

# Meet the Faculty of the 2024 Summer Child Health Research Internship

University of Colorado School of Medicine, Department of Pediatrics  
Children's Hospital Colorado

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## Jordan Abbott, MD, MA Allergy and Immunology

### Lab Overview

The Abbott laboratory, led by Dr. Jordan Abbott, MD, specializes in pediatric clinical immunology. Dr. Abbott focuses on the biology and genetics of primary immunodeficiency diseases.

### Research Areas and Current Projects

Current projects are examining the following aspects of the immune system: how defects in the AIRE protein affect central tolerance of T cells as they develop in the thymus, how regulatory T cells use CTLA-4 to regulate immune responses, and defects in B cell functions. In addition, there are a number of smaller projects whose aim is to understand novel genetic defects found in patients with immune disorders.

### Learning Opportunities

Interns will be given a small project focused around 1 or 2 techniques. Typically, projects involve a combination of PCR, qPCR, genetic sequencing, and protein identification, but additional more advanced approaches can be used depending on the degree of proficiency. The project will be designed by Dr. Abbott to be completable in the timeframe of the internship, so that interns have a complete research experience including experimental design, techniques, record keeping, data analysis, and presentation. Interns will be credited for contributions to manuscripts and abstracts.

## Sarit Polsky, MD Barbara Davis Center for Childhood Diabetes

### Lab Overview

Dr. Sarit Polsky serves as the director of the Pregnancy & Women's Clinic at the Barbara Davis Center (BDC) for Diabetes, a specialized center for type 1 diabetes. Dr. Polsky's primary focus lies in enhancing the health of men and women with diabetes through clinical research trials and the delivery of exceptional clinical care.

### Research Areas and Current Projects

The core objective of Dr. Polsky's research is to improve outcomes in pregnancies associated with type 1 diabetes. These pregnancies face increased risks of adverse health outcomes, including fetal loss, abnormal fetal size, pre-term delivery, cesarean delivery, gestational hypertensive disorders, and neonatal complications. The key strategy to mitigate these risks involves maintaining normal to near-normal blood glucose levels during pregnancy, which is particularly challenging for women on intensive insulin therapy. Dr. Polsky's research examines the impact of advanced diabetes technologies such as insulin pumps, continuous glucose monitors, and artificial pancreas systems on glycemic control and health outcomes in pregnant women with type 1 diabetes. Additionally, the lab explores the long-term impact of adverse maternal outcomes, like preeclampsia, on cardiovascular and renal health in women with type 1 diabetes. A secondary objective of Dr. Polsky's research is to improve outcome for adults (men and women) with type 1 diabetes through the impact of therapeutic agents and advanced diabetes technologies such as insulin pumps, continuous glucose monitors, and artificial pancreas systems on glycemic control and health outcomes.

### Learning Opportunities

Interns working with Dr. Polsky's team will be actively involved in cutting-edge clinical research. They will have the chance to participate in research team meetings, acquire practical experience in data collection and reporting, and learn the responsible conduct of research for human clinical trials. Interns in the Polsky lab will engage in research aimed at improving the well-being of women with diabetes and their offspring, with a specific focus on pregnancies, or on the well-being of adults with diabetes on new therapeutic agents or technologies. This hands-on experience offers a unique opportunity for skill development and an understanding of clinical research in the context of diabetes. Interns will also have the opportunity to participate in scholarly activities such as abstract writing for a scientific conference and manuscript preparation for submission to a peer-reviewed journal.

## Celiac Disease Research Team

Edwin Liu, MD

Mary Shull, MD

Monique Germone, PhD, BCBA

Pooja Mehta, MD

Marisa Stahl, MD

### Lab Overview

The Colorado Center for Celiac Disease has a clinical/translational research team led by Dr. Marisa Stahl. The team consists of five pediatric gastroenterologists, a pediatric psychologist, a dietitian, and a research assistant. Collaborators include the Sie Center for Down Syndrome, Barbara Davis Center for Diabetes, and national research consortiums. Our work focuses on mass screening for celiac disease, health behavior intervention for children and caregivers of families with celiac disease, and also new clinical and immunologic tools for celiac disease diagnosis.

### Research Areas and Current Projects

The lab has three current research studies in various stages which allows a trainee to observe and participate in various stages of research projects. Topics of study are currently: program development with an emphasis on addressing food insecurity and stakeholder engagement, celiac disease general population screening, and psychosocial impact of celiac disease on the child and family.

### Learning Opportunities

A research trainee will have access to current databases. The trainee has the opportunity to support ongoing projects or create a project of their own. Supports for the research trainee include a bi-weekly team meeting, access to a research assistant and statistician, and weekly meetings with the mentoring psychologist (Germone) and a chosen physician mentor(s). In addition to research, the intern will have the opportunity to shadow our innovative clinical work conducted by our multi-disciplinary team (gastroenterologist, nursing, dietitian, pediatric psychologist).

## Ken Maclean, PhD Clinical Genetics and Metabolism

### Lab Overview

The Maclean laboratory, led by Dr. Ken Maclean, PhD, is dedicated to studying the etiology and pathogenesis of cystathionine beta-synthase deficient homocystinuria (HCU), Down syndrome, and various hepatic disorders. Dr. Maclean's research employs a wide range of transcriptomic and proteomic platforms, combined with biochemical, behavioral, genetic, and molecular approaches. The lab primarily utilizes mouse models of these diseases to investigate pathogenic mechanisms and develop innovative treatment strategies.

### Research Areas and Current Projects

The lab's primary focus is around HCU, for which the Maclean lab has created a novel transgenic mouse model. Through a combination of behavioral analysis, hippocampal microarrays, and proteomic analysis, the lab has revealed several novel pathogenic mechanisms. These discoveries have been subsequently confirmed in human HCU tissue samples, leading to the identification of a novel treatment for HCU. An FDA-funded clinical trial is currently underway at the Children's hospitals of Denver and Philadelphia to test this treatment.

### Learning Opportunities

Interns in the Maclean lab will have the unique opportunity to actively participate in research aimed at unraveling the etiology and pathogenesis of HCU, Down syndrome, and hepatic disorders. They will work with cutting-edge research methodologies, including transcriptomics and proteomics, behavioral analyses, and molecular approaches, to study mouse models of these diseases. Interns will have opportunities to develop practical laboratory skills and contribute to advancing the understanding of pathogenic mechanisms. The projects offered in the Maclean lab typically allow the intern to contribute significantly and receive a co-authorship on a peer-reviewed publication.

## Christine Vohwinkel, MD, PhD Critical Care

### Lab Overview

Dr. Christine Vohwinkel, MD, PhD, leads the lab within the Division of Critical Care, focusing on research in the field of acute lung injury. The primary clinical manifestation of interest is the acute respiratory distress syndrome (ARDS), a severe and highly morbid critical illness characterized by acute onset hypoxemia, pulmonary edema, and bilateral chest X-ray opacities.

### Research Areas and Current Projects

The central focus of Dr. Vohwinkel's lab is the investigation of how metabolism regulates inflammation, a key element in the pathogenesis of acute lung injury and ARDS. The lab is particularly interested in understanding the mechanisms by which the lung epithelium communicates with macrophages. To explore these research questions, the lab employs various models, including mouse models of acute lung injury induced by ventilation, acid aspiration, and pneumonia, as well as cell cultures involving both mouse cells and cells donated by human patients. The lab utilizes an array of techniques such as PCR, Western Blotting, ELISA, enzyme activity assays, and histology to delve deeper into these research areas.

### Learning Opportunities

Interns in Dr. Vohwinkel's lab will have the unique opportunity to actively engage in research focusing on critical aspects of acute lung injury and ARDS. They will be exposed to various research models, including mouse models and cell cultures, and learn to apply techniques such as PCR, Western Blotting, ELISA, enzyme activity assays, and histology. This hands-on experience provides valuable insights into experimental methodologies and laboratory procedures relevant to critical care and pulmonary research. Students will work closely with Dr. Vohwinkel and her team, contributing to ongoing projects aimed at understanding the molecular and cellular mechanisms underlying acute lung injury. This experience offers the opportunity to develop practical research skills and gain a deeper understanding of the complexities of critical care research.

## Eva Nozik, MD Critical Care/Developmental Lung Biology

### Lab Overview

The Nozik laboratory, led by Dr. Eva Nozik, MD, specializes in research relevant to critical illness impacting the developing lung. The lab's overarching mission is to gain a deep understanding of the mechanisms responsible for the development of lung and blood vessel diseases in infants and children. Their ultimate aim is to develop improved tools for detecting and treating pulmonary arterial hypertension, pneumonia, and acute respiratory distress syndrome (ARDS).

### Research Areas and Current Projects

The primary focus of Dr. Nozik's lab is centered on the study of an essential antioxidant enzyme called extracellular superoxide dismutase (EC-SOD). This enzyme is highly expressed in the lung and blood vessels under normal conditions but becomes impaired in diseases such as ARDS and pulmonary hypertension. The lab primarily utilizes genetically engineered mouse strains with alterations in EC-SOD expression to investigate how EC-SOD modulates inflammation and vascular injury in variety of lung disease models. The ultimate long-term goal of the lab is to lay the foundation for the development of innovative diagnostic tools and cell-targeted antioxidant therapies. These therapies aim to address life-threatening pediatric lung diseases, including ARDS and pulmonary hypertension.

### Learning Opportunities

Interns in the Nozik lab will have a unique opportunity to engage in research that directly impacts the understanding and treatment of pediatric lung and vascular diseases. They will be actively involved in research that investigates the role of EC-SOD in modulating inflammation and vascular injury, utilizing genetically engineered mouse models. This hands-on experience provides interns with valuable insights into experimental techniques and laboratory procedures relevant to critical care and lung biology. Additionally, students may have the opportunity to contribute to ongoing projects with potential implications for novel diagnostic tools and therapies in the field. Interns can expect to gain both practical skills and a broader understanding of the challenges and opportunities in pediatric critical care research. In the past, outstanding interns in the Nozik lab had opportunities to present their research at national meetings and/or co-author a manuscript.

## Bruce Appel, PhD Developmental Biology

### Lab Overview

The Appel laboratory, led by Dr. Bruce Appel, PhD, focuses on understanding the formation of the nervous system during embryonic development. The ultimate goal is to provide insights that can aid in the repair of nervous systems that have been damaged due to disease or injury. To achieve this, the lab employs zebrafish embryos as a model system, given their unique characteristics such as transparency and development outside the mother's body. This enables the use of time-lapse microscopy to observe the dynamic processes of neural cell migration and differentiation into neurons and glia.

### Research Areas and Current Projects

The lab is engaged in several areas of research, including:

1. Investigation of neural development in zebrafish and the effects of mutations that disrupt this process, which can offer insights into the genetic basis of neurological disorders in humans.
2. Study of zebrafish as a model system to understand how to promote the regeneration of neural cells that are lost as a result of birth defects or other conditions.

### Learning Opportunities

Interns in Dr. Appel's lab will actively participate in research focused on the development of the nervous system and its potential for repair and regeneration. They will work with a unique model system, zebrafish, and leverage time-lapse microscopy to observe and understand the intricate processes of neural cell migration and differentiation. Students will delve into the effects of mutations on neural development, with direct implications for genetic diseases that lead to neurological disorders in humans. This experience offers students an opportunity to develop practical research skills and contribute to projects with the potential to advance our understanding of nervous system development and repair.

## Emily Bates, PhD Developmental Biology

### Lab Overview

Dr. Emily Bates is a prominent researcher in the field of Developmental Biology. The Bates lab specializes in the study of molecular mechanisms underlying abnormal fetal development. Dr. Bates is particularly interested in how ion channels contribute to embryonic and fetal development.

### Research Areas and Current Projects

Dr. Bates' research focuses on how ion channels contribute to embryonic and fetal development. Ion channels are the targets of medications and recreational substances that can cause differences in development- like cleft palate, or abnormal brain development. For example, recent projects have defined how nicotine vaping during pregnancy disrupts craniofacial and skeletal development through inhibition of a potassium channel. Other studies have focused on how fetal cannabidiol (CBD) exposure disrupts brain and pancreas development in offspring.

### Learning Opportunities

Interns in Dr. Bates' lab will have the opportunity to engage in research that explores the fundamental molecular basis of human genetic disorders. They will be actively involved in the process of identifying and characterizing mutations,

both in humans and in model organisms. This hands-on experience will provide interns with a unique perspective on how genetic research can translate from the clinical to the laboratory setting. Additionally, involvement in research related to structural birth defects, brain defects, and neurodegeneration offers an opportunity to understand the challenges and potential breakthroughs in addressing these complex issues. Working closely with Dr. Bates and team, students will contribute to ongoing projects that could have implications for the clinical practice. Some interns have had the opportunity to contribute to published papers as authors and to present their work at national and international meetings.

## Christian Mosimann, PhD Developmental Biology

### Lab Overview

The Mosimann laboratory, led by Dr. Christian Mosimann, PhD, studies the early development and congenital diseases of the cardiovascular system. Using zebrafish and latest genetic techniques including transgenesis and CRISPR-Cas9, the lab has generated unique tools for microscopy and genetic manipulation of the earliest steps forming the heart, blood, blood vessel cells and more to model congenital cardiovascular disease.

### Research Areas and Current Projects

The Mosimann lab pursues several research directions and projects, including:

1. Determining the signals and interactions that guide early embryo cells to form different cell types of the cardiovascular system and blood.
2. Discovering the elements in the genome that control gene expression specifically in the earliest heart progenitor cells.
3. Identifying genes that cause congenital heart and cardiovascular defects to advance predictive diagnosis and phenotype characterization.

### Learning Opportunities

The Mosimann lab has a long-standing track record of hosting intern students who contributed new data and discoveries to key projects in the lab. Interns actively participate in, and contribute to, latest research projects led by more senior lab members under supportive supervision, with the opportunity to tailor individual project parts to personal interests.

Beyond basic skills for working with embryos, interns will learn and apply several molecular techniques including vector cloning, CRISPR-Cas9, genotyping, etc. as well as fluorescence microscopy and other imaging. The acquired skills and understanding of laboratory technique provide a strong basis for future academic pursuits in research. Interns will be fully immersed and integrated in an academic research lab environment with weekly lab meetings, mentoring meetings, collaborator interactions, and more.

Altogether, an internship in the Mosimann lab provides state-of-the-art technical, conceptual, and academic exposure with opportunities to contribute to research projects, publications, and presentations as powerful stepping stone for pursuing a career in biomedical research or medicine.

## Caroline Dias, MD, PhD Developmental Pediatrics

### Lab Overview

Our lab is interested in the neurogenetic basis of brain function across the lifespan, from neurodevelopment to neurodegeneration. We study genetically defined disorders and focus on post-mortem human brain, in order to elucidate fundamental molecular mechanisms of how the brain functions.

### Research Areas and Current Projects

We use a variety of molecular approaches (RT-PCR, single-cell sequencing, whole genome sequencing, immunohistochemistry, in situ hybridization, western blotting) and study a variety of conditions, including autism, major depressive disorder, and Fragile X-related disorders.

### Learning Opportunities

This rotation would provide an opportunity to learn basic molecular biology approaches (see above) in the context of human genetics and neuroscience.

## Christine L. Chan, MD Endocrinology

### Lab Overview

Dr Christine L. Chan is a Pediatric Endocrinologist with a clinical research program focused on better understanding the causes, implications of, and best treatments for cystic fibrosis related diabetes (CFRD).

### Research Areas and Current Projects

Current areas of clinical research include observational studies investigating the implications of hyperglycemia during pulmonary exacerbations, natural history studies investigating the role of CFTR modulator therapies on dysglycemia and risk for metabolic syndrome and diabetes complications across the lifespan, interventional studies investigating pharmacologic agents and diabetes technologies in people with cystic fibrosis. Our group works closely with study teams and investigators at CF centers across the country to achieve study aims.

### Learning Opportunities

Interns working with our group will have the opportunity to engage in various aspects of clinical research related to cystic fibrosis (CF) and diabetes. Specifically, interns will work closely with our CFRD study team and participate in regular lab meetings to increase exposure to all aspects of clinical research from recruitment and engaging with people in the CF community, research visits, database management and data analysis, and scientific presentations. A typical internship will include opportunities to gain valuable experience in the applications of diabetes technology including continuous glucose monitors, insulin pumps, and research tools such as oral glucose tolerance tests and mixed meal tolerance tests to study diabetes and beta-cell function at various stages. Successful interns will be credited for their work in national and international presentations and may receive co-authorship on resultant publications, allowing for meaningful scientific contribution and advancement towards their own career goals.

## Kristen Nadeau, MD, MS Endocrinology and Diabetes

### Lab Overview

Dr. Kristen Nadeau, MD, MS, is a distinguished Pediatric Endocrinologist and serves as the Vice Chair for Clinical and Translation Science Research for the Department of Pediatrics. Her research focus lies in clinical-translational studies aimed at mitigating the long-term complications of pediatric obesity, type 1 diabetes, type 2 diabetes, and prediabetes. Dr. Nadeau's lab is dedicated to gaining a better understanding of the early contributors to cardiovascular disease (CVD), including mechanisms related to insulin resistance, cardiovascular dysfunction, and muscle dysfunction.

### Research Areas and Current Projects

The Nadeau lab is actively engaged in a variety of research areas and projects, which encompass:

1. Clinical studies involving assessments of insulin sensitivity and pancreatic function using advanced techniques such as IV hyperinsulinemic clamps with isotopes, hyperglycemic clamps, mixed meal tolerance tests, and oral glucose tolerance tests.
2. Evaluation of fat deposition in the liver, visceral, and muscle tissues via advanced imaging techniques like MRI/MRS.
3. Investigation of heart function through resting and exercise-stress echocardiography and cardiac MRI.
4. Measurement of endothelial function, arterial stiffness, blood flow, and arteriosclerosis using MRI and other vascular methodologies.
5. Assessment of exercise function, physical activity monitoring, and sleep patterns, including circadian rhythm monitoring.
6. Study of carbohydrate oxidation with metabolic cart assessments
7. Assessment of the effects of bariatric surgery on youth-onset T2D
8. Assessment of the effects of medications to improve insulin sensitivity on diabetes complications in type 1 diabetes

Dr. Nadeau's prior research portfolio also includes several large NIDDK longitudinal studies, such as the "Treatment Options for type 2 Diabetes in Adolescents and Youth (TODAY)" study, focusing on youth and young adults with type 2 diabetes. Additionally, there's a trial aimed at improving pancreatic function in individuals with prediabetes and early type 2 diabetes called "Restoring Insulin Secretion (RISE).", and currently the DISCOVERY study looking at precursors

of type 2 diabetes in youth with obesity. The lab is also involved in medication trials with the goal of reducing cardiovascular disease risk and enhancing insulin sensitivity in youth and young adults with type 1 diabetes.

### **Learning Opportunities**

Interns working in Dr. Nadeau's lab will have the opportunity to participate in clinical-translational research related to youth with obesity and diabetes. They will gain experience in various research methodologies, including advanced clinical assessments, imaging techniques, and longitudinal studies. This immersive research environment provides students with a rich exposure to clinical and translational research in the context of pediatric obesity and diabetes, contributing to a better understanding of the early contributors to cardiovascular disease and potential interventions.

## **eXtraordinary Kids Program (Interdisciplinary)**

Nicole Tartaglia, MD, MS

Shanlee Davis, MD, PhD

### **Lab Overview**

The eXtraOrdinary Kids Program is dedicated to further understanding of the diverse phenotype of individuals with sex chromosome aneuploidies, including Klinefelter syndrome (47,XXY), Turner syndrome (45,X and variants), Trisomy X (47,XXX), 47,YYY, 48,XXYY, and more. Individually, these conditions are rare and underdiagnosed, however when taken together these conditions affect 1 in 400 individuals. Our translational research program seeks to improve the lives of individuals with X&Y variations throughout the lifespan by interdisciplinary collaboration, incorporation of diverse research methods, and development of robust and sustainable resources to support ongoing discovery.

### **Research Areas and Current Projects**

The program's clinical-translational research focuses on various methodologies, including intervention trials, retrospective and prospective observational studies, translational science, secondary data analyses, patient reported outcomes (PROs), community-based participatory research, and more. These approaches are employed to address important clinical questions with the ultimate goal of improving patient outcomes in individuals with sex chromosome aneuploidies, with a specific emphasis on neurodevelopmental, endocrine, and health outcomes. The interdisciplinary team involved in this research program comprises experts in Developmental Pediatrics (Dr. Tartaglia), Pediatric Endocrinology (Dr. Davis), neuropsychology, psychology, genetic counseling, speech and occupational therapy, and clinical research professionals. Students are integral members of this team and are assigned projects tailored to their experience and career aspirations. In addition to identifying and completing research projects, students will also have the opportunity to assist with patient visits for ongoing clinical studies.

### **Learning Opportunities**

Interns in the eXtraordinary Kids Program will actively participate in research dedicated to improving the lives of youth with sex chromosome aneuploidies. They will gain hands-on experience and education in clinical-translational research. Students will contribute to projects that aim to address critical clinical questions in the field, particularly in the areas of neurodevelopment, endocrine health, and overall well-being of affected individuals. Working within an interdisciplinary team, interns will have the chance to collaborate with experts in various fields, enhancing their understanding of the comprehensive approach to patient care. Additionally, students will have the unique opportunity to engage directly with patients as they participate in ongoing studies, actively contributing to research that has the potential to significantly impact the lives of youth with sex chromosome aneuploidies. All interns will write a scientific abstract and present their work at our annual eXtraOrdinary Kids Research eXpo. Abstract submission for presentation at other local or national meetings is encouraged.



## Julia Dunn, PhD Gastroenterology, Hepatology and Nutrition

### Lab Overview

The Dunn Lab explores intriguing and unexpected aspects of innate immunity with the goal of revolutionizing treatment of allergic diseases. Dr. Julia Dunn, PhD, is an experienced researcher in the field and the newest faculty hire to the Gastrointestinal Eosinophilic Diseases Program (GEDP).

### Research Areas and Current Projects

Our cell type of interest is the eosinophil, which is thought to be a pro-inflammatory cell that causes allergic disease when it becomes activated. Recent studies, however, have shown that eosinophils may have important non-inflammatory roles in tissue development and healing. Research in the Dunn Lab explores 1) how eosinophils specialize in different environments, 2) how specialized eosinophils interact with other cells in the environment, and 3) how pro-inflammatory eosinophils may be re-specialized to assist in tissue repair. To address our core questions, we use murine models of allergic disease as well as human organoid tissue cultures to understand how eosinophils respond to environmental signals and how they, in turn, impact their surrounding tissues. We will use microscopy, flow cytometry, and transcriptomic analysis to understand reciprocal changes that occur in eosinophils, epithelial cells, and fibroblasts in the mucosal environment.

### Learning Opportunities

Dr. Dunn has substantial experience mentoring undergraduate and graduate students in both the technical aspects of laboratory work and the analytical skills that constitute true scientific training. Interns will gain experience reading and analyzing the scientific literature, designing and executing experiments, and assessing the results via statistical analysis and data visualization. Some ongoing projects in the Dunn Lab involve analysis of transcriptomic data, so students may gain experience with statistical analysis in R if they choose. It is expected that the data generated during this internship will be included in subsequent publications, for which the student will be credited as a contributing author.

## Nathan Dahl, MD Hematology/Oncology

### Lab Overview

Dr. Nathan Dahl is a Pediatric Neuro-Oncologist with a basic science lab that focuses on the study of epigenetics in childhood brain tumors.

### Research Areas and Current Projects

The primary focus of the Dahl lab is the study of chromatin biology and how it is altered in cancer states. How DNA is packaged and modified determines how genes are activated, repressed, or modulated across normal development. These regulatory mechanisms are often hijacked in cancer, co-opting normal developmental programs. This creates the opportunity to study both fundamental mechanisms of cancer biology but also how specific proteins driving these epigenetic alterations can be targeted for new cancer treatments.

### Learning Opportunities

Interns in the Dahl lab will have opportunities to engage with the spectrum of preclinical cancer research, tailored to the individual intern's interests and skill. A typical internship would include hands-on training with human tissue culture, direct measurements of RNA and protein, and preclinical pharmaceutical testing. Exposure to more advanced techniques in chromatin biology such as ChIP-seq, CUT&RUN, or RNA-seq will be integrated with an individual intern's project. We will also discuss fundamentals of scientific presentation and scientific careers according to the intern's own goals. Successful interns will be credited for their work in national and international presentations and may receive co-authorship on resultant publications, allowing for meaningful scientific contribution and advancement towards their own career goals.

## Nick Foreman, MD Hematology/Oncology

### Lab Overview

The Foreman laboratory, led by Dr. Nick Foreman, MD, specializes in pediatric Oncology. Dr. Foreman is an experienced researcher in the field with a focus on the biology and immunobiology pediatric brain tumors especially ependymoma. Recently this lab has also done published work on tumor associated with neurofibromatosis.

### Research Areas and Current Projects

The lab's primary goal is to enhance our understanding of the biology and immunobiology of pediatric ependymoma. Specifically, they seek to identify biological characteristics with clinical relevance, such as drug sensitivity, diagnosis, and prognosis. To achieve this, the lab employs cutting edge molecular tools including single cell RNA sequencing, spatial transcriptomics and CITE-seq. The lab also does translational research involving testing of new agents in vitro and then in mouse models of ependymoma. These technologies allow not only for detailed exploration of the biology of single tumor cells and tumor associated immune cells but also cross talk between cell types. The lab is regarded as the leading ependymoma lab in North America and has collaborators in several countries.

### Learning Opportunities

Interns in the Foreman lab will have the opportunity to engage in various aspects of cutting-edge research. By working with the advances molecular tools used by this lab, interns will gain valuable experience in the utility of these approaches and the associated data analyses needed to integrate findings from these complimentary approaches. Hands on experience in specimen handling and interpretation of data will be provided by the very experienced technical staff in the Foreman lab. Additionally, students will delve into the results of microarray analyses through protein expression studies. Such hands-on involvement in the lab's research processes provides an opportunity for skill development, fostering a deeper understanding of laboratory techniques and analytical tools. Students will be involved in discussion and planning of translational studies but can only be hands on involved in the in vitro experiments and not in the mouse modeling. Promising research projects within the Foreman lab typically offer opportunities for presentations at national meeting, co-authorship on publications, allowing interns to make a tangible contribution to the scientific community.

## Siddhartha Mitra, PhD Hematology/Oncology and Todd Hankinson MD, MBA Pediatric Neurosurgery

### Lab Overview

Dr. Siddhartha Mitra, PhD, leads the Mitra lab, which is an integral part of the Morgan Adams Pediatric Brain Tumor Research Program within the Department of Pediatrics Hematology/Oncology/Bone Marrow Transplantation section at the University of Colorado School of Medicine. Dr. Mitra's research combines expertise in three distinct fields: Immuno-Oncology, neurodevelopment, and brain tumor oncology. The lab's primary focus centers on understanding the mechanisms of immune surveillance in brain tumors, particularly involving cells of the innate immune system.

Dr. Todd Hankinson, MD, is the head of pediatric neurosurgery at Children's Hospital Colorado and leads the Hankinson lab, which is also part of the Morgan Adams Pediatric Brain Tumor Research Program. His research focuses on the brain tumor, Adamantinomatous Craniopharyngioma (ACP). His lab uses a combination of laboratory and computational tools to translate biological discovery into clinical application. They have developed and work with patient derived cell culture models, machine learning models, and work closely with Dr. Mitra in the study of the immunobiology of ACP.

### Research Areas and Current Projects

The Mitra/Hankinson labs are engaged in multiple areas of research, including:

1. Investigating the immune-surveillance mechanisms in brain tumors, particularly involving the innate immune system components such as macrophages and brain resident microglia. These immune cells play a vital role in the brain tumor microenvironment.
2. Exploring the inhibition of the myeloid checkpoint pathway, specifically the CD47-SIRP $\alpha$  signaling axis, to suppress the "don't eat me" signal and enhance the phagocytosis of various types of brain tumors. This research is significant in the context of immune-based approaches to combat brain tumors.

3. Focusing on translational Immuno-Oncology to better understand and harness mechanisms like efferocytosis and immunogenic cell death for the development of improved immune-modulating drugs targeting both adult and pediatric brain tumors.
4. Developing machine learning tools for the analysis and translation of large volume laboratory data

The Mitra/Hankinson labs collaborate with a broader brain tumor research program that encompasses seven labs, each specializing in various aspects, including single-cell RNA sequencing, autophagy, and oncogenic signaling pathways. This multidisciplinary approach enhances the collective expertise in the field.

#### **Learning Opportunities**

Interns joining the Mitra/Hankinson lab will be part of a brain tumor research program, offering a unique environment to gain experience and insights into Immuno-Oncology, neurodevelopment, and brain tumor oncology. Interns will have the opportunity to work on cutting-edge projects related to immune surveillance and immunotherapeutic approaches for brain tumors.

## **Jean Mulcahy Levy, MD Hematology/Oncology**

#### **Lab Overview**

Dr. Jean Mulcahy Levy, MD, has a background in oncology research, with specific training and expertise in pediatric brain tumors. Dr. Mulcahy Levy's research primarily focuses on the development of new therapies for brain tumors, with a particular interest in understanding and addressing therapy resistance mechanisms.

#### **Research Areas and Current Projects**

Dr. Mulcahy Levy's lab concentrates on harnessing autophagy, a cellular recycling program, to enhance therapy for patients with central nervous system (CNS) tumors. The lab's research aims to unravel the mechanisms by which autophagy can be utilized to improve treatment outcomes, especially in cases of therapy-resistant brain tumors. Dr. Levy's lab has made significant contributions to this area, including identifying the connection between BRAF pathway alterations and autophagy addiction in brain tumors. Their work has demonstrated the effectiveness of autophagy inhibition when tumors become resistant to BRAF/MEK inhibitors. This research has led to the initiation of a first-in-pediatrics multi-institutional trial of autophagy inhibition in collaboration with the Pediatric Brain Tumor Consortium and Novartis. Additionally, the lab has conducted extensive investigations into resistance mechanisms to BRAF/MEK inhibitors, with the publication of the largest series of paired pediatric CNS tumor samples. The lab is committed to the development of novel and rapidly translatable treatments for pediatric CNS tumors. Their research has also identified biologically driven therapies for AT/RT and other tumors through genome and pharmacologic screening. A key finding is the identification of CDK7 as a critical vulnerability in AT/RT, which forms the basis for further exploration into the mechanistic relationship between CDK7 and the SWI/SNF complex in AT/RT, and the potential for inhibiting CDK7 alone or in combination with existing AT/RT chemotherapies.

#### **Learning Opportunities**

Interns in Dr. Mulcahy Levy's lab will have the opportunity to actively engage in groundbreaking research with significant implications for pediatric oncology. They will play a pivotal role in ongoing projects related to autophagy and resistance mechanisms in CNS tumors, gaining hands-on experience in experimental techniques, data analysis, and translational research. This involvement provides a valuable opportunity for students to develop practical research skills and contribute to the development of novel therapies. Additionally, students may collaborate with a multi-institutional trial, offering a unique perspective on the clinical translation of research findings. Working closely with the experienced research team, interns can expect to contribute to research that has the potential to improve treatment outcomes for pediatric CNS tumors.

## Adam Green, MD Hematology/Oncology

### Lab Overview

Dr. Adam Green investigates novel targets and therapeutic strategies for aggressive pediatric brain tumors, specifically high-grade gliomas (HGG), including diffuse midline glioma (DMG). The Green lab is committed to advancing knowledge and improving outcomes for children facing the formidable challenge of high-grade gliomas.

### Research Areas and Current Projects

The Green lab is engaged in several areas of research, including:

1. Exploration of novel targets and therapeutic strategies for the treatment of high-grade gliomas.
2. Utilization of genomic, epigenomic, and drug screening techniques to identify vulnerabilities in these tumors.
3. Exploitation of identified weaknesses in preclinical models, including cell cultures and mouse models, to develop and test the most effective new therapies.
4. Translation of promising therapies to rationally designed early-phase clinical trials in children, aiming to improve outcomes for patients with these challenging cancers.
5. Investigation into the mechanisms of action of new therapies, addressing the complexities of drug delivery to ensure effective treatment of pediatric brain tumors.

### Learning Opportunities

Interns joining Dr. Green's lab will be actively involved in investigating and understanding the genomic and epigenomic landscape of high-grade gliomas, specifically preclinical research using cell cultures and mouse models to test and refine novel therapeutic strategies. They will work with experienced lab personnel to learn cell culture and molecular biology techniques to investigate novel targets in these diseases, along with investigation of combination therapy approaches and drug delivery. Interns will be coauthors on any national/international presentations and publications to which they contribute.

## Martin Breuss, PhD Human Genetics and Genomics

### Lab Overview

The Breuss lab focuses on the phenomenon of 'genetic mosaicism', where some but not all cells within a tissue carry unique mutations. While genetic mosaicism is commonly associated with diseases such as cancers, where specific mutations cause phenotypes, it also occurs naturally in every cell of the human body during embryonic development, aging, and homeostasis. Dr. Breuss's laboratory is dedicated to comprehending the broader implications of genetic mosaicism on human health, exploring its origins during early development, and employing mosaic mutations as markers of clonal lineages.

### Research Areas and Current Projects

The Breuss lab is involved in several research projects:

1. Analysis of mosaicism in parents and its potential implications for the transmission of disease-causing mutations to multiple children. This research is directly related to understanding the recurrence risk of 'sporadic' diseases.
2. Examination of 'neutral' mosaicism, which lacks functional impact but serves as a marker of development and cellular homeostasis. This allows the lab to reconstruct the process of development or clonal changes, which is typically challenging to achieve in humans.

The lab takes a multidisciplinary approach, combining human genetics research in collaboration with clinical researchers, molecular biology to develop and perform detection assays, and computational methods for processing and analyzing the generated data. More information about the lab's research and team can be found at [www.breusslab.org](http://www.breusslab.org).

### Learning Opportunities

Interns in Dr. Breuss's lab will actively participate in research focused on genetic mosaicism and its broader implications for human health. They will gain experience in various aspects of research, including human genetics, molecular biology, and computational analysis. Projects will be either hybrid (i.e., including experimental and computational science) or completely focused on computational analyses. Students will have the opportunity to develop practical laboratory skills and contribute to projects that enhance our understanding of genetic mosaicism and its role in

health, development, and homeostasis. Being fully integrated into the Breuss lab, they will also have opportunities to present critical scientific literature and their own work, as well as receive feedback and training to improve their skills as appropriate for their career stage. The PI and members of the laboratory will also be available as mentors to discuss scientific careers. Successful interns will be credited for their work in national and international presentations and may receive co-authorship on resultant publications, allowing for meaningful scientific contribution and advancement towards their own career goals.

## Laura Brown, MD Neonatology

### Lab Overview

Dr. Laura Brown, MD, leads a research lab in the field of Neonatology, specializing in the study of intrauterine growth restriction (IUGR). IUGR affects approximately 8% of pregnancies and results from placental insufficiency, leading to limited nutrient and oxygen delivery to the fetus and slower fetal growth. Dr. Brown's overall research goal is to understand the basic biology of fetal muscle development and protein metabolism to optimize body composition and metabolic health in infants born with IUGR.

### Research Areas and Current Projects

The Brown laboratory investigates how fetal nutrient availability influences skeletal muscle development and its long-term consequences, including conditions like sarcopenia, insulin resistance, and diabetes. The lab conducts in vivo physiological studies using large animal (sheep) models of pregnancy and complements them with in vitro experiments using muscle tissue and primary fetal myocytes to understand the cellular adaptations to nutrient restriction. Additionally, they use stable isotopic tracer and metabolomic techniques to study how nutrient supply and growth factors affect skeletal muscle-specific metabolism.

### Learning Opportunities

Interns working in Dr. Brown's lab will have the opportunity to actively engage in research with direct implications for fetal and neonatal health. They will learn to conduct physiological studies, develop hypotheses, and participate in experiments that measure nutrient uptake and metabolic processes in skeletal muscle. Student projects are designed to give interns experience in performing fundamental molecular and cellular techniques including protein/RNA analysis and histology. This hands-on experience provides valuable insights into research methodologies and laboratory procedures relevant to neonatology and maternal-fetal medicine. Working closely with Dr. Brown and her team, students may contribute to ongoing projects aimed at optimizing body composition and growth in the IUGR fetus and neonate, ultimately preempting complications related to low muscle mass. This research experience offers students the chance to develop practical skills and contribute to improving the long-term health of affected individuals. The goal is to have each student complete a project that leads to an abstract submission to attend a national meeting.

## Stephanie Wesolowski, PhD Neonatology

### Lab Overview

Our lab studies how altered nutrient supply programs fetal metabolism and how these changes may persist after birth and increase susceptibility to adult metabolic disease. Our primary research is aimed at understanding the effects of intrauterine growth restriction (IUGR) on liver metabolism and function using integrative approaches in physiology and metabolism combined with novel molecular techniques in cell biology, epigenetics, and metabolomics.

### Research Areas and Current Projects

Current studies in our research program are focused on understanding the mechanisms for the early activation of fetal hepatic glucose production and development of hepatic insulin resistance, specifically the role of reduced glucose versus oxygen supply to the fetus, both key features of placental insufficiency and resulting IUGR. This is important in understanding why IUGR offspring have increased susceptibility to diabetes across their lifespan. We also have projects investigating the effects of maternal high fat diet and obesity on offspring metabolism, specifically the early development of non-alcoholic fatty liver disease (NAFLD) and immune cell reprogramming.

### Learning Opportunities

Interns will gain hands-on experience with biochemical, molecular, and cellular techniques in the lab. They will be mentored by the PI and members on the lab. While guidance will be provided, the intern will be expected to take ownership of the project. Opportunities for abstract presentations at national meetings and co-authorship on publications are considered for interns who are interested and make appropriate contributions to the project.

## Clyde Wright, MD Neonatology

### Lab Overview

Dr. Clyde Wright, MD, leads a research lab in the field of Neonatology, with a primary focus on understanding how inflammatory insults encountered during the perinatal period contribute to the various morbidities observed in prematurely born infants. Dr. Wright's lab aims to investigate cell-specific innate immune pathways to identify potential therapeutic targets for improving the outcomes of these vulnerable patients.

### Research Areas and Current Projects

The central research area in Dr. Wright's lab revolves around the study of innate immune responses and their role in neonatal health. The lab employs in vitro and in vivo approaches to evaluate the impact of manipulating innate immune signaling in the presence of clinically relevant stressors, such as infection and oxidative stress. This research aims to reduce inflammatory injury and enhance neonatal health outcomes.

### Learning Opportunities

Interns in Dr. Wright's lab will have the opportunity to actively participate in research that directly addresses critical aspects of neonatal health. They will learn to apply the scientific method, including the development and testing of hypotheses. Interns will be mentored throughout the research process, including data analysis and presentation. This experience offers a valuable opportunity for students to develop practical research skills, conduct experiments, and gain insights into the complexities of neonatology research. Promising research projects within the Wright lab typically offer opportunities for presentations at national meeting, co-authorship on publications, allowing interns to make a tangible contribution to the scientific community.

## Russell Whelan MD, PhD Nephrology

### Lab Overview

The Whelan lab, within the Division of Pediatric Nephrology, is focused on the roles of vascular dysfunction in a wide range of kidney diseases. Utilizing multiple molecular biology, cellular biology and bioengineering techniques, we aim to better understand the roles of inflammation and cell death in mediating kidney injury, with the ultimate goal of finding and evaluating novel therapeutics for kidney disease in children and adults.

### Research Areas and Current Projects

The lab's primary goal is to better understand endothelial dysfunction in static and flow conditions, with several foci of investigation.

Currently our principal focus is on the role of complement in mediating vascular injury in the kidney. Complement is a component of the innate immune system that rapidly responds to internal and external threats in the body, but can cause severe kidney disease when dysregulated or overly active. We are particularly focusing on specific regulators of the complement pathway, known as Complement Factor H (CFH) and Complement Factor H Related (CFHR) proteins. Specific mutations of CFH and CFHRs are known to cause kidney disease in patients, and we are exploring the role of these regulators in kidney injury. To achieve this, we use cell culture and engineered microvessel studies to look at these effects, allowing us to explore mechanisms unique to the microvasculature under flow, providing a unique niche of investigation that culture and animal studies cannot provide.

We also study the effects of Shiga toxin on kidney endothelium, as Shiga-toxin mediated injury to the kidney causes significant morbidity and mortality without any effective treatment. We are focusing on a medication that specifically inhibits Shiga-toxin mediated endothelial injury. We have demonstrated near-complete protection in cell-culture and engineered microvessels under flow, and now are looking to better understand the specific mechanisms that provide this protection.

Additional studies focus on the roles of novel mechanisms of cell death and inflammation in the kidney microvasculature.

### Learning Opportunities

Dr Whelan's goal for all members of the lab is to have projects that allow for intellectual and technical growth in their skills and interests, irrespective of experience level. Dr. Whelan works with new members of the lab to identify projects that best fit their interests and established skills, and as a highly collaborative lab, the goal is for input from all members in planning and interpretation. There is a wide range of techniques utilized in lab, including cell culture, immunofluorescence, immunohistochemistry, immunoblotting, recombinant protein production, cloning and mutagenesis, microvessel fabrication. All new members will learn techniques under supervision and support until mastery is shown, and then will have the opportunity for independence in planning and executing experiments. Trainees will receive support in methods, data analysis and how to apply results to subsequent experiments. Ultimately the goal at the end of the project is to provide trainee ownership in a project, from initial planning, through data analysis and interpretation, and ultimately with presentation and sharing with others. Any work that contributes to publication will lead to co-authorship, as well as opportunities for submission to scientific meetings for presentation.

## Andra L. Dingman, MD Neurology

### Lab Overview

The Dingman lab studies long-term glial changes after neonatal stroke and global hypoxic ischemic injury. This includes chronic activation of microglial cells, abnormalities in oligodendrocyte phenotype, and the impact on white matter tract plasticity. My lab also studies long-term behavioral consequences of neonatal stroke. The long-term goal of my work is to identify new treatment opportunities to improve motor, cognitive, and emotional/social outcomes of early life brain injury.

### Research Areas and Current Projects

The Dingman lab uses a mouse model of neonatal stroke, and a rat model of global cerebral ischemia. Techniques used in the lab include immunohistochemistry analysis of cell types and phenotype, single cell RNA sequencing, in Situ hybridization and molecular analysis of brain tissue. We also employ behavioral testing in rodents to assess motor, cognitive and social function.

### Learning Opportunities

Interns in the lab will participate in ongoing projects by analyzing immunohistochemistry images, participating in and/or analyzing behavioral testing, learning sample preparation and molecular techniques such as qPCR or ELISA assays, and possibly analysis of sequencing data. Interns will learn techniques that apply to a wide range of translational research and gain a foundation in the science of developmental brain injury.

## Melissa Wright, MD, PhD Neurology

### Lab Overview

The Wright Lab, led by Dr. Melissa Wright, MD/PhD, uses a zebrafish model to better understand the pathomechanisms underlying congenital myopathies (genetic muscle diseases affecting infants and children).

### Research Areas and Current Projects

The Wright Lab is interested in better understanding the processes that lead to congenital myopathies to be able to develop targeted treatments for them. Our current work focuses on the rare SELENON-related congenital myopathy and the more common RYR1-related congenital myopathy. We use zebrafish to develop animal models of congenital muscle diseases. Using advanced genetic, immunocytological, and microscopic techniques we are able to investigate dynamic regulation of key skeletal muscle proteins at different points in develop and under different conditions of stress or injury. This allows us to better understand the function of these proteins under different conditions. Developing disease models in zebrafish allows us to understand the cellular changes that occur in skeletal muscle when a key protein is absent so we can begin to identify cellular pathways to target for eventual treatment of the disease. Zebrafish

is an excellent model to use in drug screens for congenital myopathies as zebrafish produce abundant progeny, develop rapidly, and movement phenotypes can be easily identified and quantified with automated technology.

### Learning Opportunities

Interns in the Wright Lab will have hands-on involvement in lab processes and projects. They will have the opportunity to learn about congenital myopathies and pediatric neuromuscular disease and discuss the intersection of basic science research and translational precision medicine. They will learn many key techniques for working with zebrafish as a research model and gain an advanced understanding of muscle development and physiology. Students will have the opportunity to work on a new project, developing and optimizing a screening protocol for a zebrafish model of RYR1-related congenital myopathy that will later be used for a drug screen to identify potential therapeutics for RYR1-related myopathy. This work could lead to presentation at local or national scientific meetings and/or co-authorship on publications.

## Tim Benke, MD, PhD Neurology/Neuroscience

### Lab Overview

The Benke lab studies the long-term consequences of early life seizures on the developing brain. While these changes may not always result in epilepsy, they are known to lead to cognitive and behavioral impairments. The lab's research focuses on unraveling the molecular mechanisms responsible for these cognitive and behavioral deficits, with the ultimate goal of developing innovative treatments for intellectual disability and autism, irrespective of their causes.

### Research Areas and Current Projects

The Benke lab is using animal models of early life seizures to explore the underlying molecular mechanisms. Researchers in the lab employ various techniques, including electrical recordings in living rat brain slices, stereotactic injection of antisense viral vectors, electroencephalogram (EEG) and video monitoring in freely moving rats, as well as western blotting and immunohistochemistry. These methods are central to probing the mechanisms behind cognitive and behavioral impairments resulting from early life seizures.

### Learning Opportunities

Interns in the Benke lab will participate in research that delves into the long-term consequences of early life seizures and their impact on cognitive and behavioral functions. They will have the unique opportunity to use animal models to explore the molecular mechanisms underlying these consequences. Students will engage in various techniques such as electrical recordings, stereotactic injections, EEG monitoring, and molecular analyses. This research experience offers opportunities for students to develop practical laboratory skills and contribute to advancing the understanding of cognitive and behavioral impairments.

## Nursing Research, Children's Nurse Scientist Team

Cathy Kleiner PhD, RN

Figaro Loresto, PhD, RN

Teri L. Hernandez, PhD, RN, FAAN

Lindsey Tarasenko, PhD, RN

Scott Harpin, PhD, MPH, RN, FSHAM

Avery M. Anderson, PhD, PMHNP-BC, APRN

### Lab Overview

The Nurse Scientist Team, led by Dr. Cathy Kleiner, PhD, RN, operates within the division of Nursing and Patient Care Services at Children's Hospital Colorado (CHCO). The Nurse Scientists are a collaborative team with representation from the University of Colorado and CHCO. All have advanced expertise in nursing, research methodology, and clinical knowledge:

- Teri Hernandez, PhD, RN, FAAN: Focuses on glucose and lipid metabolism during pregnancy, in-utero programming influences on CVD and diabetes risk, nutrition, metabolic health, and their impact on conditions like diabetes and obesity. Dr. Hernandez leads the Infant GOLD program, aiming to improve outcomes for women, infants, and families through multidisciplinary research.



- Scott Harpin, PhD, MPH, RN, FSHAM: Investigates health outcomes and mental health promotion in vulnerable adolescent and young-adult populations, specifically addressing runaway/homeless youth and those transitioning to foster care.
- Figaro Loresto, PhD, RN: Focuses on social network analysis and multilevel analysis of large datasets (e.g., administrative databases, electronic health records) and offers statistical consultation for nursing-led quality improvement and research projects.
- Lindsey Tarasenko, PhD, RN: Her research interests encompass organizational change, leadership roles in healthcare, and workplace mistreatment among nurse managers.
- Avery Anderson, PhD, PMHNP-BC, APRN: Focuses on addressing mental health disparities among transgender and gender diverse (TGD) young people. He has special interests in psychological and physiological mechanisms contributing to suicide among TGD young people, and he is also interested in upstream, family- and community-level interventions.

### Research Areas and Current Projects

The Nurse Scientists focus on leading, developing, and managing clinical research studies that enhance patient care and safety. This includes mentoring and educating nursing staff in research, facilitating work aimed at improving patient outcomes, and contributing to new advancements in pediatric nursing and healthcare practices.

### Learning Opportunities

Interns can anticipate learning opportunities that offer increased understanding of research methodologies, scientific writing, ethical review processes, mentorship, specialized techniques, data analysis, and networking within the field of pediatric nursing and healthcare research.

1. Clinical Research: Interns will contribute to ongoing research studies led by the Nurse Scientists. They may support with study design, data collection, analysis, and interpretation under the guidance of the Nurse Scientist team. Interns will learn the value of interdisciplinary collaboration in healthcare and research settings through shadowing experiences, educational workshops, etc.
2. Evaluation and Outcome Improvement: Interns may engage in evaluating clinical practices and outcomes that impact patient care. Opportunities for learning include evaluating ongoing research projects aimed at improving patient outcomes.
3. Specialized Research Techniques: Depending on their interests and skills, interns may receive training in specialized research techniques such as social network analysis, statistical analysis of large datasets, clinical research methodologies, and tools used for metabolic studies.
4. Quality Improvement: Interns will have the option to learn about ethical considerations involved in research by understanding the work involved with the Colorado Multiple Institutional Review Board (COMIRB) and the Organizational Research Risk and Quality Improvement Review Panel (ORRQIRP), on which the Nurse Scientists are active participants.

## Kristen Boyle, PhD Nutrition

### Lab Overview

Dr. Kristen Boyle is a leading researcher in the field of Nutrition. Her lab specializes in the study of molecular metabolism, particularly in umbilical cord stem cells, to identify factors that may predispose children to developing obesity or diabetes later in life.

### Research Areas and Current Projects

The primary focus of Dr. Boyle's research is to investigate the molecular and metabolic aspects of umbilical cord stem cells and their potential impact on children's future health. The lab explores how maternal health and pregnancy exposures, such as obesity, diabetes, and environmental pollutants, can increase a child's risk for later disease. Specifically, the lab employs various metabolic and molecular biology techniques to identify and characterize epigenetic mechanisms for altered metabolism in umbilical cord mesenchymal stem cells (MSCs) collected at birth. Current projects in the lab encompass several critical areas, including:

1. Investigating the role of maternal stressors, such as obesity, diabetes, environmental exposures or psychosocial stressors, on infant stem cell metabolism.

2. Exploring the role of cell cycle exit on adipogenesis and adipocyte metabolism.
3. Characterizing associations between maternal, MSC, and offspring metabolic phenotypes using multi-omics approaches.

### Learning Opportunities

Interns working in Dr. Boyle's lab will have a unique opportunity to engage in research focused on the molecular basis of metabolic disorders and their developmental origins. They will gain hands-on experience with a variety of metabolic and molecular biology techniques, including mitochondrial respiration, radiolabeled substrate metabolism, qPCR, luciferase gene reporter assays, and lentiviral transduction. Furthermore, students will have the flexibility to tailor their research towards specific areas of interest, whether that involves delving into metabolism, molecular biology, or statistical analyses using existing datasets. This comprehensive involvement provides a strong foundation in both experimental and analytical aspects of nutrition research and offers the chance to contribute to our understanding of the long-term health effects of prenatal exposures. Successful interns will be credited for their work in national and international presentations and may receive co-authorship on resultant publications, allowing for meaningful scientific contribution and advancement towards their own career goals.

## Minghua Tang, PhD Nutrition

### Lab Overview

Dr. Tang's lab is in Pediatric Nutrition, which leads the clinical research component in the section. The lab has Dr. Tang as the PI, and several research associates and a registered dietitian. Dr. Tang's team works closely with the Clinical and Translational Research Center at Children's Hospital to conduct clinical study visits.

### Research Areas and Current Projects

Dr. Tang's background is in the prevention and treatment of obesity and its comorbidities, with extensive training and experience in designing and conducting clinical trials and controlled feeding studies across the lifespan. One of the current focuses is the biological underpinnings of obesity and chronic disease prevention early in life, with a special interest in the interaction of diet and the gut microbiome. Toward this end, our team conducts randomized controlled feeding trials in human subjects and mechanistic animal studies. Our research program is also interested in the role of healthy eating patterns and foods affecting inflammatory status, the gut microbiome and other health indicators in overweight and obese adults, using state-of-art metabolomics techniques in foods (foodomics or nutriomics) and biospecimens.

Our group was the first to demonstrate different protein-rich foods have differential impacts on growth trajectories in formula-fed infants. One of our current projects focused on comparing common protein-rich foods on infant growth during complementary feeding. Our research group is also evaluating the effects of dietary patterns, foods (e.g., salmon, blueberry) and their bioactive compounds in regulating inflammatory responses, immunity, and gut microbiota in adult and pediatric populations, with support from USDA and NIH.

### Learning Opportunities

Interns who join Dr. Tang's team during the internship will have the opportunity to learn all aspects of clinical nutrition research in the pediatric population. The research activities include study visits at Children's Hospital, study visits at participants home to measure the infants, collecting diet records, processing samples and data entry. The intern will also have the opportunity to observe and analyze breastmilk samples. The intern will join Dr. Tang's weekly lab meeting and present research progress. Data analyses and presentation are also possible.

**Shelley Miyamoto, MD Pediatric Cardiology**  
Pediatric Cardiovascular Research Laboratory (PCRL)  
Shelley Miyamoto, MD      Kika Sucharov, PhD  
Brian Stauffer, MD        Katie Chatfield, MD, PhD

**Lab Overview**

Dr. Shelley Miyamoto, MD, leads a multidisciplinary research group with a mission to conduct translational and molecular research focused on children with heart disease. The laboratory brings together expertise spanning the cardiovascular field, encompassing pediatric and adult disease, basic molecular biology, cardiovascular physiology, and clinical translation. The research conducted in the Miyamoto lab leverages a repository of pediatric and adult heart tissues, as well as animal and primary cell culture models.

**Research Areas and Current Projects**

The lab's current projects encompass a broad range of areas:

1. Investigation of mitochondrial function in the failing hearts of children with cardiomyopathy and single ventricle heart disease.
2. Exploration of the regulation of phosphodiesterase expression and activity in pediatric heart failure.
3. Profiling of tissue and circulating microRNAs for insights into heart disease.
4. Study of myocyte mechanics in the context of the failing heart.

The research undertaken in the Miyamoto lab is pivotal in understanding and addressing pediatric heart failure, a condition for which current treatment strategies are often extrapolated from trials conducted in adult heart failure patients. Dr. Miyamoto's findings reveal that children with heart failure exhibit unique molecular adaptive responses, indicating the need for specific, targeted therapeutic approaches.

**Learning Opportunities**

Interns working in the Miyamoto lab will have the opportunity to engage in research aimed at unraveling the molecular and translational aspects of heart disease in children. They will work with a diverse set of research tools and techniques, including RT-PCR, Western blotting, various activity assays, and basic biostatistics. This experience offers students the chance to develop practical laboratory skills and contribute to projects with direct implications for the understanding and treatment of pediatric heart failure. Interns will collaborate in a multidisciplinary environment, gaining insights into the translation of research findings into clinical practice.

**Anastacia Garcia, PhD Pediatric Cardiology**

**Lab Overview**

The overall focus of my current research program is to better understand the unique adaptations governing pathological cardiac remodeling and the progression to heart failure in pediatric patients with complex congenital heart disease (CHD), including hypoplastic left heart syndrome (HLHS) and other single ventricle defects. The ultimate goal of my research is to develop the critical knowledgebase and infrastructure necessary to identify efficacious therapies for improving outcomes in this vulnerable group.

**Research Areas and Current Projects**

By using human cardiac tissue and blood samples in combination with cell and animal models, we evaluate both the basic biology of complex congenital heart disease and interventions that have the potential to address the decline in myocardial function. Currently, a major focus of the lab is to elucidate the molecular mechanisms involved in the modulation of cardiac energy metabolism and altered immune cell signaling in single ventricle heart disease. This work will be important for the identification and development of drug therapies that improve cardiac function and enhance transplant-free survival in this population. We are actively investigating the role of specific glycolipids in modulating both cardiometabolic function and inflammation. We are also actively developing a high-throughput drug screening approach to identify novel therapeutic targets.

**Learning Opportunities**

Researchers in the Garcia lab will have the opportunity to engage in a spectrum of pre-clinical cardiovascular research utilizing in vitro cell culture-based models as well as in vivo murine based models. We utilize a variety of molecular

biology techniques (DNA, RNA, protein) as well as high resolution respirometry functional analysis. A typical internship would include hands-on training with cell culture, direct measurements of RNA and protein, and preclinical pharmaceutical testing. We will also discuss fundamentals of scientific presentation and scientific careers according to the intern's own goals. Promising research projects within the lab typically offer opportunities for presentations at national meeting and co-authorship on publications, allowing interns to make a tangible contribution to the scientific community and will advance their own career goals.

## Gareth Morgan, MD Pediatric Cardiology

### Lab Overview

The Interventional Congenital Cardiac laboratory, led by Prof Gareth J Morgan, MD, specializes in benchtop, translational and clinical research to benefit babies, children and young adults requiring minimally invasive cardiac procedures. Prof Morgan and his colleague Dr Zablah are PI's and co-PI's on multiple grants and publish 15-20 peer reviewed manuscripts per year. Prof Morgan and Dr Zablah hold patents and provisional patents on several interventional cardiac inventions.

<https://som.cuanschutz.edu/Profiles/Faculty/Profile/24261>

<https://som.cuanschutz.edu/Profiles/Faculty/Profile/24322>

### Research Areas and Current Projects

Prof. Morgan's research team have an international reputation in the field with a focus on interventional device design, development of VR and AR applications for interventional cardiology as well as flow dynamics, tissue engineered device technology and transformational mathematical modelling to define functional cardiac anatomy.

### Learning Opportunities

As well as having a dedicated research wetlab within the children's hospital Prof Morgan and Dr Zablah have a full-time research fellow and a dedicated research coordinator and welcome international as well as local research collaborators on a regular basis. They are PI's on multiple large industry sponsored trials as well as focusing on local talent development and educational projects. A dedicated, talented student should anticipate co-authorship on at least one pubmed indexed manuscript as well as participation in a proven and dynamic research team.

## Stephanie Nakano, MD Pediatric Cardiology

### Lab Overview

The Nakano laboratory focuses on pediatric heart failure and transplantation. Dr. Nakano specializes in the care of children with end-stage heart failure, which can be due to congenital heart disease or cardiomyopathy, many of whom then require heart transplantation.

### Research Areas and Current Projects

The Nakano lab performs basic and translational research utilizing patient-derived samples. The current projects in the Nakano lab are focused in two main areas:

1. Children with single ventricle congenital heart disease are at lifelong risk of developing heart failure. Nevertheless, traditional heart failure medications are not effective in this population and these children often require heart transplantation. Our goal is to understand factors that may predispose certain patients to early heart failure to identify novel therapeutic medications and approaches. The lab creates cardiac cells from white blood cells from single ventricle patients and matures these cardiac cells in long-term culture. Contractility measurements, gene expression, and sarcomere morphology are compared between cells from single ventricle patients and normal controls. Additionally, the lab is interested in evaluating immune and inflammatory abnormalities which may contribute to poor outcomes in single ventricle patients.
2. While a heart transplant can be life saving, there are significant co-morbidities associated with heart transplantation, including acute rejection and cardiac allograft vasculopathy. Our goal is to identify changes in T cell populations to see if they can be used as early biomarkers for rejection or vasculopathy. Using blood samples collected from pediatric heart transplant recipients, we are collaborating with Immunology labs on campus to evaluate T cell populations in depth.

### Learning Opportunities

Interns will have a unique opportunity to gain expertise in basic and translational cardiology research utilizing human samples from one of the largest pediatric cardiac biobanks in the country. Lab members have exposure to a wide range of wet bench techniques, including peripheral blood mononuclear cell isolation, induced pluripotent stem cell culture, permeabilized single cell contractility measurements, multiplexed immunohistochemistry, single cell RNAseq, and proteomics. Furthermore, we have frequent discussions of scientific results and how they fit into the clinical context. It is our hope that successful interns will have the opportunity to present their work and be co-authors on publications in an environment that will support their future career goals.

## Stacey L. Simon, PhD, DBSM Pulmonary and Sleep Medicine

### Lab Overview

Dr. Stacey L. Simon, PhD, is a pediatric behavioral sleep medicine provider with a research focus on mechanisms underlying the negative physical and mental health consequences of insufficient sleep and circadian misalignment (mismatch between the biological and social clocks) in adolescents. Adolescents are at high risk for insufficient and mistimed sleep due to biological, psychosocial, and environmental factors such as a physiological delay in circadian rhythms, high academic and social demands, and typically early high school start times. Dr. Simon's work has demonstrated associations between short sleep duration, late bedtimes, and circadian misalignment with insulin resistance, vascular impairments, and poor mood and behavior in adolescents including otherwise healthy youth and those with obesity, PCOS, and type 1 diabetes. The overall goal of the lab is to identify countermeasures to poor sleep and circadian health as a means of improving physical and mental health outcomes in adolescents.

### Research Areas and Current Projects

Current ongoing studies include:

SUNRISE: a randomized clinical trial assessing the impact of increasing sleep duration on insulin resistance in adolescents with habitually short sleep.

SUNDIAL: a cross-sectional study examining sleep and circadian health in adolescents with type 1 diabetes.

Quantitative and qualitative data from these and other studies are available for analysis. Specific research questions interns could explore include:

- qualitative analysis of facilitators and barriers to healthy sleep in adolescents with obesity
- "morning larks" vs "night owls": differences in adolescents objective and subjective sleep health by chronotype
- anxiety and depression symptoms following a sleep extension manipulation in habitually short-sleeping adolescents

### Learning Opportunities

Interns in Dr. Simon's lab will have opportunities to engage in multidisciplinary, collaborative research across the fields of sleep medicine, pediatric psychology, endocrinology, cardiology, genetics, and pulmonology. Clinical shadowing in these areas is also possible. Opportunities for direct interaction with study participants as well as analysis of previously collected data are available. Interns will participate in weekly lab meetings with journal club and career development discussions. This research experience offers a valuable opportunity for students to develop practical research skills and contribute to a deeper understanding of the relationship between sleep and cardiometabolic health. Successful interns will have opportunities to submit an abstract for presentation at a national scientific conference and may receive co-authorship on manuscripts.

## Livia Veress, MD Pulmonary and Sleep Medicine

### Lab Overview

The Center for Advanced Drug Development translational research laboratory, led by Dr. Livia A Veress as its Director, specializes in pediatric, pulmonary, critical care medicine, and disaster response medical research, with its mission to help invent, test, develop, and FDA approve new therapeutics for patients via in vitro and animal modeling research. Dr. Veress is an experienced researcher in the field with a focus on plastic bronchitis, lung fibrosis, airway fibrotic diseases (such as bronchiolitis obliterans), inhalation injury, acute respiratory distress syndrome (ARDS) and sepsis, utilizing rodent and pig models for research, as well as in vitro and ex vivo models.

### Research Areas and Current Projects

The lab's primary goal is to enhance our understanding of the pathogenesis and treatment of various serious pulmonary and critical care diseases. As a translational research laboratory, we seek to uncover the underlying processes of serious diseases that have minimal to no treatments at the present, and then use this knowledge to target those specific pathways with novel therapeutics, such as repurposed or new drugs and devices. We model diseases in relevant animal models, and use these to perform cutting edge translational techniques to understand the disease continuum at physiologic, biochemical, tissue, cellular and molecular levels. Primary endpoints of efficacy of therapeutics are chosen with clinical relevance in mind (echocardiography, pulmonary function, EEG, etc.), for ease of translatability to humans, for follow-on clinical trials and FDA approval. Precision cut lung slice ex-vivo techniques, PCR, Western blots, cytokine ELISAs, tissue histopathologic assessment under microscopy, proteomics, microbiome assessments, BALF analysis, RNAseq and cell culture primary cell isolation studies complement all in vivo animal studies. The lab is regarded as the leading animal modeling lab internationally for pulmonary fibrosis, bronchiolitis obliterans, pulmonary coagulation dysfunction, ARDS (large animal ICU), inhalation injury and acute airway injury internationally, with several drug candidate identification and advancement.

### Learning Opportunities

Interns in the Veress lab will have opportunities to engage with the spectrum of preclinical pulmonary and critical care research, tailored to the individual intern's interests and skill. A typical internship would include hands-on training with human tissue culture, direct measurements of RNA and protein, PCR, and preclinical pharmaceutical testing to include animal handling, dosing, and data acquisition with assessment. Exposure to more advanced techniques in cardiac/pulmonary physiology, biomarker assays (CBC, cytokines, organ function biomarkers), RNA-seq, precision cut lung slices (PCLS), and others will be integrated with an individual intern's project. We will also discuss fundamentals of scientific presentation and scientific careers according to the intern's own goals. Successful interns will be credited for their work in national and international presentations and may receive co-authorship on resultant publications, allowing for meaningful scientific contribution and advancement towards their own career goals.

## Masanori Hayashi, MD Solid Tumor Program

### Lab Overview

The Hayashi lab is dedicated to investigating the biology of pediatric sarcoma metastasis. The primary research objectives are to develop targeted anti-metastasis therapies and identify biomarkers that can predict treatment failures and relapses with metastasis. The lab conducts a comprehensive program focused on liquid biopsies, including the detection of circulating tumor cells and circulating tumor DNA in pediatric sarcoma patients. Dr. Hayashi and team actively engage in preclinical investigations, concentrating on specific targets to disrupt the metastatic process in high-grade sarcomas.

### Research Areas and Current Projects

The Hayashi lab is involved in the investigation of the biology of pediatric sarcoma metastasis, with the aim of developing precise anti-metastasis therapies. Specifically, there are multiple projects aimed at testing novel therapeutic targets in pediatric sarcomas using cell culture models and mouse models of sarcomas. We use a variety of molecular biology tools, such as RNA-seq, whole genome sequencing, single cell RNA sequencing, CUT&RUN, among many standard experimental techniques. The second goal of the lab, is to develop novel biomarkers to identify patients at risk of conventional therapy failure and relapse with metastasis. The lab is the correlative biology sample center for multiple national trials, testing this rich library of samples with who genome sequencing, single cell RNA sequencing, and ddPCR. There are multiple stages of investigations ongoing for biomarker testing, ranging from early stage discovery studies to late (closer to clinical implementation) validation studies.

### Learning Opportunities

Interns in the Hayashi lab will be assigned specific individual projects, where the intern is expected to have full ownership of their specific project. Projects are determined prior to the start of the internship through multiple meetings, to meet the experience level and career interests of the student. Under guidance of the lab members, interns are expected to study the background prior to starting the internship, learning specific experimental techniques pertinent to their projects through repetition, and to be able to present a completed result at the end of the internship. The main focus will be on having a complete experience that can contribute to the career development of the intern. The

experience is designed to offer students opportunities to develop practical laboratory skills, gain confidence to work semi-independently in the lab, and to learn the fundamentals of scientific presentations. Previous successful interns have been credited for their work in national and international presentations, and have received co-authorship on resultant publications.