Riley Heart Center

Riley Hospital for Children

INDIANA’S ONLY COMPREHENSIVE CHILDREN’S HOSPITAL
Riley Heart Center at Riley Hospital for Children
A Member of Clarian Health

For more than 80 years, Riley Hospital for Children has been a major referral center for infants, children and young adults. Today, Riley has grown to be one of the nation's top children's hospitals.

Along with Methodist Hospital and Indiana University Hospital, Riley is part of Clarian Health. Clarian's affiliation with Indiana University School of Medicine helps make it one of the most highly regarded and respected partnerships in health care.

The Riley Heart Center, comprised of the sections of Cardiovascular Surgery, Pediatric Cardiology and the Riley Heart Research Center, is internationally recognized as a leader in the treatment of children with heart disorders and as a center for basic and translational cardiovascular research. The cardiac medical and surgical team is the only group performing pediatric heart transplantation in Indiana, and has led many of the advances in the treatment of children with failing hearts. The basic and translational research team is supported by a National Institutes of Health Program Project grant, a major institutional grant looking at the cause and treatment of heart failure in children. Combined with Riley Hospital's pioneering approach to family-centered care, the Riley Heart Center is the region's best place to be if you're a child facing a heart problem.

The Riley Heart Center includes Cardiovascular Surgery, Pediatric Cardiology and Heart Research working together to better the lives of children with heart problems.
The Medical Team

Cardiovascular Experts and Dedicated Specialists in a Nationally Recognized Center of Pediatric Excellence

The Riley Heart Center is built around a simple yet powerful care model — outcomes improve when top physicians, nurses and other caregivers work in an environment specifically designed to support them. National research has proven that surgical outcomes improve with consistently high case volume and ongoing care of related patient populations. By performing more than 475 pediatric heart surgeries annually, Riley has established itself as one of the top 10 pediatric heart programs in the country. At Riley, highly respected and experienced pediatric cardiovascular surgeons and cardiologists work with a dedicated team of pediatric anesthesiologists, pharmacists, perfusionists, specialty trained nurses, nurse practitioners and therapists committed to and trained in the care of children with heart disease. Just beyond the clinical care team exists a network of Child Life specialists and Cheer Guild volunteers to provide support and comfort.

Since 1950, families and their physicians have looked here for comprehensive evaluation, medical management and surgery for infants, children and adults with congenital heart disease.

In Indiana, only Riley offers this level of care.

The Research Team

Riley Heart Research Center (at the Wells Center for Pediatric Research)

The development of a child from a fertilized egg is the most complex process in human biology. When properly orchestrated, this process produces a heart capable of supporting a vigorous life for more than 80 years. When something goes wrong, though, that life can be shortened to mere minutes.

The scientists at the Riley Heart Research Center share a goal with the clinicians and surgeons of the Riley Heart Center — to give children with heart problems a chance at a better and longer life.

These scientists seek to understand why congenital or acquired heart defects occur and how they lead to abnormal heart function. By gaining a thorough understanding of these processes, the Riley Heart Research Center can develop new therapies to treat and prevent heart disease in children. Research activities include new ways to block damage to the heart that can result from defects, and new cell- and drug-based approaches to promote cardiac growth after damage has occurred. The close interactions among scientists, cardiologists and surgeons mean that research at the Riley Heart Center is highly focused on developing new therapies aimed at saving children's lives here and throughout the world.
Healing Experience

An Experienced, Interdisciplinary Team of Pediatric Cardiac Specialists

The clinical insight of the physicians treating pediatric cardiac patients at the Riley Heart Center is matched by few facilities in the United States. This has created an unparalleled level of trust among referring physicians throughout Indiana and the Midwest.

Children receiving cardiac treatment at Riley do so in the only hospital in the state dedicated exclusively to the acute care of pediatric patients. Pediatric experts in every medical and surgical specialty and subspecialty are available 24 hours a day to address any additional health problems a child may face.

Diagnostic Technologies and Expertise

Complementing their expertise in the hands-on physical exam, pediatric cardiologists at Riley Hospital employ a variety of tests to evaluate cardiovascular defects — Echocardiography, EKG, X-ray, ambulatory EKG, exercise testing, electrophysiologic testing, magnetic resonance imaging (MRI) and diagnostic heart catheterization, among others.

Echocardiography

One of the most useful diagnostic modalities for assessing congenital heart defects is the echocardiogram, which uses noninvasive, high-frequency sound waves to reveal complex cardiac anatomy and physiology. It’s an essential technology that has eliminated the need for cardiac catheterization for many defects. Riley clinicians with additional specialized training annually perform more than 10,000 pediatric and fetal echocardiograms, including about 1,100 fetal echos, and a staff of pediatric cardiologists interprets them. Their expertise is widely recognized among other hospitals in the Midwest, which rely on Riley cardiologists to interpret more than 3,100 echos from their own institutions.

Riley was the first in Indiana to have a pediatric echo lab accredited by the Intersocietal Commission for the Accreditation of Echocardiography Laboratories. In addition to traditional echos, Riley cardiologists dealing with more complex cases often perform transesophageal echos (TEE) when they need additional views. A TEE also can guide interventional catheterizations for immediate assessment in the operating room.

Echocardiograms are performed throughout Riley Hospital and the Riley Heart Center, including the operating room and catheterization lab, for intraoperative assessment, to guide surgical interventional procedures. Moreover, the Riley echo lab was one of the first all-digital laboratories in the state. We continue to apply new technologies and systems that ensure studies can be accessed and reviewed 24 hours a day to help with patient care at Riley and throughout the state.
**Cardiac MRI**

The cardiac MRI program at Riley is unique in the state of Indiana, providing thorough and in-depth details on cardiac structure and function in children and young adults with all varieties of heart disease. At Riley, we perform nearly 200 highly specialized cardiac MRI exams annually. Radiation from MRI is not used, and the imaging is not invasive, often providing an alternative to cardiac catheterization. This makes cardiac MRI a very easy procedure for many children to undergo. Cardiac MRI can also answer questions that echocardiography may not be able to answer. Cardiac MRI is often very important in making decisions and planning for heart surgery. Riley has the only pediatric cardiologist and pediatric radiologist in the state qualified to perform and interpret cardiac MRI studies.

**Cardiac Catheterizations**

Rapidly advancing catheterization technology is allowing for the diagnosis and repair of the most complex cardiac defects. Some defects that only a few years ago would require surgery can now be treated with catheter-based techniques. The interventional pediatric cardiologists of Riley Hospital have been at the forefront of those advancements. A Riley cardiologist performed a balloon valvuloplasty on the smallest patient to successfully undergo the procedure — the baby weighed less than 2 pounds. Riley cardiologists were among a small group of experts nationwide involved in clinical research trials for Amplatzer Septal and Duct Occluder and Nit-Occlud that treats atrial septal defects (ASD) and patent ductus arteriosus (PDA). Numerous clinical trials of other medical devices are ongoing.

A team model of care shapes the treatment in the catheterization laboratory and recovery within the Riley Heart Center. Pediatric interventional cardiologists, anesthesiologists, nurse practitioners and other intensivists are involved at every step. A partial list of procedures includes the following:

- **Balloon angioplasty and stent placement**
- **Balloon valvuloplasty**
- **Balloon/blade atrial septostomy**
- **Coil closure of various vascular abnormalities**
- **Device closure of cardiac defects**
- **Fontan fenestration closure**
- **Transhepatic catheterization**

Combined interventional and surgical techniques (hybrid procedures) have been performed at Riley since 2004. All told, more than 500 pediatric cardiac catheterizations (diagnostic, interventional, biopsy and electrophysiologic) take place each year at Riley Hospital — more than at any other facility in Indiana and the most in the region.

**Arrhythmias**

The Riley Heart Center provides the complete range of state-of-the-art services for the diagnosis and treatment of cardiac rhythm disorders, performing and interpreting more than 6,000 electrocardiograms (EKGs), 450 24-hour, continuous EKG monitors, 200 event recorders and 60 radio frequency catheter ablations annually.

A busy and active service follows about 200 patients with various pacemakers and defibrillator devices. With the guidance of pediatric cardiologists specially trained in pediatric electrophysiology, clinicians ensure that patients receive the best and most current care for heart rhythm problems.
Riley Hospital has become Bailey Hunsberger’s second home — and the physicians, nurses and staff her extended family.

Bailey needed two open-heart surgeries before her fourth birthday. As she grew, though, her heart couldn’t keep up; at age 12, she faced the prospect of a transplant. The most promising option presented the biggest challenge — a mechanical pump could allow Bailey’s body to get strong enough to survive the procedure.

The Berlin Heart, however, wasn’t approved for pediatric use in the United States. Fortunately, the Riley team had the experience and skill to qualify for an FDA exemption.

For three months, Bailey watched the external device pump blood to her body and waited anxiously for a matching donor heart. Then, Dr. Mark Turrentine delivered unexpected and delightful news: Bailey’s heart and lungs remarkably had healed enough to take her off the transplant list. The pump came out, and Bailey went home.

For awhile, Bailey lived as a normal teenager, even taking driver’s ed. But then her heart began falling out of rhythm, requiring an electrical shock 27 times in 2007 to return it to normal.

“It was such a long year for us,” said her mom, Angie McGraw. “For months, she didn’t stay out of the hospital for three weeks at a time.”

Bailey attended only the first two weeks of school before she was too sick to go back. She needed yet another open-heart surgery.

“They fixed two valves, replaced a third and created a path that hopefully will keep her heart in rhythm, and they drained about seven liters of fluid from her belly,” Angie said. “So far, so good — she’s back in school and nearly caught up with her classes.”

A heart transplant isn’t out of the question.

“We have no idea what our future holds, but right now we’re celebrating every single day,” Angie said. “For so long, we couldn’t do anything because we didn’t dare stray too far from the folks at Riley. And, boy, what folks they are. I wonder how I kept from losing my mind, but without a doubt it was Bailey’s medical team — from the ladies at the registration desk to the nurses on the Heart Center, to Dr. [Robert] Darragh and Dr. Turrentine, and every single person in between. I can’t imagine going through it all at any other facility in the world.”

The improvement in Bailey’s heart following treatment with the Berlin Heart was truly remarkable. Scientists at the Riley Heart Research Center are developing model systems to study why some hearts improve with ventricular assist devices like this one. They hope to uncover intrinsic protective and regenerative pathways within the heart, information that may, in turn, be translated into treatment that can help all children suffering from heart failure. 🌼
Stress Tests

More than 350 cardiac exercise stress tests take place at the Riley Heart Center each year in a laboratory dedicated to sophisticated evaluation of children and their responses to maximal exercise. Reasons for exercise stress tests vary from cardiac clearance for school sports to evaluations after fainting episodes, exercise-induced chest pain, abnormal heart rhythms, cardiac surgery or heart transplantation. State-of-the-art equipment used for exercise testing includes treadmills and bicycles with computer-controlled workload adjustments, measurement of peak oxygen consumption, blood oxygen saturation, continuous heart rate and rhythm, blood pressure, and other respiratory and metabolic parameters. The Riley Pediatric Cardiology department utilizes an exercise physiologist to coordinate exercise stress tests, provide individualized exercise programs for patients and assist in exercise-related research endeavors.

Adult Congenital Heart Disease Program

As a result of extremely successful diagnostic and treatment strategies developed and employed over the past half century, the number of adults with congenital heart defects in the United States is approaching one million. Of these, at least half are complex enough to require ongoing follow-up and treatment by health care professionals with expertise in the care of these patients. Meeting the unique and complex needs of this special population of patients is the mission of the Riley Heart Center's Adult Congenital Heart Disease Program. This program was established in 1991 to provide multidisciplinary, continuing care for adolescents and adults with chronic congenital cardiac conditions. The service is jointly staffed by Riley Heart Center pediatric cardiologists and adult cardiologists from the Krannert Institute of Cardiology, Indiana University School of Medicine. This collaborative effort among leading physicians ensures our expertise in the wide range of cardiovascular problems facing these patients. Specially trained technicians, sonographers, and nurse clinicians complete the team and provide the breadth of services necessary for optimal health care. Other subspecialty services such as hematology, pulmonology, psychology, neurology and obstetrics are readily available.

Preventive Pediatric Cardiology Program

Riley Hospital for Children's Preventive Pediatric Cardiology Program aims to identify and manage risk factors in children that contribute to heart disease as adults. Modifying behaviors and medically managing high cholesterol and blood pressure during childhood will significantly decrease the chances of a heart attack or other cardiac-related concerns in the future. Riley Hospital's Preventive Cardiology Program treats children with abnormal cholesterol and hypertension, primarily on an outpatient basis. During the course of treatment, patients and their families will meet with a multidisciplinary team, including a pediatric cardiologist, a dietitian, a nurse specially trained in blood pressure assessment and an exercise physiologist.
In the waiting area at Riley, Dr. Randall Caldwell walked by a 3-month-old Filipino orphan and the couple who was caring for her while she received medical care.

“Dr. Caldwell stopped, walked back and said,’We need to measure her oxygen level right now. It looks like it’s about 60 percent,’ said Roger Helmkamp, the child’s guardian — and future dad. “He was right. Lydia was admitted that night and had open-heart surgery the next day.”

Three-month-old Lydia had tetralogy of Fallot, a congenital heart condition marked by four imperfections, including a hole between the ventricles. It was a condition the Helmkamps knew well.

“A year and a half earlier, we had agreed to be guardians for an orphaned Filipino boy who was here for heart surgery due to tetralogy of Fallot,” Roger said. “John Michael had had two surgeries when we heard about Lydia. We were told her condition wasn’t as serious as his had been.”

In fact, hers was worse. Lydia also had pulmonary atresia, which means blood couldn’t flow to her lungs. Her struggling heart had formed its own conduits to try to move her blood around. And she was much tinier, weighing only 7 pounds when she arrived.

After surgery, excessive swelling in her chest cavity caused surgeons to leave her sternum open and the infant in a drug-induced coma for four days.

She had a second open-heart surgery later that year and a third surgery 10 months later. Now 6, she continues to have echocardiograms, chest X-rays and heart catheterizations.

Both Lydia and John Michael, 8, will face additional surgeries as their hearts outgrow the repairs Riley surgeons have made. This time, though, they’ll undergo them as siblings of the Helmkamps’ 16-year-old birth son, Andrew. The Helmkamps have adopted John Michael and Lydia.

Riley Hospital has been a moving force in their lives — literally.

“One of the last times we took Lydia to the hospital in our small hometown in northwest Indiana, she scared the emergency room staff,” Roger said. “We decided right then we needed to move closer to Riley.”

The family now lives in Carmel.

“We wanted to know that if there was ever any critical condition with our children, we’d only be 20 minutes away. Riley Hospital was worth it to us,” Roger said.
Advanced, Effective Care
Care that Begins Before Birth

Congenital heart defects are the most common birth defects, occurring in approximately one out of every 125 live births. Many of these defects can be identified in utero with specialized fetal echocardiography. This can allow for immediate treatment if available, or more often counseling and planning that enhances outcomes. Our fetal cardiology specialists work closely with the maternal-fetal medicine specialists at Indiana University Hospital, Clarian North Medical Center, Community Hospital North and others in the Indianapolis area. We routinely perform detailed fetal cardiac ultrasounds at these sites and provide immediate consultation and discussion. Fetal echocardiograms also are performed at the Riley Outpatient Center to accommodate patient and obstetric physician needs. We work closely with these referring physicians, as well as the surgical, neonatal and other Riley specialists necessary to help formulate the best course of treatment for the individual patient and specific congenital heart defect. All the while, Riley clinicians include parents and the referring physician in dialogue. Many patients are still able to deliver at their local hospital with their primary obstetrician. However, if in the best interest of the baby, sometimes delivery at Indiana University Hospital is recommended, with immediate transfer of the infant to Riley Hospital Neonatal Intensive Care Unit.

Advanced Neonatal Care Before and After Surgery

Riley Hospital’s 55-bed Newborn Intensive Care Unit (NICU) has ranked in the nation’s top five and, in partnership with Indiana University School of Medicine, is a National Institutes of Health research center.

The Riley NICU is staffed 24 hours a day with board certified neonatologists, supported by a large staff of neonatal nurse practitioners and clinical specialists. Riley is one of the few centers offering extracorporeal membrane oxygenation (ECMO) for patients with failing heart function and nitric oxide (NO) for patients with pulmonary hypertension.

The NICU also is the training center for LifeLine Critical Care Transport’s specialty neonatal teams. These teams provide care during transportation via mobile intensive care units, helicopter and airplane. No child in the region, state or nation is too far away to be treated at Riley.
Sandra Smith was at home, asleep next to her daughter, SaDeria Cheatem, when the girl suddenly started jerking. She was in cardiac arrest.

“I had to do CPR,” Sandra said. Eventually, LifeLine transported SaDeria from her local hospital ER to Riley.

The thing was, 10-year-old SaDeria had long recovered from heart surgery. Her problems had first occurred in 1996, when she was an infant living in Evansville.

“Doctors first thought it was asthma, then RSV (respiratory syncytial virus),” Sandra said. “Finally, I took her to a doctor’s appointment when she was sound asleep, and he heard a murmur.”

SaDeria had an enlarged heart and a hole in her left ventricle. The pediatric cardiologist prescribed medication until her heart was healthy enough for surgery to repair the hole when she was 2.

For the next eight years, SaDeria did fine — until her heart failed the night her mother saved her. Riley Hospital physicians Robert Darragh and Mark Turrentine implanted a defibrillator, and SaDeria went home.

She started getting sick again two years later. After being hospitalized for what doctors thought was pneumonia, Sandra and Daryl Cheatem decided to take their daughter back to Riley.

“The very next morning, they knew she had a blood clot in her heart,” Sandra said. “It dissolved with medication and we went home, but another clot formed.”

This time, SaDeria needed a transplant. She arrived at Riley on Feb. 11, 2008, and surgeons implanted a ventricular assist device, a mechanical pump to increase blood flow to the body. The wait for a donor heart began.

SaDeria was afraid.

“She didn’t want a transplant, and I wanted it to be her decision. I explained to her that without it, she was going to die and that the doctors were trying to give her a future,” Sandra said. “She finally agreed.”

Two months later, Sandra had a feeling.

“I was restless all night. I woke up at 5:30 a.m. on April 9. A nurse came in and said, ‘I think we have a heart.’”

She asked the nurse, Debbie, to wake her daughter and tell her.

“SaDeria just looked up and said, ‘Thank you, Debbie.’ Then they both started crying. We all were crying. It was a good experience,” Sandra said.

Dr. John Brown led the team that performed the transplant.

Today, SaDeria and her mom agree that the ordeal brought them closer.

“God doesn’t tell us how long I have her or she has me. You have to come to peace with the situation you’re dealing with. You can see more clearly that way,” Sandra said. “I just thank God for my daughter and for everyone at Riley. SaDeria remembers one nurse in the ICU who was so comforting. ‘Heidi’s like my mama when you’re gone,’ SaDeria said. That’s special.”

Any surgery adds stress to the body, so when surgeons at the Riley Heart Center successfully repaired the hole in SaDeria’s heart, the already overworked organ became susceptible to progressive injury that ultimately required transplantation.

Scientists at the Riley Heart Research Center have identified a number of molecular pathways in animal models that block or even reverse these types of injuries. They hope to translate their findings to children like SaDeria and block the progression toward heart failure. ☮️
Pediatric Cardiac Surgery

Like the children born with them, congenital abnormalities of the heart have distinctly individual characteristics. The interdisciplinary surgical teams of Riley Hospital have the experience to repair or palliate many of them. Cardiovascular surgeons at Riley perform more than 475 cardiac surgeries a year. This means Riley cardiac surgeons are expanding the range of treatable patients — children who were once surgically untreatable are now routinely treated.

Risks and outcomes vary with procedures, but when all pediatric cardiac surgeries performed at Riley are considered, the hospital’s overall mortality is among the best in the country. The cardiothoracic surgery staff at Riley has earned an international reputation for its pioneering skills and excellence in this technically difficult subspecialty. In every surgical case, the first option is always the least invasive procedure that does not compromise outcomes. Our aim is to minimize surgical trauma, while accelerating recovery. Technology and technique are constantly changing; thus, surgeons at Riley continually evaluate new methods.

A big step in pediatric cardiac surgery is the ventricular assist devices that allow for ventricular muscle recovery or serve as a bridge to transplant. Techniques for single ventricle heart surgery have improved as well with successful outcomes. A cardiologist-surgeon team successfully performs hybrid ventricular septal defect (VSD) closures in the operating room for patients who are younger, smaller or have difficult defects to correct.

Closed- and open-heart procedures are routinely done at the Riley Heart Center, using a 1- to 3-inch incision. The limited-incision decreases pain, scarring and hospital stay, enhancing recovery.

Experts in the Operating Room

Treatment in the operating room is tightly coordinated within a team of pediatric cardiac surgical experts. Surgeons, anesthesiologists, perfusionists and nurses — all with years of pediatric cardiac surgical experience — work together to perform some of the most complex and difficult procedures in medicine.

Riley cardiac surgeons perform all open- and closed-heart procedures available to treat every pediatric cardiac problem. They are at the forefront of developing and evaluating new techniques. Surgical categories include the following:

- **Congenital heart defects**
  - All developmental defects of the heart and great vessels
- **Acquired heart disease**
  - Heart valve replacement/repair
  - Coronary artery procedures
  - Cardiac tumors
- **Heart failure**
  - Mechanical heart device implantation/support
  - Cardiac transplantation
- **Thoracic/vascular**
  - Chest wall (pectus) defects
  - Lung/mediastinal
  - Aortic repair/replacement
Halfway through her pregnancy, Lindy and Jason McHenry of Bloomington, Ind., went for an ultrasound expecting to find out whether they were having a boy or a girl.

“They told us we’d have a son, and he’d be born with half a heart,” Lindy said.

Their child had hypoplastic left heart syndrome (HLHS), a condition in which the left side of the heart is too underdeveloped to pump blood to the body. If not diagnosed before or at birth, the condition is fatal within days.

“As soon as Ethan was born, they took him straight from me to Riley,” Lindy said. “He had open-heart surgery seven days later, and he was three weeks old before I got to hold him again.”

HLHS requires multiple open-heart surgeries; a transplant usually isn’t viable because a matching infant donor is difficult to find. Ethan’s first surgery, called the Norwood procedure, allowed his heart’s fully developed right ventricle to pump blood to his lungs and body. He left Riley after six weeks.

“It was nerve wracking to be at home. He was on eight medications and had a feeding tube in his nose; yet he wasn’t gaining any weight,” Lindy said. “We kept getting nervous, saying, ‘Where’s the nurse call button?’”

The second surgery, called the hemi-Fontan, reduces the work of the right ventricle by allowing blood to flow automatically from the body into the lungs. This time, Ethan went home after just a week.

“The difference was amazing,” Lindy said. “We went home on a Thursday, and he was crawling by Sunday.”

Normally, the third surgery, the Fontan procedure, is done when a child is almost 3 and his lungs have grown enough to withstand changes in pressure. Riley physicians didn’t think Ethan could wait.

“His oxygen level was really low, so they decided it was worth the risk,” Lindy said. “At the time, Ethan was the youngest patient ever to have the Fontan procedure at Riley. He came through with flying colors.”

And he’s been doing well ever since.

“He’ll never play contact sports, and he’ll always need medications, but we’re fine with that,” Lindy said.

She educates people about HLHS and the value of fetal echocardiograms. She also tells people about Riley Hospital.

“The Riley staff is so kind, and they make sure you understand what’s going on. They allowed me all the privacy I needed to pump breast milk for Ethan and even stored it for me. It’s an amazing facility.

“Riley Hospital is definitely a lifesaver. If it wasn’t for them, our son wouldn’t be here with us today.”

Ethan McHenry

Prenatal ultrasound gave the Riley Heart Center surgeons and cardiologist sufficient warning to successfully treat Ethan’s hypoplastic left heart. Scientists there have used sophisticated genetic experiments to generate models exhibiting similar hypoplastic ventricular development. They hope to identify therapeutic interventions to promote reparative growth in hypoplastic hearts like Ethan’s. 😊
Anesthesia and Perfusion

Children are not small adults. Riley has the only anesthesia group in the state providing care exclusively to pediatric patients.

Pediatric perfusionists are specially trained to keep patients stable during complex cardiac surgeries. The perfusion team’s clinical and research experience translates into recognized academic excellence as one of the few groups in the country involved in the training of tomorrow’s pediatric perfusion specialists.

Riley anesthesiologists were instrumental in introducing nitric oxide for the treatment of pulmonary hypertension, a major clinical problem that can occur following cardiac surgery.

Leaders in Neonatal and Pediatric Heart Transplantation

When a child’s heart is so damaged that surgical intervention is not an option, a transplant may be the only option. Few hospitals in the country can match the pediatric transplant experience and capabilities at Riley Hospital for Children.

Riley is a national leader in heart transplantation. The first infant heart transplant in Indiana was performed at Riley in 1989. A second pioneering case took place that same year when a 4-day-old infant — the youngest child to undergo a heart transplant in an Indiana hospital — received a new heart in the world’s first and only twin-to-twin transplant. In 2005, Riley became only the ninth hospital ever to perform 100 pediatric heart transplants. Today, it’s still the only Indiana hospital with enough skill and experience to perform heart transplants for children.

Riley is one of 22 leading hospitals in the United States and Canada that meets strict criteria for volume, quality of care and outcomes in pediatric heart transplant and membership in the Pediatric Heart Transplant Study Group.

Cardiac Critical Care Program

After surgery, it is imperative patients are treated by a well-trained intensive care unit staff. At Riley, postsurgery patients are treated in the Cardiac Critical Care Program by an interdisciplinary team that includes pediatric cardiac surgeons, cardiac intensivists, cardiac anesthesiologists, cardiologists, nurse practitioners, ICU nurses, respiratory therapists, nutritionists, pharmacists and social workers. Since starting the Cardiac Critical Care Program, the numbers of days spent on a ventilator and hospital length of stay have declined, along with several other indicators that translate into positive outcomes.
Hearts Aligned

The Pediatric Cardiovascular Nurses of Riley Hospital and the Riley Heart Center

Just as early intervention is critical to positive outcomes, so too is high-level postoperative care. At Riley, patients are always in the hands of nurses who have attained Magnet designation, national recognition of excellence in nursing services and high-quality patient outcomes. The Magnet Recognition Program was developed by the American Nurses Credentialing Center to recognize health care organizations that provide the very best in nursing care. In addition, Riley received the American Nursing Association’s National Database of Nursing Quality Indicators (NDNQI) Award for outstanding nursing quality in the pediatric hospital category. Riley demonstrated superior patient outcomes and high nurse job satisfaction on 18 nursing-sensitive performance indicators tracked by NDNQI.

Specialized Nurse Practitioners

Leading the pediatric nursing care team is a group of full-time nurse practitioners and advanced practice nurses specializing in congenital heart disease. These advanced practice nurses are involved at nearly every stage of patient care, including assessment and treatment.

All of Riley’s cardiac nurses have hundreds of hours of training and experience in every aspect of pediatric cardiovascular care. They are senior-level clinicians delivering care throughout the hospital’s pediatric cardiology areas — from the outpatient clinics to the catheterization lab to the operating room.

Nursing professionals are dedicated to advancing the practice of cardiovascular nursing by improving the care of patients. They are also advocates for families, responding to fear and pain with a compassion that defines the care at Riley.

A Team of Allied Professionals

The nurses of the Riley Heart Center join pediatric pharmacists, occupational therapists, respiratory therapists, nutritionists, social workers and other pediatric specialists in delivering tightly coordinated care. Staff chaplains help families seeking spiritual guidance.

Child Life Services Focuses on Individual Needs

Child Life experts are involved in preoperative procedures, working to help the child understand what’s happening and to reduce stress and fear. During difficult or painful procedures, a Child Life specialist is there to help distract and soothe. Postoperative education is a part of every child’s stay, and playtime sessions — including music therapy — take place throughout the unit. Child Life specialists help patients keep up with their schoolwork.
A Treatment Partnership

Referring Physicians and the Riley Heart Center

Referring pediatricians and primary care physicians, and often perinatologists, are effectively integrated into each patient’s treatment team from initial consultation to release. A nurse practitioner or physician contacts each referring physician daily with reports on treatment, challenges and diagnosis, and provides a direct line to the lead cardiologist or surgeon. A comprehensive discharge summary is created and then forwarded to the primary care physician promptly at discharge. The goal is to expand the treatment team so that every relevant clinician is informed, involved and in a position to contribute. Riley specialists are available to any referring physician and any family who wishes to have a child evaluated, even if it’s only for peace of mind.

Outpatient Care

Outpatient services for a broad spectrum of Riley specialists, including the pediatric cardiologists and cardiothoracic surgeons, are offered in the Riley Outpatient Center. Children with suspected or proven cardiac disease, including those recovering from surgery, require clinical services outside the scope of an acute hospital unit.

The excellent cardiovascular care provided by Riley’s team of heart specialists isn’t limited to the four walls of the hospital. Satellite subspecialty outpatient clinic locations are available throughout Indiana:

- Southern Indiana Pediatrics, Bloomington
- Columbus Pediatric Associates, Columbus
- Deaconess Riley Children’s Services, Evansville
- Pediatric Associates at Lutheran Hospital Medical Office Building, Fort Wayne
- Fort Wayne Pediatrics, Fort Wayne
- North Central Pediatrics, Kokomo
- Cardinal Health System Pediatrics, Muncie
- Ohio Valley Heart Center, Evansville
- Pediatric and Internal Medicine Center, Richmond
- St. Joseph’s Regional Medical Center, South Bend
- St. Francis Pediatric Cardiac Clinic, Greenwood
- AP & S Clinic, Terre Haute
- Decatur County Memorial Hospital, Greensburg
  - Clarian Arnett Hospital, Lafayette
  - Clarian North Medical Office Building, Carmel
Philanthropic Care
While Riley cares for children from every county in Indiana, Hoosiers aren’t the only children who benefit from the hospital’s philanthropy. Riley Hospital for Children partners with various community, national and international agencies to provide unparalleled care to not only the kids who need it most, but also those who may not be able to receive or afford that level of care close to home. As a partner in the Rotary Service Club’s Gift of Life program, Riley Heart Center cardiologists and surgeons have provided treatment to children from as far away as Jordan, Russia, China, Nigeria, Honduras and Afghanistan.

Higher Volume
Better Outcomes
The connection between higher patient and procedure volumes and improved outcomes is clear. There is simply no substitute for experience.

Riley Hospital and the Riley Heart Center contain a clinical infrastructure that continues to deliver improved outcomes through increased volumes, and a significantly lower cardiac mortality rate than the national average for pediatric hospitals despite our much greater mix of high-complexity cases.

Riley Hospital for Children
- Opened in 1924
- Received the American Nurses Association (ANA) National Database of Nursing Quality Indicators (NDNQI) Award for outstanding nursing quality in the pediatric hospital category.
- Has one of the highest numbers of pediatric intensive care beds in the U.S.
- Houses one of the nation’s largest pediatric residency programs and the only training site in Indiana
- Seven specialty programs ranked among the top 30 children’s hospitals in the nation by U.S. News & World Report
- Provides care for more than 231,500 patient visits each year
- Is supported by two Ronald McDonald houses
- Integrates and supports family-centered care by bringing in the perspectives of patients and families directly into the planning, delivery and evaluation of health care
Contacting Riley Heart Center and Riley Hospital for Consultations or Referrals

IMACS (Indiana Medical Access and Communication System) OneCall is a toll-free, direct line that gives health care professionals prompt access to Indiana University School of Medicine faculty physicians for clinical consultations, patient referrals and patient information. Operated by Clarian Health, IMACS OneCall follows detailed guidelines, established by our medical staff.

IMACS’ physician resource specialists are trained professionals who will expertly direct your call, even if you are not certain who can help you, and help ensure that you have reached the correct person or department.

For routine consultations or referrals, please call IMACS OneCall Monday–Friday, from 8 a.m.–5:30 p.m. For emergency consultations or referrals, IMACS operates 24 hours a day, seven days a week. Families may call Clarian On-Call for more information about hospital programs and to reach a physician office.

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For questions regarding the Riley Heart Center, please contact our office.

| 317-274-8906 | 1-866-864-0855 |

Please visit our Web site, rileyhospital.org, for more information about Riley Hospital for Children. For more information about the Riley Heart Research Center, please visit heartresearch.iupui.edu.

Parking for families visiting the experts at Riley Hospital for Children is conveniently located in the Riley Outpatient Center Garage, adjacent to the Riley Outpatient Center.
Riley Hospital for Children • 702 Barnhill Drive • Indianapolis, IN 46202

INDIANA’S ONLY COMPREHENSIVE CHILDREN’S HOSPITAL

rileyhospital.org

Riley Hospital for Children
A Clarian Health Partner

SCHOOL OF MEDICINE
INDIANA UNIVERSITY

A private, nonprofit organization, Clarian Health is Indiana’s most comprehensive health system.
Affiliated with Indiana University School of Medicine, Clarian Health operates Methodist Hospital, Indiana University Hospital and Riley Hospital for Children campuses as a single hospital under Indiana law.

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Dr. Simon Conway received his PhD in genetics and biometry from University College of London, England. He completed his postdoctoral fellowship in developmental biology from the Institute of Child Health, Great Ormond Street Children's Hospital, University College, London; and a travel fellowship in cell biology and anatomy at the Medical College of Georgia, Augusta. Dr. Conway joined Indiana University School of Medicine in 2003 as associate professor with tenure; he was promoted to professor in 2007, and he has secondary appointments in the Departments of Anatomy and Cell Biology, Medical and Molecular Genetics, and Biochemistry and Molecular Biology. Research in his laboratory is focused on understanding the molecular and cellular pathways that result in structural and functional congenital heart defects and in discovering strategies to prevent in utero lethality.

Dr. Loren Field received his PhD in cell and molecular biology from State University of New York at Buffalo. He completed his postdoctoral fellowship in molecular biology at Roswell Park Memorial Institute, Buffalo. Prior to joining IU, he was a senior staff investigator at Cold Spring Harbor Laboratory. Dr. Field joined the Herman B Wells Center in 1998; he holds a joint primary appointment as a tenured professor in the Departments of Medicine and Pediatrics, and his secondary appointment is in the Department of Physiology and Biophysics. He is currently the director of the Riley Heart Research Center. Research in his laboratory is focused on developing strategies with which to augment myocyte content in developing, postnatal and adult hearts, with the aim of effecting regenerative growth of the cardiac muscle.

Dr. Anthony Firulli received his PhD in molecular biology from State University of New York at Buffalo, Roswell Park Graduate Division. He completed his postdoctoral fellowship in biochemistry and molecular biology from M.D. Anderson Cancer Center, Houston; and the Hamon Center for Basic Cancer Research, University of Texas Southwestern Medical Center, Dallas. Dr. Firulli was hired in 2003 as an associate professor; he was awarded tenure in 2005, and was promoted to professor in 2009, and his secondary appointment is in the Department of Medical and Molecular Genetics. Research in his laboratory is focused on understanding the transcriptional mechanisms that control the cell specification and differentiation of multi-potential cells.

Dr. R. Mark Payne received his MD from University of Texas School of Medicine, Houston. He completed his residency in pediatrics, his pediatric cardiology fellowship, and a research fellowship in molecular biology from the Children's Hospital at Washington University Medical Center, St. Louis. Dr. Payne was hired in 2005 as a tenured professor; his secondary appointment is in the Department of Medical and Molecular Genetics. Research in his laboratory is focused on understanding the role of protein targeting and import into mitochondria to design genetic therapies to repair or protect mitochondrial function in the heart.
Riley Heart Research Center Faculty

Dr. Michael Rubart received his MD from the University of Bonn, Germany. He completed his postdoctoral fellowship from University of Vermont, Burlington; Technical University Aachen, Germany; Community Hospital Duren, Germany; and Krannert Institute of Cardiology at Indiana University School of Medicine. Dr. Rubart was hired in 2005 as an assistant professor (tenure track), and his secondary appointment is in the Department of Pharmacology. Research in his laboratory focuses on the application of linear and nonlinear optical microscopy of the living heart.

Dr. Weinian Shou received his PhD in cell and developmental biology from Shanghai Institute of Cell Biology, Chinese Academy of Sciences, Shanghai, P.R. China. He completed his postdoctoral fellowship in molecular genetics from M.D. Anderson Cancer Center, University of Texas, Houston; and in pathology from Baylor College of Medicine, Houston. Dr. Shou was hired in 1999 as assistant professor; he was promoted to associate professor with tenure in 2005, and his secondary appointment is in the Departments of Biochemistry, Pharmacology and Toxicology, and Medical and Molecular Genetics. Research in his laboratory is focused on the investigation of molecular mechanism for cardiac development and congenital heart defects, with special emphasis on myocardium development and chamber formation.

Dr. Lei Wei received her PhD in molecular and cellular pharmacology from University of Paris VI, INSERM U. 36, France. She completed her Postdoctoral Fellowship from INSERM U. 36, Paris, and the Institute of Biosciences and Technology, Texas A & M University, Houston. Dr. Wei was hired in 2005 as associate professor (tenure track), and her secondary appointment is in the Department of Physiology and Biophysics. Research in her laboratory is focused on understanding the molecular basis of cardiomyocyte death and cardiac fibrosis associated with cardiac hypertrophy and failure.
Riley Hospital for Children

The physicians and surgeons of the Riley Heart Center carry on a long legacy of excellence in the diagnosis and treatment of pediatric cardiac diseases and disorders. Team members are selected with great care to enhance the high standards set in clinical expertise, research innovation and academic excellence.

Pediatric Cardiologists

Dr. John P. Breinholt III received his medical degree from University of Utah School of Medicine. He completed a residency in pediatrics and fellowships in pediatric cardiology, pediatric cardiac catheterization, and heart transplant research at Baylor College of Medicine/Texas Children’s Hospital in Houston. He is certified by the American Board of Pediatrics in both pediatrics and pediatric cardiology. Dr. Breinholt joined the staff of Riley Hospital for Children in 2008, where he is an assistant clinical professor of pediatric cardiology specializing in pediatric cardiac catheterization and interventional cardiology.

Dr. Randall L. Caldwell received his medical degree from Indiana University School of Medicine. He completed a residency in pediatrics and a fellowship in pediatric cardiology at IUSM. Dr. Caldwell has been on the staff at IUSM and Methodist Hospital since 1978. He is certified by the American Board of Pediatrics in both pediatrics and pediatric cardiology, and is currently the Peter Lawrence Phillips Professor of Pediatrics in the section of Pediatric Cardiology and the director of Pediatric Cardiology at Riley Hospital for Children. His special interests include cardiac transplant and echocardiography.

Dr. Timothy Cordes received his medical degree from Michigan State University College of Human Medicine in 1988 and completed his pediatric residency there in 1991. He completed a pediatric cardiology fellowship at the Mayo Clinic in Rochester, Minn., in 1994. Dr. Cordes is certified by the American Board of Pediatrics and the Sub-board of Pediatric Cardiology. He is currently a clinical associate professor in Pediatrics and is the director of the pediatric echocardiography laboratory at Riley Hospital for Children. His special areas of interest, training and expertise include transthoracic, transesophageal echoes and fetal echocardiography.

Dr. Robert Darragh received his degree in medicine from University of Pittsburgh in 1983. He completed a pediatric residency at the Children’s Hospital of Buffalo/SUNY-Buffalo School of Medicine. His pediatric cardiology fellowship was completed at Children’s Hospital of Buffalo and Children’s Hospital, Pittsburgh. He is certified by the American Board of Pediatrics and the Sub-Board of Pediatric Cardiology. On staff at Riley Hospital for Children since 1989, Dr. Darragh is a clinical associate professor of pediatrics, specializing in fetal echocardiography, heart failure and cardiac transplants.
**Pediatric Cardiologists**

**Dr. Eric S. Ebenroth** received his degree in medicine from IUSM and completed his pediatric residency training at the Children’s Medical Center in Dayton, Ohio. He spent four years at Shaw Air Force Base as director of pediatric services before returning to Indiana University for his pediatric cardiology training. He is certified by the American Board of Pediatrics and joined the staff of Riley Hospital for Children in July 2000. His special interests include transthoracic, transesophageal and fetal echocardiography as well as exercise testing.

**Dr. Anne Farrell** received her medical degree from Loyola University Stritch School of Medicine in Chicago. She completed her pediatric residency and pediatric cardiology fellowship at IUSM. She is board certified by the American Board of Pediatrics and Sub-board of Pediatric Cardiology. Dr. Farrell joined the staff of Riley Hospital for Children in 1999, where she is an associate clinical professor of pediatric cardiology. Her special interests include pediatric transthoracic transesophageal and fetal echocardiography.

**Dr. Donald Girod** completed fellowships at Columbus Children’s Hospital and the University of Minnesota hospitals. He is currently the Carleton Buehl McCullough Professor of Pediatrics. Special interests include all aspects of clinical pediatric cardiology and long-term follow-up of complex cardiac conditions.

**Dr. Mark Hoyer** received his medical degree from Ohio State University College of Medicine. He completed his pediatric residency at Wright-Patterson Air Force Medical Center and his pediatric cardiology fellowship at Children’s Hospital of Pittsburgh. After active duty service as a major in the U.S. Air Force, Dr. Hoyer became the director of cardiac catheterization at the University of Florida. Board certified in pediatric cardiology, he joined the Riley staff in October 2000, where he is a professor of clinical pediatrics and serves as the director of cardiac catheterization and interventional cardiology. His special interests include endovascular device repair of cardiac defects, angioplasty and complex congenital heart disease.

**Dr. Joyce Hubbard** received her medical degree from Indiana University School of Medicine, where her pediatric residency was also completed. She completed her pediatric cardiology residency at Indiana University with two years of electrophysiology training at the Krannert Institute of Cardiology. Dr. Hubbard was on staff at Emory University in Atlanta for three years, joining the Riley Hospital for Children staff in 1987. She is currently an assistant clinical professor of pediatrics, specializing in pediatric cardiology electrophysiology and cardiac ablations.

**Dr. Roger Hurwitz** is a graduate of Dartmouth Medical School and Northwestern University Medical School. His pediatric residency was at Children’s Memorial Hospital in Chicago, and his cardiology fellowship was completed at UCLA. He is the Phillip Murray Professor of Pediatrics at Riley Hospital for Children, where he is medical director of the statewide pediatric cardiology outreach program and co-director of the congenital heart disease adult program. Previously, Dr. Hurwitz was elected chairman of the cardiology section of the American Academy of Pediatrics and received the Founders’ Award from that organization.
**Dr. Tiffanie R. Johnson** received her medical degree from University of Missouri School of Medicine. She completed a residency in pediatrics at the University of Missouri School of Medicine. She completed a fellowship in pediatric cardiology at Indiana University School of Medicine and a fellowship in cardiac MRI at The Children's Hospital of Philadelphia. She is certified by the American Board of Pediatrics in both pediatrics and pediatric cardiology. Dr. Johnson joined Riley in 2004 where she is an associate professor of clinical pediatrics and of Radiology and Imaging Sciences, and is co-director of the Congenital/Pediatric Cardiac MRI Program. She specializes in noninvasive congenital cardiac imaging, including MRI and echocardiography.

**Dr. David K. Lawrence** received his medical degree from University of Pennsylvania School of Medicine in Philadelphia. He completed a residency in pediatrics and fellowships in pediatric cardiology and pediatric cardiology electrophysiology at Emory University School of Medicine in Atlanta. He is certified by the American Board of Pediatrics in pediatrics. Dr. Lawrence joined Riley in 2009 where he is an assistant clinical professor of pediatric cardiology specializing in pediatric cardiology electrophysiology and cryoablation.

**Dr. Jacqueline A. Maiers** received her medical degree from Indiana University School of Medicine. She completed a residency in pediatrics and a fellowship in pediatric cardiology at Indiana University School of Medicine. She completed a fellowship in preventive pediatric cardiology at Cincinnati Children’s Hospital Medical Center. She is certified by the American Board of Pediatrics in both pediatrics and pediatric cardiology. Dr. Maiers joined Riley in 2007 where she is an assistant clinical professor of pediatric cardiology specializing in preventive pediatric cardiology.

**Dr. Julio A. Morera** received his medical degree in 1976 from Facultad de Medicina, Mexico. He completed both an internship and residency in pediatrics at University Hospital of Jacksonville, Fla. He completed a fellowship in pediatric cardiology at Medical College of Georgia and Children's Hospital. Dr. Morera has been an associate professor of clinical pediatrics since 2006, and he is licensed by the American Board of Pediatrics and American Board of Pediatric Cardiology. He practices at Deaconess Riley Children's Specialty Center in Newburgh, Ind. Dr. Morera’s special interests are fetal echocardiography and adolescent obesity.

**Dr. R. Mark Payne** received his MD from University of Texas School of Medicine, Houston. He completed his residency in pediatrics, his pediatric cardiology fellowship, and a research fellowship in molecular biology from the Children's Hospital at Washington University Medical Center, St. Louis. Dr. Payne was hired in 2005 as a tenured professor; his secondary appointment is in the Department of Medical and Molecular Genetics. Research in his laboratory is focused on understanding the role of protein targeting and import into mitochondria to design genetic therapies to repair or protect mitochondrial function in the heart.

**Dr. Marcus S. Schamberger** received his medical degree from the University of Erlangen-Nuremberg/Germany. He completed his pediatric residency at the University of Missouri School of Medicine, serving as pediatric chief resident. He completed his pediatric cardiology fellowship training at Indiana University School of Medicine before joining the staff in 1999. Dr. Schamberger is currently an associate clinical professor of pediatrics in the section of Pediatric Cardiology. His special interests include pediatric transthoracic, transesophageal and fetal echocardiography and exercise stress testing.
Pediatric Cardiothoracic Surgeons

Dr. John W. Brown received his medical degree from Indiana University School of Medicine in 1970 and completed a cardiothoracic surgery residency at the University of Michigan in 1978. He spent two years at the National Institutes of Health as a clinical associate in cardiovascular surgery. Dr. Brown is certified by the American Board of Surgery and the American Board of Thoracic Surgery. He has served as the chief of the cardiothoracic surgery section at Indiana University School of Medicine since 1990, is the Harris B Shumacker Professor of Surgery and is the surgical director of Clarian Health cardiovascular services.

Dr. Mark W. Turrentine received his medical degree from the University of Kansas School of Medicine. He underwent training in general surgery at the University of Kansas and completed a cardiothoracic surgery residency at Indiana University. Dr. Turrentine completed fellowship training in both pediatric and adult cardiac and pulmonary transplantation at IUSM. He is certified by the American Board of Thoracic Surgery and is currently a professor of surgery in the Cardiothoracic Surgery division. Dr. Turrentine serves as surgical director of the mechanical circulatory assist program at IU and Riley hospitals and is co-director of pediatric cardiac and pulmonary transplantation at Indiana University School of Medicine.

Dr. Mark D. Rodefeld completed his general and thoracic surgery residencies at Washington University in St. Louis. He completed two years of pediatric cardiovascular surgery fellowship at Stanford and University of California, San Francisco. He is an associate professor of surgery with a primary interest in congenital cardiac surgery and cardiac research.