Riley Children’s Health is Indiana’s only full-service statewide pediatric health system. Riley Children’s Health offers complete, comprehensive pediatric care ranging from routine primary care checkups to the most complex acute care needs from highly skilled pediatric specialists. The system connects patients with 200 primary care and 400 specialty care physicians in 15 communities across the state of Indiana. Riley Physicians treat patients in their home communities, bringing top-notch care close to home. This statewide network is an extension of Riley Hospital for Children at Indiana University Health, one of the nation’s leading children’s hospitals.
Welcome to Surgery at Riley Children’s Health

We are pleased to present the Riley Children’s Health Surgery Annual Report, which provides an overview of our surgical specialties and highlights the expertise of our talented surgeons and skilled surgical teams. As healthcare continues to change, data transparency influences our culture of quality and patient safety and is a significant driver in shaping the behavior of healthcare providers as we strive for the best outcomes for our patients. This report is designed to share vital information with our colleagues, care partners and the community to reinforce how Riley Surgery contributes to the exceptional care for which Riley Children’s Health is known throughout Indiana, across the nation and around the world.

Improving access to advanced surgical care
Performing more than 18,500 operating room procedures in 2018, dedicated surgeons at Riley at IU Health collaborate with multidisciplinary teams of nurses, anesthesiologists, child life specialists and other medical professionals to provide children and families with the best possible patient experience. With the development of perioperative surgical homes, clinical pathways and multidisciplinary programs, we’ve streamlined complex medical and surgical treatment, offering families easier ways to navigate care with fewer visits to the hospital.

Additionally, Riley surgeons and advanced practice providers improve access to essential surgical services by visiting outreach offices in communities across Indiana to keep pace with the rapid increase in the number of children needing high-level medical and surgical care.

Statewide and regional center of excellence
Riley Hospital for Children at IU Health is currently in the process of verification as a Level I Children’s Surgical Center by the American College of Surgeons (ACS). Level I designation is the highest recognition that can be achieved by a children’s hospital, certifying that healthcare resources and staff are available to provide top-tier surgical quality and patient safety. In addition, this past year, Riley earned ACS reaccreditation as a Level I Pediatric Trauma Center—the only such center in Indiana.

As you review this report, we encourage you to take note of the new surgery team members we’ve welcomed in the past year, achievements recognized during our second annual Riley Surgical Research Day and progress with the construction of our comprehensive maternity and newborn health center, which is scheduled to open in 2021.

We trust this report is a valuable resource for learning about our surgical expertise, our dedication to research and scholarly activity, and our commitment to improving the health and quality of life of the children we serve.

Andrew H. Jea, MD, MHA
Surgical Director of Quality and Patient Safety

Frederick J. Rescorla, MD
Surgeon-in-Chief

On the cover
Beth Strange, certified child life specialist, provides support for Declan Gist, age 5, before his surgery at Riley Hospital for Children at IU Health. With advanced education in child life, children’s health and development, or related fields, Riley child life specialists use developmentally appropriate learning tools and distraction techniques to minimize the anxiety and fear of surgery and hospitalization. Our skilled child life specialists work with patients in surgery, inpatient units, radiology, the Emergency department and in outpatient offices.

Exceptional patients, exceptional care: stories of Riley kids
Thousands of children are treated by surgeons and surgical teams at Riley Children’s Health each year. Read some of their stories on pages 3, 4 and 40.

* The medical specialties of Riley Children’s Health are highlighted in a separate annual report. To view this report, visit rileychildrens.org/medicalannualreport; print copies may also be requested from rileychildrens@iuhealth.org.

Riley Children’s Health welcomed these new surgery team members in 2018

Neurosurgery
Karl Balsara, MD

Orthopedic Surgery
John P. Dormans, MD, FACS
Division Chief

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About Riley Children’s Health

Treating more than 300,000 inpatients and outpatients each year, Riley Children’s Health is the state’s largest and most skilled pediatric health network, providing care in communities across Indiana. We are part of Indiana University Health, a nationally ranked health system offering expert primary and specialty care to adults and children in hospitals and healthcare facilities throughout the state.

As one of the nation’s leading healthcare networks specifically for children, Riley Children’s Health has 200 primary care and 400 specialty care physicians across 40 specialties who deliver and coordinate healthcare for children of all ages.

Located in downtown Indianapolis and part of the IU Health Academic Health Center, our flagship hospital—Riley Hospital for Children at Indiana University Health—is the only pediatric research hospital in the state and is among the few children’s hospitals in the nation to be ranked in multiple pediatric specialties. We are also the eighth-ranked children’s hospital in the United States for research funding, and home to the Herman B Wells Center for Pediatric Research, the Children’s Clinical Research Center and the Center for Children’s Health Services Research.

Additionally, Riley Hospital for Children at IU Health North Hospital, located in Carmel, Indiana, serves rapidly growing communities on the north side of Indianapolis. This location offers specialty pediatric care, including acute care and critical care beds, pediatric emergency services, surgical suites, and subspecialty centers. 

CHILDREN’S HEALTH SYSTEM OF

Indiana University Health

Among fewer than 500 hospitals nationwide to earn Magnet® status from the American Nurses Credentialing Center, Riley Hospital is recognized for nursing excellence and high-quality clinical outcomes.

Indiana University School of Medicine

Riley Children’s Health is affiliated with Indiana University School of Medicine, one of the largest medical schools in the United States and one of the busiest locations for pediatric research funded by the National Institutes of Health and other sponsors. Our collaboration with IU School of Medicine attracts thousands of families to Riley at IU Health for clinical trials and to improve upon standard care options. With a desire for rapid innovation in children’s health, Riley at IU Health and IU School of Medicine are committed to providing excellent healthcare for children through prominence in education, training and research.

AFFILIATED WITH

INDIANA UNIVERSITY

SCHOOL OF MEDICINE

One child’s Riley story: Jonathin Perez, age 4

Skillful surgery and lifesaving treatment give young boy a second chance.

When necrotizing fasciitis, commonly known as flesh-eating disease, resulted in severe infection and septic shock for 4-year-old Jonathin Perez, Riley orthopedic surgeon Ryan Fitzgerald, MD, knew immediate surgery was required to save the boy’s life. With Jonathin too unstable to go to the OR, Dr. Fitzgerald was forced to do the surgery at his ICU bedside, making two incisions—one on either side of the child’s left hand—that ran up the arm.

“You need to know how serious a condition this is, to be aggressive with irrigation, debridement and releasing the infection,” he said. “You have to know the anatomy and get through the fascia, the thick coating that surrounds all of our muscles, and take away any dead tissue. It’s lucky we got there when we did because it was just a few inches from his chest wall; we were lucky to get it before it made that turn.”

While vasopressors kept blood flowing to vital organs, they were taking blood away from the extremities. Jonathin’s right leg suffered compartment syndrome, a condition in which increased pressure results in insufficient blood supply to tissue.

“We had to do a fasciectomy to decrease pressure and increase the body’s ability to get blood flow to the leg,” Dr. Fitzgerald said. “Because it was pushing all the blood flow to the internal organs, it couldn’t push it into the leg, That’s why he ended up with an amputation.”

Riley doctors first feared they would have to amputate the boy’s left arm and right leg, but after determining the arm still had good blood flow, they were able to save it. Riley plastic surgeon Sunil S. Tholpady, MD, PhD, used skin grafts from the child’s thighs to cover exposed bone and muscle on his arm.

“We were able to salvage that, and he has a functional arm—all of his nerves are working,” Dr. Fitzgerald said. The leg could not be saved, but Dr. Fitzgerald was able to save half of the knee. An above-the-knee amputation would have been much more difficult for Jonathin to deal with long term.

“He was on the brink of death, and we were able to pull him back from that. If he’d been here a couple of hours later, he probably would have died,” he said. “Now, with modern medicine and technology, we have a kid who can do pretty much anything he wants to do.”
One child’s Riley story: Britton Helmuth, age 13

Two surgeries—13 years apart—and reassurance remains at the heart.

Earlier this year, Riley cardiothoracic surgeons John W. Brown, MD, and Jeremy L. Herrmann, MD, teamed up to perform the Ross procedure on 13-year-old Britton Helmuth, taking out his abnormal aortic valve—further diseased by a staph infection—and putting his pulmonary valve in its place, then replacing the pulmonary valve with a cadaver valve, called a pulmonary allograft.

It’s a procedure Dr. Brown has been doing for 25 years at Riley and training others to do around the world. He and Dr. Herrmann have performed the operation together for the past three years.

“A lot of valves we can repair; his valve was unrepairable,” Dr. Brown said. “It leaked horribly, and the infection had eaten part of the valve away. We found a bit of a mess in there, but we got it all taken out.”

It’s not the first time Dr. Brown has seen Britton in the operating room. Thirteen years ago, when Britton was just three months old, he was diagnosed with aortic valve stenosis, a narrowing of the aortic valve opening, which restricts blood flow.

Britton’s mom, Laura Helmuth, still remembers the terror she felt when her firstborn turned blue and vomited in his car seat one day while she was out shopping. His breathing returned, but it was irregular. She rushed him to a hospital in Fort Wayne, where medical staff determined he needed to go to Riley. She and her husband Myron followed in a car, while a team of specialists rushed their baby via ambulance to Riley.

“It was basically life or death every fleeting second,” Myron Helmuth said. “We almost lost him; that was the true test of our faith for his life.”

They were comforted by the calm confidence of Dr. Brown, who would go on to repair their son’s leaky mitral valve and explain to them that down the road Britton would need aortic valve surgery.

“I remember when Dr. Brown came in before the surgery 13 years ago, he just assured us that he was going to take care of Britton as if he was his own son or grandson, and I just remember how much that did for my mommy heart,” Laura said. “I remember those words even this time. I just knew he was going to care for him and do like he would for his own. It was reassuring.”

Riley Surgery summary

Riley Surgery includes dedicated teams in 13 pediatric surgical specialties:

- Cardiothoracic Surgery
- Dentistry
- Interventional Cardiology and Electrophysiology
- Interventional Radiology
- Maternal Fetal Medicine
- Neurosurgery
- Ophthalmology
- Orthopedic Surgery
- Otolaryngology – Head and Neck Surgery
- Pediatric Surgery
- Plastic Surgery
- Transplant Surgery
- Urology

Riley Surgical Research Day honors academic achievement

The second annual Surgical Research Day at Riley Hospital for Children was held on May 9, 2018. Attended by more than 200 perioperative team members, the conference included 50 abstracts highlighting Riley at IU Health perioperative services. All surgical specialties, anesthesiology and nursing were represented.

Troy A. Markel, MD, and the Riley Pediatric Surgery team received the Best Oral Presentation award for their work, “Use of Environmental Air Quality Indicators to Assess the Types of Surgical Headgear Used in a Dynamic Operating Room Environment.” Riley Otolaryngology – Head and Neck Surgery earned Best Poster Presentation for “Interdisciplinary Tracheostomy Rounds: Impact on Tracheostomy Associated Pressure Injuries.” Riley Anesthesia was recognized for submitting the most abstracts.

Keynote speaker Sundeep Keswani, MD, (left) spoke about groundbreaking findings in fetal interventions for sacrococcygeal teratoma, spina bifida, congenital diaphragmatic hernia, congenital heart disease and pulmonary sequestration. Dr. Keswani is a member of the fetal surgery team at Texas Children’s Hospital.
Riley Maternity and Newborn Health

Riley Maternity and Newborn Health is a comprehensive statewide program consisting of a hospital-based center and an expanded perinatal network. The program is designed to increase access to coordinated, high-quality medical care to improve the health outcomes for at-risk pregnant women and infants throughout Indiana.

Offering obstetric, delivery, newborn and comprehensive pediatric subspecialty services, the integrated program will be a new model of coordinated care that essentially treats mother and baby as one patient, surrounding them with the medical support they need.

In addition to the Maternity Center at Riley Hospital for Children, Riley Maternity and Newborn Health includes:

- A statewide network of maternal fetal medicine specialists
  - Ten maternal fetal medicine physicians currently practice in five locations across the state.
  - The program serves pregnant women, with specialists completing more than 11,000 patient visits annually.

Riley Fetal Center

- The center’s multidisciplinary approach supports pregnant women whose fetuses are diagnosed with congenital anomalies.
- In 2018, the center coordinated care for 200 referral patients.

Maternity and newborn health statewide simulations

- Riley facilitates educational simulations for maternity centers and neonatal units across Indiana.
- Thirty neonatal unit and eight maternity outreach simulation programs were completed in 2018.

Community initiatives

- Maternal substance abuse. In 2018, the Riley perinatal program at IU Health University Hospital facilitated nine centering groups to support 84 opioid-exposed pregnant women.
- Infant mortality. Riley supports community infant mortality efforts and provides systems improvement expertise to the Indiana Perinatal Quality Improvement Collaborative.

“The Riley Children’s Health is deepening its impact on the health of Hoosiers by expanding our focus to include comprehensive obstetric care for pregnant women while continuing our long-standing commitment to children. Indiana currently ranks poorly in infant mortality rates, and this program is designed to provide the best possible outcomes for expectant mothers and their newborns.”

Matthew Cook
President, Riley Children’s Health

Coming soon: Maternity Center at Riley Hospital for Children

Construction is underway for a comprehensive maternity and newborn health center that centralizes all obstetric services and neonatal care offered at the three downtown Indianapolis hospitals of IU Health. The $142 million building project includes renovation of one existing section of Riley Hospital for Children at IU Health, located adjacent to the original hospital lobby, as well as the fourth floor of the Riley Outpatient Center. The maternity center, which will provide care for routine to highly complex pregnancies, will include more than 60 beds for mothers.

Four floors at Riley at IU Health will be renovated to house inpatient services, including a labor and delivery (plus antepartum) unit, a Level III neonatal intensive care unit (NICU), and a postpartum unit. This will replace the existing inpatient labor and delivery, NICU, and postpartum spaces at IU Health Methodist Hospital.

The existing Level IV NICU at Riley at IU Health will stay in place, allowing mothers and babies who need the highest level of care to remain in the same building after birth. The combined 47-bed Level III NICU and 60-bed Level IV NICU will make Riley at IU Health home to the largest NICU in Indiana and among the largest in the country.

The project will also relocate the existing outpatient maternal fetal medicine offices from both IU Health University Hospital and IU Health Methodist Hospital to the Riley campus. The outpatient space will also house the Riley Fetal Center, which provides coordinated care for expectant mothers carrying a fetus with a suspected birth defect. The Riley Fetal Center is staffed by maternal fetal medicine physicians, neonatologists and pediatric subspecialists.

Riley Fetal Center

The Riley Fetal Center supports preeminent management of a broad range of complex or high-risk fetal conditions, while providing advanced, coordinated care to support families during this critical time.

- Advanced fetal imaging, including MRI, echocardiography and extensive ultrasonography.
- Personalized, multidisciplinary and family-centered care consultations with families and support team members.
- Multidisciplinary fetal conferences to discuss best practice and management plans for complex fetal diagnoses.
- Development of a fetal intervention program for delivery of evidence-based and innovative care for fetal anomalies.
Comprehensive, specialized pediatric heart care
Offering a fully integrated program to care for children and adults with congenital heart disease, Riley at IU Health attracts patients from Indiana, the United States and many parts of the world. With a variety of resources, we are organized and ready to provide a rare level of coordinated care at one of the nation’s top destinations for acute care.

Our team is comprised of world-renowned specialists trained in cardiovascular and cardiothoracic surgery, cardiac anesthesiologists, imaging technicians, congenital cardiologists, cardiovascular intensive care specialists, dedicated cardiovascular nurses and many others who specialize in working with heart defects and thoracic conditions. As part of a comprehensive pediatric healthcare system for advanced care, our team collaborates with other highly skilled specialists to deliver the right care at the right time.

The Riley at IU Health Adults with Congenital Heart Disease Program manages a child’s condition into adulthood to promote optimal health through every stage of life. In addition, families affected by congenital heart disease linked to their genetic traits can also seek guidance from our Cardiovascular Genetics Program to determine whether future children or other family members may be at risk for the same disorder.

Skilled, nationally recognized treatment
Riley at IU Health is nationally known as a high-volume center for the Ross procedure, a surgery that uses a patient’s pulmonary valve to replace the aortic valve. Our specialists are recognized nationally and internationally as respected resources for procedures that repair undersized pulmonary arteries, remove cardiac tumors and rebuild complex heart anatomies. We also have a full complement of ventricular assist devices to support the function of a failing heart, including the total artificial heart.

Advanced surgical capabilities
- One of the first pediatric heart programs in the U.S. to give a child a Berlin heart
- Part of a select group of hospitals in the nation certified to perform pediatric heart transplants

Experts committed to excellence and innovation
Our heart surgeons have an extra tier of training and practice in congenital heart defects and thoracic disease. These credentials set them apart as a rare breed of surgeons offering a degree of expertise found only in the most advanced pediatric hospitals.

The team's pursuit of excellence also keeps them invested in research to find new ways of resolving complex congenital heart defects and diseases of the lung, blood vessels and heart. They share their knowledge globally through lectures and humanitarian work that promotes children's heart health.

With a unique integrated care model, Riley achieves exceptional outcomes year after year and is recognized among the top 10 pediatric heart programs by U.S. News & World Report.

OPERATIVE OUTCOMES

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Dentistry

Faculty members of the Indiana University School of Dentistry, the pediatric dentists at Riley at IU Health have years of experience providing comprehensive dental care to children of all ages, including those with special healthcare needs. In our advanced, 12-chair dental facility, we offer a full range of pediatric dental services, including sealants, restorations, fluoride and limited orthodontics for children and adolescents. Our skilled dental team and expert pediatric anesthesiologists from Riley at IU Health administer sedation and general anesthesia for children, including those with special needs such as developmental, emotional, behavioral or cognitive impairments.

Our pediatric dentists collaborate with other Riley at IU Health specialists such as otolaryngologists, ophthalmologists, oral surgeons and plastic surgeons to manage conditions and improve children’s health.

Preventive dental care
Children should see a dentist when their first tooth erupts into the mouth or by the age of one year. Though this may seem early, we see the best outcomes for dental health when children receive dental care at this age. With early intervention, pediatric dentists are able to identify and diagnose any dental development issues before they become serious problems. We also teach parents how to care for their child’s teeth and offer guidance about foods to avoid, brushing and general dental care. These early childhood visits can prevent dental problems or complicated surgeries later in a child’s life.

Trauma care
For children suffering from dental trauma or other emergencies, Riley at IU Health dentists provide 24/7 emergency coverage.

Research and training
Riley dentists are dedicated to improving pediatric dentistry through compassionate care, education and research. In addition to conducting research to advance children’s dental health, our dentists teach dental students and pediatric residents how to care for children’s unique health needs. Residents receive hands-on training in our practice, working with patients under the supervision of IU School of Dentistry faculty.
Interventional Cardiology and Electrophysiology

Riley at IU Health offers a comprehensive interventional cardiology program to diagnose and treat congenital heart defects from the simple to the most complex. Specially trained to perform the latest invasive, catheter-based procedures, our skilled and experienced pediatric cardiologists are available to consult with referring physicians regarding indications for and timing of these procedures.

Interventional Cardiology

Board certified and fellowship trained, our interventional cardiologists provide essential anatomic evidence during diagnostic procedures to direct cardiovascular surgical interventions. In addition, they repair heart defects, such as patent ductus arteriosus (PDA), atrial septal defect (ASD) and ventricular septal defect (VSD), that allow both children and adults to avoid open heart surgery altogether.

The interventional cardiology team collaborates with Riley cardiovascular surgeons to perform “hybrid” procedures either in the operating room or the catheterization suite to overcome challenging situations such as device closure of muscular VSDs with transesophageal echo guidance; open sternotomy in the catheterization lab to implant stents in the PDA for infants with hypoplastic left heart syndrome; or open chest to help provide more direct approach for balloon angioplasty or stent implantation.

Interventional Cardiology procedures performed at Riley at IU Health include:

- Stenosis or obstruction of the great arteries
- Transcatheter implantation of pulmonary and tricuspid valves
- Implantation and revision of permanent pacemakers and defibrillators
- Balloon atrial septostomy (often for transposition of the great arteries)
- Vascular access from femoral, jugular, subclavian and transhepatic routes
- Device/coil occlusion of: – Venous or arterial collateral vessels – Coronary fistulas and pseudoaneurysms – Stent implantation in aorta, pulmonary arteries and obstructed veins – Creation or enlargement of ASD or Fontan fenestration – Hybrid procedures in collaboration with cardiac surgeons – Vascular access from femoral, jugular, subclavian and transhepatic routes
- Balloon pulmonary and aortic valvuloplasty
- Transcatheter balloon dilation of aortic arch, branch pulmonary arteries, conduits and venous obstructions
- Transcatheter balloon dilation of the aorta, pulmonary arteries and obstructed veins
- Total cavopulmonary connection

Electrophysiology

Pediatric electrophysiologists at Riley at IU Health treat patients with various arrhythmias, often during ablation procedures that abolish the focus of an arrhythmia or by implantation of a pacemaker or implantable defibrillator. These sophisticated methods provide treatment for conditions such as supraventricular tachycardia (SVT), ventricular tachycardia (VT), ventricular fibrillation for history of sudden cardiac arrest and Wolff-Parkinson-White syndrome (WPW).

Riley at IU Health electrophysiologists perform the following procedures:

- Mapping of arrhythmia-causing electrical pathways
- Radiofrequency and cryo-ablation of abnormal bypass tracts causing arrhythmia (for SVT, VT and WPW)
- Implantation and revision of implantable permanent pacemakers and defibrillators
- Implantation and removal of loop recorders used to detect possible arrhythmias

Interventional Cardiology and Electrophysiology procedures: 2018

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Interventions by type: 2018

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<td>PDA closure</td>
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</tr>
<tr>
<td>Bi-atrial septostomy (all sites)</td>
<td>46</td>
</tr>
<tr>
<td>Balloon pulmonary valvuloplasty (all sites)</td>
<td>18</td>
</tr>
<tr>
<td>Pulmonary valve implant</td>
<td>10</td>
</tr>
<tr>
<td>Implantable pacemaker implant</td>
<td>18</td>
</tr>
<tr>
<td>Implantable defibrillator</td>
<td>42</td>
</tr>
<tr>
<td>Others</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
</tbody>
</table>
Interventional Radiology

Skilled interventional radiologists at Riley at IU Health perform a wide variety of minimally invasive procedures to diagnose and treat many pediatric conditions. By minimizing the physical trauma associated with open surgery, our interventional radiology program contributes to decreased infection rates, shorter hospital stays and faster overall recoveries. Children benefit greatly from this approach to treatment, which often results in less pain than standard procedures.

Our environment is specifically suited to treating pediatric conditions and caring for emotional needs. Our team uses procedural sedation and surgical anesthesia to control pain. A trained child life specialist is available to support and calm children before procedures, if needed. We also use tools that are smaller in size and made especially for children.

Our advanced interventional radiology suites offer low-dose technology to minimize risk and maximize the benefit to our pediatric patients. All preparation, procedure and recovery rooms are together in one location.

Specialized techniques for diagnosis and treatment

Using X-ray, computed tomography or ultrasound, specially trained Riley interventional radiologists are able to see inside the body and guide tools such as catheters, stents and needles to:

- Diagnose conditions
- Obtain biopsies
- Stop internal bleeding caused by organ trauma or pelvis fractures
- Stop intestinal bleeding
- Treat:
  - Tumors
  - Blocked or damaged arteries or veins
  - Urinary tract blockages
  - Bile ducts that are blocked and damaged
  - Joint pain

Some of the specific conditions we treat include varicoceles, juvenile idiopathic arthritis, osteoid osteomas and liver tumors. In addition, Riley Interventional Radiology works with the Vascular Anomalies Program to treat vascular malformations through sclerotherapy and embolization. Our team also places catheters for children who require long-term use of intravenous medicines or fluids.

RILEY INTERVENTIONAL RADIOLOGY SERVICES*

- Angiography and angioplasty
- Biliary drainage
- Biliary endoscopic laser lithotripsy
- Biliary stent insertion
- Chest tube insertion
- Cholecystostomy
- Cryoablation of venous malformations
- Dialysis angioplasty
- Dialysis catheter
- Ureteropyelogram
- Double J ureteral stent
- Embolization gastrointestinal bleeding
- Embolization of varicocele
- Embolization of organ trauma and tumors
- Gastrostomy tube, gastrojejunostomy tube and cecostomy tube placement
- Joint injection and aspiration
- Lymphangiography and embolization
- Nephrostomy tube
- Nephroureterostomy tube
- Paracentesis
- Percutaneous biopsy of solid organs, bone and masses
- Percutaneous drainage of abscesses and fluid collections
- Percutaneous stone retrieval
- Peripherally inserted central catheter (PICC)
- Port-a-cath
- Radiofrequency ablation of osteoid osteomas
- Sclerotherapy and embolization of vascular malformations
- Suprapubic catheter
- Thoracentesis
- Triple lumen catheter
- Transhepatic and transarterial central venous catheter
- Tunneled central venous catheter

*Not an all-inclusive list of interventional radiology services

DIVISION CHIEF
Francis E. Marshalleck, MD

“We aim to improve patient care through minimally invasive guided therapy—‘surgery without a scalpel’—and to deliver treatment with a high standard of quality and safety, while also looking for new ways to innovate.”

Refer a patient: 317.948.6328

Interventional Radiology

Interventional radiology volume: 2016 – 2018

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>4,828</td>
</tr>
<tr>
<td>2017</td>
<td>4,888</td>
</tr>
<tr>
<td>2018</td>
<td>5,159</td>
</tr>
</tbody>
</table>

Refer a patient: 317.948.6328
Maternal Fetal Medicine

The maternal fetal medicine program at Riley at IU Health provides comprehensive high-risk pregnancy consultation and services for women with medical and obstetrical issues, including preexisting diabetes, chronic high blood pressure, preeclampsia, preterm labor and other complex medical conditions that affect pregnancy. Our maternal fetal medicine specialists also care for women who experience unexpected problems during pregnancy, such as early labor, bleeding or high blood pressure, and provide care for newborns who may have birth defects or growth problems.

We offer a wide spectrum of multidisciplinary healthcare, available 24 hours a day, seven days a week. Our nurses, social workers and specialists meticulously coordinate evaluation, diagnosis and treatment to make a seamless process for the patient and family.

Leadership in training and research

Riley at IU Health offers Indiana’s only maternal fetal medicine fellowship to train physicians in evaluating and treating complex pregnancies. In addition, our maternal fetal medicine specialists conduct research aimed at improving care in pregnancies complicated by preterm labor, diabetes and maternal opiate dependence.

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Maternal Fetal Medicine team members

Frank P. Schubert, MD
Director
Mary Abernathy, MD
Lauren Dungy-Poythress, MD
Sherrime Ibrahim, MD
Caroline Rouse, MD
Christina Scifres, MD
Anthony Shanks, MD
Susan Sherman, MD
Methodius Tuuli, MD
Jennifer Weida, MD

Riley Children’s Health Surgery Annual Report 2018

Outpatient-Based Opioid Treatment Program

Riley at IU Health maternal fetal medicine physicians provide outpatient treatment for opioid-exposed pregnant women. In 2018, our team treated 167 patients through this medical recovery program.

Riley Fetal Center

Our maternal fetal medicine specialists work closely with the Riley Fetal Center to coordinate care for pregnant women whose fetuses are diagnosed with congenital anomalies. In 2018, the multidisciplinary center managed treatment for 200 referral patients—52 more than in 2017.

For more on the Riley Fetal Center, refer to page 7.

Maternal conditions

- Antiphospholipid syndrome
- Asthma in pregnancy
- Cervical insufficiency
- Gestational diabetes
- Maternal acquired cardiac disease
- Maternal congenital heart disease
- Preexisting diabetes
- Prior stillbirth
- Prior venous thromboembolism or deep venous thrombosis
- Recurrent pregnancy loss
- Rheumatologic diseases
- Substance abuse in pregnancy
- Systemic lupus erythematosus
- Thyroid disease in pregnancy

Fetal conditions

- Amniotic band syndrome
- Anencephaly
- Bladder outlet obstruction
- Brain malformations
- Bronchopulmonary sequestration
- Congenital heart block
- Congenital pulmonary airway malformation
- Duodenal atresia
- Encephalocoele
- Hydrops
- Mateiet alloimmunization
- Pleural effusions
- Pylectasis/hydronephrosis
- Red blood cell alloimmunization
- Skeletal dysplasia
- Twin-to-twin transfusion syndrome

New maternal fetal medicine patient visits: 2017 – 2018

<table>
<thead>
<tr>
<th>Year</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>1,852</td>
</tr>
<tr>
<td>2018</td>
<td>2,171</td>
</tr>
</tbody>
</table>
Neurosurgery

As one of the largest and most experienced pediatric neurosurgery teams in the United States, Riley at IU Health neurosurgeons manage complex brain, spine and nervous system conditions in children of all ages, from infants to young adults. Our skilled surgeons routinely treat the most complicated issues, including intractable epilepsy, skull and spine deformities, traumatic injuries, congenital conditions, such as spina bifida, and benign and malignant tumors.

Part of a team ranked among the top 25 pediatric neurology and neurosurgery programs by U.S. News & World Report, Riley neurosurgeons treat patients from all over the world.

Our team is committed to treating any neurological need, and as a result, partners closely with the neurology team and other colleagues at Riley at IU Health, including departmental specialists in oncology and hematology, neonatology, urology, neuro- oncology, cleft and craniofacial anomalies, otolaryngology, developmental pediatrics, adolescent medicine, interventional neuroradiology, and physical therapy and rehabilitation. Together, our teams have developed a number of programs and centers of excellence (such as the comprehensive Epilepsy Program) that focus on providing specialized treatment for neurologic disorders.

Performing approximately 1,000 procedures annually, Riley at IU Health neurosurgeons use specialized training and expertise to provide:

**Leading-edge patient care.** We are one of a limited number of hospitals nationally to offer superior tertiary and quaternary care for children with severe neurologic injuries or illnesses. These services require highly specialized equipment and access to rare procedures and clinical trials.

**Neurosurgery advancements.** Our team is developing new pediatric neurosurgery programs in neuro-oncology. We offer clinical trials, minimally invasive epilepsy surgery (featuring laser ablation of seizure foci) and fetal surgery for the repair of myelomeningocele/spina bifida.

Riley at IU Health neurosurgery uses the Donabedian model to evaluate quality of care.

With the exception of same-day appointments, we strive for the lowest number possible.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process: Use of non-standardized shunt valves</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: CSF leak</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Shunt infection</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Baclofen pump infection</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Other surgical site infection</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Readmission &lt; 90 days</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure: Overusage of OR block time</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Number equals occurrences in each category.

By adopting this framework for quality improvement in pediatric neurosurgery, we meet or exceed national benchmarks for post-operative complications, such CSF leaks, shunt infections, baclofen pump infections, other surgical site infections and readmissions within 90 days of surgery.

Pediatric neurosurgery is at the center of many multidisciplinary clinics and perioperative surgical homes at Riley:
- Adult spina bifida
- Brachial plexus injuries/peripheral nerve disorders
- Complex spine/scoliosis
- Craniosynostosis/craniofacial deformities
- Epilepsy
- Movement disorders/spasticity
- Neuro-oncology
- Pain management
- Traumatic brain injury/concussion
- Vascular/stroke/moyamoya

**Neurosurgery outpatient visits: 2015 – 2018**

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits</td>
<td>5,397</td>
<td>7,234</td>
<td>9,294</td>
<td>9,679</td>
</tr>
</tbody>
</table>

Since launching our same-day appointment program in October 2016 and opening neurosurgery outreach offices in South Bend, Fort Wayne and Carmel, our outpatient visit volume has increased by 55%.

**Neurosurgery TEAM MEMBERS**

- **Andrew H. Jea, MD, MHA**
  - Division Chief
  - Laurie L. Ackerman, MD
  - Karl Balsara, MD
  - Katrina Dicus, MD
  - Jeffrey S. Raskin, MD, MS
  - Jodi L. Smith, PhD, MD*
  - Denise Ash, NP
  - Gloria Fritzsch, NP
  - Kimberly Minnick, NP*
  - Natasha Virjee, NP

* Team member until May 2019

Committed to research and innovation

Our team of neurosurgeons and scientists is actively involved in research to improve understanding of why spine and brain disorders occur and to develop better operative and nonoperative treatments that are safe and effective for children. In 2018, Riley Neurosurgery participated in 30 IRB-approved studies, investigating topics such as:

- Use of Fast-Spin T2 MRI in children with subdural hematoma
- Treatment of papilledema with distraction
- Traumatic brain injury in pediatric patients
- Giant dural venous sinus formations
- Role of inflammatory mediators in cerebrospinal fluid
- Detethering in spina bifida
- Pure arterial malformation of the brain
- Pediatric craniopharyngioma treated with adjuvant proton radiotherapy

**2018 NEUROSURGERY CASE VOLUME**

<table>
<thead>
<tr>
<th>Category</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shunt surgery</td>
<td>186</td>
</tr>
<tr>
<td>Spinal dysraphism repair</td>
<td>70</td>
</tr>
<tr>
<td>Chiari malformation decompression</td>
<td>96</td>
</tr>
<tr>
<td>Craniosynostosis surgery</td>
<td>62</td>
</tr>
<tr>
<td>Brain tumor surgery</td>
<td>52</td>
</tr>
<tr>
<td>Spinal instrumentation (by pediatric neurosurgery)</td>
<td>51</td>
</tr>
<tr>
<td>Epilepsy surgery</td>
<td>52</td>
</tr>
<tr>
<td>Vagus nerve stimulator placement/revision</td>
<td>35</td>
</tr>
<tr>
<td>Neuroendoscopic procedure</td>
<td>41</td>
</tr>
<tr>
<td>Spasticity surgery</td>
<td>16</td>
</tr>
<tr>
<td>Vascular (including endovascular procedures)</td>
<td>35</td>
</tr>
<tr>
<td>Brachial plexus/peripheral nerve surgery</td>
<td>22</td>
</tr>
<tr>
<td>Other neurosurgery procedures</td>
<td>239</td>
</tr>
</tbody>
</table>

**New locations and same-day appointments improve access.**

Since launching our same-day appointment program in October 2016 and opening neurosurgery outreach offices in South Bend, Fort Wayne and Carmel, our outpatient visit volume has increased by 55%.
Ophthalmology

The only program of its kind in Indiana, Riley at IU Health Ophthalmology offers comprehensive care and early detection for children with all types of eye conditions and visual impairments, from vision problems remedied only with eyeglasses to complex conditions that require sophisticated surgical procedures. Our team is led by board certified, fellowship-trained pediatric ophthalmologists who collaborate with pediatric optometrists and certified ophthalmic technicians to offer the most advanced eye care available to children, as well as adults with strabismus (eye muscle disorders).

Riley’s eye specialists have detailed knowledge of children’s developing visual systems and can objectively evaluate children of all ages and developmental stages, regardless of their ability to communicate what they see. We bring specialized skills to every child’s evaluation, diagnosis and treatment—all of which require an approach that is different from adult care.

Leadership in pediatric ophthalmology

Riley at IU Health ophthalmologists train the next generation of pediatric eye specialists and hold national and international leadership roles in pediatric ophthalmology through professional associations such as the American Academy of Ophthalmology, the American Association for Pediatric Ophthalmology and Strabismus, and the International Pediatric Ophthalmology and Strabismus Council. We are also active in clinical trials that study new methods of treatment and diagnosis, and our physicians are widely published in peer-reviewed medical journals and texts that are used to train medical students, residents and fellows.

Experts in the latest treatments for eye disorders

Our ophthalmologists evaluate and treat all eye conditions, including:

- Amblyopia (“lazy eye”)
- Pediatric glaucoma
- Pediatric cataract
- Eyelid lesions, including ptosis, tumors, etc.
- Ocular trauma
- Optic nerve diseases
- Refractive errors
- Retinoblastoma and other ocular tumors
- Retinopathy of prematurity
- Strabismus (eye muscle disorders)

Riley at IU Health eye specialists also provide multidisciplinary care with other departments, including neurosurgery, neurology, rheumatology, hematology/oncology and developmental pediatrics to evaluate and address the variety of ocular manifestations of many systemic conditions, including Down syndrome, juvenile idiopathic arthritis, idiopathic intracranial hypertension, retinoblastoma and neurofibromatosis.

In 2018, our team of skilled ophthalmologists performed more than 2,900 surgeries.

DIVISION CHIEF
David A. Plager, MD

“Riley is home to one of the most prestigious ophthalmology fellowships in the country. Since 1972, we’ve trained more than 100 pediatric ophthalmologists—the second largest alumni group in the United States.”

Advanced care that includes adults

Many adults do not realize there are options for repairing eye muscle imbalances and other conditions that were once untreatable. Riley ophthalmologists treat adults with strabismus or double vision. Based within a healthcare system committed to research and innovation, our pediatric ophthalmologists offer both children and adults advanced treatment options not available elsewhere.
Orthopedic Surgery

The pediatric orthopedic specialists at Riley at IU Health are committed to ensuring children receive leading-edge, patient- and family-centered musculoskeletal care with superior outcomes. Treating infants and children of all ages, our orthopedics program is a major regional referral center with a team of fellowship-trained surgeons who are internationally recognized as clinical experts. Our specialists provide consultation, diagnosis and treatment for a variety of orthopedic concerns:

- Fractures/broken bones/injuries and trauma. Riley at IU Health is the only children’s hospital in Indiana—and one of just a few across the country—to be verified as a Level I Pediatric Trauma Center by the American College of Surgeons. For more on trauma services, refer to page 36.
- Sports injuries. We are committed to providing advanced care to young athletes in a friendly, professional and responsive manner. Our orthopedic specialists collaborate with skilled physical therapists to provide the treatment and rehabilitation needed for recovery from a number of sports-related conditions, including:
  - Knee injuries
  - Low back injuries or pain
  - Shin splints

- Spinal deformity
- Musculoskeletal tumors and tumor-like conditions
- Limb deformity, including bowlegs, knock knees and Blount’s disease
- Injuries, trauma and infection
- Foot and ankle deformities, including clubfoot
- Congenital/developmental hip dysplasia, Perthes and slipped capital femoral epiphysis (SCFE)
- Leg length discrepancy and other limb disorders
- Neuromuscular disorders, including muscular dystrophy, spina bifida and cerebral palsy (including gait laboratory evaluation)
- Shoulder and upper extremity injuries and disorders
- Sports injuries

Scoliosis and other pediatric spine conditions. We provide treatment for a variety of spinal malformations in patients from infancy to adolescence, especially surgical treatment for idiopathic scoliosis and kyphosis. Our innovative surgical techniques include the use of growing spine constructs such as the MAGEC rod, which minimizes spinal fusion, preserves spine motion and results in better patient outcomes. Riley at IU Health is the only location in Indiana to provide casting for infantile or early onset scoliosis.

Skeletal malformations and congenital/developmental conditions. We care for children of all ages with a wide range of skeletal malformations and congenital/developmental conditions. Riley orthopedic specialists use a variety of treatment methods, including guided-growth procedures, external fixation devices and multiple-level osteotomies (the cutting of bones). Long bone lengthening is also possible for patients with leg length discrepancies.

Neuromuscular conditions. Our physicians diagnose and treat a variety of orthopedic complications related to neuromuscular conditions—such as spinal deformities and gait abnormalities. These conditions include any syndrome or disorder that impairs the functions of the nervous system or muscles, such as cerebral palsy or muscle disorders.

The Riley at IU Health orthopedics team provided surgical care to 1,168 pediatric patients in 2018, treating conditions such as:

- Spinal deformity
- Musculoskeletal tumors and tumor-like conditions
- Limb deformity, including bowlegs, knock knees and Blount’s disease
- Injuries, trauma and infection
- Foot and ankle deformities, including clubfoot
- Congenital/developmental hip dysplasia, Perthes and slipped capital femoral epiphysis (SCFE)
- Leg length discrepancy and other limb disorders
- Neuromuscular disorders, including muscular dystrophy, spina bifida and cerebral palsy (including gait laboratory evaluation)
- Shoulder and upper extremity injuries and disorders
- Sports injuries

Under new leadership since late 2018, Riley Orthopedic Surgery is developing new initiatives to expand access, including a same-day fracture program and a statewide orthopedics network. The program is also actively recruiting subspecialists to broaden Riley’s expertise in the field.

Riley Orthopedic Surgery uses the latest diagnostic and surgical technology:

- **EOS imaging** – Our team uses Indiana’s only EOS imaging machine for most patients who have conditions such as scoliosis, leg deformities or differences in leg lengths. EOS provides patients with up to four times less radiation than other imaging services, an especially important value to patients requiring many radiographic studies as part of their care plan. Primary care doctors can request use of the EOS imaging machine whether or not the child is a patient of Riley at IU Health.

- **Intraoperative O-arm** – This surgical imaging system provides high-quality 2D and 3D intraoperative images of the anatomy and is designed for use in orthopedic, spine and related surgeries.

- **DEXA scanning** – Dual energy X-ray absorptiometry (DEXA) is an advanced test that measures bone density and screens for conditions such as osteogenesis imperfecta, Vitamin D deficiency and brittle bones caused by chemotherapy and many other conditions.
Otolaryngology – Head and Neck Surgery

Riley at IU Health otolaryngology specialists offer the full range of pediatric ear, nose and throat care from common issues to more complex disorders. Our expert team of board certified otolaryngology – head and neck specialists, as well as audiologists and speech-language pathologists, uses the latest technology to perform extensive diagnostic evaluation of conditions and provide customized treatment.

Directed by fellowship-trained otolaryngologists, our team is committed to ensuring patients receive highly advanced head and neck care for the best outcomes. Our specialists evaluate and treat a variety of conditions, including:

- Acute and chronic airway obstruction
- Balance and dizziness disorders
- Chronic ear disease
- Cleft lip and palate
- Communication disorders
- Congenital ear anomalies
- Head and neck masses
- Hearing loss
- Nasal breathing problems
- Salivary gland conditions
- Sinusitis
- Sleep apnea
- Snoring, voice and sinus disorders
- Vascular anomalies
- Voice and speech conditions

Additionally, skilled Riley otolaryngology surgeons routinely perform thyroid surgeries and surgical interventions for disorders involving the tonsils and adenoids.

Interdisciplinary, patient-centered care

Our otolaryngologists work closely with other Riley specialists to coordinate excellent care, and are integral members of a number of multidisciplinary programs:

**Vascular Anomalies Program**
The Vascular Anomalies Program at Riley at IU Health provides high-quality, advanced care for children with vascular anomalies to help restore function and a more normal appearance. Children with vascular anomalies receive care from our multidisciplinary team that includes board certified specialists in:

- Blood disorders
- Dentistry
- Dermatology
- Interventional radiology
- Oral and maxillofacial surgery
- Otolaryngology – head and neck surgery
- Plastic surgery
- Physical therapy

**Cleft and Craniofacial Anomalies Program**
The Cleft and Craniofacial Anomalies Program cares for more children with cleft lip and/or cleft palate than any other hospital in Indiana and is one of the largest and most experienced programs of its kind in the nation. For more on this program, refer to page 28.

**Aerodigestive Program**
Providing multidisciplinary care to children with structural airway and functional gastroenterology disorders, this program strives to improve clinical outcomes by coordinating outpatient evaluations and diagnostic and operative procedures, while conveying timely feedback to referring physicians and families for ongoing care.

**Deaf and Hard of Hearing Clinic**
This specialized program is designed to support children through medical, social and educational care related to hearing loss.

**Cochlear Implant Program**
The Riley at IU Health Cochlear Implant Program—a leader in cochlear implants and related research—includes surgeons and audiologists specially trained to treat all patients with cochlear implants. The program is internationally recognized both as a clinical center and research resource for children with severe to profound hearing loss.

**DIVISION CHIEF**
Bruce H. Matt, MD, MSc

“The first in Indiana with fellowship-trained pediatric otolaryngologists, we offer advanced care, including cochlear implants and cleft palate surgery. We take pride in being part of multidisciplinary teams committed to helping children with hearing loss and other challenging conditions.”

Otolaryngology – head and neck surgery volume: 2017 – 2018

<table>
<thead>
<tr>
<th>Year</th>
<th>Surgical cases</th>
<th>Outpatient visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>2,518</td>
<td>6,711</td>
</tr>
<tr>
<td>2018</td>
<td>2,689</td>
<td>6,951</td>
</tr>
</tbody>
</table>

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Pediatric Surgery

Pediatric surgeons at Riley at IU Health are experienced in performing the full spectrum of pediatric surgery. With nine board certified pediatric surgeons, the team provides 24/7, on-site surgical coverage allowing for timely evaluation of children with emergent and urgent surgical conditions. The Riley at IU Health surgery team leads Indiana’s only pediatric Level I Trauma Center, which serves more than 1,600 patients each year. For more on trauma services at Riley, refer to page 36.

Caring for children of all ages, our surgeons, anesthesiologists and clinical team members are committed to advancing techniques for improved recovery after surgery and limiting opioid use. We participate in multidisciplinary teams and coordinate seamless care for even the most complex patients. In addition, Riley Pediatric Surgery continues to expand the use of minimally invasive surgical techniques, including thoracoscopy, laparoscopy and robotic surgery, and therapeutic interventions, such as extracorporeal membrane oxygenation (ECMO).

Advancing surgical care through research

The surgical team at Riley directs many clinical and basic science research programs aimed at improving surgical quality, reducing lengths of stay and achieving superior surgical outcomes. In addition, our surgical team participates in a multi-institutional consortium that shares clinical resources to allow wider investigation among larger patient populations. Our surgeons are also active in designing new clinical care pathways and conducting research to continually advance pediatric surgery at Riley Children’s Health and pediatric hospitals nationwide.

Riley pediatric surgeons treat a number of conditions, including:

- Appendicitis
- Chest wall conditions
  - Pectus excavatum
  - Pectus carinatum
  - Pseudoxoid syndrome
  - Slipping rib syndrome
- Colon and rectal surgery
  - Imperforate anus
  - Hirschsprung’s disease
  - Anorectal abscess/ fistula
  - Ulcerative colitis
  - Crohn’s disease
  - Familial adenomatous polyposis
  - Short bowel syndrome
- Gastroesophageal reflux
- Gastrostomy tube placement
- Hypertrophic pyloric stenosis
- Ingual hernias, hydropses and undescended testes
- Neonatal surgical conditions
  - Intestinal obstructions
  - Congenital diaphragmatic hernia
  - Esophageal atresia and tracheoesophageal fistula
  - Omphalocele, Gastrochisis
  - Necrotizing enterocolitis
  - Sids tumors
  - Trauma
  - Vascular access devices

Select pediatric surgical procedures: 2018

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>Abdominal wall</td>
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<tr>
<td>Chest wall</td>
<td>234</td>
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<tr>
<td>Colorectal</td>
<td>226</td>
</tr>
<tr>
<td>Neonatal</td>
<td>106</td>
</tr>
</tbody>
</table>

Pediatric Surgery Basic Science Research Laboratory

Under the direction of Troy A. Markel, MD, the Pediatric Surgery Basic Science Research Laboratory at Riley at IU Health focuses on defining novel diagnostic tools and therapies for neonatal intestinal disorders such as necrotizing enterocolitis and intestinal ischemia. In 2018, Dr. Markel received more than $600,000 in grant funding from the National Institutes of Health to support the lab for the next four years. In addition, he was awarded $225,000 through the American College of Surgeons Clowes’ Memorial Fund. The lab continues to partner with private philanthropists and local industry in an attempt to detect and eradicate these conditions in newborns.

Research conducted by Riley surgeons led to nearly 20 national presentations and more than 25 journal publications in 2018.

Partners in providing specialized care

Riley Fetal Center

Riley surgeons are integral members of the multidisciplinary care team at the Riley Fetal Center. In addition to playing active roles in prenatal consultation and multidisciplinary care management conferences, our surgeons are experts in performing a wide range of operations for complex congenital conditions. In 2018, our surgical team performed more than 200 operations on newborns with conditions such as congenital diaphragmatic hernia and congenital intestinal atresia. For more on the Riley Fetal Center, refer to page 7.

Chest Wall Program at Riley Children’s Health

Riley pediatric surgeons lead a multidisciplinary group of surgeons, anesthesiologists, pain specialists, physical therapists, nurses and child life therapists focused exclusively on the diagnosis and treatment of pectus excavatum, pectus carinatum, Poland syndrome and other chest wall anomalies. The team performed 106 procedures and managed 446 clinic visits in 2018. Video visits are now offered for some post-operative visits to decrease travel time and improve the overall patient experience.

Center for Colorectal and Urogenital Health

Riley at IU Health houses a multidisciplinary center to serve children with complex colorectal and urogenital anomalies, including anorectal malformations, Hirschsprung’s disease, cloaca and exstrophy of the cloaca, idiopathic constipation, colonic motility disorders, and other colorectal and urogenital conditions. The program enables us to provide comprehensive care, coordinating multiple disciplines into a single visit for a more patient- and family-centered care experience. Our team performed nearly 250 complex colorectal operations in 2018 and manages more than 500 patients on an ongoing basis.

Lab members: Frederick J. Rescorla, MD Division Chief

Deborah F. Billmire, MD
Cartland Burns, MD
Brian W. Gray, MD
Alan P. Ladd, MD
Matthew P. Landman, MD
Troy A. Markel, MD
Thomas M. Rouse, MD
Lauren Bates, CPNP
Tina Blank, CPNP
Melissa Croucher, CPNP
Stephanie Dunn, CPNP
Lori Miller, CPNP
Julie Resler, CPNP
Joling Tidwell, CPNP
Lauren Yeagerlehner, CPNP
Jill Coss, FNP
Kristine Nagle, FNP

For more on the Riley Fetal Center, refer to page 27.
Plastic Surgery

Led by skilled board certified plastic surgeons, the plastic surgery team at Riley at IU Health provides a wide range of reconstructive surgical care to children throughout Indiana. Our surgeons, who have subspecialty fellowship training, are committed to providing leading-edge, compassionate care to restore patients to their best selves.

Cleft and Craniofacial Anomalies Program

The Riley at IU Health Cleft and Craniofacial Anomalies Program, which treats nearly 2,000 children each year, is Indiana’s only comprehensive, multidisciplinary cleft and craniofacial program and is accredited by the American Cleft Palate Association. Patients are able to see nine specialists in the fields of plastic surgery, dentistry, speech pathology, craniofacial orthodontics, oral and maxillofacial surgery, developmental pediatrics, nutrition, audiology, and otorhinolaryngology. Specialized treatment is available for many craniofacial conditions, including:

- Cleft lip
- Cleft palate
- Palatal fistulas
- Velopharyngeal dysfunction
- Acrocephalosyndactyly
- Hemifacial microsomia
- Craniosynostosis
- Pierre Robin sequence
- Midface hypoplasia and other jaw abnormalities
- Craniofacial syndromes (Apert, Crouzon, Pfeiffer, Saethre-Chotzen, Muenke, Goldenhar, 22q11.2 deletion syndrome, Treacher Collins)

The program is managed by fellowship-trained specialists certified by the American Board of Plastic Surgery. Authors of peer-reviewed scientific literature on craniofacial surgery, Riley at IU Health plastic surgeons have contributed to research in craniofacial surgery in the areas of Pierre Robin sequence, mandibular distraction, cleft lip and palate, and many other topics.

In 2018, plastic and reconstructive surgeons at Riley at IU Health performed 408 cleft and craniofacial surgeries. The team, collaborating with partners in neurosurgery, completes 100 craniosynostosis surgical procedures annually.

Specializing in hand surgery

Skilled in treating children born with hand and upper extremity abnormalities, Riley plastic surgeons provide operative solutions and treatment for:

- Polydactyly
- Syndactyly (hands and feet)
- Apert finger and thumb anomalies
- Thumb duplication
- Thumb hypoplasia/aplasia
- Clinodactyly/Clampodactyly
- Cleft hand
- Amniotic band
- Arthrogryposis
- Radial club hand
- Brachial plexus palsies
  (part of a multidisciplinary team)
- Cerebral palsy
  (part of a multidisciplinary team)
- Traumatic bony and soft tissue injuries
- Nerve and tendon reconstruction

Riley at IU Health Burn Center

The comprehensive pediatric burn center at Riley provides care for children with burns to all parts of the body. The inpatient unit provides critical care, wound management and rehabilitation for children who have been burned. With the help of nursing, occupational therapy, physical therapy, wound care and reconstructive plastic surgery, outpatient care assists patients in transitioning back to normal life.

Microvascular reconstruction

Our plastic and reconstructive surgeons specialize in the microvascular transfer of skin, muscle and bone flaps to reconstruct the scalp, oral cavity, limbs and other areas.

Pediatric plastic surgery

Offering a wide range of plastic surgery services, Riley at IU Health plastic and reconstructive surgeons use the latest techniques to treat these and other conditions:

- Breast abnormalities (macromastia, Poland syndrome, constricted breasts, tuberous breasts, breast asymmetry, gynecomastia)
- Ear anomalies (prominent ears, cryptotia, microtia, constricted ears)
- Skin conditions (nevi, giant congenital nevi, melanoma, tissue expansion, serial excision)
- Vascular anomalies (hemangiomas, port wine stains, venous and lymphatic malformations)
- Keloids and hypertrophic scars
- Traumatic scar revisions
- Laser therapy for scars

Hand and upper extremity abnormalities: 2018

- 164 surgeries
- 312 outpatient visits

Pediatric Burn Center: 2018

- 797 patient consultations
- 2,826 outpatient visits
- 80 burn surgeries
  (for acute burns)
- 47 outpatient reconstructive surgeries
  (for post-burn recoveries)
- 150 admissions

Riley’s plastic surgery team is committed to surgical excellence, advancing clinical science, compassionate care and rapid recovery from surgery.

**Division Chief**

Patrick A. Gerety, MD

“With expertise in cleft, craniofacial, reconstructive and burn surgery, Riley’s plastic surgery team is committed to surgical excellence, advancing clinical science, compassionate care and rapid recovery from surgery.”

**Pediatric Surgery team members**

Patrick A. Gerety, MD  
Division Chief

Joshua M. Adkinson, MD  
Brett Hartman, DO  
Sunil S. Tholpady, MD, PhD
The Riley transplant surgical team performs transplants for a variety of conditions:

### Kidney transplant
- Congenital diseases of the kidney and urinary tract
  - Dysplasia
  - Obstructive uropathy
  - Reflux nephropathy
- Focal segmental glomerulosclerosis (FSGS)
- Glomerulonephritis
- Kidney tubular acidosis
- Nephrotic syndrome
- Polycystic kidney disease

### Liver transplant
- Biliary atresia
- Autoimmune liver diseases
- Liver cancer
- Metabolic disorders
- Acute/fulminant liver failure
- Cystic fibrosis

### Intestine/multivisceral transplant
- Intestinal atresia
- Midgut volvulus
- Gastrochisis
- Necrotizing enterocolitis (NEC)
- Short bowel syndrome (SBS)
- Hirschsprung’s disease

*IU Health Transplant at Riley Children’s Health is one of the few programs in the nation with Medicare approval to perform pediatric intestine and multivisceral transplants.*

Since 1969, more than 750 abdominal organs have been transplanted by our pediatric transplant surgeons. More than a number, these surgeries represent lifesaving organ transplants made possible through organ donation and the children who have received a second chance at a longer, healthier life.
Urology

Riley Hospital for Children at IU Health performs more pediatric urologic surgeries (based on surgical case volume) than any single children's hospital in North America.

Riley urologists treat a wide variety of conditions, including:
- Congenital adrenal hyperplasia
- Hemi- and hydroureteronephrosis
- Kidney stones
- Labial adhesions/vaginitis
- Neurogenic bladder
- Phimosis and paraphimosis
- Posterior urethral valves
- Undescended testes
- Ureteropelvic junction obstruction
- Ureterovesical junction obstruction
- Urinary tract infections
- Vesicoureteral reflux
- Voiding dysfunction

Urology outcomes with at least two years of follow up: 2018

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal hypospadias (N = 250)*</td>
<td>98%</td>
</tr>
<tr>
<td>Pyeloplasty (N = 62)*</td>
<td>100%</td>
</tr>
<tr>
<td>Unplanned readmissions for complex surgery</td>
<td>2.5%</td>
</tr>
<tr>
<td>Unplanned readmissions for outpatient surgery</td>
<td>0%</td>
</tr>
</tbody>
</table>

*R: Successful surgeries without need for revision

In addition to these multidisciplinary centers, Riley Urology provides care at 16 outreach offices across Indiana.

A multidisciplinary approach to care

Riley at IU Health urologists and nurse practitioners are actively involved in numerous multidisciplinary clinics to provide a wide range of unique services in collaboration with other physicians. Each of these clinics is unique, representing the only opportunity for patients in the state to receive coordinated care for these complex medical problems.

- Spina Bifida Clinic
- Transitional Spina Bifida Clinic
- Complex Voiding Dysfunction Center
- Refractory Bowel and Bladder Dysfunction Clinic (Sacral Neuromodulation Clinic)
- Congenital Adrenal Hyperplasia Clinic
- Disorder of Sexual Differentiation Clinic
- Maternal Fetal Medicine Program
- Urology-Nephrology Stone Clinic
- Center for Urogenital and Colorectal Health

In addition to these multidisciplinary centers, Riley Urology provides care at 16 outreach offices across Indiana.

Active in clinical research

Our team is academically productive in virtually all areas of urology, including two NIH-funded grants investigating patient-centered and long-term outcomes of robotic kidney surgery and hypospadias.

Urology team members

- Rosalia Misseri, MD
  Division Chief
- Katherine Hubert Chan, MD, MPH
- Martin Kaefer, MD
- Richard C. Rink, MD
- Konrad M. Szymanski, MD, MPH
- Benjamin M. Whittam, MD, MS
- Shelly King, NP
- Hillary Risk, NP
- Taylor Wang, NP
- Melissa A. Young, NP

Urology

Ranked as the third leading pediatric urology program in the nation by U.S. News & World Report, Riley at IU Health Urology specializes in treating conditions of the pediatric urinary tract (kidneys, ureter, bladder) and genitalia. These conditions come in many forms—from common pediatric and adolescent urologic problems to the most complex abnormalities affecting urogenital development. All of our surgeons are fellowship trained and board certified in pediatric urology surgery and are recognized leaders in the field.

Riley Urology is considered an international leader in complex surgical reconstruction for urinary incontinence in children with spina bifida. In addition, we also maintain the largest database in the world for complex urinary tract reconstruction, including bladder augmentation with intestine, Mitrofanoff/Monti bladder channels and MACE procedures. This allows us to continually monitor our success and refine our techniques. Our focus on clinical translational research is supported by three National Institutes of Health grants and by the Riley Children's Foundation.

Riley at IU Health, known for expertise in complex genital reconstruction, is one of only four centers in the nation designated as a Center of Surgical Excellence for pediatric urology. Riley Hospital for Children at IU Health performs more pediatric urologic cases than any single children's hospital in North America.

Riley Urology is considered one of only two such clinical care programs in the country based in a children's hospital. Riley's Transitional Urology Clinic provides specialized services for patients requiring lifelong care and follow up after surgery, and is one of only two such clinical care programs in the country based in a children's hospital.

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Anesthesia

The anesthesia team at Riley Children’s Health delivers safe, evidence-based, compassionate and value-based care to pediatric patients in all aspects of anesthesia, perioperative medicine, and acute and chronic pain management. Offering outstanding care, our team also is committed to providing high-quality educational training and engaging innovative and personalized perioperative care research, and improving health outcomes.

Dedicated to achieving the best outcomes, maximizing safety and minimizing discomfort, our multidisciplinary team of board certified pediatric anesthesiologists tailors equipment and protocols to meet children’s unique needs and physiology. We continually improve the standard methods of clinical care based on the latest evidence and develop more effective, safe and reliable practices for protecting a child’s heart, lung and brain function, and blood circulation during anesthesia and medical care.

With dedicated pediatric experience, clinical skills and expertise, Riley at IU Health anesthesiologists safely deliver surgical anesthesia for pediatric patients of all ages, from babies still in the womb to young adults.

Riley at IU Health anesthesiologists provide comprehensive anesthesia services to approximately 21,000 children annually.

Pediatric anesthesiologists at Riley offer a wide range of services, including:
- Surgical anesthesia for all types of common pediatric surgical procedures, including outpatient surgery at Riley Hospital for Children and IU Health North Hospital.
- Anesthesia for complex surgeries in children, such as complex urogenital reconstruction, major neurosurgery, orthopedic surgery including spine fusions, congenital heart surgery, organ transplantation and craniofacial reconstruction.
- Anesthesia management for diagnostic and therapeutic procedures, including MRI, CT scanning, interventional radiology, gastrointestinal endoscopies, radiotherapy, vesico-urethrogram and cardiac catheterization.
- Acute post-operative pain management, including standardized protocol-driven epidural, spinal, caudal and advanced regional analgesia, as well as patient-controlled analgesia.
- Chronic pain management in children.
- Multidisciplinary consultation with surgeons and pediatricians.
- Preadmission anesthetic evaluation and testing, including preoperative consultations and instructions.

Leaders in pediatric anesthesia

- More than 50 anesthesia physicians, anesthetists, nurse practitioners and research nurses from top programs
- Largest anesthesia service in Indiana for pediatric cardiovascular surgery, neurosurgery and transplant surgery
- Recognized National Institutes of Health and industry-funded pediatric anesthesia/pain management research programs aimed at improving clinical outcomes in children
- Largest anesthesia programs for pediatric acute and chronic pain management in the state
- Leading-edge, safe, evidence-based clinical care before, during and after surgery and procedures
- Only pediatric chronic and medical pain management program in Indiana

To refer a patient to the pediatric pain management program, call 317.944.2353.

DIVISION CHIEF

Senthilkumar Sadhasivam, MD, MPH

“With our enhanced recovery after surgery program and minimal use of opioids, children undergoing major spinal fusions at Riley have some of the best post-operative pain control and shortest hospital stays in the country.”

CARE – Center for Anesthesia Research Excellence

CARE, the Riley Anesthesia research program, has three goals specific to the services we provide:

1. To lead the research field in translating personalized anesthesia and pain management research to clinical practice, as well as pediatric anesthesia safety and outcomes research
2. To discover the mechanisms, physiologic and clinical elements of pediatric anesthesia and pain management, and to translate into clinical practice
3. To develop the next generation of clinical researchers in the field of pediatric anesthesia and pain medicine and developmental neurobiology

Clinical anesthesia sections at Riley at IU Health

The Section of General Anesthesia provides anesthesia before, during and shortly after inpatient surgical procedures. The division provides patient-centered, multidisciplinary and coordinated care that strives for better health, better healthcare and reduced cost of care. These goals are met through patient-centered decision-making and seamless continuity of care from preoperative preparation and surgery through recovery, discharge and follow up.

The Section of Cardiac Anesthesia provides anesthesia and pain management for patients undergoing complex cardiac, thoracic or vascular surgeries and procedures in the catheterization laboratory, imaging suites and cardiac operating rooms. We support Riley’s ninth-ranked* cardiothoracic surgery program, which has earned a three-star rating from the Society of Thoracic Surgeons. For more on the program, refer to page 10.

The Section of Pain Medicine makes surgical procedures in children safe, comfortable and less painful. We provide excellent and cost-effective outcomes with an interactive team approach to acute pain treatment and chronic pain management with consultative and outpatient programs that tailor treatment options to individual patient needs.

* 2019-20 U.S. News & World Report

To refer a patient to the pediatric pain management program, call 317.944.2353.
Trauma Services

As a Level I Pediatric Trauma Center, Riley Hospital for Children at IU Health provides 24/7 trauma care to evaluate and treat the most severely injured pediatric patients. Our experienced pediatric surgeons, emergency medicine physicians, anesthesiologists, critical care physicians and other healthcare specialists work collaboratively as a team, taking rapid and decisive action to provide effective treatment in critical situations when seconds matter.

In 2018, approximately 47% of all trauma cases came directly to Riley at IU Health from the scene of the injury, while 53% of children in need of trauma care were transferred from other hospitals in the state and region. With four trauma bays in the emergency department and an operating room always available for incoming critical cases, our trauma services team is ready for any scenario.

Riley at IU Health has the only Level I Pediatric Trauma Center in Indiana

Verified by the American College of Surgeons (ACS) as a Level I Pediatric Trauma Center since 1992, Riley Hospital is one of a select number of children’s hospitals in the nation to earn this designation. Riley at IU Health requested the verification with an on-site review conducted by an ACS team of reviewers experienced in trauma care.

Established by the ACS in 1987, the verification program for hospitals promotes the development of trauma centers in which verified centers provide not only the hospital resources necessary for trauma care, but also the entire spectrum of care to address the needs of all injured patients from the prehospital phase through the rehabilitation, as well as injury prevention.

More than 80% of all injured children arrive at Riley hospitals during the evening or at night, making our 24/7 in-house coverage by pediatric specialists essential.

Pediatric Traumatic Brain Injury and Concussion Program

Continuing to discover more about the complexities of concussions, medical professionals are studying why concussions occur, which patients are susceptible, how problems develop and the role of healthcare providers in helping to ensure good outcomes. The Riley Traumatic Brain Injury and Concussion Program, the first and only program of its kind in Indiana, facilitates a multidisciplinary, team-based approach to the care of infants, children and adolescents with concussions and other traumatic brain injuries. Care is provided by specialists in:

- Neurosurgery
- Physical medicine and rehabilitation
- Neuropsychology

Pediatric trauma quality improvement benchmarks

The American College of Surgeons trauma quality improvement benchmarking is risk based and allows comparison of patient outcomes with other trauma centers across the nation that care for pediatric patients. The ACS cited the robust quality improvement process for injured children at Riley as one of the many strengths of the hospital’s trauma program.

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>RILEY</th>
<th>NATIONAL DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median injury severity score</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Blunt splenic injury with splenic preservation</td>
<td>97.5%</td>
<td>94.8%</td>
</tr>
<tr>
<td>Time to operative fixation of mid-shaft femur greater than 24 hours</td>
<td>2.2%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Time to intracranial pressure (ICP) monitoring</td>
<td>1.9 hours</td>
<td>2.9 hours</td>
</tr>
<tr>
<td>Time to craniotomy</td>
<td>1.4 hours</td>
<td>1.8 hours</td>
</tr>
</tbody>
</table>

Increasing recognition by referring physicians, parents and others that children should be treated by pediatric specialists contributes to continued growth in the number of injured children treated at Riley at IU Health.
Riley Surgery team member directory

Surgery leadership
Frederick J. Rescorla, MD
Division Chief
Senthilkumar Sadhasivam, MD, MPH
Anesthesiologist-in-Chief
Andrew H. Jea, MD, MHA
Surgical Director of Quality and Patient Safety
DeAnn Martin, MSN, BSN, RN
Director of Perioperative Services
Margo Regas, MSN, RN, CNOR, RN-BC
Clinical Director of Perioperative Services

Anesthesia
Senthilkumar Sadhasivam, MD, MPH
Division Chief
Rania K. Abbasi, MD
Michael A. Acquaviva, MD
Jaqucelyn E. Allison, MD
Tanna N. Agan, MD
John D. Emhardt, MD
Thomas Feehan, MD
Morton C. Green, MD
Matthew C. Hamilton, DO
Doris M. Hardacker, MD
Michele Hendrickson, MD
Nicole D. Horn, MD
Michele J. Hovland, MD
Matthew C. Hamilton, DO
Doris M. Hardacker, MD

Cardiothoracic Surgery
Mark W. Turrentine, MD
Division Chief
John W. Brown, MD
Jeremy L. Herrmann, MD
Mark D. Rodefeld, MD

Dentistry
Brian J. Sanders, DDS, MS
Division Chief
Jeffrey A. Dean, DDS, MSD
James E. Jones, DMD, MSD, EdD, PhD
LaQuia A. Vinson, DDS, DMD
Juan F. Ypes, DDS, DMD, MPH, MS, DPh

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Riley Children’s Health Surgery Annual Report 2018
One child’s Riley story: Racheal Opaczewski, age 15

Neurosurgery for rare condition relieves debilitating pain.

For nearly 15 years, Racheal Opaczewski endured periods of excruciating facial pain. At first, she’d wake up screaming in the middle of the night, but then the pain started happening during the day too. Numerous ER visits and medical evaluations were unproductive with doctors diagnosing her with everything from inner ear infections to dental issues.

“Racheal’s condition, trigeminal neuralgia, is an irritation of the trigeminal nerve, which supplies sensation to most of the face. It usually occurs in adults and rarely in children,” explains Andrew H. Jea, MD, MHA, division chief of pediatric neurosurgery at Riley at IU Health. “The overall incidence of this disorder is around 10 new cases per 100,000 people each year. Because this condition is so rare in children, it likely wasn’t top of mind for some providers.”

“In Racheal’s case, medications, namely anti-seizure medications, had worked to calm the irritation of the trigeminal nerve for a while,” explains Dr. Jea. “But they gradually lost their effectiveness. It was at that point that I encountered Racheal.”

“During our first meeting, he [Dr. Jea] came over to Racheal, looked her in the eyes, held her hand and said, ‘I believe you, Racheal. I believe you have been and are really in pain and we are going to stop it,’” recalls Racheal’s mother, Crystalina. “With everything we had been through, to hear a doctor say that was so significant.”

Dr. Jea told the family that a surgery called microvascular decompression could be a solution. The stakes were high, however, with blindness or deafness existing as potential risks.

“The surgery involved creating a small window of bone through the skull just behind the ear to find the trigeminal nerve as it courses back to the brainstem, and looking for anything that could be compressing or irritating it, such as a pulsating artery,” explains Dr. Jea. “Once we found the artery pushing on the trigeminal nerve, we placed a pledget of Teflon to cushion the nerve from the artery.”

The multidisciplinary collaboration that exists at Riley was an important factor in Racheal’s successful outcome. “It was our close relationship with our partners in neurology that brought Racheal to my attention,” says Dr. Jea.

Today, Racheal has a new life. “I can brush my teeth now for the first time in six years without pain and I ate sour candy for the first time recently and opened the car window and let the air hit my face. It’s awesome,” she says.

Crystalina says the family is indebted to Dr. Jea. “Dr. Jea was so calm and considerate, even after we discussed the diagnosis he asked us to go home and think about it. To find a neurosurgeon who was sure of what was wrong but was humble and respectful to us as parents—it was an incredible thing.”

Refer a patient

Riley Children’s Health cares for children in Indiana, across the nation and around the world. Same-day appointments are available for some providers. To schedule an appointment or to speak with a surgical specialty administrator, please call:

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