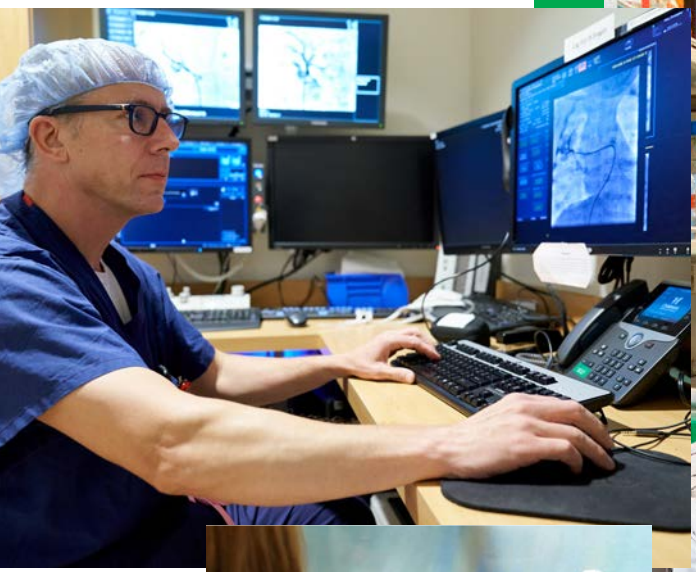
Children's℠ Healthcare of Atlanta



Breaking barriers and fighting for the future

Children's and Emory University School of Medicine Department of Pediatrics Research Report

EMORY UNIVERSITY

A message from Dr. Lucky Jain

Dear friends,

This past year, a novel coronavirus changed our world in a way we never imagined. COVID-19 challenged us to think and operate differently. Our academic enterprise has an extensive footprint, with a multi-institutional research enterprise and the largest pediatric training program in the Southeast. At short notice, research operations needed to be ramped down, precious laboratory resources secured and clinical trials scaled down to just those deemed critical. More than 300 trainees were placed under a pandemic emergency and extensive plans were put in place for their deployment, safety and efficiency. I am proud to say that our teams have exceeded all expectations in achieving these goals and are leading the way in COVID-19 science and discovery.

Children's Healthcare of Atlanta and Emory University School of Medicine scientists have focused on four broad areas:

- Unraveling the pathophysiology of COVID-19 and its propensity to create an intense inflammatory response, including the Multisystem Inflammatory Syndrome in Children (MIS-C)
- Understanding the immune response to this novel virus, serology and vaccine development
- Acceleration and validation of COVID-19 testing approaches, including an engagement with the National Institutes of Health (NIH) Rapid Acceleration of Diagnostics (RADx) program
- Drug discovery efforts to help treat severely affected cases

Currently, we have dozens of investigator-led COVID-19 projects underway. Most notable is our participation through Wilbur Lam, MD, PhD, a Pediatric Hematologist/Oncologist at the Aflac

Cancer and Blood Disorders Center of Children's, Associate Professor of Pediatrics and Biomedical Engineering at Emory University, and Chief Innovation Officer at the Pediatric Technology Center with Emory University and Georgia Institute of Technology, in the RADx program to validate and accelerate COVID-19 diagnostic testing and clinical trials of two high-profile COVID-19 vaccine candidates at the Emory Children's Center Building through Evan Anderson, MD, Infectious Disease Physician at Children's and Professor of Medicine and Pediatrics at Emory University.

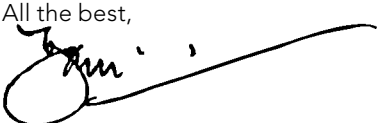
Our record high level of funding for grants and contracts for fiscal year 2020 to the Emory University Department of Pediatrics investigators has pushed us into a new level of national preeminence. We received $111.8 million in total extramural funding and $97 million in NIH funding, our highest NIH funding ever.

We have also had a banner year of philanthropy, with a $200 million gift from the Arthur M. Blank Family Foundation for the North Druid Hills campus at Children's, a $90 million gift from the Robert W. Woodruff Foundation to recruit leading clinicians and scientists for the next phase of our research expansion, and a large multiyear gift from the Lettie Pate Evans Foundation to support the largest-ever expansion of our Graduate Medical Education Program.

Children's is ranked among the nation's top pediatric hospitals by U.S. News & World Report, with four specialties ranked in the top 10 and eight specialties ranked in the top 20. Atlanta Magazine has also recognized a record number of Children's and Emory University physicians as Atlanta's top doctors.

With so much to report, I am delighted to share highlights of our accomplishments in the 2020 Children's and Emory University Department of Pediatrics Research Report. We are confident the efforts put in by clinicians and scientists on these extraordinary projects will improve clinical care, research and education for generations to come!

All the best,



Lucky Jain, MD, MBA
Chief Academic Officer,
Children's Healthcare of Atlanta
George W. Brumley Jr. Professor and Chair,
Emory University School of Medicine Department of Pediatrics

Partnering to save lives and make history

Children's and Emory University work together to facilitate leading-edge pediatric research, training and innovation. This long-standing partnership between one of the country's largest freestanding pediatric healthcare systems and a leading research university is mutually beneficial. Emory University's expertise and oversight are invaluable during clinical trials, and Children's provides a training site for the Emory University Pediatric Residency Program. Discoveries in Emory University's research laboratories are deployed in real lifesaving situations at Children's. Together, our partnership advances research and facilitates evidence-based quality care for children.

Children's℠ Healthcare of Atlanta

EMORY UNIVERSITY

In 1956, the board of trustees for both Emory University and the former Henrietta Egleston Hospital for Children signed an agreement to make Egleston a first-rate teaching hospital.

Research by the numbers

$97 million
in funding from NIH—
a new record*

$111.8 million
in total extramural funding

4,588
Children's patients enrolled in clinical research

443
Children's patients participated in clinical trials

1,732
publications

6
newly recruited investigators

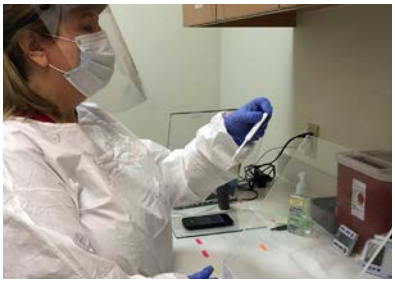
680
residents and fellows trained

1,266
hours of CME credits through
244
educational activities

Visit **choa.org/research** to learn more.

*NIH funding period from Oct. 1, 2019, through Sept. 30, 2020

Fighting COVID-19 with what we do best: Research



Cheryl Stone, Clinical Research Manager, validates a COVID-19 diagnostic test.

Greg Martin, MD, MSc

Wilbur Lam, MD, PhD

Oliver Brand, PhD

Verifying COVID-19 diagnostic tests

Children's, Emory University and Georgia Tech were entrusted to lead a national effort in COVID-19 diagnostic tests validation and verification. With a total of $54 million in funding from the RADx program, Children's, Emory University and other institutions are leading the initiative designed to transform innovative technologies into widely accessible COVID-19 diagnostic testing. The goal is to make millions of accurate and easy-to-use COVID-19 tests available for at-home or other point-of-care use. Under the direction of co-principal investigators Dr. Lam, Greg Martin, MD, MSc, Director of the Predictive Health Institute and Center for Health Discovery and Well-Being at Emory University and Georgia Tech, and Oliver Brand, PhD, Executive Director for the Institute for Electronics and Nanotechnology at Georgia Tech, the initiative is delivering essential data to the NIH to help determine which tests merit additional federal support to progress to market.

Because we transformed early, innovative technologies into widely accessible COVID-19 diagnostic testing, Children's in collaboration with our academic partner, Emory University, was awarded **$31 million—the largest NIH grant ever received** by Children's or Emory University in a single fiscal year.

We're on the front lines of COVID-19 vaccine research

Emory University was the second site in the nation to enroll volunteers in the initial Phase 1 trial of the COVID-19 vaccine, mRNA-1273, which was co-developed by researchers at the National Institute of Allergy and Infectious Diseases and biotech

company Moderna Inc. Our testing, led by Dr. Anderson, helped demonstrate the vaccine to be 94.1% effective at preventing COVID-19. Additionally, Dr. Anderson was instrumental in a large trial of another vaccine candidate developed by the Janssen Pharmaceutical Companies of Johnson & Johnson to assess if a single-dose vaccine can protect people against COVID-19.

Evan Anderson, MD

Putting kids first during the pandemic

Dr. Anderson, a Principal Investigator for the Moderna trial of the investigational vaccine mRNA-1273, published a paper in *Clinical Infectious Diseases* arguing that delays in starting COVID-19 vaccine clinical trials in children would prolong overall recovery from the global pandemic. Availability of a vaccine for children, he argued, could facilitate return to school and other activities—critical for their well-being. As always, Children's puts children first.

Zahidee Rodriguez, MD

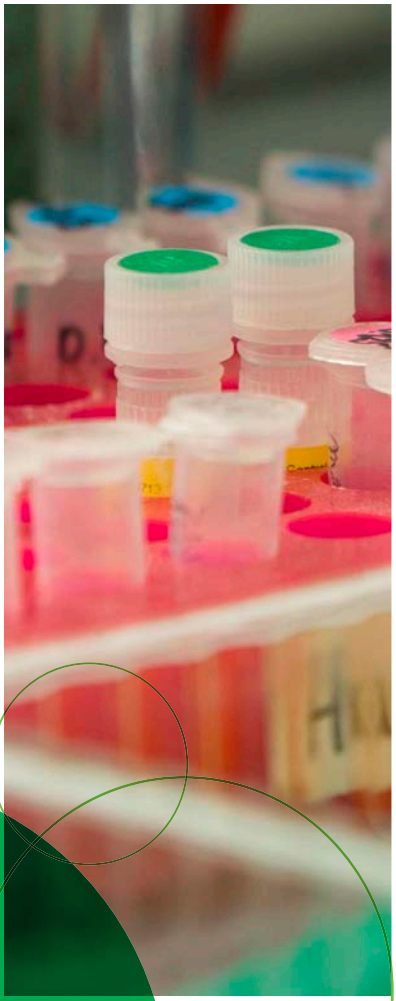
Successfully treating pediatric COVID-19 with an experimental treatment

Zahidee "Saidie" Rodriguez, MD, Assistant Professor of Pediatrics at Emory University, wrote, "The convalescent plasma helped our patient through the COVID-19 infection and was very well tolerated," in a paper she published in *Blood Advances*. A multidisciplinary team of experts, including Cassandra Josephson, MD, a Pathologist at the Aflac Cancer and Blood Disorders Center, collaborated to guide the infusion process. The COVID-19 infection cleared, and the patient was healthy enough to undergo heart surgery. It was an extraordinary outcome during an extraordinary time.

Joanna Newton, MD

Helping solve the PPE crisis for frontline healthcare workers

Joanna Newton, MD, a Pediatric Hematologist/Oncologist at the Aflac Cancer and Blood Disorders Center, led a team working to develop mass manufacturable medical face shields. Working in collaboration with Georgia Tech researchers and students, the Children's Healthcare of Atlanta Pediatric Technology Center, Georgia Tech and the Global Center of Medical Innovation, the team sought to help make sure frontline healthcare employees had access to personal protective equipment (PPE) as supplies became depleted due to COVID-19. The goal was to produce hundreds of these shields each day to provide to hospitals, as well as to give the open-source design to others to fabricate anywhere around the world. Over the course of the pandemic, more than two million face shields were delivered nationwide. This project was unwritten and supported by Aflac Inc.



Recognized for our pediatric research efforts

Our people are doing everything they can to fight the pandemic and they've recently been recognized for it. Emory University's Woodruff Health Sciences Center has named award recipients for the latest cycle of Synergy Awards. The recipients were recognized for their longitudinal surveillance study of antibodies to SARS-CoV-2 in pediatric healthcare workers, enrolling more than 640 participants. The team includes:

- Miriam B. Vos, MD, MSPH, Co-PI (Medicine/Pediatrics)
- Travis Sanchez, DVM, MPH, Co-PI (Public Health/Epidemiology)
- Claudia R. Morris, MD (Medicine/Pediatrics)
- Andrés Camacho-González, MD (Medicine/Pediatrics)
- Srikant Iyer, MD (Medicine/Pediatric Emergency Medicine)
- Patrick Sullivan, DVM, PhD (Public Health/Epidemiology)
- Mehul Suthar, PhD (Medicine/Infectious Diseases, Pediatrics)
- Jens Wrammert, PhD (Medicine/Pediatrics)

On the front lines: Testing COVID-19 treatments

When the National Institute of Allergy and Infectious Diseases needed to evaluate the safety and efficacy of a treatment regimen of remdesivir, plus baricitinib, in COVID-19 patients, they turned to us. Raymond F. Schinazi, PhD, DSc, the Frances Winship Walters Professor of Pediatrics at Emory University, was one of the lead virologists on the study, which sought to determine the drug combination's efficacy in combating the inflammatory response in the lungs during COVID-19 infections. The team's experience with infectious diseases, as well as their previous work with baricitinib, made them logical choices for the joint project with Eli Lilly. For the past eight years, Dr. Schinazi, Vincent C. Marconi, MD, Professor of Medicine and Global Health in Emory University, and Christina Gavegnano, PhD, Assistant Professor of Pediatrics at Emory University, have been exploring the role of baricitinib as a treatment for patients with HIV.

Beyond the pandemic

Launching research into space

Seeking additional treatment options for kids with heart diseases, Chunhui Xu, PhD, Director of the Cardiomyocyte Stem Cell Laboratory at Emory University, and Kevin Maher, MD, a Pediatric Cardiologist at Children's, sent stem cells to the International Space Station on board a SpaceX resupply launch. Their research sought to learn whether cardiac cells created from the stem cells would multiply more quickly in the weightless environment of space.

Their work could have an important clinical impact for the field, including the research of Michael Davis, PhD, Director of the Children's Heart Research and Outcomes (HeRO) Center. He is looking into 3D-printing aortic valves made from a patient's own stem cells. His approach would allow for custom-size valves that could grow with the child, eliminating the need for replacements. And because the valve is made from the child's own cells, there would be no need to take anti-rejection drugs. The only issue is making enough cardiac cells, which is where Dr. Xu's research fits in. Sometimes, in research, you have to shoot for the stars.

Kevin Maher, MD; Chunhui Xu, PhD; and Antonio Rampoldi, PhD

Brian Vickery, MD

Introducing life-changing treatment for peanut allergies

Earlier this year, Brian Vickery, MD, Director of the Children's Food Allergy Program, administered the first-ever dose of Palforzia, a newly U.S. Food and Drug Administration (FDA)-approved oral immunotherapy treatment (OIT) for patients with peanut allergies. The treatment, which involves giving gradually increasing amounts of peanut protein to patients with peanut allergies, could potentially protect peanut-allergic children from severe reactions due to accidental exposures. Though it is not a complete remedy, Palforzia allows kids with peanut allergies to live with a little less fear of having a life-threatening reaction. But the work isn't done, and Dr. Vickery and his team continue their ongoing research into peanut and other food allergies, including participating in the OUtMATCH clinical trial for multi-food allergies, in search of better futures for children and, one day, maybe even a cure.

Jason Fangusaro, MD

Redefining the standard of care for brain tumors

Jason Fangusaro, MD, Director of Developmental Therapeutics at the Aflac Cancer and Blood Disorders Center, is exploring a new targeted treatment that could replace chemotherapy as the standard treatment for patients with low-grade glioma, the most common form of pediatric brain cancer. Dr. Fangusaro is overseeing a trial comparing the two treatments, which is one of the first in over a decade to study a frontline therapy in children with newly diagnosed low-grade glioma. The trial, which is sponsored by Children's Oncology Group (COG), a National Cancer Institute (NCI)-supported clinical trials group and the world's largest organization for childhood and adolescent cancer research, could revolutionize the treatment of pediatric brain tumors.

From research to practical technology

Dr. Lam and his post-doctoral fellow, Rob Mannino, PhD, are making giant leaps forward in the noninvasive detection of anemia—and they're being recognized for it. Results from their work developing the smartphone anemia app, AnemoCheck Mobile, were selected for publication in *Nature Communications*, and the app was later chosen as one of the top three new technologies in the NIH Technology Accelerator Challenge. Instead of a blood test, the app uses photos of an individual's fingernails taken on a smartphone to determine whether the level of hemoglobin in their blood is low. It is available on Google Play.

Reducing pain for sickle cell disease patients

A study being conducted by Claudia Morris, MD, a Pediatric Emergency Medicine Physician at Children's, could be life-changing for patients with sickle cell disease. The study, funded by $8.7 million from the NIH, seeks to determine whether giving additional arginine can reduce the length and severity of a sickle cell disease pain crisis. Dr. Morris will lead the multicenter study of intravenous arginine therapy in collaboration with Carlton Dampier, MD, and Nitya Bakshi, MD, both pediatric hematologists and oncologists at the Aflac Cancer and Blood Disorders Center. Children's and Emory University serve as the lead sites and clinical coordinating centers among 10 sites through the national Pediatric Emergency Care Applied Research Network (PECARN) during the six-year study. At the end of the study, arginine could be an important addition to the arsenal of therapies available to treat sickle cell disease pain, perhaps even helping to lessen pain during an episode.

Nicholas Fletcher, MD

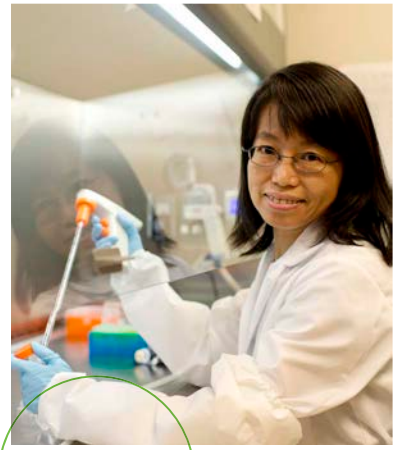
Getting kids back on their feet and back in school

Opioids are part of any spinal fusion recuperative regime, but using too many is never productive. Nicholas Fletcher, MD, Medical Director of Spine Quality and Outcomes at Children's, is looking for a solution, and he may have found one in a steroid treatment. According to findings that Dr. Fletcher published in the *Journal of Bone and Joint Surgery*, Vol. 00-A, No. 00., teens undergoing posterior spinal fusion surgery for adolescent idiopathic scoliosis (AIS) decreased post-operative opioid use by 40% when steroids were added to their pain management treatment. Not only that, but they walked sooner and left the hospital earlier. Most importantly, their risk of significant opioid use is dramatically diminished.

Collaborating in the fight against cystic fibrosis

Thanks to a $1.7 million grant from NIH, the Emory and Children's Cystic Fibrosis Center of Excellence has established the Georgia Cystic Fibrosis Research and Translation Core Center to solve critical problems associated with cystic fibrosis (CF) and focuses on non-pulmonary aspects of CF. The grant will leverage activities not only at Emory University and Children's, but at Georgia Tech and Augusta University. The association with Augusta University is important, as it is home to the Medical College of Georgia, which is the location of the only other CF Foundation-accredited CF Care Center in Georgia. The 61 investigators participating in this proposal reported $45.4 million active total funding as of August 2019, much of which is for CF-related projects.

A generous gift. A new hospital. A new era.



Chunhui Xu, PhD

Next-level funding leads to next-level research

The Robert W. Woodruff Foundation's $90 million grant to Children's and the Emory University Department of Pediatrics solidifies Atlanta's role as a major center for pediatric research. Children's position as a major hub of groundbreaking pediatric research will only be enhanced as leading pediatric researchers are drawn to the Atlanta area by the endowment. Children's and Emory University already rank among the best children's hospitals for research for the treatment of autism spectrum disorder, sickle cell disease and congenital heart disease. The $90 million grant will help Children's and Emory University continue to invest in those fields, as well as boost our research in other areas of pediatric health, such as gene therapy, stem cell therapy and food allergies. With the grant, the Woodruff Foundation recognized that Children's, Emory University, Georgia Tech and institutions like the Centers for Disease Control and Prevention (CDC) make the Atlanta community a fertile and promising area for pediatric research.

Arthur M. Blank

Children's announces Arthur M. Blank Hospital

Children's is opening a 1.5-million-square-foot hospital that will be designated as the only dedicated Level 1 pediatric trauma center in Georgia. Set to open in 2025, Arthur M. Blank Hospital will help accelerate research by creating a dedicated space for breakthroughs, including clinical research, clinical trials and overall patient care. Together with our neighboring academic and scientific institutions, we'll make even greater strides to help ensure swifter recoveries, develop more effective treatments and even discover cures.

Emory University breaks ground on innovative biomedical research facility

A new eight-story facility, the Health Sciences Research Building II (HSRB II), will be a dedicated research space for imaging sciences, biomedical engineering, cardiovascular medicine, children's health like cancer, adult cancer, inflammation, immunity and immunotherapeutics, emerging infections and other cutting-edge interdisciplinary research programs. The new facility will be funded in part by a generous $400 million gift from the Woodruff Foundation, with $200 million of that gift directed to biomedical research. Children's provided $46 million in funding for the soon-to-open HSRB II at Emory University. Approximately two floors of laboratory space in the new building will be reserved for pediatric research.

We have a bold, five-year plan

Over the next five years, we will accelerate research in a number of critical disciplines. And we'll implement growth plans for research and education by recruiting 30 new investigators and 45 medical residents and pediatric subspecialty fellows.

- **Pediatric technologies** will focus on microsystems-engineered point-of-care technologies, nanomedicine for pediatric cancers and technology-enabled tissue engineering, such as 3D printing and bioprinting.
- **Health disparities research** will include outcomes and population-based research, growing our Sickle Cell Disease Program, and behavioral and mental health initiatives.
- **Sickle cell disease** will highlight stem cell biology, the basis for blood formation; cellular therapies, including stem cell transplant and gene-based therapy; and drug discovery and development, including small molecules and biologicals.
- **Behavioral and mental health** will enhance behavioral and mental healthcare, improve access to community resources, pioneer prevention through innovative programs, and build a strong foundation through leadership recruitment and partnerships.
- **Cell therapies** will establish the Center for Pediatric Cellular Therapy, involve rapid translation of "homegrown" discoveries into early phase clinical trials and expand capacity for infusion treatments.
- **Clinical informatics** will accelerate the development of evidence-based practices and their implementation into clinical care by partnering with frontline doctors and nurses, data analysts and electronic health record (EHR) developers.
- **Bioinformatics** will nurture next-generation genome and large biological data-driven discoveries for better treatment of complex and heterogeneous diseases.

Our pediatric research enterprise has experienced astounding growth over the past decade, positioning Children's and Emory University as a leader in child health research. We are proud to share with you these examples of some of the exciting work that reflects this progress. As we look to the future, we will continue to leverage our nationally leading clinical volumes and the unique partnership of Children's, Emory University and Georgia Tech to improve the health of children in Georgia, across the nation and around the world. We will never settle for less.

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