Transfer to Transform

THE OFFICE OF TECHNOLOGY COMMERCIALIZATION
AT NATIONWIDE CHILDREN'S HOSPITAL

SPRING 2015

NATIONWIDE CHILDREN'S

When your child needs a hospital, everything matters.℠

Our Mission

The Research Institute at Nationwide Children's Hospital is dedicated to enhancing the health of children by engaging in high-quality, cutting-edge research according to the highest scientific and ethical standards.

The Office of Technology Commercialization at Nationwide Children's facilitates the transfer of new technologies, research and innovations to outside partners to benefit pediatric care, our community and the general public.

Affiliations

Rev1 Ventures partners with The Research Institute at Nationwide Children's Hospital to accelerate the formation and growth of life science companies in central Ohio. Through our partnership, we seek out high growth opportunities and advise entrepreneurs who are developing innovative therapies and technologies at Nationwide Children's. The goal is to improve children's health in central Ohio and throughout the world by catalyzing ideas developed by innovators and researchers who may provide solutions that improve patient outcomes.

As Ohio's bioscience membership and development organization, BioOhio is focused on networking the state's outstanding bioscience assets to accelerate growth of a globally competitive bioscience industry. High on this list of assets is pediatric research, in which Nationwide Children's exhibits leadership every day. The Research Institute at Nationwide Children's has been a Pillar Member of BioOhio for the past seven years.

13 RESEARCH CENTERS

- Battelle Center for Mathematical Medicine
- Biobehavioral Health
- Biopathology Center
- Cardiovascular and Pulmonary Research
- Childhood Cancer and Blood Diseases
- Clinical and Translational Research
- Gene Therapy
- Injury Research and Policy
- Innovation in Pediatric Practice
- Microbial Pathogenesis
- Molecular and Human Genetics
- Perinatal Research
- Vaccines and Immunity

NATIONWIDE CHILDREN'S HOSPITAL START-UPS

2102

milo BIOTECHNOLOGY

2013

avexis

Abeona THERAPEUTICS Working together to find a cure.

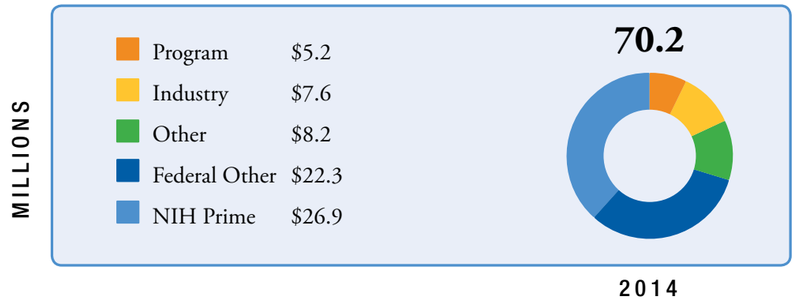
2014

GENOME NEXT

LATTICE BIOTECH

Aggregate Financing of Start-Ups as of Q4 2014: > 22 M

2014 EXTERNAL AWARDS BY SOURCE



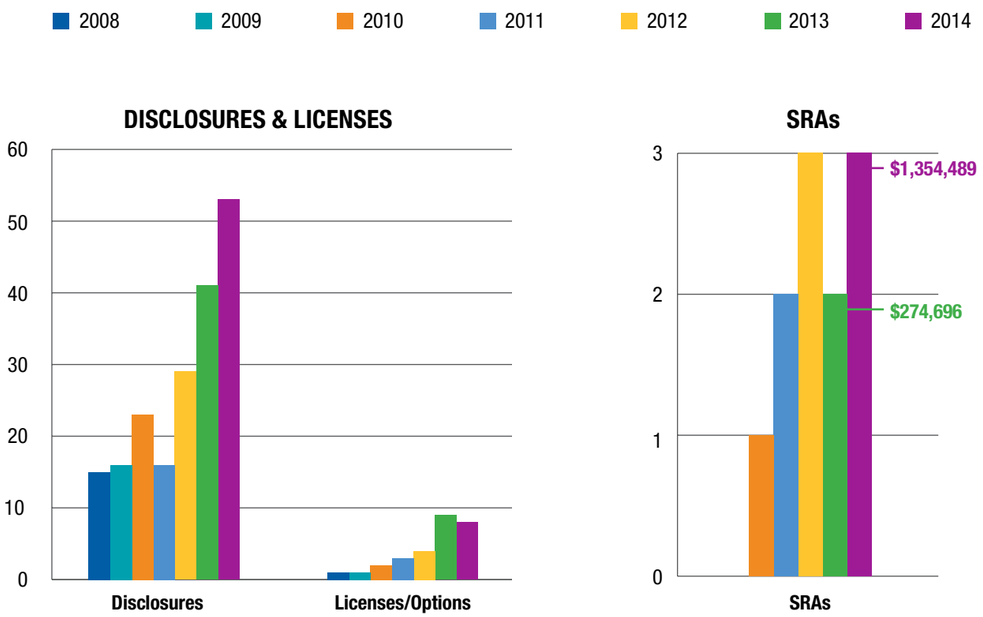
RESEARCH FUNDING BY THE NUMBERS

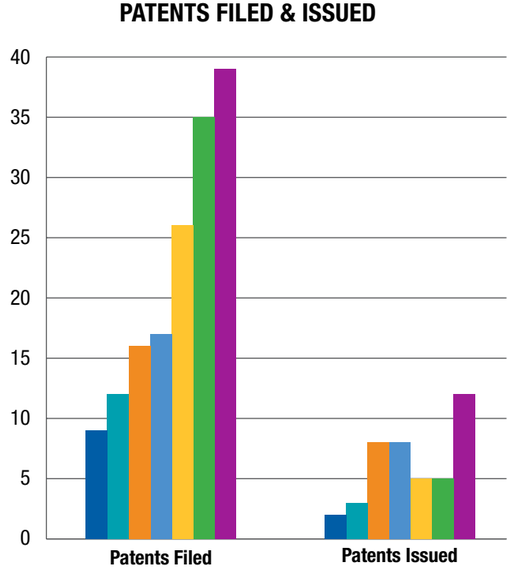
From research funding support and publications, to patents and inventions, The Research Institute at Nationwide Children's continues to grow each year.

	2012	2013	2014
Principal Investigators*	160	161	166
Research Fellows	51	55	61
Graduate Students	43	45	44
Employees	934	1007	1103
Publications	522	609	713
Patents Filed	27	35	39
Patents Issued	5	5	12
Inventions	29	41	53

**Includes faculty from The Research Institute and faculty from Nationwide Children's Hospital with $50,000 or more in research funding support.*

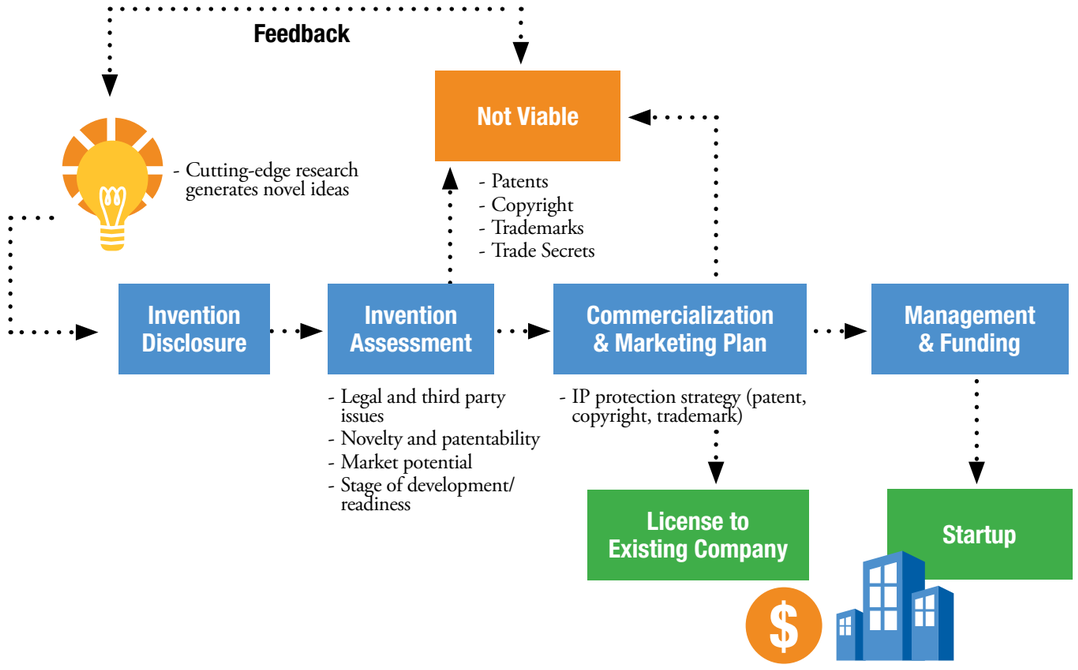
Metrics



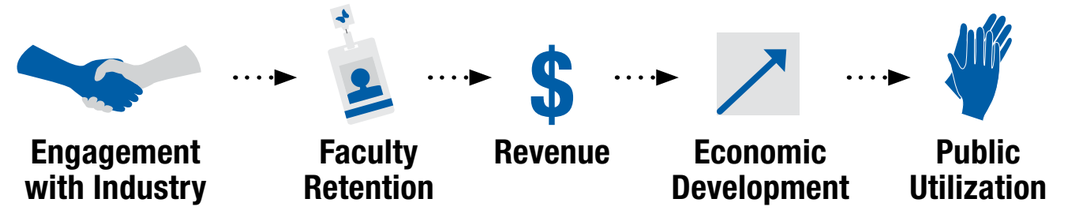


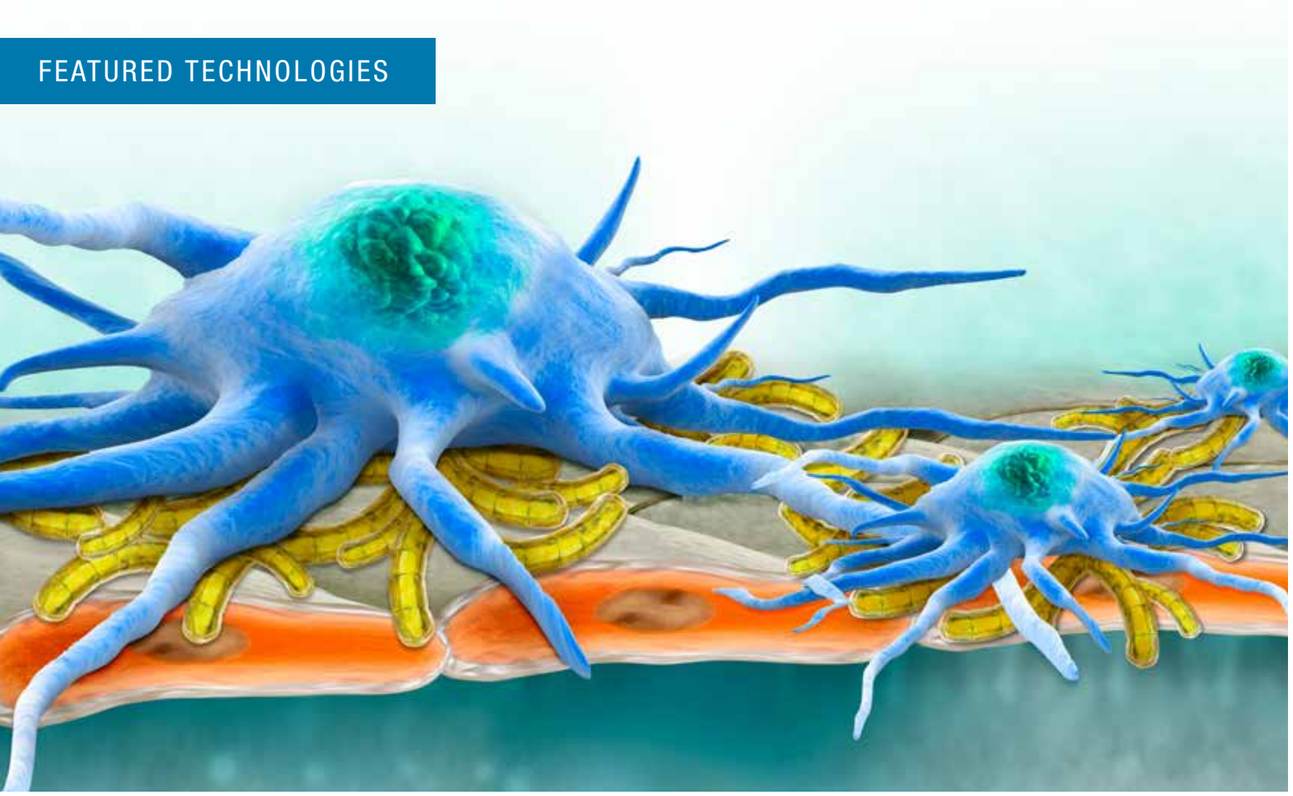
Our Process

When our doctors, nurses, researchers and other staff members have an idea, they head to our Office of Technology Commercialization. Together, we take these ideas and innovations and translate them into the commercial sector, bringing about new patents, start-up companies and innovations.



GOALS FOR TECHNOLOGY COMMERCIALIZATION





Research on Exosomes Holds Promise for Detecting and Treating Fibrosis

Fibrosis, chronic scarring that can interfere with organ function, accounts for up to 45% of deaths in the developed world, but there are no FDA-approved anti-fibrotic therapies currently available. More than 100 liver diseases and a wide variety of other medical complications can cause liver fibrosis in children. Estimates suggest that as many as one in every 10 U.S. children have fatty livers, a major risk factor for developing future liver fibrosis.

Biopsies are the gold standard for measuring liver fibrosis, but this approach is subject to errors in sampling and is highly invasive, carrying rare but significant risks of complications and presenting obstacles for patients who need to be tested repeatedly. And although imaging technologies are evolving rapidly and have the advantage of being noninvasive, readings may not provide the desired discrimination and can be skewed by the presence of other liver pathologies.

"Theoretically, this concept could be applied to any organ, since the process of fibrosis and collagen production is very similar throughout the body."

–David R. Brigstock, PhD

A simple blood or urine test that can accurately measure the severity of scarring in internal organs would help hundreds of thousands of people — adults and children alike — to avoid risky biopsies and expensive imaging tests each year.

The research of David R. Brigstock, PhD, principal investigator in the Center for Clinical and Translational Research in The Research Institute at Nationwide Children's Hospital, has identified a striking way to resolve both the diagnostic and therapeutic challenges of fibrosis with a molecular answer: exosomes.

Exosomes are tiny vesicles that carry molecular information from cell to cell, serving as communicators. They travel, making their way into the bloodstream when secreted by liver cells. This activity of exosomes inspired Dr. Brigstock's idea for a novel blood test to indicate the presence and severity of liver fibrosis.

"If we can 'read' the molecular information being conveyed in exosomes, we may be able to filter out the molecular messages related to liver fibrosis and use them as biomarkers for assessing different levels of scarring," says Dr. Brigstock. "Theoretically, this concept could be applied to any organ, since the process of fibrosis and collagen production is very similar throughout the body."

Dr. Brigstock and his research team found that exosomes from healthy cells contain molecular signals reflective of a healthy state, and these exosomes can be delivered to fibrotic cells to mitigate or reverse fibrosis. This novel therapy will have an impact on numerous diseases, including liver disease, cardiovascular diseases, pulmonary fibrosis, kidney disease and macular degeneration.

"Exosomes appear to be critical in telling other cells whether to increase or decrease their production of fibrosis-inducing molecules such as connective tissue growth factor," says Dr. Brigstock. "The molecular information packaged into exosomes changes dynamically according to the status of the cell that loaded it up and sent it off into the world. In turn, this information is conveyed to neighboring cells that respond according to the exosomal messages received."

In research published in the journal Hepatology, Dr. Brigstock's team demonstrated that mouse models benefit from exosome therapy — within a week, fibrosis disappeared when exosomes from healthy mice were injected into mice with induced liver fibrosis. The Research Institute at Nationwide Children's Hospital has filed a patent to protect the methods and the process that were employed to complete this work, and are currently developing a commercialization plan for the technology and selecting the appropriate first path to market.

"When you test these approaches in animal models, you don't really get a sense of whether they'll work in people, so I'd ideally like to see exosomal therapy proven in other models of fibrosis and then investigated in clinical trials," explains Dr. Brigstock. "It may be a difficult path to tread, but I have an innovative and resourceful team working on this project, and I think it's the most exciting work that we've participated in during the nearly 25 years I've been at Nationwide Children's."

RELATED CITATIONS:

Charrier A, Chen R, Chen L, Kemper S, Hattori T, Takigawa M, Brigstock DR. Exosomes mediate intercellular transfer of pro-fibrogenic connective tissue growth factor (CCNS) between hepatic stellate cells, the principal fibrosis cells in the liver. *Surgery.* 2014 Sep, 156(3):548-55.

Chen L, Charrier A, Zhou Y, Chen R,Yu B, Agarwal K, Tsukamoto H, Lee LJ, Laulaitis ME, Brigstock DR. Epigenetic regulation of connective tissue growth by MicroRNA-214 delivery in exosomes from mouse or human hepatic stellate cells. *Hepatology.* 2014 Mar;59(3):1118-29. PMID: 24122827

MAKE SAFE HAPPEN™

Mobile Application Impacts Home Safety for Parents and Caregivers

Many parents and caregivers have the willingness to make their homes safer for their children, but a comprehensive resource with safety tips and recommendations from experts is hard to come by. The Center for Injury Research and Policy (CIRP) at Nationwide Children's Hospital fulfilled this need by developing a mobile app to help families make their homes safer. Subsequently, the app was licensed to Nationwide Insurance to be incorporated into their innovative Make Safe Happen™ program.

Lara McKenzie, PhD, principal investigator in the Center for Injury Research and Policy at The Research Institute at Nationwide Children's, decided to create the mobile app after becoming the mother of triplets. While Dr. McKenzie had devoted her career to childhood injury research and prevention, it wasn't until she became a parent herself, that she realized how challenging creating a safe home could be for a busy family.

"I had the willingness to make my house safer, and the knowledge to do it," says Dr. McKenzie. "I had been researching ways to prevent injuries in and around the home for years and gave interviews about it, but the process was still so difficult."

Along with her research associate, Kristi Roberts, Dr. McKenzie began working on an app, collaborating with the Office of Technology Commercialization to seek out a partner for further development. They then learned that Nationwide, the Columbus-based insurance company and long-time supporter of the Center for Injury Research and Policy's work, was interested in creating a program focused on preventing injuries in children.

This national program from Nationwide Insurance, known as Make Safe Happen™, aimed to address the leading cause of death among children in the United States: preventable injury. It was a perfect partnership for the Center for Injury Research and Policy and Dr. McKenzie's team.

"Our office was very excited to see the final version of this app come to fruition," says Matthew McFarland, RPh, PhD, director of the Office of Technology Commercialization. "There was a tremendous amount of work that Dr. McKenzie and her team put into developing the concept and the app functionality that positioned it to be an attractive opportunity for Nationwide Insurance. It was an honor for the OTC to be a part of that process."

The Make Safe Happen™ app was built with the knowledge and commitment of the Center for Injury Research and Policy at Nationwide Children's, and funded by a grant from the Nationwide Foundation with additional financial support from Nationwide Insurance. The app became available for free on iOS and Android systems in January 2015.

"The Make Safe Happen™ app is designed so parents and caregivers can learn as they go with room-by-room safety checklists and links to purchase safety products that are best-suited for their homes," Dr. McKenzie says. "Since not all homes are the same, the app offers different solutions for different situations, and you can track your progress in making your home as safe as possible."

Video Game Technology
Helps Measure Upper Extremity Movement in Patients with Neuromuscular Disorders

Currently, patients with diseases like muscular dystrophy and spinal muscular atrophy who have lost mobility and use wheelchairs are excluded from clinical trials. There simply is not an easy, affordable or comprehensive way to measure their muscular function. The standard measurement to demonstrate mobility is having the patient walk for a six-minute test.

Researchers at Nationwide Children's Hospital, however, have developed a way to measure upper extremity movement in these patients using interactive video game technology. Their goal is to expand inclusion criteria for clinical trials to incorporate patients using wheelchairs.

Ability Captured Through Interactive Video Analysis, or ACTIVE-seated technology, utilizes a Kinect gaming camera, found in Xbox consoles. Development of the game relied almost entirely on patients with muscular dystrophy. With a patient-requested zombie theme, the game requires patients to reach with their arms in various directions to push down a force field. The Kinect camera and ACTIVE-seated software measures how far and how long they reach.

This change in the measure of movement ability over time is a primary clinical outcome. In a study published in Muscle and Nerve, researchers found that scores in the game were highly correlated with parent reports of daily activities, mobility and social and cognitive skills. Sixty-one patients, recruited from the Nationwide Children's Hospital Muscular Dystrophy Association Clinic, participated in the study.

"We were thrilled with the results," says Linda Lowes, PT, PhD, clinical therapies research coordinator for the neuromuscular program at Nationwide Children's. "It's very reliable day to day because it's just fun. The scores are related to function, and really reflect what the boys could do in their life."

According to Lowes and her team, motivation is an important factor when it comes to the success of the game's results. If a patient is not motivated to do something day after day, their performance will be different, making the assessment tool useless, since it would not be measuring true function. Finding out what is motivating yields the best outcome measure for a patient.

The team hopes that the video game will demonstrate to the Food and Drug Administration that repeating the game with a patient accurately yields the same results, and that results will change according to the progress of the patient.

"We developed this game because there was not an accepted outcome measure for boys with muscular dystrophy who couldn't walk," says Lowes. "We needed an outcome measure that would be reliable, valid and also give discrete quantitative measurements so they could measure small changes or big changes over time."

The study focused on patients with Duchenne muscular dystrophy, a type of muscular dystrophy that is most common in children, specifically young boys. But the ACTIVE-seated technology is an affordable and entertaining physical therapy assessment tool that can be used as a clinical outcome measure for neuromuscular diseases, stroke, head injury, or other conditions in which the functional abilities of the arms and legs are being investigated.

"As a clinical outcome measure, we really wanted this to be as universal as possible," says Lindsay Alfano, PT, DPT, a physical therapist at Nationwide Children's who works with Lowes. "We want to be able to use this across sites, both in the U.S. and internationally, because most of the clinical trials are international at this point. Having something that's commercially available, low cost and easy to implement was really a huge goal for us."

Out-licensing activity from the OTC has already enabled the use of the ACTIVE suite of technologies in pharmaceutical clinical trials, and they continue to be available for partnership opportunities.

RELATED CITATIONS:
Lowes LP, Alfano LN, Crawfis R, Berry K, Yin H, Dvorchik I, Flanigan KM, Mendell J. Reliability and validity of active-seated: an outcome in dystrophinopathy. *Muscle and Nerve.* 2015 Jul 2. [Epub ahead of print].

Therapeutics

New Probiotic Biofilm Formulation to Encourage Sustained Colonization (Reference #: 2013-040)
Probiotic bacteria protect and restore gut flora to a healthy state, but their delivery in a planktonic form results in poor ability to establish and persist. Researchers at Nationwide Children's propose to deliver probiotics in a biofilm state. This will allow for increased efficacy and durability of probiotic strain introduction and colonization and, therefore, increased magnitude and duration of their healthful effects.

Exosomes as a Novel Therapy for Fibrosis (Reference #: 2014-024)
Fibrosis (chronic scarring) accounts for up to 45% of deaths in the developed world, but there are no FDA-approved anti-fibrotic therapies. Researchers at Nationwide Children's have found that exosomes from healthy cells contain molecular signals reflective of a healthy state and can be delivered to fibrotic cells and mitigate or reverse fibrosis. This novel therapy will have an impact on numerous diseases, including liver disease, cardiovascular disease, pulmonary fibrosis, kidney disease, and macular degeneration.

Combined Therapy for Enhanced Protection Against Nephrotic Syndrome (Reference #: 2013-035)
Nephrotic syndrome is the most common kidney disease seen in children and adults. It is currently treated with glucocorticoids, but glucocorticoids have many side effects and are ineffective in steroid resistant patients. Researchers at Nationwide Children's have found that using drugs for type II diabetes, thiazolidinedones, in combination with low dose glucocorticoids reduces the side effects of steroids and enhances treatment efficacy in nephrotic syndrome cases.

Patch Delivery System for Vaccines Against Ear Infections (Reference #: 2013-041)
Non-invasive immunization tends to be more cost effective and has increased compliance compared to invasive vaccination methods, making it ideal for both the developed and developing world. Researchers at Nationwide Children's have developed a method of immunizing against bacterial diseases of the respiratory tract, including ear infections, by applying a vaccine formulation to a patch and placing it on the skin behind the ear. Placement in this unique location is a non-invasive way of promoting an immune response to prevent or resolve infections.

Novel Therapeutic Strategy to Prevent Calcification in Heart Valve Interstitial Cells (Reference #: 2015-017)
Calcific aortic valve disease is the most prevalent valvular disorder, but no preventative therapies exist and treatment methods are invasive. Researchers at Nationwide Children's have identified key processes in the molecular underpinnings that drive calcification in heart valve interstitial cells and have developed a novel therapeutic strategy to prevent calcific aortic valve disease.

Therapeutics

Sodium Pyruvate Supplementation as a Treatment for Charcot-Marie-Tooth Neuropathies (CMT) (Reference #: 2014-038)
Charcot-Marie-Tooth neuropathies (CMT) affect approximately 1 in 2,500 people in the United States, but there is currently no treatment for CMT. Researchers at Nationwide Children's Hospital have found that oral delivery of sodium pyruvate as an energy source for peripheral neurons results in functional improvement in a mouse model of CMT. Sodium pyruvate has been used to safely treat a variety of conditions, suggesting that oral delivery will be a safe, effective treatment for CMT.

Live, Attenuated Vaccines Against Pneumoviruses (Reference #: 2011-001, 2014-004, 2014-045, 2015-004)
Respiratory syncytial virus (RSV) is the most frequent cause of lower respiratory disease and hospitalization in infants, but there is currently no vaccine or effective therapy available to prevent or treat RSV disease. Researchers at Nationwide Children's Hospital and The Ohio State University are working to develop a live, attenuated RSV vaccine to prevent infection in at-risk populations. There are several technologies that have resulted from the RSV research program with more than one performing well in pre-clinical animal trials. Researchers are also working to develop a live, attenuated vaccine to protect against human metapneumovirus (hMPV). For example, a strategic mutation in one of the vaccine candidates has been shown to attenuate virus replication in cotton rats while retaining immunogenicity.

Gene Therapies

Use of a U7snRNA Vector to Skip Duplications in DMD Exon 2 (Reference #: 2013-012)
Duplicated exons in the DMD gene represent approximately 6% of the Duchenne muscular dystrophy (DMD) patient population, with the duplication of exon 2 being the most common. The laboratory of Dr. Kevin Flanigan has found that expression of four U7 small nuclear RNA carrying two new antisense sequences results in efficient skipping of exon 2. This novel treatment will restore protein function and persist over years due to its expression from an AAV vector.

Rescue of Protein Function by Activating an Internal Ribosome Entry Site in the DMD Gene (Reference #: 2014-021)
Mutations in exons 1-4 of the DMD gene are present in 6% of patients with Duchenne muscular dystrophy (DMD). Researchers at Nationwide Children's have identified a novel internal ribosome entry site (IRES) in exon 5 of DMD and have developed an AAV vector encoding antisense sequences to remove exon 2, resulting in a premature stop codon and activation of this IRES. Activation of this IRES results in production of a functional N-truncated protein and will, thus, correct the pathologic and physiologic features of muscle injury.

Gene Therapies

Gene therapy with AAVrh74 Dysferlin Dual Vector (Reference #: 2013-015)
Deficiency in functional Dysferlin results in the progressive muscle wasting characteristic of Limb Girdle Muscular Dystrophy type 2B and Myoshi Myopathy. Investigators at Nationwide Children's have developed a novel therapeutic approach to restore Dysferlin function by using a dual vector delivery system whereby two AAV vectors deliver the 5' and 3' ends of Dysferlin. These vector share 1000 bp of identical sequence, resulting in recombination, generation of the full-length therapeutic gene and long-term correction of functional deficits.

Increasing Expression of HLA-F to Treat Amyotrophic Lateral Sclerosis (ALS) (Reference #: 2014-033)
90% of cases of amyotrophic lateral sclerosis (ALS) are sporadic and lack a familial association, but the etiology of sporadic ALS remains largely unknown. The laboratory of Dr. Brian Kaspar has discovered that overexpression of the HLA-F MHC class I molecule in motor neurons is protective against ALS. Further, they have identified a pharmaceutical composition that increases the expression of HLA-F in motor neurons and would serve as a treatment option for patients with both sporadic and familial ALS.

Gene Therapy Approach for Muscular Dystrophy Using GalgT2, a Glycosyltransferase (Reference # 2005-008)
DMD is an X-linked inherited disease that causes rapid muscle degeneration. A mutation in the dystrophin gene causes loss of dystrophin protein expression, which is responsible for the disease. Researchers at Nationwide Children's Hospital have developed a gene therapy approach which delivers the glycosyltransferase GalgT2 using a gene therapy vector, adeno-associated virus (AAV), for the potential treatment of several muscular dystrophies. This therapy could potentially be delivered locally via intramuscular injection; to groups of muscles via limb perfusion; or systemically via vascular delivery.

AAV9-Mediated Suppression of Mutant Superoxide Dismutase 1 as a Therapeutic Potential for Mutation in SOD1 in Amyotropic Lateral Sclerosis (Reference #: 2013-031)
Amyotropic lateral sclerosis (ALS), also known as Lou Gehrig's disease, is a rapidly progressive and fatal neurodegenerative disease that is responsible for one in every 200 deaths related to motor neuron diseases. Twenty percent of familial cases are caused by mutation in superoxide dismutase 1 (SOD1). Attempts at improving therapy by reducing synthesis of SOD1 have been the focus of multiple therapeutic approaches. Currently, only one drug is FDA-approved as a therapy for ALS. Researchers at Nationwide Children's Hospital and Ludwig Institute for Cancer Research have identified a groundbreaking therapeutic approach that involves the suppression of SOD1 levels via adeno-associated virus 9 (AAV9) mediated delivery of shRNA. This method has been shown in animal studies to be effective in slowing disease progression and extending survival, even when treatment is initiated after onset.

RNAi Therapy for Dominant Limb Girdle Muscular Dystrophy Type 1A (Reference #: 2011-002)
Researchers at Nationwide Children's Hospital have designed novel microRNAs that specifically knock down the expression of the protein Myotilin. Animal studies assessing decreased expression of Myotilin suggest that targeting the protein may be a viable therapeutic strategy for treatment of Limb Girdle Muscular Dystrophy Type 1A (LGMD 1A). This RNAi strategy can also be adapted to broadly impact a large class of dominant muscle disorders.

Gene Therapy Approach for Limb Girdle Muscular Dystrophy Type 2D (Reference # 2009-016)
The field of gene therapy for the muscular dystrophies is progressing in a stepwise fashion. Researchers at Nationwide Children's Hospital have developed a new gene therapy approach to restore alpha-sarcoglycan deficiency in Limb Girdle Muscular Dystrophy Type 2D. This therapy can be delivered locally via intramuscular injection, limb perfusion, or systemically by vascular delivery. This methodology is generalizable to any limb, both upper and lower, and is modifiable to control limb perfusion pressure, oxygenation, pH and removal of blood and plasma. These enhancements to current gene targeting protocols will increase gene targeting efficacy and result in broader whole-limb delivery of the transgene.

Gene Therapies

Gene Therapy Approach for Charcot-Marie-Tooth Neuropathy (Reference # 2008-002)
Charcot-Marie-Tooth (CMT) neuropathies are one of the most common inherited neurological conditions affecting 1 in 2,500 people in the United States. Both children and adults are affected, causing sensory and motor dysfunction, pain, and a need for ambulatory aids. Researchers at Nationwide Children's Hospital have developed a gene therapy approach that delivers neurotrophic factor NT-3 by intramuscular injection to promote nerve regeneration in CMT disease as well as other nerve diseases with impaired nerve regeneration.

Gene Therapy Approach for Duchenne Muscular Dystrophy Using a Micro-Dystrophin (Reference # 2015-027)
Despite many lines of research following the identification of the DMD gene, treatment options are limited. Researchers at Nationwide Children's Hospital have developed a gene therapy approach using adeno-associated virus (AAV) to deliver micro-dystrophin, a modified version of the defective dystrophin gene, to replace the missing gene in DMD disease.

Biomarkers

MicroRNA Biomarkers of Transfusion-Related Immunosuppression (Reference #: 2015-014)
Blood transfusion is associated with risk of infection and death in critically ill children. Researchers at Nationwide Children's Hospital have found that microRNA in stored blood products modulates transfusion-related immunosuppression. Screening for immunomodulatory microRNA prior to transfusion will allow for the identification of stored blood products most likely to cause immune suppression and serious infections.

Screening for Selected Biomarkers to Predict Steroid Resistance in Childhood Nephrotic Syndrome (Reference #: 2013-038)
Steroid resistance is a major problem in ~20% of patients with nephrotic syndrome. Identifying patients who have or will develop steroid resistance would improve the effectiveness of their treatment regime, but there is currently no method for this in the majority of cases. Investigators at Nationwide Children's have identified a panel of biomarkers that are reduced in patients with steroid resistant nephrotic syndrome. Use of these biomarker-based assays may be a cost effective method of predicting steroid resistance.

Cord Blood Haptoglobin Switch-On as a Biomarker of Cerebral Palsy (Reference #: 2014-046)
Predicting children at risk for cerebral palsy allows physicians to prioritize interventions to prevent additional damage, but there are currently no good strategies to do this. Researchers at Nationwide Children's have found that newborns unable to switch on haptoglobin expression when exposed to stress are at risk for cerebral palsy. They have developed a diagnostic application that assesses fetal or neonatal haptoglobin levels in order to determine which patients should receive interventions, including those aimed to elevate haptoglobin levels.

Identification of a Biomarker Profile for Diagnosis of Necrotizing Enterocolitis (NEC) (Reference #: 2015-019)
Necrotizing enterocolitis (NEC) is the most common and serious intestinal disease among premature infants. Diagnosis of NEC involves exposure to radiation (X-rays) or invasive procedures. Investigators at Nationwide Children's have developed a novel, non-invasive platform for diagnosing NEC by screening for microRNA biomarkers in circulating exosomes. This will allow for differentiation between of non-NEC sepsis, NEC and NEC requiring surgery and administration of targeted and prompt therapy.

Combined Biomarkers for Accurate Urinary Tract Infection Diagnosis (Reference #: 2015-024)
Screening for white blood cells in urine is a convenient, rapid method of diagnosing urinary tract infections. Investigators at Nationwide Children's have found that screening for antimicrobial peptides as well as white blood cells increases diagnosis specificity without decreasing sensitivity. The increased specificity of this screening method will result in fewer antibiotics prescribed to patients who do not have urinary tract infections, thus reducing the risk of developing antibiotic resistant bacteria.

End User Innovation

Sternal Realignment Device (Reference #: 2014-009)
Current sternotomy techniques use heavy gauge wires and have a high complication rate. The Sternal Realignment Device, developed at Nationwide Children's, will require fewer wires to properly align the sternum and increase stability of the bone, resulting in improved recovery time and reduced risk of complications such as wound dehiscence and infection.

Novel Endoscope Cap for Disinfection Quality Control (Reference #: 2014-015)
Sterilization of endoscopes prior to reuse protects patients from the risk of contracting infectious diseases, but accidental use of contaminated endoscopes occurs because current devices to safeguard against this are easy to circumvent. Researchers at Nationwide Children's have developed a one-time use, peel away cap that acts as a physical barrier to endoscope use until it is removed. This cap, which is designed to fit a wide variety of devices, will eradicate system shortcuts by inhibiting scope functionality and creating a hard stop checkpoint.

Disposable Device to Protect Patients' Lips During Surgery (Reference #: 2014-032)
Lip lacerations and burns can occur during surgical procedures in the mouth and throat. Surgeons at Nationwide Children's have developed a disposable device to cover a patient's upper and lower lips during surgery. This device adjusts to fit the patient's mouth and will act as a physical and thermal barrier to prevent injury.

End User Innovation

Vitrification Insert Device for Cryovials (Reference #: 2014-005)
Vitrification provides many advantages over slow cooling cryopreservation methods, but requires the use of expensive, specialized tools. Investigators at Nationwide Children's Hospital have invented a vitrification insert device that can be manufactured with inexpensive, sterilization-durable material and fit securely into multiple cryovial models. Further, this cost-effective solution can include various end designs to suit many functions, such as preventing sample contact with cryovial walls.

Dose Wizard: a Method of Calculating Anatomically Correct Radiation Exposure During CT Imaging (Reference #: 2015-001)
Calculation of radiation exposure during computed tomography (CT) imaging helps physicians estimate a patient's risk of future radiation-related cancer. Physicians at Nationwide Children's have developed a program that uses anatomically correct models to determine radiation exposure. This program can be used to determine the total radiation dose a patient receives over a period of time and allows for a personalized assessment of the risk of negative effects.

Mobile Application to Reduce Injury (Reference #: 2013-013)
There are numerous mobile applications that pertain to individual safety-related topics. Researchers in the Center for Injury Research and Policy at Nationwide Children's have developed a mobile app that encompasses multiple injury topics. This customizable application will use injury prevention messaging and research-based recommendations to prevent home injury.

Modified Endotracheal Tube Cuff System (Reference #: 2013-017)
Endotracheal tube cuffs are used to secure the airway for supportive ventilation. Overinflation of cuffs occurs frequently and can result in injury. Investigators at Nationwide Children's have developed a pressure release valve to be added to the cuff system to prevent overinflation. This valve would be set to a pre-determined value under the threshold of mucosal injury and prevent overinflation that may occur during many common procedures.

Stackable IV Pole Which Allows Children to Walk Alongside (Reference #: 2013-042)
Commonly used IV poles can be bulky and difficult to use for children or when pushing the pole alongside a wheelchair. Inventors at Nationwide Children's have designed a linear IV pole that is easier to use and reduces required floor space. The design of the pole allows for it to be stacked with other like IV poles during storage, further reducing required floor space.

Sensor-Based System for Automatically and Accurately Measuring Body Morphometrics (Reference #: 2014-006)
Current techniques for evaluating body measurements rely on outdated large-population averages and can result in errors leading to medical complications. Researchers at Nationwide Children's have developed a program that uses a database of diverse child body morphotypes and a sensor-based measurement system to determine body measurements. This program will improve patient care by generating a quantitatively accurate model of the body.

Computerized Screening Tool for Behavioral Health (Reference #: 2014-017)
Assessing symptoms of and impairment due to mental health problems is important for patient care, but the field of behavioral health rarely makes use of objective screening tools over the course of treatment leading to sub-optimal care. Inventors at Nationwide Children's have developed a screening tool that is able to administer and score a set of existing, well validated mental health questionnaires. This web-based program is entirely self-sufficient and will allow for longitudinal tracking of data leading to improved care.

End User Innovation

Device for Detection, Localization, and/or Characterization of Metallic Foreign Objects Inside the Body (Reference #: 2014-031)
Ingestion of button cell batteries by children occurs more than 3000 times per year in the United States and early identification of a battery in the esophagus is required to prevent severe injury or death. Inventors at Nationwide Children's have prototyped a handheld device to detect and localize foreign metallic bodies in a patient. Further, the proposed device is able to differentiate between a coin and a battery without the use of radiation (x-rays).

Sublingual Immunotherapy (SLIT) Game Application to Increase Compliance (Reference #: 2014-034)
Sublingual immunotherapy (SLIT) is an alternative method to treat allergies without injections. Long-term benefits require a patient to be routinely adherent and aware of possible adverse reactions. Investigators at Nationwide Children's are developing a mobile application that will encourage proper use of the medication by incorporating a pre-dose health screen, allowing the patient to play a game while taking the medication, and reminding them to be aware of adverse symptoms following the dose. Further, data from the application can be sent to the physician, allowing for better personalized care.

Modified Transgastric-Jejunal Feeding Tubes (Reference #: 2014-035)
Transgastric-jejunal feeding tubes are used to provide nutrition to patients who cannot eat enough to grow. However, backing up of food source and mucus from the body can occur, resulting in aspiration, other comorbidities or even death. Physicians at Nationwide Children's have developed a modified transgastric-jejunal tube that can drain gastric contents into the jejunum, but not affect feeding through another area of the tube. This device will be especially useful in patients requiring long-term feeds and those with special needs of ventilation who are at a high risk of aspiration.

Neonatal Face Ice Pack (Reference #: 2015-012)
Cardiac arrhythmias are common in infancy. The most common method to stop arrhythmias is to apply a bag of ice to an infant's face, but this can cause trauma. Physicians at Nationwide Children's have designed an ice pack that can be applied to an infant's face to break arrhythmia by the cold touch to sensitive areas of the face, but not hurt the infant's eyes and nose.

Electronic Whack-A-Mole: An Interactive Device for Measuring Task Performance and Motion Parameters (Reference #: 2015-021)
Inventors at Nationwide Children's have developed an interactive screening tool that measures a user's ability to quickly touch target LEDs and uses these results to calculate motion variables i.e., speed or reach), cognitive variables (i.e., focus or prioritization) or other variables (i.e., color distinction). This platform can be used longitudinally to measure changes related to neuromuscular disease, injury or vision in children and adults.

The Host Defense Program BMT (Bone Marrow Transplant) Smart Form (Reference #: 2015-028)
Integration of patient information across medical institutions is difficult, particularly due to use of separate information technology systems across institutions. This is especially difficult for patients utilizing extensive organizational resources, like those undergoing bone marrow transplantation (BMT) for malignant or non-malignant diseases. Physicians at Nationwide Children's have developed the software-integrated, EPIC-based BMT Smart Form to facilitate data sharing across institutions. This form will enable prediction modeling in this high risk, high resource utilizing patient population and, thus, reduce transplant-related morbidity and mortality.

End User Innovation

Interactive Asthma Inhaler Spacer (Reference #: 2015-020)
Using an asthma inhaler can be frightening for small children, leading to reduced compliance. Inventors at Nationwide Children's have developed an interactive spacer to be used with an asthma inhaler that makes the experience more enjoyable by incorporating lights and music. Additionally, the vertical design of the spacer allows for one-handed use which lets a parent hold the child with the other hand while administering the medication.

PS Rocker: A Multi-Head Skin Allergy Testing Device (Reference #: 2012-028)
There are 10 skin testing devices marketed in the United States for diagnosing allergies. These include single-tipped devices for testing allergens one at a time, as well as multi-head devices containing multiple testing tips on one device. One of the recently introduced multi-head devices is designed to decrease pain associated with skin testing. Current multi-head testing devices with fixed horizontal surfaces do not provide consistent intra-device contact with skin, while the single-prick devices can be impractical for children and time consuming. Clinicians at Nationwide Children's Hospital and The Ohio State University, in collaborations with other independent inventors, have developed a new allergy skin testing device, PS Rocker, which improves upon existing products by combining the precision of a single-prick test with the ease and speed of a multi-head device. Additionally, PS Rocker is less painful than traditional skin prick testing. The PS Rocker's crescent-shaped, ergonomic design enables more reproducible tip contact with the skin than conventional horizontal multi-head devices, efficiently leading to more reliable results.

Testing Targets: An Innovative Device to Improve Efficiency and Accuracy of Single-Prick Allergy Skin Tests (Reference #: 2012-029)
Food allergies have long been a significant public health issue, particularly in the pediatric population. Six to 8% of children under the age of three have food allergies, and nearly 4% of adults have food allergies. One of the commonly used allergy testing methods is the skin prick test. This method requires accurate marking of testing sites on the patient's skin prior to the application of an allergen, which could be time consuming and difficult to perform on a moving patient. Researchers at Nationwide Children's Hospital have invented a device called Testing Targets (Lil's Testing Targets for kid-friendly version) to be used with the previously existing single-prick allergy test for improving efficiency and accuracy of testing and interpretation. Testing Targets is a disposable plastic device with hollow projections along one side of the device that is used with non-toxic ink to mark placement for allergy skin test. Lil' Testing Targets shares the same design with Testing Targets, except the hollow cylinders are replaced with outlines of animal faces without noses.

ACTIVE Suite: Abilities Captured Through Interactive Video Analysis — A Clinical Outcomes Tool for SMA and DMD Patients (Reference #: 2012-011 and 2014-001)
This technology is a video-based affordable and entertaining physical therapy assessment tool that measures movement abilities. It can be used as a clinical outcome measure for neuromuscular diseases, stroke, head injury, or other conditions in which the functional abilities of the arms and legs are being investigated.

Research Tools

Novel Screening Assay to Identify and Evaluate Drugs that Target Familial and Sporadic Amyotrophic Lateral Sclerosis (Reference # 2011-016)
This is an in vitro cell-based assay that enables investigating molecular disease mechanisms and evaluating potential therapies for Sporadic Amyotrophic Lateral Sclerosis (ALS). This assay utilizes human derived cells from individuals with the disease.

Cmah-Deficient mdx Mice: A Better Mouse Model for Duchenne Muscular Dystrophy (Reference # 2010-019)
A new mouse model for DMD-related research has been created at Nationwide Children's Hospital. A double knock-out mouse strain was generated that better mimics the human disease than the current standard model and thus provides a model for DMD where translational research will be more relevant to issues affecting humans with the disease.

Monoclonal and Polyclonal Antibodies Against Anoctamin 5 (Reference # 2012-012)
Researchers at Nationwide Children's Hospital have developed a polyclonal antibody directed against human Anoctamin 5 (ANO5). Defects in ANO5 are the causative agent of Limb Girdle Muscular Dystrophy Type 2L (LGMD 2L), an autosomal recessive degenerative myopathy. This antibody can be used as a diagnostic and for research applications.

Tissue Engineering

Production of Tissue Engineered Intestine (TEI) to Treat Short Bowel Syndrome (Reference #: 2013-009)
Short bowel syndrome is a consequence of massive bowel resection performed in patients with various diseases. Transplantation of the small bowel may be beneficial, but results in risk of graft rejection and complications. Investigators at Nationwide Children's and Nanofiber Solutions have developed a method of generating tissue engineered intestine (TEI). This process uses multiple cell types of a patient's own cells and multi-layered nanofiber scaffolds to generate full thickness, functional intestine that can be used to treat and manage short bowel syndrome.

Novel Inhibitor of Stenosis of Tissue Engineered Vascular Grafts (Reference #: 2014-002)
Stenosis is the most common graft-related complication for tissue engineered vascular grafts and the immune system plays an important role in this process. Inventors at Nationwide Children's Hospital have found a novel therapeutic that modulates this immune process and inhibits the formation of stenosis. This therapy can serve as a method of inhibiting the formation of tissue engineered vascular graft stenosis, as well as promoting tissue regeneration, improving wound healing, modulating the foreign body response, and preventing scar formation.

| Our Team |

Matthew McFarland, RPh, PhD, *Director*

Matthew joined Nationwide Children's as director of the Office of Technology Commercialization in the spring of 2012. As director, he works closely with Nationwide Children's faculty and staff to identify intellectual property with commercial potential and to facilitate the transfer of new technologies to outside partners, ultimately for the benefit and enhancement of pediatric care. He has a diverse background in technology transfer, technology valuation and licensing, academic research and pharmacy practice.

Prior to joining Nationwide Children's, Matthew was the associate director of commercialization, innovation strategy manager and technology manager in the Office of Technology Commercialization at the Purdue Research Foundation. He received a Bachelor of Science degree in pharmacy from Ohio Northern University and his PhD in medicinal chemistry and molecular pharmacology from Purdue University. He also completed a postdoctoral research fellowship in translational genetics and pharmacogenomics of neuropsychiatric disorders at the Institute of Psychiatric Research, Indiana University Medical School.

Matthew has authored several articles for peer-reviewed journals including Molecular Pharmacology, Journal of Biological Chemistry and Medical Innovation & Business. He also has received the Jenkins/Knevel Award for Excellence in Research and the Albert and Anna Kienley Award for Excellence in Teaching from the School of Pharmacy at Purdue University.

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Margaret Barkett, PhD, *Senior Licensing Associate*

Margaret joined The Research Institute at Nationwide Children's Hospital as a licensing associate in February 2010, and currently serves as a senior licensing associate for the Office of Technology Commercialization. In her role with the office Margaret manages the assessment, protection, valuation and out-licensing of a portfolio of intellectual property assets owned by The Research Institute. She is also actively involved in managing many of the office's relationships with both internal and external stakeholders.

Margaret has a Bachelor of Arts degree in biology from Emory University and earned her PhD degree in molecular and cell biology from Boston University, where she continued her training as a postdoctoral fellow. Her doctoral and postdoctoral research in cell death biology spanned different areas including cancer biology and development. Prior to joining The Research Institute, she completed a one-year technology licensing internship at Massachusetts Institute of Technology focusing on medical devices and biotechnology.

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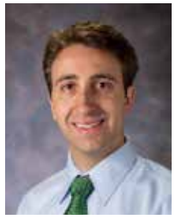

Kyle Murrah, PhD, *Licensing Associate*

Kyle joined The Research Institute as a licensing associate in the Office of Technology Commercialization in July 2014. In his role, he promotes technology transfer through the evaluation, protection, and out-licensing of technologies developed at Nationwide Children's.

Kyle has a Bachelor of Science degree in biological sciences from North Carolina State University and a PhD in microbiology and immunology from Wake Forest University. His doctoral research focused on polymicrobial interactions in middle ear infections. While earning his doctorate, he completed a two year technology transfer internship at Wake Forest Innovations.

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Andrew M. Corris, PharmD, B.Eng, JD, *Agreements Coordinator*

Andrew joined The Research Institute in March 2015 as agreements coordinator for the Office of Technology Commercialization and is responsible for negotiation and review of incoming agreements with intellectual property implications. He also provides technical and authoritative contract policy advice and assistance to the office's licensing team and direct service to external and internal investigators and commercial entities to develop contracts, amendments, and agreements.

Andrew has a Bachelor of Science in chemical engineering and a minor in chemistry from the University of Pittsburgh, a Doctor of Pharmacy degree from The Ohio State University, and a Juris Doctor, cum laude, from Capital University, specializing in intellectual property law.

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Susan S. Allen, *Agreements and Intellectual Property Coordinator*

Susan joined Nationwide Children's in the summer of 2013. She manages the intellectual property and patent portfolio, as well as agreements records, for the Office of Technology Commercialization. She assists the team with invention evaluation and efforts aimed at marketing and licensing. Susan also manages compliance with regard to reporting requirements for federal and/or non-government research sponsors.

Susan has 23 years of experience including work for federal and state governments, academia, private industry and nonprofits. She has a strong background in intellectual property management and research administration; research education and communications; and budget management and accounting practices including patents, agreements, contracts, and grants management and compliance.

Susan has a Bachelor of Science degree in biology from The Catholic University of America in Washington DC. She is a member of the Association of University Technology Managers. Past professional memberships include: National Council of University Research Administrators, American Medical Writers Association, and American Management Association.

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Supatra S. Davis, *Business Compliance and Projects Coordinator*

Supatra joined The Research Institute at Nationwide Children's Hospital in August 2008. She is primarily responsible for information and business systems. She tracks and invoices license terms and follows up as necessary to insure licensee compliance. She oversees the annual budget, purchasing, and the file management database. Supatra also assists technology transfer professionals with department initiatives, events management, and operational issues. She also serves as a Notary Public for the State of Ohio.

Supatra is a dedicated business and financial support professional with 10+ years of experience in providing outstanding service. She has a Bachelor of Science degree from National Paralegal College and is currently pursuing a Master's degree in business administration with a major in financial management at Franklin University.

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