Children’s Healthcare of Atlanta and Georgia Institute of Technology

Partnership Report
At Children’s Healthcare of Atlanta, research is an important part of our mission. We work with academic and scientific institutions throughout Georgia to discover and develop treatments for the most difficult childhood medical conditions.

Children’s and the Georgia Institute of Technology have a common interest in collaborative research that brings clinicians from Children’s, academic scientists from Emory University and engineers from Georgia Tech together to solve important problems in pediatrics and develop technological solutions for improving children’s health. With the formation of the Pediatric Technology Center, Children’s and Georgia Tech will provide extraordinary opportunities for interdisciplinary collaboration in pediatrics, creating breakthrough discoveries that often can only be found at the intersection of multiple disciplines. It is through generous donations that we are able to strategically foster these alliances that help enhance the lives of children and young adults.

2012
- Atlanta Pediatric Device Consortium founded with $1.8 million in Food and Drug Administration funds
- Children’s and Georgia Tech announce alliance and $20 million investment in pediatric research
- Center for Pediatric Nanomedicine founded at Georgia Tech

2013
- Quick Wins research funding program kicks off
- PediatriConnect, a program to facilitate collaboration, launches
- Global Center for Medical Innovation (GCMI) receives FDA approval to manufacture pediatric medical devices

2014
- Children’s invests in Engineered Biosystems Building
- First pediatric medical device prototype delivered

History

Investing in our future:

Return on investment
Of the initial partnership funds, a joint investment of $3.2 million in seed grants resulted in a 6:1 return, or nearly $18.6 million in extramural funding.

Faculty: 83 total
- Center for Pediatric Innovation: 30
- Center for Pediatric Nanomedicine: 10
- Center for Transforming Pediatric Healthcare Delivery: 30
- Innovation Quick Wins: 10
- Pediatric Manufacturing: 3

Reputation
- 5 patents filed
- 54 joint publications
- 1,074 citations of joint research
Nanoparticle technology provides new drug delivery intervention for blood disorders

The Aflac Cancer and Blood Disorders Center of Children’s Healthcare of Atlanta follows more than 2,500 children and teens with blood disorders, including sickle cell disease, hemophilia and others, through its programs every year.

A research team from Children’s and Georgia Tech has developed artificial platelets with the goal of being able to infuse them into a patient to start the healing process at the site of an injury. The artificial platelets are composed of nanoparticles and function as a new smart drug delivery system, in which the nanoparticles become functional only at the site of injury and augment the blood clotting process. The clotting particles, which are based on soft and deformable hydrogel materials, are triggered by the same factor that initiates the body’s own clotting processes.

“For a patient with insufficient platelets due to bleeding or an inherited disorder, physicians often have to resort to platelet transfusions, which can be difficult to obtain,” said Wilbur Lam, M.D., a physician in the Aflac Cancer and Blood Disorders Center and an assistant professor in the Coulter Department of Biomedical Engineering at Georgia Tech and Emory University.

“These particles could potentially be a way to avoid the need for a transfusion. Though they don’t have all the assets of natural platelets, a number of intriguing experiments have shown that the particles help augment the clotting process.”

In addition to providing new treatment options, the particles could also cut costs by reducing expensive natural transfusions.
Anna Malcom, 15, is a frequent visitor to the Children’s Healthcare of Atlanta Sibley Heart Center. Before she was born, an ultrasound revealed that Anna would have a complex series of problems with her heart’s ventricles and valves. Her heart was pumping blood in all the wrong directions: oxygenated blood was going back to her lungs, and un-oxygenated blood was going out into her body. As a young child, Anna went through three open heart surgeries to reroute the blood flow from her heart to her lungs. The third was called a Fontan procedure.

A particularly complex reconstructive surgery for children with congenital heart defects, the Fontan procedure has been made much safer and more effective for children by experts at Children’s and Georgia Tech. Kirk Kanter, M.D., Director, Heart Transplant Program at Children’s and Professor of Cardiothoracic Surgery at Emory, has teamed up with Georgia Tech’s Ajit Yoganathan, a world leader in computational methods, to analyze cardiovascular systems and develop a computer simulation of this complex surgery using images of the individual patient’s anatomy.

By generating a 3-D image of a patient’s heart, this computer program helps surgeons determine where blood vessels should be attached so they can ensure the blood flows as it should. Surgeons can test procedures by moving arteries around virtually, closing holes and seeing the heart’s output to the body and lungs for any given technique, all before making an incision. Because there’s no one-size-fits-all approach for fixing these complicated heart problems, the simulator takes into consideration the age, sex and disease state of the patient. It customizes the surgery for each patient, advancing the goal of personalized precision medicine.

Anna’s Fontan procedure worked for a while, but when she started getting sick again, they went in for a fourth surgery—the Fontan revision. This time, Dr. Kanter had a perfect 3-D computer model of Anna’s heart on which he could perform a virtual surgery to explore various surgical options for correcting Anna’s heart problems before the actual operation. Dr. Kanter typically performs four or five virtual surgeries before he operates, and the Georgia Tech team looks at how each option would affect the patient’s heart function.

For Anna, the fourth surgery seems to be the charm. She’s feeling stronger and more energetic. “She can actually get out and do things,” her mom said. “I think she’s doing well. She’s doing really well.”

Cardiothoracic surgeons from around the country and as far away as Switzerland have sent cases to Children’s and Georgia Tech for consultations using this technology. The research team hopes to use the computer model to create simulations for other childhood diseases and surgeries.

Improving asthma outcomes through texting

Researchers from Children’s and Georgia Tech have identified a way to improve the health of children with asthma, the leading cause of hospitalization for Georgia kids ages 5 to 9, through text messages. Communication with the entire family is a priority when it comes to keeping kids out of the hospital, and smartphones can play an important role. More than 85 percent of applicants to Women, Infants and Children (WIC), the federal supplemental nutrition program, have a smartphone.

The research team assembled a group of cellphone-carrying kids ages 9 to 15 with asthma and sent daily text messages with questions about their symptoms and information that debunked common asthma myths. They found that communicating with pediatric asthma patients in this way led to improved pulmonary function. Just two texts a week helped educate patients about asthma and generated positive results. Children’s and Georgia Tech are also beginning to develop an icon-based asthma action plan-app, allowing users to open their personal asthma action plan with a smartphone and follow along regardless of language or reading level.
iEAT app helps children with feeding disorders

When he was eight months old, Hudson Day stopped eating and drinking. Born with a lung disease that requires him to take supplementary oxygen full time, Hudson was having difficulty breathing, which affected his ability to eat. Hudson lost so much weight in four days that an emergency medical helicopter was called to fly him from his home in Jackson Hole, Wyo., to a medical center in Denver, Colo. Doctors inserted a feeding tube into Hudson’s stomach to keep him alive.

Three to five percent of children in the United States have feeding disorders so serious they live on feeding tubes. Marcus Autism Center is a world leader in treating these disorders in children, but there is a waiting list of more than 300 children, and there are very few people trained in treating these patients.

Georgia Tech and Children’s have developed an app that would make it easier to train additional clinicians, resulting in more children getting the help they need more quickly. The app, called iEAT, walks clinicians through the treatment process step by step. It also collects data in real time, allowing doctors and clinicians to discuss the results with parents immediately.

Hudson’s feeding therapy was the first use of iEAT following the completion of clinical trials on the technology. The feeding program lasted for eight weeks, during which doctors used the app to track Hudson’s progress toward eating food and relying less on the feeding tube. The app would then make suggestions on how to advance Hudson’s feeding therapy based on positive or negative reactions to food in previous sessions.

Treatment of pediatric feeding disorders usually takes several weeks of therapy and can cost up to $60,000. In testing, the iEAT app has been highly effective at helping children with mild disorders, allowing Marcus Autism Center to help kids more efficiently and ensuring that the most severe cases receive the extra attention required for the patients to develop healthy eating habits.

Researchers hope to make the app widely accessible so that one day parents can learn and carry out this therapy in the comfort of their own homes, with only the most challenging cases being treated at Marcus Autism Center.

Hudson finished his program at Marcus Autism Center before he turned 2, and he has not needed the feeding tube since returning to Wyoming. Hudson is now eating 1,400 calories a day from a spoon, in a regimented feeding schedule where meals take 30 to 45 minutes to consume.

“This program has been a complete life-changer,” said Melinda, Hudson’s mother.

Not long after his second birthday, Hudson had a breakthrough—he ate a peanut butter and jelly sandwich. It was the first time he had chewed food.

“Microscopic cardiac muscle

Training young hearts to heal themselves

Children’s Healthcare of Atlanta treats more than 150 pediatric cardiology patients with long QT syndrome, a genetic defect that can result in a lethal arrhythmia, or irregular heartbeat. This syndrome currently has no cure. Our researchers and physicians are working together to develop a stem cell therapy that treats the problem by telling the heart when to beat. Researchers hope to teach stem cells how to grow in the lab and then place them back into the patient where they will grow, spread and fix the problem.

“Our current goal is to demonstrate that we’re able to genetically cure the disease using this process,” said Kevin Maher, M.D., Pediatric Cardiologist at Children’s. The process begins with a skin biopsy that is turned into stem cells. Those stem cells become heart cells, or cardiomyocytes. Doctors isolate the DNA in those heart cells and correct it using genetic mutations.

“Microscopic cardiac muscle

“It’s often hard to connect this exciting research to clinicians and human subjects, but through this partnership with Children’s, the doctors become part of the science. It’s enormously satisfying and rewarding to see these tough problems being solved.”
With the official launch of our partnership in 2012, Children’s and Georgia Tech laid the foundation of clinicians and engineers working together toward pediatric solutions. Today we have an integrated infrastructure of people working together, doing research across disciplinary and institutional boundaries, and a host of shared labs and buildings where this groundbreaking research takes place:

- Engineered Biosystems Building
- Pediatric Technology Center
- BioQuad
- Marcus Nanotechnology Building
- Glen P. Robinson (Saat) Molecular Science and Engineering Building
- Parker H. Pett Institute for Bioengineering and Biosciences
- Ford Environmental Science and Technology Building
- U.A. Whitaker Biomedical Engineering
- Tech Square
- Tech Square Research Building Centergy
- Georgia Tech Research Institute
- Ivan Allen College of Liberal Arts
- H. Milton Stewart School of Industrial and Systems Engineering (ISyE) Annex
- Christopher W. Klaus Advanced Computing Building
- Global Center for Medical Innovation

Visit choa.org/pediatrictechnologycenter to find out more about the partnership between Children’s and Georgia Tech and how you can support this work.

**Sensing danger in the NICU**

In the Neonatal Intensive Care Unit (NICU), identifying which infants are most at risk for serious complications can be a challenge. The machines and sensors in the NICU collect massive amounts of information on each tiny patient, but there hasn’t been a way to analyze all the data at once until now.

Our collaborative research team is developing a new system that is expected to find clues in the unused data that could help save the lives of these fragile infants.

The system serves as an automated triage tool, analyzing information from various NICU technologies to help doctors more quickly determine when a baby’s life is in immediate danger.

This new system will use data analysis to predict hard-to-diagnose, potentially deadly conditions like necrotizing enterocolitis (NEC), primarily seen in premature infants, before any clinical signs. It may also provide doctors with the information needed to customize care so that the tiny infants get the right tests and avoid unnecessary ones.