund pre-clinical research studies of inflammasome inhibitors. These inhibitors could potentially reduce aortic destruction and prevent the progression of aortic disease. Another study that is supported by these grants will allow the lab to evaluate and develop a new therapeutic strategy that prevents aortic destruction by reducing protein misfolding and dysfunction. Lastly, the funds will help to sponsor the research training of a promising young scientist.

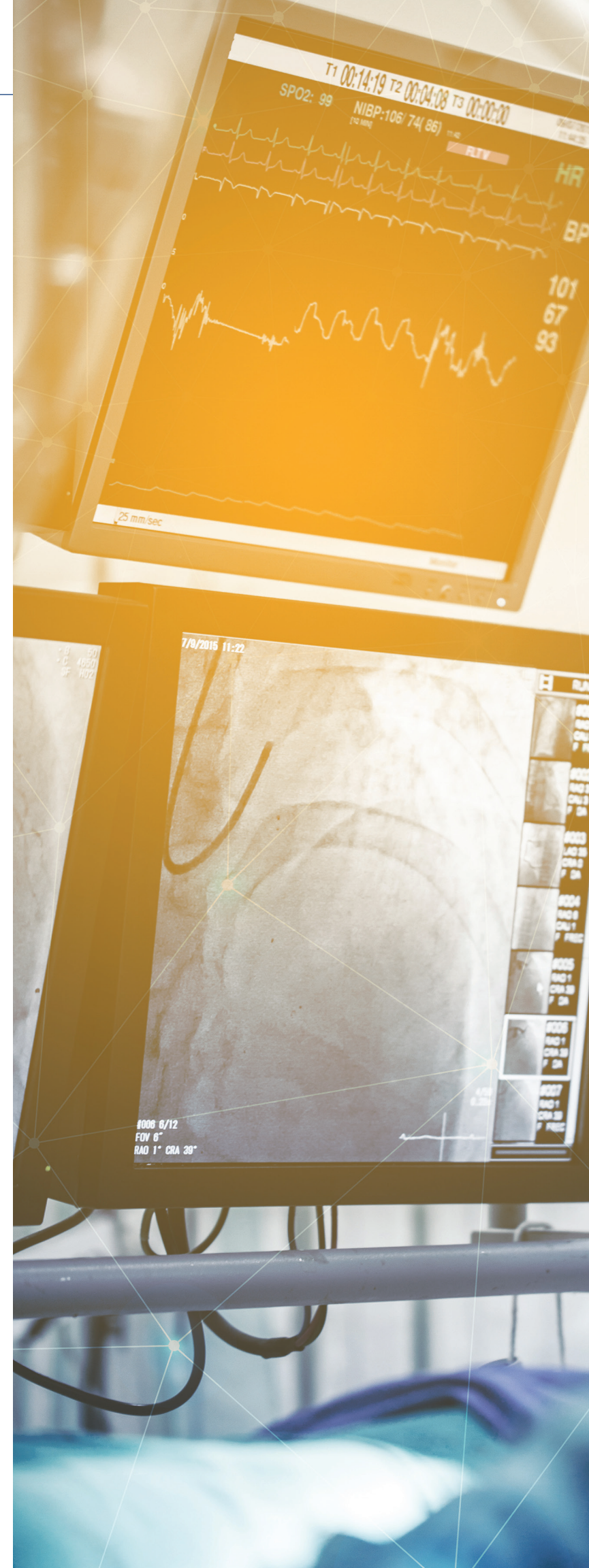
In 2016, the team also began the process to join the International Registry of Acute Aortic Dissection (IRAD), a consortium of research centers that evaluates the current management and outcomes of acute aortic dissection. Participation in IRAD will help Dr. Coselli and his team contribute to the consortium's database and develop suitable research to better understand acute aortic dissection. Aortic dissection – which has claimed the lives of well-known personalities such as John Ritter and Alan Thicke – is a life-threatening acute event that is difficult to diagnose. The team will begin data collection for the IRAD database in 2017.


Looking forward, the world-renowned Dr. Coselli and his Aortic Surgery Research team will seek to develop new clinical trials and continue to participate in existing trials, including those focused on less invasive aortic valve replacement procedures and new methods of endovascular aortic repair. Their work will fundamentally change the effectiveness of care for aortic damage.

## DIRECTOR SPOTLIGHT


In 2016, Dr. Joseph Coselli published the landmark "Outcomes of 3309 Thoracoabdominal Aortic Aneurysm Repairs," which chronicles his three-decade experience with thoracoabdominal aortic aneurysm repairs. This is the largest single-surgeon experience ever published. Additionally, the department chief received the Houston Surgical Society's Distinguished Houston Surgeon Award for 2016, and he completed his year as President of the American Association for Thoracic Surgery. His leadership is also reflected in his role as the Principal Investigator for ten ongoing clinical trials, and his support of five additional trials as a sub- or co- investigator. Dr. Coselli is helping to lead the charge in new discovery for aortic surgery techniques and improvements.

**When a problem with the aorta occurs, the heart and the entire body's blood supply can be jeopardized.**



 **28**  
PAPERS  
PUBLISHED

 **3** : **3**   
BOOK CHAPTERS : NIH GRANTS  
PUBLISHED : AWARDED

 **43** : **49%**  
PRESENTATIONS : AT INTERNATIONAL  
GIVEN : CONFERENCES

 **COSELLI**  
PRINCIPAL INVESTIGATOR

**10** : **+5**  
ON-GOING : SUPPORTED IN  
CLINICAL TRIALS : OTHER CAPACITIES



# CARDIAC ARRHYTHMIAS

The ability to pinpoint abnormalities before a disease or condition is clinically apparent is highly beneficial to directing curative or even preventive therapies. A key area of research at Texas Heart Institute involves cardiac arrhythmias—abnormal heart rhythms—and their earlier detection, identification, intervention and management.

Scientists at THI acknowledge the multiple underlying causes for arrhythmias. Research efforts, therefore, are also multifactorial. In 2016, each of our programs made significant progress, and highlights follow in the subsequent pages.

Critical to discovering the next first in management of cardiac arrhythmia is patiently gathering insight and learning in the laboratory. Better understanding of signaling pathways and genetics, and their impact on progression of disease, creates opportunities for meaningful solutions. Our researchers remain steadfast in their commitment to developing these therapies and procedures which may mitigate life-threatening situations like sudden cardiac arrest or stroke.





## PUBLICATIONS



**4 ABSTRACTS**  
SELECTED FOR PRESENTATION AT  
HEART RHYTHM SOCIETY 2017

**RODERICK D. MACDONALD  
GRANT AWARDED**

## ELECTROPHYSIOLOGY CLINICAL RESEARCH & INNOVATION

*Dr. Mehdi Razavi*

Spearheaded by Dr. Mehdi Razavi, MD, the Electrophysiology Clinical Research and Innovation (EPCRI) Laboratory had an exciting year in 2016. Through the utilization of innovative devices and processes, the lab focused on understanding arrhythmias and improving overall cardiac care to identify and terminate rhythm abnormalities in the heart.

The lab made progress in the research of a novel technique using real-time bioimpedance measurements to help physicians navigate a needle while gaining access to the fluid pericardial space that surrounds the heart, which is extremely difficult to access. This technique will potentially increase the accuracy and speed of navigating within the thin pericardial space. Moreover, current research in further developing this technology hopes to provide a method that minimizes the current dependence on radiation. Additionally, the team made significant progress in researching the use of carbon nanotube fibers to improve myocardial conduction and better regulate heartbeat rhythm. The lab has been able to show that carbon nanotubes serve as great candidates in restoring electrical conduction across tissue scars on the heart. This project, funded by a grant from the American Heart Association, aims to develop a revolutionary method to combat heart failure.

Continuing traditions of collaboration between academia and industry, the team formed several new collaborative efforts in 2016. The laboratory's partnership with Rice University has led to what Dr. Razavi calls "the 'Triple Crown' of treatment for the management of both the most common and most lethal cardiac arrhythmias: External Powering, Wireless Pacing and—far and away most importantly—Cardiac Defibrillation, which is not only painless but is actually imperceptible to the patient." This project abstract was accepted as a featured poster at the 2017 Meeting of the Heart Rhythm Society.

The EPCRI team was also awarded the Roderick D. MacDonald grant to support research in thermal mapping of heart muscle tissue in an irregular heartbeat to map epicenters of the arrhythmia. The team also conducted industry-funded clinical research, furthering understanding of arrhythmias and testing devices designed to diagnose and manage them. Four abstracts

were accepted for presentation at the Heart Rhythm Society 2017 and the clinical research findings resulted in a publication in the PACE journal with additional pieces in preparation. In addition, one abstract was selected for presentation at the Alexander Research Symposium. Toward the end of 2016, the team conducted clinical studies focused on the accuracy of pacing catheters during radiofrequency ablation.

Led by Dr. Razavi, the lab's continuous efforts will undoubtedly lead to groundbreaking advances in cardiac care. In 2017, the EPCRI lab plans to continue research on innovative methods to treat and manage heart failure, develop new pacing techniques and imperceptible defibrillation techniques, and to mitigate risks associated with irregular heartbeats.

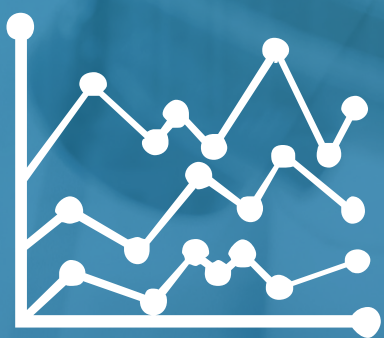
“

This year marked the start of a new era of research for our lab involving development of new ideas and collaborations to advance management of cardiac disease. ”





**4** TRAINED  
POST-DOCTORAL  
FELLOWS  
FROM CHINA



COMPLETED  
FINAL DATA ANALYSIS  
OF HIBERNATING ELECTRICAL ACTIVITY  
IN CHRONIC HEART DISEASE  
FINDINGS LED TO APPROVAL OF FURTHER STUDY

## ELECTROPHYSIOLOGY BASIC RESEARCH

*Dr. Jie Cheng*

Any irregularity in a heart's natural rhythm is called an arrhythmia. About 4 million Americans have recurrent arrhythmias and these arrhythmias can pose major problems over a long period, with potentially fatal outcomes.

Electrophysiologists study the electrical activity of the heart to find where an arrhythmia originates, which can help physicians better treat these conditions. Under the direction of Jie Cheng, MD, Texas Heart Institute's Cardiac Electrophysiology (EP) Research Lab focuses efforts on two important projects. Each is designed to improve detection of abnormal rhythms and pinpoint best treatment options.

### ATRIAL FIBRILLATION

Atrial fibrillation is a commonly occurring arrhythmia in which the upper chambers of the heart quiver. Such irregular heartbeats cause uncomfortable symptoms in most patients, increased hospitalizations, and in worst cases, stroke. Dr. Cheng and EP researchers at THI continue their study of vasoactive intestinal polypeptides (VIP), which are neurotransmitters that have been shown to aggravate atrial fibrillation. Their team identified two types of mRNA forms of VIP receptors—VPAC2—which can occur in the presence or absence of clinical heart failure. Cheng and colleagues successfully cloned VPAC2 forms, facilitating future studies of signaling pathways. Being able to explore the relationship between VIP and the onset of atrial fibrillation can lead to remedies and/or prevention.

### CHRONIC HEART FAILURE

The Cardiac EP lab also explored cases of chronic heart failure and the potential for restoration of hibernating electrical activity. Stem cell transplantation made the study possible. In 2016, the team completed final analysis of study data and discovered abnormal electrophysiological characteristics in hibernating myocardium (heart muscle). Findings led to approval of new protocols. The team ultimately hopes to demonstrate that transplanted stem cells can restore normal electrical activity in hearts suffering from chronic failure. If true, this could reduce the occurrence of lethal arrhythmias and save lives. Cheng and colleagues are collecting data they hope will be worthy of grants from NIH to cover additional basic research and clinical investigations.

**Neurotransmitters are chemical messengers that deliver chemical signals to receptors. Receptors receive these signals from other parts of the body, which then cause a cellular/tissue response.**





# WOMEN'S CARDIOVASCULAR HEALTH

In the United States, a wife, a mother, a daughter or sister dies from heart disease, stroke or another form of cardiovascular disease every minute. With the significant gender gaps that exist in cardiovascular medicine and research, it is clear that more needs to be done to understand and proactively address the progression and prevention of heart disease in women.

That's why Texas Heart Institute dedicates a number of research initiatives, educational programs and outreach efforts to women's heart health, which began with the launch of our Center for Women's Heart & Vascular Health in 2010. Since that time, our efforts to close the gaps in available treatment and prevention strategies targeted specifically at cardiovascular disease in women have grown and achieved significant milestones.

Through the coordination of clinical research, continuing education for medical professionals and community awareness, our team has established unparalleled trust and strong relationships with the diverse Houston community and beyond, positioning the Institute as a leading authority on women's heart health. But our work isn't nearly complete. We are doubling down on our efforts to push for new discoveries, not only in how to care for female patients, but in the way we approach the design of cardiovascular studies overall, accounting for differences between men and women in how and when disease progression occurs.





**200+** WOMEN CONSENTED TO ENROLL IN ONE-OF-A-KIND CLINICAL DATABASE REGISTRY



**4** SCREENING EVENTS IN HOUSTON TO SERVE UNDERINSURED MEMBERS OF OUR COMMUNITY



COMPLETED 7TH ANNUAL ACCREDITED SYMPOSIUM DEDICATED TO CARDIOVASCULAR DISEASE IN WOMEN



**1,000+** WOMEN EDUCATED AT VARIOUS EVENTS WITH COMMUNITY PARTNERS

LAUNCHED SPANISH-SPEAKING SUPPORT GROUP FOR WOMEN LIVING WITH HEART DISEASE

## WOMEN'S CENTER

*Dr. Stephanie Coulter*

Over the last 30 years, we have seen declines in deaths from heart disease in men and older women, but not in younger women. Furthermore, more women than men die of stroke each year. The Texas Heart Institute's Center for Women's Heart & Vascular Health is dedicated to closing this gap by conducting studies focused entirely on women and developing outreach initiatives designed to improve the understanding of heart disease and prevention methods. Stephanie Coulter, MD, has been dedicated to this pursuit since the Center's inception and continues to investigate the roles biology, psychology and lifestyle play in putting a woman at risk for heart disease, and how this information can be used to combat the disease in women while improving cardiovascular research and techniques in patient care.

In addition to research and education efforts, the Women's Center developed a highly effective outreach model for community healthcare based on partnerships with a variety of local organizations, linking formal and non-formal caregivers, and empowering individuals, the family and the community. This program, called Houston HeartReach, provides women in the Greater Houston area the opportunity to learn more about their health and their risk for heart disease. Since the launch of the program, 32 Houston HeartReach events have been organized, reaching over 1,500 underserved and underinsured members of our local Houston community.

As an extension of Houston HeartReach events, Texas Heart Institute plans to investigate gender and racial disparities in the development of cardiovascular disease within Harris County, through the Houston HeartReach Registry. Throughout 2016, the Women's Center team focused on building an exceptional team to carry out the goal of the registry—to create a one-of-a-kind clinical database dedicated to supporting the study of heart disease in women. The registry launches in 2017 with over 1,000 ethnically diverse participants consented from throughout the Greater Houston area.

Gender-specific research of cardiovascular disease today continues to show discrepancies in how best to diagnose, treat and prevent the number one cause of death in women. In the coming year, the team at THI's Women's Center will push for further research on the gender gap in cardiovascular disease and

work to increase knowledge and understanding of vascular diseases in women. They will achieve this by developing more community outreach and education initiatives in the Houston area and within the medical community. The Houston HeartReach Registry is an important component of these plans, and the team will look at how the registry can be maximized to gain insight into conditions known to impact women disproportionately, such as non-coronary, non-atherosclerotic, non-inflammatory cardiovascular disease, with a particular emphasis on heart failure and fibromuscular dysplasia (FMD) initially.

In addition to research initiatives, the Women's Center focused on several education programs in 2016, including leveraging the large network of loyal volunteers and advisors who support the mission of Texas Heart Institute and are dedicated to helping to serve women across Houston and beyond. In 2016 alone, the team educated over 1,000 women at various events in partnership with the FDA Office of Women's Health Research, WomenHeart National Hospital Alliance, Elnita McClain Women's Center, Rotary Club Houston, The Professional Group of Houston, Exxon Mobil Corporation, Faith Tabernacle Church, Girl Scouts of San Jacinto, Alpha Kappa, Lonestar College-Montgomery Student Nurse Association, Neighborhood Centers Inc, and Les Tres Gentile (LTG).

Dr. Coulter also continued to publish her educational e-newsletter Straight Talk from Dr. Stephanie which addresses current topics related to women and heart disease, aiming to separate fact from fiction in the media. The communication is also provided in Spanish, offering an informative educational resource to the Spanish speaking community.

In addition to providing helpful materials in Spanish, the Women's Center also launched a Spanish-speaking support group pilot in 2016. The team supported the launch of the first ever WomenHeart support group in Houston in 2012 and hopes that this Spanish-speaking pilot group will see similar success, providing a critical resource to women living with heart and vascular illness.



# EDUCATION

Texas Heart Institute was founded to tackle cardiovascular disease via research and education. To do so meant attracting a team of the brightest physicians, scientists and researchers who are also dedicated educators, imparting knowledge among peers, current trainees and future clinicians. We provide continuing education activities for physicians, nurses and others in related specialties who are involved in patient care.

We achieve these aims through several avenues, including Texas Heart Institute's School of Perfusion Technology—the first accredited and longest operating school of its kind in the U.S.; our postdoctoral residency and fellowship programs; and via our Continuing Medical Education department, which provides faculty-led series, topic-specific symposia and live activities.

Education is at the core of everything we do at THI. Over the last year, our teams educated current and future generations of practitioners and researchers on the latest innovations, scientific advancements, expert consensus statements, outcomes data and practice standards relating to cardiovascular care.

We continue to enhance our educational offerings, and respond to needs regarding subject-specific matters. Our audiences acknowledge via evaluations that our symposia, publications and web-based tutorials favorably impact their clinical practices. We are gratified, for high caliber patient care remains at the forefront of why we do what we do.







**AWARDED ACCREDITATION  
WITH COMMENDATION  
FOR THE FIRST TIME**  
BY THE ACCREDITATION COUNCIL FOR CONTINUING MEDICAL EDUCATION



**LIVE  
CME SYMPOSIA**

**2,220 ATTENDED  
LIVE THI CME ACCREDITED ACTIVITIES\***

\*DOES NOT INCLUDE ATTENDEES FOR HOT TOPICS OR NEUROCRITICAL CARE SYMPOSIA



**20 COMPLETED  
SCHEDULED  
SERIES**

EDUCATION

**CONTINUING MEDICAL EDUCATION**

*Elaine Allbritton*

The mission of the Texas Heart Institute's Continuing Medical Education (CME) program is to provide comprehensive and innovative continuing medical education activities that are designed to increase medical knowledge and skills and, ultimately, to change practice behavior to improve patient care. These goals are accomplished while working alongside symposia Program Directors and speakers through the implementation of high-quality medical education, and 2016 saw continued success for this critical department.

In 2016 alone, the CME team accredited 18 live CME symposia and 20 regularly scheduled educational series. A total of 1,127 physicians and 1,093 non-physicians attended THI CME-accredited live activities. This is in addition to a record-breaking final year for offerings through the CME's website, which since 2005 has issued 22,711 certificates online via 176 AMA PRA Category 1 credit. The success of THI's CME program illustrates the Institute's extensive reach within the medical community and the vital role it plays in continuing the education of cardiovascular physicians and medical professionals around the world.

Perhaps most significant for the program was a milestone reached in July. For the first time in THI's CME history, the program was awarded Accreditation with Commendation for the next six years by the Accreditation Council for Continuing Medical Education (ACCME). This award recognizes medical education providers who not only demonstrate compliance with core accreditation criteria, but who aim for even higher levels of achievement. ACCME accreditation seeks to assure the medical community and the public that Texas Heart Institute provides physicians with relevant, effective, practice-based continuing medical education that supports U.S. health care quality improvement, and this award is a testament to the team's relentless pursuit to improving continuing medical education.

Looking toward the future, Texas Heart Institute's CME program will continue to expand the meaningful impact it has on the local and global medical community, supporting an important piece of the Institute's overall mission to reduce the devastating toll of cardiovascular disease through medical education programs.



**Our Continuing Medical Education Department has been recognized as an accredited provider for over 35 years, and this year's re-accreditation with commendation is a testament to the hard work and dedication of our team.**



*James T. Willerson, President Emeritus*





# MOVING FORWARD

The Texas Heart Institute's Board of Trustees, with continued focus on the legacy of accomplishment and the many firsts that have defined the organization, unanimously selected Dr. James Willerson to assume the role of President Emeritus, the same role as his mentor, Dr. Denton Cooley, held until his passing.

Dr. Willerson served as THI's President from 2008 until early 2017 and was responsible for its strategic direction and outreach. Recognized for his achievements in cardiac research, he expanded programs in stem cell therapy and regenerative medicine. With other leading physicians and scientists on the professional staff, he launched studies into coronary anomalies and women's health. He recruited the best talent from around the world who shared the bold vision of Texas Heart Institute.

He frequently contributed to scientific literature, publishing in peer-reviewed journals, editing textbooks and delivering lectures worldwide. First and foremost, he always remembers the patient. He has treated untold numbers of patients, and will continue his clinical practice in addition to his service as President Emeritus.

The Board is honored to continue the tradition of the Texas Heart Institute with Dr. Willerson, an internationally distinguished cardiologist, research scientist and educator, serving in his new role. We remain grateful for his focus, passion and unrelenting commitment to eradicating cardiovascular disease.

# IN MEMORIAM DR. DENTON COOLEY

Denton A. Cooley, MD, heart surgeon extraordinaire, pioneer and founder of Texas Heart Institute, died November 18, 2016, at age 96.

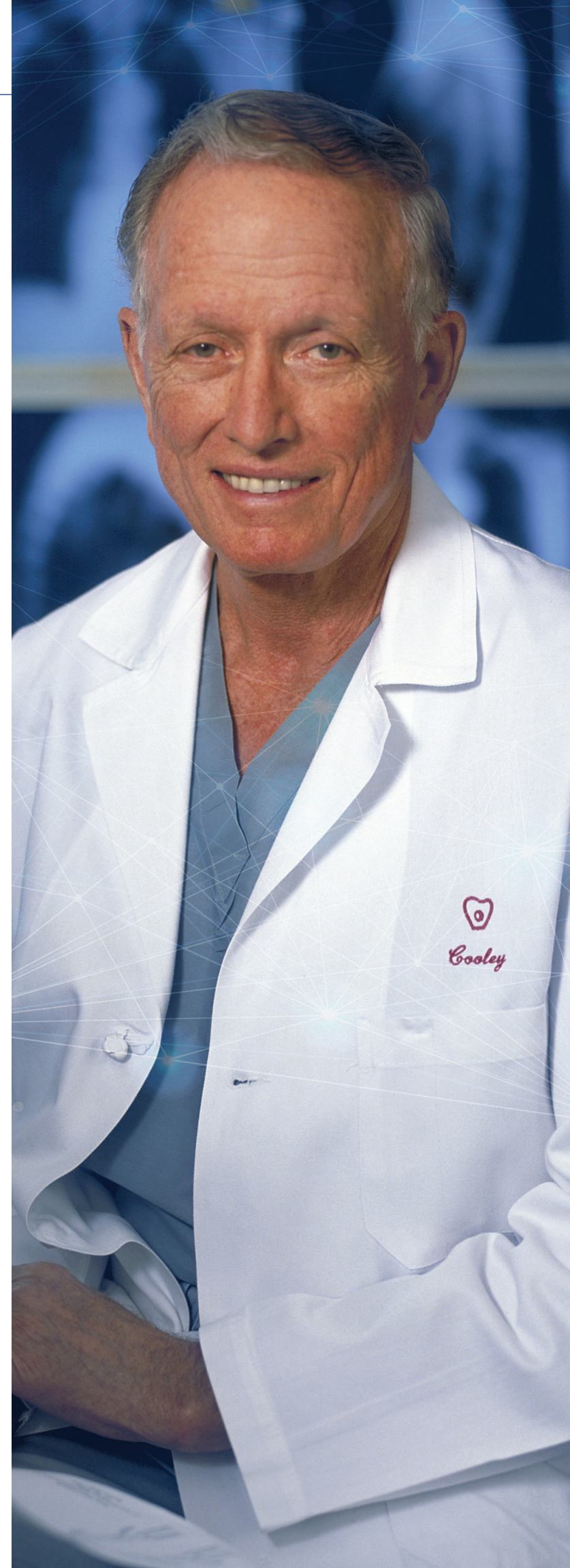
His career spanned the history of modern cardiovascular surgery. Beginning in the late 1940's to the 2000's, he developed and refined many cardiovascular procedures, techniques, instruments, devices, products and processes that are still used today in the surgical care of children and adults. Despite these, he is perhaps best known for performing the first successful heart transplant in the U.S. (1968) and the world's first implantation of a total artificial heart in man (1969).

Many of Cooley's surgical contributions were revolutionary, given the reticence among the surgical community at the time to attack such lesions. Among them are his firsts in performing a successful repair of an aortic aneurysm (1949); ruptured abdominal aneurysm (1954); ventricular septal defect as a result of a heart attack (1956); carotid endarterectomy to avert stroke (1956); original techniques to repair diseased heart valves and the gamut of congenital heart defects...the list includes more than 30 such firsts.

Yet Cooley maintained that his most important contribution to cardiovascular medicine and surgery was founding the Texas Heart Institute (1962). He boldly led, mentored, inspired and encouraged each person who touched the Institute—whether patient, family, trainee, staff, visitor or benefactor. We are eternally grateful for the personal example he established and modeled for us. We promise to continue building on his legacy with the next wave of innovations and firsts.

A handwritten signature in black ink that reads "James T. Willerson, M.D." The signature is written in a cursive, flowing style.

James T. Willerson, MD  
President Emeritus





Texas Heart Institute remains at the forefront of tremendous achievement and discovery in our pursuit to reduce the devastating toll of cardiovascular disease around the world. Our progress would not be possible without the confidence, commitment and support of our donor community.

In no other field of medicine has the generosity of people like you made such a great difference in improving the lives of heart patients. It is that generosity that enables us to harness the power of progress and build on each and every accomplishment to discover the next first. Your support has changed our future, and that of so many afflicted by heart disease.

As our discovery continues with the same pioneering spirit that has defined Texas Heart Institute for 55 years, we express profound gratitude for your continued support.

[WWW.TEXASHEART.ORG/SUPPORT](http://WWW.TEXASHEART.ORG/SUPPORT)



THE NEXT FIRST  
IS HAPPENING HERE





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