murdoch children's research institute

MCRI 2026 PhD Projects

Contents

Lab Based Projects

Clinical Sciences

One Size Does Not Fit All: Optimising Respiratory Support for the Smallest Neonates

Dr. Prue Pereira-Fantini
prue.pereira@mcri.edu.au

Prof. David Tingay
david.tingay@mcri.edu.au

The number of neonates in Australia receiving intensive care at the borderline of viability (22-25 weeks gestation) has increased 2.3-fold in the last decade. These neonates have the highest early mortality and suffer life-long disability, mainly from early respiratory failure. How best to care for this new generation of our most vulnerable neonates has lagged as the threshold of viability has decreased.

Current clinical care is extrapolated from evidence-based practices established in neonates born >25 weeks' gestation. Our previous work has shown that this premise may be fundamentally flawed, as the lungs of our most preterm neonates are developmentally and structurally different from other preterm neonates, resulting in different and unique patterns of lung injury. Clinicians have no scientific framework on how best to apply the fundamentals of good-evidence-based neonatal intensive care, antenatal corticosteroids, surfactant replacement therapy and lung protective ventilation to neonates born at 22-25 weeks.

This project will address this knowledge gap by using a human induced stem cell platform and our established preterm lamb model of the 22-25 week gestation lung to assess the cellular, functional, and proteomic impact of current clinical care scenarios.

SPILLOVER! Exploring the Extrapulmonary Impact of Mechanical Ventilation in Preterm Infants

Dr. Prue Pereira-Fantini
prue.pereira@mcri.edu.au

Prof. David Tingay
david.tingay@mcri.edu.au

This PhD project investigates the extrapulmonary impacts of mechanical ventilation in preterm infants, with a specific emphasis on the effectiveness of lung protective strategies in preventing extrapulmonary damage. Mechanical ventilation is a cornerstone intervention for managing respiratory distress syndrome (RDS) in preterm infants, yet it carries inherent risks of ventilator-induced lung injury (VILI) and potential extrapulmonary effects on neurological, cardiovascular, and gastrointestinal.

This project bridges basic research with clinical applications, leveraging the preterm sheep model to simulate human neonatal conditions and investigate comprehensive impacts of mechanical ventilation.

The project will utilise the extensive an biobank of plasma, lung fluid and tissue samples collected during simulations of delivery room scenarios. The extrapulmonary impact of these strategies will be investigated in brain, heart and gastrointestinal tissue using mass spectrometry-based proteomics to characterise molecular changes within systemic plasma and tissues and histology to identify structural alterations.

Findings from this study aim to advance understanding of the holistic impacts of mechanical ventilation in preterm infants, informing evidence-based practices to optimize lung protection and mitigate extrapulmonary complications. The research will contribute crucial insights into improving long-term outcomes for vulnerable neonatal populations, guiding future developments in neonatal intensive care protocols and reducing the burden of neonatal morbidity associated with respiratory support.

Mechanistic Insights Into CDKL5-Associated Epilepsy Using Resected Brain Tissue and Patient-Derived Neuronal Models

Sarah Stephenson
sarah.stephenson@mcri.edu.au

Nicole Van Bergen
nicole.vanbergen@mcri.edu.au

Katherine Howell
katherine.howell@mcri.edu.au

John Christodoulou
john.christodoulou@mcri.edu.au

CDKL5 encephalopathy is a severe early-onset epilepsy caused by mutations in the X-linked CDKL5 gene, leading to intractable seizures and profound neurodevelopmental impairment. We have already applied Xenium spatial transcriptomics to resected cortical tissue from CDKL5 patients to better understand the factors that underlie seizures in these children.

In this project, the student will undertake a comprehensive analysis of these spatial datasets to identify cell-type-specific transcriptional alterations and disrupted molecular pathways. Key tasks include image-guided region segmentation, differential gene expression and pathway enrichment analyses, and integration with in house and publicly available single-cell and bulk RNA-seq resources, and validation with immunohistochristry on additional brain regions.

To validate candidate drivers of seizures the student can leverage existing patient-derived iPSC lines differentiated into cortical neurons. Validation approaches may include qPCR, immunostaining for synaptic markers, and multielectrode array recordings to assess network activity. Pharmacological perturbations using compounds known to modulate CDKL5-linked pathways will test the functional relevance of top candidate genes.

By combining spatial transcriptomics with patient-derived neuronal models, this honours/master's/PhD project aims to uncover the cellular and molecular underpinnings of CDKL5-associated epilepsy and to identify potential targets for therapeutic intervention.

Functional Validation of Epilepsy-Associated Variants of Uncertain Significance

Sarah Stephenson
sarah.stephenson@mcri.edu.au

Katherine Howell
Katherine.Howell@mcri.edu.au

IPCHiP (International Precision Child Health Partnership) is an initiative to accelerate discovery and improve outcomes in rare paediatric disease, and Gene-STEPS is its flagship programme-a rapid genetic-diagnostic pipeline for childhood epilepsies that integrates high-coverage sequencing with detailed phenotyping across four international centres. Despite these advances, many variants of uncertain significance (VUS) in epilepsy genes remain unclassified, leaving families without clear answers.

In this project, the student will collaborate across our laboratory and clinical teams to identify patients harbouring high-priority VUS, then draw on our in-house multi-omic datasets to design and implement bespoke functional assays. Using cell-based models, including patient-derived induced pluripotent stem cell lines, the student will apply molecular and cellular readouts to detect variant-driven changes in gene function, protein behaviour and cellular physiology to determine VUS pathogenicity. In addition, they will evaluate targeted interventions for their ability to rescue any observed deficits. By leveraging the Gene-STEPS discovery pipeline, this project will deliver the functional evidence needed to reclassify VUS, improve diagnostic yield in epilepsy, and potentially uncover novel targets for precision therapy.

Genomic Medicine

Discovering Novel Genes and Pathways to Ataxia

Prof. Paul Lockhart
paul.lockhart@mcri.edu.au

Prof. Martin Delatycki
martin.delatycki@vcgs.org.au

Ataxia is the term for a group of neurological diseases that affect movement and coordination, impacting ~1:15,000 individuals. While there is considerable evidence that gene mutations cause ataxia, currently only ~30% of affected individuals receive a genetic diagnosis. We have a large program that aims to identify novel genes that cause ataxia and subsequently generate cell and animal models to understand development and progression of the condition.

There are PhD opportunities within multiple areas of the research program that can be tailored to suit a candidate's research interests. One area of focus is novel gene identification, performing next generation sequencing and analysis of individuals with ataxia to identify new causes of the condition. In addition, opportunities are available to investigate the molecular causes of ataxia. We have recently identified several novel genetic causes of ataxia, caused by pathogenic repeat expansions. Candidates will utilise modern genomic and proteomic technologies to characterise these genes. Subsequently, patient-derived cells will be used to generate neuronal cell and organoid models to study disease-specific mechanisms and identify potential therapeutic treatments. Finally, current diagnostic testing methods for repeat expansions are inefficient, low throughput and only test a small subset of known repeat expansions. One area of active research is developing new testing methods and technologies that can subsequently be utilised by diagnostic laboratories to screen all repeat expansion simultaneously and at low cost. Candidates will work closely with clinicians and bioinformaticians within a large multidisciplinary team.

Understanding the Role of Histone Methylation in Neurodevelopment and Intellectual Disability

Prof. Paul Lockhart
paul.lockhart@mcri.edu.au

Dr. Jordan Wright
jordan.wright@mcri.edu.au

Prof. David Amor
david.amor@mcri.edu.au

The brain is the most complex organ in the human body where billions of interconnected neurons provide the framework for us to interpret our environment, instruct other organs, and enable intellectual thought which uniquely defines our human qualities. Development of the brain, termed 'neurodevelopment,' is a highly organised process governed at the molecular level by epigenetics - a cellular process regulating which genes to silence and activate. Epigenetic regulatory proteins are responsible for silencing non-neural genes and activating transcriptional programmes driving neurodevelopment in a temporal and spatial manner to ensure the brain develops and matures correctly.

What happens when epigenetics goes wrong? The brain is highly susceptible to loss-of-function in epigenetic genes, even when a single allele is not functional.

A growing body of evidence has linked errors in over 70 epigenetic regulator genes to neurodevelopmental disorders resulting in intellectual disability. Beyond clinical and behavioural assessment, little is known about how these genetic errors affect neurodevelopment and neurobiology in these individuals.

This PhD project is focused on a class of epigenetic neurodevelopmental disorders affecting the KMT2 family of histone methyltransferase genes - an epigenetic process which adds methyl groups to histone tails.

6/7 members of this family are associated with a neurodevelopmental disorder resulting in lifelong intellectual disability.

This project will involve using CRISPR/Cas9-mediated gene editing in human pluripotent stem cells to generate genetic models of the KMT2 neurodevelopmental disorders, differentiating these models into neurons, assess neurobiological phenotypes including neuronal activity, synaptogenesis, and neurite morphology and multi-omic analysis including RNAseq, CUT&Tag and ATACseq.

This program of work will determine how molecular pathology of these disorders culminate into cellular pathology and to what degree these disorders overlap in molecular and cellular phenotypes. This PhD project will provide vital information into these neurodevelopmental disorders and the role histone methylation plays in neurodevelopment.

Improving Outcomes of Mitochondrial Diseases Using Human Stem Cell Models

Dr. Ann Frazier
ann.frazier@mcri.edu.au

Prof. David Thorburn
david.thorburn@mcri.edu.au

Mitochondria are our cellular power plants that burn sugars, fats and proteins to generate energy. Each week in Australia a child is born with a severe mitochondrial disorder. Many of these children die in the first years of life and most suffer from severe disease, particularly affecting their brain and/or heart. Access to these tissues from patients is limited, making it difficult to assess the impact on mitochondrial and other pathways contributing to disease pathology. This project will therefore use human pluripotent stem cell models of mitochondrial diseases that can be differentiated into clinically relevant cell types, such as neurons and cardiomyocytes, to investigate disease mechanisms and treatment approaches.

The aims include:

1) Developing cellular models of mitochondrial disease using human Embryonic Stem Cells (hESCs) and human Induced Pluripotent Stem Cells (iPSCs) to study phenotypic rescue of novel defects, pathogenicity and treatment approaches.

2) Characterize pathogenic pathways by assessing the impact of these energy generation defects on cardiomyocytes or neurons generated from hESCs or iPSCs, as well as their impact on mitochondrial function and cellular physiology.

3) Define the impact of targeted therapeutic strategies in these models on the cellular proteome and other markers of cellular homeostasis.

We have established a panel of pluripotent stem cell models representing a range of mitochondrial diseases and pathways. This project will validate selected cell lines from this panel and differentiate them to cardiomyocytes and/or neurons to assess the impact of the gene knockout on various aspects of mitochondrial and cellular function.

Molecular and cellular characterizations may include generation of correction lines, mitochondrial and cellular functional assays (e.g. ATP synthesis, fluorescence microscopy, FACS, multi-electrode arrays), quantitative proteomics, RNAseq and organoid modelling. Students will develop skills in cell culture, molecular biology and biochemistry.

Finding Novel Causes of Differences of Sex Development (DSD)

A/Prof. Katie Ayers
katie.ayers@mcri.edu.au

Dr. Lucas Ferreira
lucas.ferreira@mcri.edu.au

Prof. Andrew Sinclair
andrew.sinclair@mcri.edu.au

Differences of sex development (DSDs) are a complex group of conditions that affect an alarming 1.7% of babies. For affected individuals early and accurate genetic diagnosis is of critical importance for optimal clinical management which includes endocrine, reproductive, cancer, surgical and psychosocial care. Currently 60% of DSD patients will receive a negative or uncertain genetic result.

Differences of sex development (DSDs) are a complex group of conditions that affect an alarming 1.7% of babies. For affected individuals early and accurate genetic diagnosis is of critical importance for optimal clinical management which includes endocrine, reproductive, cancer, surgical and psychosocial care. Currently 60% of DSD patients will receive a negative or uncertain genetic result.

This student project aims to identify new genetic causes of DSD using whole exome and genome sequencing from undiagnosed patients. Bioinformatics tools will be used to prioritise rare, likely pathogenic variants in patients and families. Selected candidates will be studied using molecular techniques such as qPCR, Western blotting, and reporter assays in cultured cell lines. The student will also use induced pluripotent stem cells (iPSCs) and CRISPR editing to model gene function during gonadal development using our unique gonadal organoid models.

Skills Gained

- Genomic data analysis and variant interpretation
- Molecular cloning and gene expression studies
- Cell culture and stem cell differentiation techniques

Functional genomics using cell culture and reporter studies

Androgen Imprinting: A Novel Physiological Concept in Long-Range Androgen Action on Skeletal Muscle Due to Minipuberty and Muscle Memory

Dr. Jane Seto
jane.seto@mcri.edu.au

Prof. David Handelsman
djh@sydney.edu.au

Prof. Kathryn North
kathryn.north@mcri.edu.au

Even before puberty, boys aged 7-11 years substantially surpass girls in most, but not every, exercise performance test for unexplained reasons. This study evaluates androgen imprinting as a novel concept of long-range androgen action creating durable androgen effects on target tissues such as muscle, bone, brain, liver and kidneys. The present study focuses on androgen imprinting in skeletal muscle whereby the neonatal testosterone (T) surge in the first 6 months after birth of males, a period known as mini-puberty, primes the functional response of muscles to create enhanced response with subsequent exercise or T stimuli. We hypothesize that this muscle memory effect provides a biological explanation for sex differences in skeletal muscle performance even before male puberty. More widely we hypothesize that androgen imprinting via minipuberty plus muscle memory induced by androgen treatment can result in long-term, latent benefits for muscle performance, with implications on appropriate sanctions for sports androgen doping and the validity of eligibility of male-bodied athletes or transgender men who discontinue gender affirming testosterone treatment for elite female sports.

Rewiring Skeletal Muscle Regeneration in Aging and Disease

Dr. Peter Houweling
peter.houweling@mcri.edu.au

Dr. Leon Kiriaev
leon.kiriaev@mcri.edu.au

Healthy skeletal muscle possesses a unique capacity to regenerate following injury. However, in ageing and neuromuscular diseases, the muscle's ability to repair is disrupted, leading to ineffective recovery following injury, increased fibrosis (scar tissue), progressive weakness and wasting.

On a global scale, musculoskeletal wasting conditions, including sarcopenia and genetically inherited neuromuscular diseases, like Duchenne muscular dystrophy (DMD), affect an estimated 1.7 billion people and cost the Australian healthcare system $14.7 billion annually. Unfortunately, there are currently no effective treatments available for any of these conditions, which has resulted in a significant unmet need in both ageing and neuromuscular disease management and underscores the need for therapies that go beyond the underlying cause to restore the regenerative capacity of skeletal muscle.

Here, we propose a fundamentally different approach to improving muscle function: enhancing endogenous muscle regeneration by targeting key molecular pathways activated during healthy muscle repair. Our preliminary data reveal, for the first time, that healthy muscle exposed to repeated cycles of injury and repair undergoes adaptive remodelling, resulting in increased resistance to acute strain and protection against contraction-induced damage. This adaptive response is associated with transcriptional changes that suppress fibrosis, promote myogenic fusion, and remodel the muscles structural matrix to improve muscle function.

The central hypothesis of this work is that by harnessing the muscles' intrinsic regenerative capacity we will identify novel therapeutics that improve muscle function.

This project will address three key questions:

1. What are the key molecular adaptations that follow repeated injury in healthy skeletal muscle?
2. Can targeting pro-regenerative pathways enhance muscle function in healthy human muscle models? And
3. Do pro-regenerative therapeutics protect muscle function in models of aging and neuromuscular diseases?

This PhD aims identify and then rewire the muscle's intrinsic capacity to heal following injury to provide novel treatments for individuals impacted by muscle wasting and disease.

Therapeutic Development for a Neurodegenerative Metabolite Repair Disorder Caused by NAXD Deficiency

Dr. Nicole Van Bergen
nicole.vanbergen@mcri.edu.au

Prof. John Christodoulou
John.christodoulou@mcri.edu.au

There are major gaps in our basic understanding of the inborn error of metabolism, NAXD deficiency, a febrile-induced infantile neurodegenerative disease, and no specific treatments demonstrating long-term benefit are available. It is likely that disruption of core metabolic processes in this disorder, including ATP synthesis, the Krebs cycle and other pathways could be aggravated by intercurrent illnesses and challenge an already compromised energetic state. Advances in next generation sequencing provide rapid diagnosis of critically ill infants, highlighting the need for current research to focus on understanding underlying disease mechanisms to develop timely therapeutic interventions. Our team was the first to identify that pathogenic variants in NAXD cause a rapid and lethal neurodegenerative disease following what would normally be a mild illness. Our skilled team is perfectly positioned to better understand the biology of NAXD deficiency and to develop iPSC-based models to study NAXD disorder.

The project aims are:

Aim 1: To develop a better understanding of the consequences of NAXD deficiency in relevant cell types (neurons and microglia) which will aid in identifying targeted therapies.

Aim 2: To screen an FDA-approved drug library for new compounds effective against NAXD deficiency.

Aim 3: To validate the efficacy of the hits, and test their toxicity, in relevant diseased cell types and an animal model.

We will address the significant knowledge gap of how genetic abnormalities in metabolite damage and repair pathways affect brain function, in particular the processes involved in repairing the central metabolic enzyme cofactor, NAD. To do this we will use cellular models that we have developed, and will utilise a high-throughput drug repurposing program to identify potential targeted therapies to protect brain function in children with NAD metabolite repair disorders.

Modelling and Treating Brain Development Disorders Linked to Epigenetic Regulatory Genes

Prof. Paul Lockhart
paul.lockhart@mcri.edu.au

Dr. Jordan Wright
jordan.wright@mcri.edu.au

Prof. David Amor
david.amor@mcri.edu.au

The cerebral cortex -

the outer layer of the brain - is highly expanded in humans compared to other mammals, and it is this unique human characteristic which is thought to account for our species increased intellectual capacity.

Impaired cognition, as observed in people with intellectual disabilities, is associated with defects during brain development.

Advances in genetic sequencing have linked a growing number of developmental disorders to genetic variants in specific genes. Interestingly, a number of these genes are involved in epigenetic regulation - a process which regulates which genes are expressed through reversible modification of histones or DNA. Errors in epigenetic genes result in dysregulation of transcriptional programmes important for cortical development and culminate in altered neurological capacity including long-term intellectual disability.

Using in vitro human models of cortical development and CRISPR/Cas9 gene editing techniques we can now assess the effect patient-specific variants have on neurodevelopment in a laboratory setting, allowing us to interrogate neuron-specific cellular and molecular processes.

Furthermore, there are exciting pathway-specific compounds now available which can modulate the epigenetic landscape in neurons and may provide therapeutic benefit across these neurodevelopmental disorders.

The aims of this project are to: 1. Model human cortical development in vitro using human pluripotent stem cells (hPSC) and introduce patient variants using CRISPR/Cas9 gene editing 2. Identify gene-dependent deficits during cortical development 3. Run a small-scale drug screen for treatment of these genetic disorders. We aim to explore multiple epigenetic disorders across the research programme to compare how mechanistically similar disorders result in distinct syndromes and can tailor which disorders to prioritise based on an individual's research interests.

The successful PhD candidate will be exposed to a broad set of techniques including

human stem cell culturing, CRISPR/Cas9 gene editing, neuronal differentiation, electrophysiology, molecular biology techniques, advanced microscopy and flow cytometry, drug screening pipelines and automation.

A High Throughput Drug Screen to Identify Candidate Targets for the Treatment of Neurofibromatosis Type 1

Dr. Kiymet Bozaoglu
kiymet.bozaoglu@mcri.edu.au

Prof. Paul Lockhart
paul.lockhart@mcri.edu.au

A/Prof. Jonathan Payne
jonathan.payne@mcri.edu.au

NF1 is a single-gene disorder caused by a loss-of-function mutation on one allele of the NF1 gene resulting in a reduction of the protein neurofibromin. Cognitive deficits occur in approximately 80% of children with the genetic syndrome, neurofibromatosis type 1 (NF1), making them the greatest cause of disability for individuals with this lifelong genetic condition. These manifest as academic failure due to learning disabilities (70%), attention deficit-hyperactivity disorder (ADHD; 40%) and a significantly increased risk for autism spectrum disorder (ASD; 25%). Current therapies, whether medication or behavioural interventions, are often ineffective because they use 'trial and error' approaches targeting symptoms, rather than the cause. Therefore, there is an urgent need to discover new therapeutics for the impairing neurodevelopmental symptoms experienced by children with NF1.

This drug screening project aims to identify compounds that may modulate neurofibromin expression using patient derived stem cell lines. The patient derived stem cells will be differentiated into neuronal cells and then used to perform a high throughput drug screening analyses using 4,500 FDA approved compounds. Functional readouts from the screen will include assessment of neurofibromin steady state levels as well as structural readouts including neurite development, length and number of neurons in the cultures. Once candidate compounds have been identified, validation assays will be performed using NF1-patient derived stem cells in 2D and 3D brain organoid models to determine whether the candidate compound treatment/s can ameliorate neuronal structural and functional deficits previously observed in our 2D cortical neuron studies.

Extensive functional analyses will be performed including the assessment of neuron growth and maturation (using immunofluorescence assays), neuron function (using multi electrode arrays and calcium imaging) as well as biochemical assays such as western blotting, real time PCR and ELISAs to determine biological changes in our patient lines versus control lines.

Population Health

Characterising the Immune Responses That Prevent, Promote or Predict the Development or Resolution of Allergies

Dr. Craig McKenzie
craig.mckenzie@mcri.edu.au

Prof. Kirsten Perrett
kirsten.perrett@rch.org.au

Allergies are a considerable burden to quality of life and can be potentially fatal in the case of anaphylaxis. The incidence of allergic diseases is rapidly increasing which necessitates a need to better understand how these diseases can be prevented, managed and treated. Allergies arise from allergen-specific IgE immune responses, whereby IgE on the surface of effector cells binds to an allergen and subsequently causes degranulation, releasing a wide variety of inflammatory mediators. In contrast, allergen-specific IgG and potentially IgA can prevent allergic responses by preferentially binding to an allergen and competitively inhibiting IgE from binding instead. As such, allergen-specific antibodies and the T and B cells responsible for making such antibodies are fundamental in promoting or preventing allergic diseases. However, how these immune responses arise remains poorly understood. The potential factors that influence the progression toward or away from IgE immune responses remain to be properly elucidated. This project will wholistically characterise the immune responses to allergens in food allergic or tolerant children from world-leading intervention trials at the National Allergy Centre of Excellence. Furthermore, it will investigate the influence of dietary or antimicrobial chemicals associated with increased allergy incidence on the induction of allergic responses. As part of the ongoing work at the Population Allergy laboratory, this project will provide cutting edge experience in epidemiology and immunology in an exciting and supportive work environment. Diverse laboratory techniques including ELISA, flow cytometry, cell culture and RNA sequencing will be utilised to determine the allergen-specific B and T cell responses that are associated with tolerance or allergy to foods in children. This project will greatly advance our understanding of how allergies arise in early life and has exciting potential to provide novel strategies or biomarkers for better prevention or treatment of food allergy in children.

Stem Cell Medicine

Unraveling the Complexity of Alexander Disease by Using Advanced Brain Organoid Models

A/Prof. Silvia Velasco
silvia.velasco@mcri.edu.au

A/Prof. Mirana Ramialison
mirana.ramialison@mcri.edu.au

Alexander Disease (AxD) is a progressive neurodegenerative disease caused by gain-of-function mutations in the glial fibrillary acidic protein (GFAP) gene and is characterized by alterations in astrocytes, microglia activation and oligodendrocyte damage that ultimately cause myelin loss. Animal models do not fully recapitulate disease pathology, therefore are unsuitable to model AxD. Pluripotent stem cell-derived 3D brain organoids offer a significant opportunity to understand the pathogenesis of AxD in vitro. To investigate complex processes of neuronal and glial dysfunction in this condition we will generate an advanced brain organoid model which incorporates cell types found in the developing human cerebral cortex, including astrocytes, oligodendrocytes, and microglia, which are affected in AxD. By leveraging organoids obtained from pluripotent stem cell lines derived from patients with different disease severity and age of onset and advanced experimental technologies, including single-cell multiomics, we aim to disentangle the intricate crosstalk between cell types and understand its role in disease pathogenesis and progression. This research will pave the way for effective therapeutic strategies targeting AxD and other neurodegenerative disorders.

The selected candidate will use a variety of laboratory techniques, including stem cell culture, differentiation into 3D brain organoids, immunohistochemistry, microscopy, and single cell RNA-sequencing. This project would suit a student with an interest in developmental neurobiology, and disease modelling. Essential criteria: Bachelor in neuroscience or computational biology; High academic marks that would meet eligibility for enrolment at the University of Melbourne. Desirable: previous experience in stem cell culture techniques and cell/tissue analysis (immunohistochemistry and microscopy), or single cell RNA sequencing data generation and analysis. The successful applicant will be co-supervised by A/Prof. Velasco and A/Prof. Ramialison and will work closely with stem cell biologists and bioinformaticians within their teams. This project involves close collaboration with neurologists leading the Australian Leukodystrophy Clinical and Research Program at the Royal Children's Hospital.

Improving the Growth, Maturation, and Accuracy of Human Kidney Organoid Models

Dr. Jessica Vanslambrouck
j.vanslambrouck@mcri.edu.au

Prof. Melissa Little
melissa.little@mcri.edu.au

Within the human kidney, approximately 1 million functionally segmented nephrons perform blood filtration, secretion, and re-absorption roles critical to maintain body homeostasis. However, common conditions such as diabetes, hypertension, and drug toxicity, can reduce the number of these functional nephrons and increase the risk of chronic kidney disease (CKD) in later life. As a leading causes of death worldwide, the great need for novel CKD treatments and improved disease models has driven our development of kidney tissue from human stem cells. These mini kidneys, or 'kidney organoids', show striking similarity to human fetal kidneys, with nephrons, stroma, and endothelial populations. However, their potential applications are limited by their immaturity and the growth off-target cell types. In this project, the pathways governing kidney development will be explored and manipulated to improve the growth, maturation, and accuracy of human kidney organoid models with a view to applying them to disease research and treatment approaches.

Characterising the Pathophysiological Mechanism of Congenital Nephrotic Syndrome to Develop Novel Treatments

Dr. Aude Dorison
aude.dorison@mcri.edu.au

Prof. Melissa Little
melissa.little@mcri.edu.au

Congenital nephrotic syndrome presents early in life and results in kidney failure and resulting severe proteinuria which can be life threatening. No treatments are available for this condition other than renal transplantation and dialysis. The genetically inherited forms of this condition most commonly result from variant in genes expressed in the podocytes of the glomerulus. Using human kidney tissue generated from pluripotent stem cells, we have characterised the pathophysiological mechanism associated with one of the most common causative gene in congenital nephrotic syndrome, NPHS2. This project will explore the pathophysiological mechanisms linked to other common causative genes looking to identify a shared molecular mechanism that could be targeted for broader treatment development.

Gene Regulation in the Developing Retina and the Childhood Eye Cancer Retinoblastoma

Prof. David Eisenstat
david.eisenstat@mcri.edu.au

Dr. Maree Faux
maree.faux@mcri.edu.au

Retinoblastoma is the most common eye cancer of infancy and childhood; these tumours are considered to be developmental in origin. The seven cell types of the retina all derive from a pool of retinal progenitor cells (RPC). The distalless (DLX) family of evolutionarily conserved homeobox genes encode transcription factors expressed in the developing and mature retina as well as the majority of retinoblastoma tumours examined to date. The DLX transcription factors are necessary for retinal ganglion cells (RGC) development, in part due to direct regulation of other transcription factors that are either activated or repressed during eye development. The student will undertake RNAseq and ChIPseq studies in the developing mouse retina to identify DLX2 gene regulatory networks, validate in transgenic mouse models available in the laboratory and assess expression of these DLX2 targets in retinoblastoma. The student will learn key methods in molecular, cell and developmental biology, including primary cell culture and advanced microscopy skills. The student should preferably have an undergraduate background in cell, developmental and/or molecular biology.

Increasing Beta Cell Yield for Treatment of Type 1 Diabetes

Dr. Jacqui Schiesser
jacqui.schiesser@mcri.edu.au

Prof. Ed Stanley
ed.stanley@mcri.edu.au

Pluripotent stem cells (PSCs) are a promising alternative to cadaver-derived islets, potentially providing an unlimited supply of insulin-producing beta cells for transplantation therapies to treat type 1 diabetes. Numerous protocols that promote the differentiation of PSCs towards a beta cell fate have been published and generally aim to recapitulate signalling processes that occur during embryogenesis. However, there is one noticeable discord between in vivo pancreatic development and in vitro pancreatic differentiation - the absence of a clearly defined progenitor expansion stage in in vitro differentiations. In the embryo, prior to pancreatic specification, the gut tube undergoes significant expansion as the embryonic axis extends. Following this, the pancreatic progenitor compartment rapidly proliferates, undergoing branching morphogenesis, prior to endocrine differentiation, delamination and islet formation. The goal of this project will be to identify factors and/or pathways that can expand human PSC-derived pancreatic progenitor pools, thus allowing for efficient generation of large numbers of human PSC-derived beta cells for subsequent use in transplantation therapies. This project will involve but is not limited to cell culture, directed differentiation of human pluripotent stem cells and flow cytometry

Defining Stem Cell Therapies for the Treatment of Type 1 Diabetes

Dr. Jacqui Schiesser
jacqui.schiesser@mcri.edu.au

Prof. Ed Stanley
ed.stanley@mcri.edu.au

Stem cell-derived islets (sc-islets) generated from pluripotent stem cells (PSCs) are an

alternative to donor-derived islets, potentially providing an unlimited number of insulin producing cells for transplantation. Numerous protocols that promote the differentiation of PSCs towards endocrine cell fates have been developed, with some underpinning clinical trials of PSC-derived products. To date, most trials have used of allogeneic PSCs, meaning, as with alloislet transplantation, recipients will still require extensive immunosuppression. However, a recent report describing the use of an autologous cell product - albeit in an immunosuppressed recipient, provides a proof of principle for autologous sc-islets, if certain challenges can be addressed. One hurdle for the use of autologous sc-islets is the widely recognized variability in the capacity of different PSC lines to differentiate to specific cell lineages. The difficulty of this challenge is compounded by the lack of predictive assays to quantify both differentiation efficiencies and to characterize the presence of off-target lineages. Similarly, in instances where differentiation efficiencies are poor, methods for enriching for desired target cell populations could circumvent the need to optimize differentiation methods for each personalized PSC line. The goal of this project is to identify and validate novel stage-specific markers for benchmarking PSC differentiation to pancreatic endocrine cell types. This project will involve but is not limited to cell culture, directed differentiation of human pluripotent stem cells, flow cytometry, single-cell RNA sequencing and associated bioinformatic techniques.

Infection, Immunity and Global Health

Determinants of COVID-19 Risk and Severity

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Prof. Nigel Curtis
Nigel.Curtis@rch.org.au

Following SARS-CoV-2 exposure, outcomes range from asymptomatic-mild disease to severe disease and death. There are multiple known clinical and demographic risk factors for severe COVID-19 including age and comorbidities. However, even among high-risk individuals there is high variability in COVID-19 severity.

The BRACE trial is our international RCT of 6828 healthcare workers across 36 sites in five countries. This trial is working to determine if BCG vaccination reduces the impact of COVID-19 and other respiratory diseases. The availability of BRACE trial samples taken prior to SARS-CoV-2 infection will give us the unique opportunity to assess associations between the pre-existing immunophenotype with disease severity in COVID-19.

Using the unique collection of samples from the BRACE trial, you will determine how pre-existing interindividual variability in the immune system contributes to the range in the severity of diseases resulting from SARS-CoV-2 infection. In this project you will have the opportunity to use a combination of analysis techniques including multi-omic analysis, single cell immunophenotyping, multiplex cytokine assays, and serological analysis.

This project will establish an immune signature of COVID-19 susceptibility and reveal key immunological pathways for protection against COVID-19 to be targeted in future vaccine development and COVID-19 treatments.

The Infectious Diseases Laboratory is located at the Murdoch Children's Research Institute, part of the Melbourne Children's Campus, which also includes the Royal Children's Hospital and the University of Melbourne.

Interested in being part of the largest BCG vaccine trial of its kind worldwide? Email: id.research@mcri.edu.au

Defining the Mechanisms That Underpin the Beneficial Off-Target Effects of BCG

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Prof. Nigel Curtis
Nigel.Curtis@rch.org.au

In addition to protecting against its target disease, tuberculosis, the Bacillus Calmette-Guérin (BCG) vaccine has beneficial off-target ('heterologous' or 'non-specific') effects on human health. This includes reducing all cause infant mortality, likely by protecting against non-mycobacterial infectious diseases. The protection is proposed to result from the immunomodulatory effects of BCG.

Our team has established two randomised controlled trials investigating whether BCG protects against non-mycobacterial diseases:

- The BRACE trial: our international RCT of 6828 healthcare workers across 36 sites in five countries. This trial is working to determine if BCG vaccination reduces the impact of COVID-19 and other respiratory diseases.

- Melbourne Infant Study: BCG for Allergy and Infection Reduction (MIS BAIR): our RCT of neonatal BCG vaccination in >1200 children in Melbourne to determine if BCG protects against allergic disease, eczema, asthma and infections.

Using samples from these trials we have previously shown that neonatal BCG vaccination reduces cytokine responses to a range of pathogens (MIS BAIR) and adult BCG vaccination reduces cytokine but increases T cell responses to SARS-CoV-2 (BRACE).

You will use samples from participants in one or both of these clinical trials to help characterise BCG-induced changes in the immune system and the underlying mechanism of action. In this project you will have the opportunity to use a combination of analysis techniques to investigate the immune system such as in vitro stimulation, single cell RNA sequencing, flow cytometry and more.

The findings of this project will provide important insights into the immunomodulatory effects of BCG and the associations between these changes as well as the beneficial clinical effects of this 100-year-old vaccine.

The Infectious Diseases Laboratory is located at the Murdoch Children's Research Institute, part of the Melbourne Children's Campus, which also includes the Royal Children's Hospital and the University of Melbourne.

Interested in being part of the largest BCG vaccine trial of its kind worldwide? Email: id.research@mcri.edu.au

Understanding Streptococcal Pathogenesis

Prof. Catherine Satzke
catherine.satzke@mcri.edu.au

Dr. Sam Manna
sam.manna@mcri.edu.au

Streptococcus pyogenes ('Strep A', group A streptococcus) is an important global pathogen. In a related bacterial species, Streptococcus pneumoniae, we and others have shown that viral co-infection can enhance bacterial virulence, by increasing bacterial density and inflammation in the host, and by driving changes in bacterial virulence gene expression. There is recent clinical epidemiologic evidence that viruses are also important in S. pyogenes pathogenesis, but little is known about this process. In this project, you will use murine and cell-culture models to examine the effect of viruses on S. pyogenes colonisation, transmission (spread to co-housed littermates) and disease, and the mechanisms involved. To achieve these aims, you will employ a range of methods such as bacterial transcriptomics, working with in vitro and/or in vivo models such respiratory cells from patients grown as air-liquid interface, genetic manipulation, as well as microbiological and immunological analysis of local and systemic samples. Your project will provide important novel data on key components of S. pyogenes pathogenesis and inform a pathway towards improving strategies for preventing S. pyogenes infections.

Changes in the Pneumococcal Population Following Vaccine Introduction

Prof. Catherine Satzke
catherine.satzke@mcri.edu.au

Dr. Sam Manna
sam.manna@mcri.edu.au

Streptococcus pneumoniae (the pneumococcus) is a bacterial pathogen and a leading cause of morbidity and mortality worldwide. Pneumococci are classified into serotypes based on the type of capsule they produce. Although safe and effective vaccines that target of a subset of these serotypes have been available for over two decades, introduction in many low- and middle-income countries (where the burden of pneumococcal disease is greatest) is frustratingly slow. Vaccine introduction also leads to profound changes in the pneumococcal population structure. This can include a decline in vaccine-serotypes and replacement with non-vaccine-serotypes. Changes to the capsule of some strains means they are not recognized by vaccine-induced immunity (serotype switches, variants and new serotypes). However, these changes in the pneumococcal population have rarely been examined in low- and middle-income countries. In this project, you will leverage our unique set of samples from the Asia-Pacific to examine changes in the genetics of the pneumococcal population following vaccine introduction. Key approaches to this project include using genomics, bioinformatics, molecular biology, genetic manipulation of pneumococcal isolates and testing in a range of microbiological assays in vitro. Optional aspects include testing isolates in murine models of carriage, transmission and disease. Your research will provide new insights into how pneumococcal populations can change following vaccine introduction in high disease burden settings including Asia.

Improving Immunodiagnostic Tools for Tuberculosis Through Insights Into Mtb Infection and Host Response

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Prof. Nigel Curtis
nigel.curtis@rch.org.au

This project focuses on improving immunodiagnostic tests for Mycobacterium tuberculosis (Mtb) infection by investigating host immune responses that reflect an individuals ability to clear the infection without antibiotic treatment. Current immunodiagnostics for tuberculosis (TB), such as interferon-gamma release assays (IGRAs), have important limitations, particularly in distinguishing latent infection from active disease and in predicting which individuals are at highest risk of developing TB.

This project aims to improve the performance and interpretability of immunodiagnostic tests for TB, with a focus on identifying immune signatures that predict susceptibility to chronic Mtb infection. Characterising these responses in clinical samples from well-characterised local and international cohorts, the project will develop and validate new biomarkers for diagnosing Mtb infection and will contribute to understanding the immunopathogenesis of TB.

The candidate will apply immunological and molecular techniques (e.g. cytokine profiling, epigenetic analysis) to identify markers with diagnostic and prognostic potential. The project will explore how these immune signatures vary by factors such as age, comorbidity and lifestyle (e.g. smoking).

This project is well suited to a student with a background in immunology, infectious diseases, or a related field, and an interest in host-pathogen interactions and translational research. The student will gain skills in translational immunology, assay development, and working with human samples from clinically relevant settings.

The work will contribute to the development of improved diagnostic tools and a deeper understanding of TB pathogenesis, supporting efforts to detect, treat, and ultimately prevent active disease.

Shaping TB Risk and Vaccine Response: the Role of Age in Mycobacterial Immunity

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Prof. Nigel Curtis
nigel.curtis@rch.org.au

Tuberculosis (TB) is the leading cause of death from a single pathogen and a major global health threat, particularly in low-resource settings. Despite a vaccine being available for over 100 year, protective immunity against tuberculosis is not understood. In addition to Mycobacterium tuberculosis (Mtb), the bacterium that causes TB, other mycobacteria can cause devastating diseases such as leprosy and Buruli ulcer. While mycobacterial exposure is common only a small proportion of exposed individuals develop disease.

Susceptibility to mycobacterial infection, disease progression, and vaccine effectiveness change across the human lifecourse. This project will collect samples from different age groups to characterise innate and adaptive immune responses to mycobacteria. A key focus will be on identifying age-specific immune profiles and understanding how immune maturation, and prior exposures shape the nature and magnitude of responses.

The student will gain experience in human immunology (immunophenotyping and functional assays), comparative analysis across age groups, and interpretation of immune function in the context of infectious disease risk.

Findings from this work will contribute to a broader understanding of immune development and ageing, and inform more effective interventions for TB and other mycobacterial diseases across the lifespan.

Investigating the Off-Target Effects of Vaccines on Antiviral Immunity

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Prof. Nigel Curtis
nigel.curtis@rch.org.au

This project will explore how vaccines influence immune responses beyond their intended targets, with a particular focus on effects on antiviral immunity. While vaccines are designed to protect against specific pathogens, increasing evidence suggests they can have broader immunological effects-sometimes enhancing or modulating responses to unrelated infections, including viruses.

Bacillus Calmette-Guérin (BCG), the vaccine for tuberculosis is one that has been shown to have beneficial off-target ('heterologous' or 'non-specific') effects on human health. Through the BRACE trial, our large international randomised controlled trial of BCG vaccination healthcare workers in five countries, our team is investigating the clinical and immunology off-target effects of the BCG vaccine.

Using the extensive biobank of samples from this well-characterised clinical trial, you will apply a range of immunological techniques (e.g. flow cytometry, cytokine profiling, transcriptomics) to examine how BCG vaccination shapes innate and adaptive antiviral responses. A key strength of this project is the ability to link immunological findings to clinical outcomes, including susceptibility to viral infections.

The project is suited to a student with a background in immunology, infectious diseases, or a related field, and an interest in translational human immunology. The candidate will gain experience in immunoprofiling, data analysis, and working with clinically derived human samples.

This work will contribute to a broader understanding of how vaccines influence immune function in complex, real-world settings, with potential implications for vaccine design and public health policy.

Non-Lab Based Projects

Clinical Sciences

Understanding the Relationship Between Cognitive Development and Academic Achievement in Children and Adolescents

A/Prof. Melissa Mulraney
melissa.mulraney@unimelb.edu.au

Prof. David Coghill
david.coghill@unimelb.edu.au

A/Prof. Jonathan Payne
jonathan.payne@mcri.edu.au

There is strong evidence that key aspects of healthy development such as academic achievement, prosocial behaviours, and positive emotional health are underpinned by cognitive development, which in turn is dependent on healthy brain maturation. Unfortunately, current knowledge about brain-behaviour relationships and their maturation is limited. Major contributing factors to this are the cost and complexity of large-scale neuroimaging studies and a reliance on traditional psychological assessments that do not accurately reflect the nature and timing of development across different brain regions and the differential trajectories of brain-behaviour relationships from childhood to adulthood. In the COGNITION study, we address these limitations using a comprehensive battery of neuroscientifically informative cognitive tasks, recently updated to improve access and facilitate administration, to map brain maturation across the school-age years. This observational study will use the 'CANTAB' to reliably assess and describe cognitive development and brain maturation in children and young people without the need for expensive neuroimaging. Approximately 1100 participants (aged 6-17 years) will be tested twice, at baseline and approximately 12 months. There is an opportunity for a PhD student to contribute to this study by investigating the relationships between neurocognitive development and academic achievement. This project would suit a student with an interest in developmental psychology, neuropsychology, and education. The successful candidate will be supported by an experienced supervision team with expertise in developmental and educational psychology, neuropsychology, and child and adolescent psychiatry.

Improving Identification of ADHD in High-Risk Settings

A/Prof. Melissa Mulraney
melissa.mulraney@unimelb.edu.au

Prof. David Coghill
david.coghill@unimelb.edu.au

Attention deficit/hyperactivity disorder (ADHD) is a major cause of disease burden across the life course and has a devastating impact with significant social, economic, and personal consequences. However, only a minority of Australians with ADHD receive a diagnosis and current approaches to identification and screening are inefficient. Screening, as a mechanism for improving identification, is only appropriate if it is then possible to provide appropriate care for those screening positive. As ADHD is a common disorder affecting 5-7% of children and youth, population-based screening for ADHD, no matter how accurate, is not currently considered feasible as the demand created would far exceed capacity. However, targeted screening focussed on high prevalence/high-risk clinical settings, where individuals with ADHD are already engaged with clinical services, but whose ADHD is currently not recognised or treated, is a viable alternative. To develop a scalable approach to screening we have identified a need for 1) better understanding of the barriers to recognition within services and 2) an approach to screening that avoids the high rates of false positives inherent to traditional single stage approaches. We have NHMRC funding to develop and test varied approaches to augmented screening for ADHD within high-risk settings. There is an opportunity for a PhD student to explore the impact of demographic characteristics (e.g., gender and age) on the accuracy of varied augmented screening approaches for ADHD. A three-year stipend is available for this project. The successful candidate will be supported by an experienced supervision team with expertise in developmental mental health and child and adolescent psychiatry.

Divergence of Typical Brain Development Over Childhood and Adolescence: Identifying Cortical Signatures of Psychiatric Symptomatology

Sila Genc
sila.genc2@rch.org.au

Vanessa Cropley
vcropley@unimelb.edu.au

The transition from childhood to adolescence is a dynamic period of development that involves remodelling and reorganisation of brain structure, partly in response to the rising pubertal hormone levels that cross the blood-brain barrier. Coinciding with brain reorganisation at the time of pubertal onset, is an increased risk of onset of mental health disorders. In Australia, 50% of all lifetime cases of mental health disorders start by age 14. And about 50 per cent of people who develop a psychotic disorder - a condition that describes a person's loss of contact with reality, will do so by the time they are in their early 20s.

Brain imaging studies using MRI have been key in revealing ongoing cortical thinning and volume loss over adolescence. However, the exact neurobiological mechanisms underlying these changes are unclear. Diffusion MRI is one way to access micro-metre structural properties in vivo. Cortical morphology and myelination abnormalities have been linked to various neuropsychiatric disorders, including psychosis. This project will aim to build a comprehensive understanding of typical cortical development of morphology and microstructure and assess deviations to typical patterns of cortical development with symptoms of psychosis.

To do this, the student will leverage diffusion MRI data from previously collected datasets consisting of typically developing youth (such as the Philadelphia Neurodevelopmental Cohort, Developmental HCP) and longitudinal cohorts consisting of young people at-risk for, or diagnosed with, psychosis.

Improving Outcomes of Childhood Brain Tumour and Epilepsy Surgery with Advanced MRI and Tractography

Dr. Joseph Yuan-Mou Yang
joseph.yang@mcri.edu.au

Dr. Sila Genc
sila.genc@mcri.edu.au

Brain tumour and epilepsy are among the leading causes of childhood chronic illness-related death in Australia and worldwide. Brain surgery is the mainstay treatment that reduces disease burden and prolongs survival. Surgery performed near functional brain regions and the inter-connecting nerve fibre tracts has a high morbidity risk, particularly in paediatrics due to the dynamically developing brain.

Advanced MRI-based nerve fibre tract imaging (tractography) has been a key imaging development that assists surgeons in the pre-operative (before surgery) planning and intra-operative (interactively, during surgery) stages. Accurately mapping fibre tracts can greatly assist with post-surgical functional preservation by avoiding surgical tract injuries. Existing commercial surgical tractography software is based on outdated techniques producing anatomically inaccurate tractography image reconstructions that urgently need updating. However, tractography processing takes a long time, relying heavily on a neuroanatomical expert to manually process imaging data, making it infeasible in acute brain surgery settings.

The aim of this project is to develop and implement an automated surgical tractography technique leveraging neurosurgical knowledge and machine learning. To do this, the student will leverage locally and internationally collected multi-modal MRI data and build an automated AI-based tractography model. Neurosurgeons from local and international sites will evaluate the anatomical accuracy and surgical utility of the tractography, to help validate and improve the model.

This project will suit a student that has technical knowledge in computational neuroscience or engineering, and a keen interest in learning how to apply machine learning techniques for use in clinical imaging and neurosurgery.

This project is a collaboration between the Neuroscience Advanced Clinical Imaging Service (NACIS) at the Royal Children's Hospital, the Developmental Imaging Group MCRI (https://www.mcri.edu.au/research/research-areas/clinical-sciences/developmental-imaging), and the University of Melbourne. The project would suit an individual with a background in computational neuroscience or engineering (or similar) background, with a keen interest in applying machine-learning approaches in clinical imaging and neurosurgery.

Surgical Outcomes of Gastrocsoleus Lengthening and Bony Foot and Ankle Surgery

A/Prof. Erich Rutz
erich.rutz@rch.org.au

Dr. Elyse Passmore
elyse.passmore@mcri.edu.au

Ms. Pam Thomason
pam.thomason@rch.org.au

Motion Connect is a new network over Australia and New Zealand which consists of seven Motion Laboratories. We plan several retrospective studies and prospective data collection through all of the sites. Ethical approval has already been granted, and we offer a fully funded PhD position for 3 years through the University of Melbourne. Project

The research question would be to compare different surgical outcomes including short- and long-term results from multiple sites in regards to gastrocsoleus lengthening including bony correction of foot and ankle surgery.

Outcome parameters

The primary outcome would be gait kinematics and kinetics as well, represented by Movement Analysis Profile (MAP)/Gait Variable Score (GVS) and Gait Profile Score (GPS).

Secondary outcome would include function and participation represented by FMS Goal Questionnaire.

PhD Project

The PhD project will start with a systematic review analysing all existing literature from 2000 to present. Furthermore, we will then stratify the large set of data by age, type of involvement and type of surgery.

Funding

Full scholarship through the University of Melbourne and as well, affiliation the world leading Murdoch Children's Research Institute (MCRI) will be granted through the project.

Further information

Please do not hesitate to reach out in case of any questions or interests to Associate Professor Erich Rutz.

Foot Deformities in Children with Cerebral Palsy

Dr. Elyse Passmore
elyse.passmore@mcri.edu.au

A/Prof. Erich Rutz
erich.rutz@rch.org.au

Foot and ankle deformities are common in children with cerebral palsy and can cause pain as well as have a severe impact on a child's walking. To improve function and reduce pain, these children may undergo surgical correction. Structural deformities of the foot are assessed pre- and post-operatively using radiology. We evaluate foot function and structure pre and post-surgery using a range of measures; radiology, 3D motion capture, plantar pressure and physical examination.

This project will explore methods for analysing foot function from 3D motion analysis and plantar pressure data, and their relation to structural measures from radiology and physical examination. These methods will be used to compare foot structure and function pre- and post-surgery and will ultimately serve as an objective clinical measure for assessing and grading foot deformities in children.

This project can be tailored to the interests of the successful applicant. Areas that may be explored are machine learning approaches for image analysis of plantar pressure data, musculoskeletal modelling and relationship between clinical measures and 3D motion analysis of the foot. The successful candidate will require some programming experience.

This project is a collaboration between the Hugh Williamson Gait Analysis Laboratory Royal Children's Hospital and the Murdoch Children's Research Institute (https://www.rch.org.au/gait/, https://www.mcri.edu.au/research/themes/clinical-sciences/gait-lab-orthopaedics).

Measuring Involvement in Important Life Situations: A Necessary Precursor to Designing Effective Participation Interventions for Those with Childhood-Onset Disability

Prof. Christine Imms
christine.imms@unimelb.edu.au

Stacey Cleary
stacey.cleary@mcri.edu.au

Being able to attend and be involved in a variety of activities and meaningful life situations is a strong contributor to long-term health and wellbeing. There is a growing body of evidence about effective approaches and interventions that promote participation outcomes in those growing up with childhood onset disabilities. However, most research focuses on measuring and changing the attendance aspect of participation - can you turn up to a life situation. 'Being there' (attendance) is necessary but not sufficient to ensure involvement. Involvement is necessary to drive development, a sense of belonging and a good life quality. Research addressing the involvement element of participation is limited by the lack of measures that capture of the experience of involvement, as well as the lack of measures that assess the elements of the environment that most strongly influence involvement.

This research sits within an international network of participation-focused research encompassing Australia, Canada, Sweden, The Netherlands, South Africa, China and Taiwan. We hope to recruit a high-quality allied health, psychology or educational professional into this PhD position. Experience in disability is desirable.

Interested applicants should email Professor Christine Imms at christine.imms@unimelb.edu.au

Understanding and Improving Screening for Developmental Dysplasia of the Hip

Dr. Natalie Hyde
Natalie.hyde@mcri.edu.au

A/Prof. Leo Donnan
Leo.donnan@mcri.edu.au

Developmental dysplasia of the hip (DDH) is the most common hip pathology in childhood. Early detection of DDH is vital, as a delay in diagnosis increases the risk of more invasive surgical interventions and poorer outcomes such as chronic pain, gait abnormality and degenerative arthritis. If diagnosed in a timely

manner DDH can be relatively conservatively treated with much lower risk of necessary surgical intervention. Despite this, there are no consistent and reliable screening protocols nationwide. Initial screening for DDH in Australia is performed most often by community practitioners and most frequently

paediatricians shortly after birth and by maternal child health care nurses (MCHN). These physical examinations consist of the Ortolani and Barlow tests, and examination of the thigh and gluteal creases. Even in experienced

clinicians the accuracy of these tests have been reported at 60% and in Victoria, there currently are no formalised processes by which standards of practice are taught, assessed or maintained. Thus, there is a clear need for better screening protocols.

Using data collected as part of the Victorian Hip Dysplasia Registry, this project will aim to evaluate current screening protocols and investigate alternate solutions such as the use of artificial intelligence.

Two of the overarching objectives of this project are to:

1. Enhance the early diagnosis of hip dysplasia; and

2. Produce the evidence and methodology for a change in screening practices.

This project will largely involve face-to-face data collection for the Victorian hip dysplasia registry, review of medical records of patients for missing data, data entry into both local and international registries for DDH and quantitative statistical analyses.

Improving Outcomes for Transgender Youth Via the Trans20 Cohort Study

Dr. Michelle Tollit
michelle.tollit@mcri.edu.au

A/Prof. Ken Pang
ken.pang@mcri.edu.au

Dr. Pip Buckingham
pip.buckingham@mcri.edu.au

We are offering supervision for an outstanding PhD student to look at longitudinal data from our flagship longitudinal project Trans20. Trans20 was established in 2017 with the support of the RCH Foundation, and represents the largest comprehensive prospective, longitudinal cohort study of trans and gender diverse children and adolescents in Australia. Trans20 assesses children and adolescents at first presentation to the RCH Gender Service and then again at 12 month intervals, with the goal of following their progress over a 20 year period.

The broad aims of Trans20 are to: 1) evaluate the impact of psychosocial and hormonal interventions on the health and wellbeing of trans young people; 2) identify modifiable risk and resilience factors that can be targeted via future interventions; and 3) translate knowledge learnt from aims 1 and 2 to improve clinical care for trans young people not only at RCH but everywhere. With multiple waves of data now collected, the Trans20 study is ideally positioned to make a significant contribution to this important and relatively new area of paediatric healthcare. We have broad-ranging data collected across gender identity, mental health, physical health, quality of life and family functioning domains, and welcome potential candidates designing their own research project within these fields.

We encourage applications from people with lived experience as a trans and/or gender diverse person or people who identify as being a part of the broader LGBTIQA+ community.

Early Detection of Focal Cortical Dysplasia in Infants

A/Prof. Gareth Ball
gareth.ball@unimelb.edu.au

Dr. Emma Macdonald-Laurs
emma.macdonald-laurs@rch.org.au

A/Prof. Katherine Howell
katherine.howell@rch.org.au

Focal cortical dysplasias (FCDs) are brain malformations which cause drug-resistant epilepsy in infants and children. Early surgical intervention can improve seizure control and prevent long-term cognitive and behavioural difficulties. FCDs are often difficult to diagnose on neuroimaging, particularly in infants and young children, in whom unrecognised FCDs pose the greatest risk to brain development. In this age group, immature myelination reduces grey and white matter contrast on MRI, making FCDs especially challenging to for radiologists to visualize. Most existing automated FCD detection tools are trained and tested on adults or older children, limiting their utility in infant brains.

This project aims to develop and validate novel artificial intelligence (AI)-based detection methods using MRI and PET data, in infants and young children (aged 0-3 years). This work will address a critical unmet need in early epilepsy diagnosis and treatment.

The Self-And Others' Emotion and Cognition in Adolescent Life (SOCIAL) Study

Prof. Vicki Anderson
vicki.anderson@mcri.edu.au

Dr. Kate Bray
kate.bray@mcri.edu.au

Social processes, such as empathy and theory of mind, are vital for social functioning and building social competency in young people. Empathy is a social-affective process involving sharing someone's emotion. Theory of mind (ToM) on the other hand, is a social-cognitive process that involves reasoning about the thoughts or emotions of others. Both of these processes are required for successful social interactions. Impairments in these processes have been found in mental health and neurodevelopmental disorders.

This project will behaviourally validate an empathy and ToM task for adolescents for ultimate use in the Magnetic Resonance Imaging (MRI) scanner. This will result in a tool for neuroscientists to investigate these processes, how they are impacted in clinical populations, and evaluate treatments aimed to improve social processes.

Depending on length of project (Masters versus PhD) and student interest/experience, this project may involve the following: working with young people, fMRI task programming and piloting, investigation of psychophysiological or neural correlates of social processing.

Take C.A.Re (Concussion Assessment and Recovery Research) Team

Prof. Vicki Anderson
vicki.anderson@mcri.edu.au

Dr. Kate Bray
kate.bray@mcri.edu.au

Concussion is defined as a traumatic brain injury where an impulsive force, caused by direct blow to the head, neck or body, is transmitted to the brain, triggering a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain. Concussion can result in a constellation of non-specific and heterogeneous post-concussion symptoms (PCS), including balance impairment, somatic and/or emotional symptoms, cognitive impairment, and/or sleep disturbance. For most children and adults, PCS tend to resolve spontaneously within 2 to 4-weeks post-injury, however, approximately 30% will experience persisting PCS (pPCS) for greater than 4-weeks. pPCS can interfere with participation in school, sport, social, and recreational activities, with secondary consequences on mental health and quality of life.

For the 30% of children and adolescents who experience pPCS, emerging biopsychosocial conceptualisations emphasise the contribution of injury, pre-injury, psychological, social, and environmental factors to the development and maintenance of these symptoms.

Our team developed a multimodal intervention, Concussion Essentials (CE), that combines targeted education and management strategies for common symptoms, with physiotherapy and psychology treatment.

Student projects will involve examination of child, parent or intervention factors that contribute to recovery of pPCS.

Relevant for longer projects (e.g. PhD), the team is also beginning a new study trialling a pediatric concussion clinic. This is an implementation study which will examine the acceptability, feasibility, adoption and costs of a new concussion service. The Concussion Clinic will offer an innovative, integrated stepped-care model that provides individualised, evidence-based intervention and continuity of care for children and adolescents following the initial assessment and diagnosis of concussion in Emergency or Primary Care settings. This would suit students interested in translation, implementation science and people interested in the multi-disciplinary context (ED physicians, psychologists, physiotherapists).

Outcomes of Shoulder Instability in Children and Adolescents

Dr. Natalie Hyde
natale.hyde@mcri.edu.au

Dr. Kemble Wang
kemble.wang@mcri.edu.au

Dr. M Denika C Silva
denika.silva@mcri.edu.au

Shoulder instability is defined as the lack of joint stability due to undesirable translation of the humeral head in the glenoid fossa, causing pain and loss of function. Shoulder instability is common in the paediatric and adolescent populations, and it is crucial to study because it helps to identify risk factors, optimise treatment strategies, and prevent long-term complications. Management of shoulder instability can be challenging, and treatment options include both surgical and non-surgical.

Our team is developing a clinical registry with the purpose of studying the outcomes of shoulder instability in children and adolescents at the Royal Children's Hospital, Melbourne (RCH). We have applied for ethics approval from the RCH ethics committee, which is currently under review.

This PhD project can collect data from our registry and retrospectively from RCH medical records.

This PhD aims to understand the natural history of shoulder instability, review the outcomes of current treatments, and develop evidence-based treatment strategies that optimise clinical outcomes and standardise care.

Data will be collected from medical records on patients' demographics and socioeconomics; clinical data (history of shoulder instability; treatment methods, etc.); adherence to treatment and adverse effects (ad-hoc to clinical data); physical examination outcomes such as range of motion and radiographic outcomes. Patient survey will be completed by participants and their parents on patient-reported outcomes (pain, function, quality of life, and return to sports activity).

Understanding the Needs of Trans and Gender Diverse Children

Dr. Carmen Pace
carmen.pace@mcri.edu.au

Dr. Tim Cronin
tim.cronin@mcri.edu.au

Trans and gender diverse young people can experience poorer mental health and well-being than their cisgender peers. This is largely due to stigma, such as discrimination, rejection, and bullying, as well as gender dysphoria, the distress arising from the incongruence between a person's gender and the sex they were assigned at birth. Trans and gender diverse children and their caregivers have unique needs to aid in managing their well-being, and may benefit from access to different supports including peer-led community organisations and tertiary paediatric gender services. While a range of supports are available, more information is needed about the experiences of children leading to service access and their preferences for care if and when this is engaged. This project aims to: 1) understand the experiences of trans and gender diverse children and their caregivers relating to their gender, development, and overall well-being; 2) to evaluate the preferences of trans and gender diverse children and their caregivers when accessing care; and 3) understand how current models of care for trans and gender diverse children and their caregivers meet their needs. This project will suit a candidate interested in conducting mixed methods research with children, caregivers, and services. Importantly, this project will suit a candidate passionate about engaging in approaches designed to elevate the voices of children to share their own experiences and needs for care. Clinicians and service providers working with trans and gender diverse children, and those with lived experience of gender diversity or being a parent/caregiver for trans and gender diverse children, are encouraged to apply.

Understanding and Improving Developmental Outcomes in Infants with Epilepsy

A/Prof. Katherine Howell
katherine.howell@rch.org.au

Dr. Kristina Haebich
kristina.haebich@mcri.edu.au

Infantile-onset epilepsies are often associated with significant developmental and neurobehavioural comorbidities, including intellectual disability and autism spectrum disorder; developmental impairments worsen the longer seizures remain uncontrolled. Frequently, infant epilepsies have a genetic basis, with >1000 different genes implicated. Optimal treatment depends on the underlying cause, making prompt aetiologic diagnosis critical.

Gene-STEPS is an international, multicentre cohort study investigating the role of rapid genome sequencing in improving aetiologic diagnosis, management and outcomes of infantile epilepsy.

This PhD project will focus on understanding the developmental and neurobehavioural outcomes of infants enrolled in Gene-STEPS, with the goal of identifying early predictors of outcome, measuring developmental trajectories, and evaluating the long-term impact of a timely genetic diagnosis.

The project will draw on rich clinical datasets and leverage collaboration across leading paediatric epilepsy centres. It will provide a strong foundation in neurodevelopmental research, epilepsy genetics, and longitudinal data analysis, with the potential to inform early identification of children at risk and guide precision care strategies.

This PhD will suit a candidate with interests in paediatric neurology, developmental neuroscience, or clinical psychology/neuropsychology, and offers the opportunity to make a meaningful contribution to improving outcomes for infants with epilepsy.

Family Experiences of Rapid Genome Sequencing in Infantile-Onset Epilepsy - Insights from the Gene-STEPS Study

A/Prof. Katherine Howell
katherine.howell@rch.org.au

Prof. Sue White
sue.white@vcgs.org.au

The Gene-STEPS (Shortening Time to Evaluation in Paediatric epilepsy Services) study is an international, multicentre cohort investigating the impact of rapid genome sequencing (rGS) in infants with new-onset epilepsy. This PhD project will explore the experiences of families undergoing rGS, focusing on how they navigate complex genetic information during a highly stressful period of diagnosis and early care, and how they utilise this information over time.

The project will examine a range of themes, which may include family expectations of rGS, the emotional response to receiving a genetic diagnosis (including diagnostic shock or relief), experiences with diagnostic and prognostic uncertainty, and the impact on parent-child bonding. It will also explore how families engage with cascade testing of other relatives and how they incorporate genomic information into reproductive decision-making, including choices about future pregnancies.

Qualitative research methods-particularly semi-structured interviews and thematic analysis-will be used to gather rich, narrative data from a diverse group of families participating in Gene-STEPS. Surveys and clinical data may also be integrated to complement qualitative insights.

This PhD project is ideally suited to a genetic counsellor or other clinician with an interest in family communication, ethical genomics, and paediatric neurogenetics. This research will contribute critical evidence on how families of infants with epilepsy experience and utilise genomic information, informing family-centred approaches to genetic counselling, consent processes, and long-term support. It will also offer guidance for ethical and policy frameworks around the delivery of rGS in acute paediatric settings.

Clinical Phenotyping and Broader Impacts of Early-Life Epilepsies - Insights from Gene-STEPS and Related Studies

A/Prof. Katherine Howell
katherine.howell@rch.org.au

Prof. Sue White
sue.white@vcgs.org.au

This PhD project will utilise data from the Gene-STEPS (Shortening Time to Evaluation in Paediatric epilepsy Services) study, and related research studies led by the Epilepsy Team at the Murdoch Children's Research Institute (MCRI), to explore the clinical spectrum and broader impacts of early-life epilepsies.

Focusing on detailed clinical phenotyping, the project will characterise epilepsy features, developmental and neurobehavioural comorbidities (including autism, ADHD, and intellectual disability), and multimorbidities such as sleep, gastrointestinal, and feeding difficulties. These phenotypes will be examined both at a group level and within subgroups defined by underlying genetic diagnoses, enabling the identification of genotype-phenotype correlations and predictors of clinical outcome.

The project will also assess the wider impacts of these conditions on families and health systems, including healthcare utilisation, caregiver burden, and psychosocial stressors. This comprehensive view will support a more holistic understanding of early-onset epilepsies and their consequences beyond seizure control.

This research will help define the natural history and full clinical spectrum of early-life epilepsies, providing essential baseline data as novel precision therapies emerge. Findings will contribute to improved prognostic counselling, early identification of high-risk children, and prioritisation of care needs.

The project will draw on patient cohorts and rich longitudinal datasets collected through prospective, multicentre collaborations, and offers opportunities to work within an interdisciplinary research team.

This PhD would ideally suit a paediatric neurologist or neurology fellow, but is also appropriate for medical practitioners or allied health professionals with experience in paediatrics and a strong interest in neurodevelopmental and genetic disorders. The project offers the opportunity to build expertise in translational neuroscience and to directly inform clinical care for children with complex neurological conditions.

Genomic Medicine

Advancing Phenotypic Measurement and Outcome Prediction for Child Language in a Mega Cohort

Prof. Angela Morgan
angela.morgan@mcri.edu.au

Loretta Gasparini
loretta.gasparini@mcri.edu.au

Dr. Susan Clifford
susan.clifford@mcri.edu.au

Industry supervisor from Redenlab (to be determined)

1 in 7 preschool children present with oral language impairment; equating to half a million Australian children. Oral language impairments triple the risk of poor reading, spelling and maths outcomes with higher rates of school non-completion and restricted job opportunities. Just as excellent oral language skills can lead to better psychosocial and wellbeing outcomes, conversely, poor oral language skills can result in poor mental health and antisocial behaviour; 50% of offenders in the juvenile justice system have an oral language disorder. What we need to understand is: Who needs oral language therapy? Who will recover without services?

GenV, Australia's largest-ever birth cohort, is designed to help solve such complex issues at high-value prevention points (early and pre-midlife) and at a whole-population level. Central to this is leveraging innovative, scalable technologies to enable large scale data collection like never before in the language field. This PhD will: 1) help design an accessible, integrated suite of language phenotypic measures able to be employed at scale, 2) pilot these measures and write up findings exploring predictive language models, ahead of GenV's 2028/29 School Gateway assessing 50,000+ children and 75,000 parents. Ideal for students passionate about language, population health, prediction and prevention.

Population Health

Why Are Babies in SCNs/NICUs at Higher Risk of Permanent Hearing Loss?

A/Prof. Valerie Sung
valerie.sung@rch.org.au

Dr. Jing Wang
jing.wang@mcri.edu.au

Dr. Peter Carew
pcarew@unimelb.edu.au

Prof. Melissa Wake
melissa.wake@mcri.edu.au

This PhD offers potential for practice changes that could improve lifelong hearing for infants admitted to SCNs/NICUs. Supervised by leading researchers in children's hearing loss, epidemiology, paediatrics and audiology, it offers immense opportunities to establish a career and leadership in transformative newborn and child hearing loss research within the GenV initiative and beyond.

Around one in five liveborn babies require admission to a special care nursery (SCN) or neonatal care unit (NICU). Admission to SCN/NICU is a known risk factor for permanent hearing loss. Compared to healthy babies, those admitted to NICUs are at 8 times the risk of hearing loss, with many hypothesized and interacting causal factors including immaturity, anaemia, infection/inflammation, ototoxic drugs, environmental noise, jaundice, intracranial haemorrhage/encephalopathy, hypoxia and genetic susceptibility. Large sample sizes and variations in care that equate to natural experiments are needed to clarify causal pathways and thence effective prevention and treatment.

This PhD project will be conducted within the GenV (short for Generation Victoria) cohort and encompassing Victoria's 5 NICUs and 40 SCNs. GenV seeks to transform the health and wellbeing of an entire generation. Led from the Murdoch Children's Research Institute (MCRI), with over 120,000 participants across Victoria, GenV is Australia's largest parent and child longitudinal cohort. You will help set up a new statewide SCN data registry within GenV within which you will study critical SCN/NICU causal to hearing loss, including objective measurement of noise in each SCN/NICU.

Use and Impact of Psychotropic Medication in Pregnancy

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Dr. Yanhong (Jessika) Hu
jessika.hu@mcri.edu.au

Prof. Peter Coghill
david.coghill@unimelb.edu.au

Up to 20% of women suffer from mood or anxiety disorders during pregnancy, whose impacts on adverse pregnancy and child outcomes could be mitigated by antenatal psychotropic medications (such as antidepressants, antipsychotics, sedative-hypnotics and other sleep medications). While these medications appear safe in pregnancy, the knowledge base is incomplete, so some mothers choose against needed medication due to fear it may affect their unborn baby.

This PhD project will be conducted within the GenV (short for Generation Victoria) cohort. GenV seeks to transform the health and wellbeing of an entire generation. Led from the Murdoch Children's Research Institute (MCRI), with over 120,000 participants across Victoria, GenV is Australia's largest parent and child longitudinal cohort, comprising consent, biosamples, and wide-ranging exposures and outcomes including administrative and clinical data. The student will contribute to creating a unique whole-of-state prescribing dataset within GenV by linkage/access to both primary care/outpatient medicines (Pharmaceutical Benefits Scheme (PBS)) and birthing hospitals prescribing data during pregnancy and the perinatal period. They will map ante/perinatal psychotropic medication use in the GenV cohort and then use causal techniques (including consideration of regional variations in medication use) to assess impacts on perinatal and infant/toddler outcomes such as language development, fine motor skills, and body composition.

The student will need a stipend to undertake this PhD.

Do We Have Sufficient Safe Medicine Use Information for Pregnant Women and Their Offspring?

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Dr. Yanhong (Jessika) Hu
jessika.hu@mcri.edu.au

Most women are prescribed at least one medicine during pregnancy. However, data are scant regarding the safety of medicines exposures for infants, as >98% of medicines do not have evidence regarding teratogenic risks and 73% of them have no human data.

This PhD project will be conducted within the GenV (short for Generation Victoria) cohort. GenV seeks to transform the health and wellbeing of an entire generation. Led from the Murdoch Children's Research Institute (MCRI), with over 120,000 participants across Victoria, GenV is Australia's largest parent and child longitudinal cohort, comprising consent, biosamples, and wide-ranging exposures and outcomes including administrative and clinical data. The student will contribute to creating a unique whole-state prescribing dataset within GenV by linkage/access to both primary care/outpatient medicines (Pharmaceutical Benefits Scheme (PBS)) and birthing hospitals prescribing data during pregnancy and the perinatal period. Exploring the

expected systematic variation in prescribing patterns by hospital region, size and sector, they will investigate pathways from prescribing policies to variations in medication use and thence pregnancy and newborn outcomes, seeking causal insights into medicine benefits and safety. The landmark GenV platform thus offers immense opportunities to establish a career with leadership in pregnancy pharmacovigilance and child health research.

The student will need a stipend to undertake this PhD.

Neighbourhood Environment Exposures Prior to Birth and Child Health and Development

A/Prof. Suzanne Mavoa
suzanne.mavoa@mcri.edu.au

Prof. Melissa Wake
melissa.wake@mcri.edu.au

The environments in which we live, work and play impact our health. It is also likely that the neighbourhood environments that parents are exposed to during preconception and pregnancy have lifelong health impacts. Studies have shown that exposure to air pollution in pregnancy is linked to a range of negative health effects at birth and in later life. However, we don't yet know: 1) whether preconception exposures to neighbourhood environments are linked to health; 2) how parental exposures to other aspects of the neighbourhood environment such as greenspace, noise and access to services influence health; or 3) how different aspects of the neighbourhood interact, for example, does living in a greener neighbourhood offset the negative effects of air pollution?

This PhD project will address these knowledge gaps by investigating the relationship between different aspects of the neighbourhood that parents were exposed to prior to birth and health outcomes in the early years of life. The project will use data from the Generation Victoria (GenV) cohort, which has collected parents' residential address data and has information on child health. Multiple measures of the neighbourhood will be developed using geospatial data and methods (e.g., geographic information systems and remote sensing). These measures will be linked to GenV participant addresses, and statistical analyses will be used to investigate the relationship between parental exposures prior to birth and child health (e.g., preterm birth, child development). Findings from the PhD will inform environmental interventions via urban planning and design.

This project will suit a researcher with strong quantitative skills, an interest in geography and neighbourhood environments, and a willingness to learn geospatial skills.

The Impacts of Adolescent Stress and Adversity on the Developing Brain

Dr. Nandi Vijayakumar
nandi.vijayakumar@mcri.edu.au

Prof. Marc Seal
marc.seal@mcri.edu.au

Prof. Sarah Whittle
swhittle@unimelb.edu.au

This project investigates how the experiences of stress and adversity during adolescence impact the developing brain, as well as consequences for future mental health and wellbeing. The project will use data from a unique longitudinal study, the Child to Adult Transitions Study (CATS) that has followed a cohort of young people since they were 8 years old (currently 21 years old). CATS has collected information on participants' social environments and mental health at every year, over 13 waves of data collection so far. In addition, two waves of MRI assessments have collected information on brain structure, function, and connectivity in earlier adolescence, and a third wave is planned for 2025. The overarching project will investigate how stressful and adverse environments influence brain development across adolescence, but the successful PhD candidate will have the opportunity to develop their own research questions using this wealth of data. They will gain expertise in neuroimaging analyses and longitudinal modelling, as well as developmental and clinical psychology.

Supervisory team: The successful candidate will be co-supervised by Dr Nandi Vijayakumar, Prof Marc Seal & Prof Sarah Whittle. They will be based across the Centre for Adolescent Health and Developmental Neuroimaging at MCRI. They will also work closely with Prof Whittle's team at Orygen and the Centre for Youth Mental Health (University of Melbourne).

The successful candidate: They will conduct high-level neuroimaging research, work collaboratively within a team, and contribute to publications in international journals. They will have:

• An undergraduate or graduate degree with upper class honours in psychology, neuroscience, or a closely related field.

• Research experience in neuroimaging is desired, but not a requirement.

• Excellent analytical thinking, data analysis and critical problem-solving skills.

• Willingness to learn neuroimaging software and programming languages (such as R and Python) for data analysis.

• Strong writing and communications skills in English.

• Ability to work independently and as part of a multidisciplinary team.

PhDs Within the Generation Victoria (GenV) Program

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Prof. Sharon Goldfeld
sharon.goldfeld@rch.org.au

Prof. Richard Saffery
richard.saffery@mcri.edu.au

Interested in a PhD with Generation Victoria (GenV), Australia's largest and most inclusive children's and pre-midlife cohort? Make cutting-edge discoveries or test new interventions to help young children and adults flourish and manage 21st-century challenges. Contact a GenV Director to discuss.

The GenV cohorts, an international asset led from Victoria (population 6.8m), Australia, include 120,000+ young children and parents representing Victoria's birthing population. It comprises a consented cohort, linked data, universal biosamples, GenV-collected data, collaborator-led studies and an Open Science platform, offering access far beyond a stand-alone PhD.

With its establishment phase complete and building blocks emerging, now is the perfect time for a PhD in GenV as children approach school age and parents approach mid-life. Explore discovery, effectiveness or policy questions through trials, natural experiments and causal epidemiology. GenV also supports PhD opportunities in -omics bioassays, data science, AI, ecological and linkage data, universal-capable measurement technology, and implementation science. We look forward to developing projects with high-potential students, placed with senior and early career supervisors tailored to need.

While stipends and/or top-up scholarships may sometimes be available, students generally need to attract scholarship stipends for these PhDs.

Supervisors: Prof Melissa Wake, Prof Sharon Goldfeld, Prof Richard Saffery. (We will help match

successful students with supervisors.)

Dysmenorrhoea, Pelvic Pain and Endometriosis

Prof. Sonia Grover
sonia.grover@rch.org.au

Dr. Courtney Munro
courtney.munro@mcri.edu.au

Dysmenorrhoea (period pain) affects 90% of adolescents and for 21% this pain is severe. An estimated one in seven to one in ten women have endometriosis, and persistent pelvic pain is reported by about 25% of women. Period pain and pelvic pain and endometriosis-associated pain often begins in adolescence and often results in school absenteeism as well as contributing to worse mental health and quality of life. To date, there have been no rigorous studies that further our understanding of the origins of endometriosis in teens, and yet we know that managing dysmenorrhea (period pain) can prevent long-term complications such as endometriosis-associated pain, chronic pain and infertility.

LongSTEPPP is an established observational study that has recruited over 200 participants across Australia. LongSTEPPP tracks young people's (aged 10-23) development and trajectories of period and pelvic pain, and endometriosis with current gynaecological care.

LongSTEPPP has a comprehensive set of data variables from young people and families through questionnaires and clinic visits for pain-orientated sensitivity testing. The PhD student will examine survey, clinical and administrative data, to consider the wide-ranging exposures and outcomes in relation to endometriosis and persistent pelvic pain, as well as differences in care pathways between settings.

We are looking for an enthusiastic PhD candidate to join a dynamic team of gynaecologists and researchers. The candidate will analyse the wealth of LongSTEPPP data to determine trajectories of pain and quality of life. Findings from LongSTEPPP will directly inform guidelines for the management of dysmenorrhoea in teens to improve long-term outcomes. The project gives the possibility of reducing presentation of endometriosis and persistent pelvic pain through identifying predisposing factors and potential positive interventions for adolescents.

The project would suit someone with a background in medical science or epidemiology. Some experience in data management and statistical analysis is required. For candidates with a background in psychology, there is also the potential to examine mental health trajectories more closely in relation to pain and employ qualitative research methods. A stipend may be available.

Understanding the Long-Term Impact of Nurse Home Visiting on Children's Development

Dr. Anna Price

anna.price@mcri.edu.au

Are you passionate about using data to improve children's lives? Do you want to be part of a high-impact project influencing real-world policy?

Join the right@home research team in a unique PhD opportunity focused on improving outcomes for children growing up in adversity.

right@home is a landmark, longitudinal randomised trial of a sustained nurse home visiting (SNHV) program delivered by trained child and family health nurses from pregnancy until age two. Based on the MECSH (Maternal Early Childhood Sustained Home-visiting) model, the program supports families at risk of poorer maternal and child outcomes.

This PhD will contribute to the third phase of the trial, evaluating the program's long-term impact on children's academic achievement using linked data from the National Assessment Program for Literacy and Numeracy (NAPLAN) (2022-2024), when children were in Grade 3, 8-to-10 years after randomisation.

Key responsibilities:

- Finalise data linkage with education departments (noting this is partially completed).
- Clean and code the linked dataset.
- Lead analysis of linked trial and NAPLAN data to assess intervention outcomes.
- Apply advanced statistical methods and manage missing data (with expert support).

Ideal for students with:

- A background in biostatistics, epidemiology, or quantitative research.
- An interest in early childhood, public health, and evidence-informed policy.
- Strong analytic skills and a commitment to research that matters.

You'll be part of a nationally significant study with strong mentorship and a direct policy impact, shaping how governments invest in early years services.

Please note: This PhD project is currently unfunded. Students will be expected to apply for candidature and competitive scholarships (e.g., through their university), with support from the supervisory team. For more information on the project, please visit us at: https://www.ccch.org.au/our-work/project/right-home/

Improving the Financial Wellbeing of Families by Connecting Health and Social Care - Healthier Wealthier Families (HWF), Queensland

Dr. Anna Price

anna.price@mcri.edu.au

Are you passionate about improving the financial and emotional wellbeing of families? Join the Healthier Wealthier Families (HWF) initiative in Queensland, an innovative, large-scale research and implementation project designed to reduce financial hardship for families with young children.

The HWF model links universal child and family health services (e.g. nurse home visits) with financial wellbeing supports, helping families access the help they need, when they need it. Adapted from a successful Scottish model and underpinned by a proportionate universalism approach, HWF is now being scaled and rigorously evaluated across Queensland in partnership with health services, government, and community organisations.

We are offering several PhD opportunities within this nationally significant research program. Potential focus areas include:

- Implementation science: Explore how HWF is delivered in real-world settings, examining enablers, barriers, and local adaptations using interviews, process mapping, and implementation science frameworks. Ideal for students interested in systems, policy, and mixed methods.
- Health economic evaluation: Assess the cost and cost-effectiveness of HWF, examining the value of integrating referrals to financial support into child health services. Suitable for students with a background in health economics, public health, or applied statistics.

What you'll gain:

- Experience in applied, policy-relevant research.
- Opportunities to collaborate with national and international partners.
- Skills in evaluation design, stakeholder engagement, and knowledge translation.
- Mentorship from an interdisciplinary team at the Murdoch Children's Research Institute and Queensland partners.

Who should apply:

Students with backgrounds in public health, epidemiology, social sciences, economics, psychology, or biostatistics. A commitment to equity and real-world impact is essential.

Please note: These PhD projects are currently unfunded. Students will be expected to apply for candidature and competitive scholarships, with support from the supervisory team. For more information on the project, please visit us at: https://www.ccch.org.au/our-work/project/healthier-wealthier-families/.

Social Determinants and Health Outcomes of Homelessness from Childhood to Adulthood

A/Prof. Jess Heerde
jessica.heerde@unimelb.edu.au

Prof. Susan Sawyer
susan.sawyer@rch.org.au

Prof. Craig Olsson
craig.olsson@rch.org.au

Child and adolescent homelessness is appreciated as a significant problem but the causes and consequences, including health outcomes (social, psychological, and physical), remain understudied. The proposed project will utilise data from population-based cohort studies of child and adolescent development to examine: (a) key modifiable social determinants of homelessness in childhood and adolescence and the earliest timing of interventions to either improve or reduce these determinants, and/or (b) the impacts of early life homelessness on health outcomes across the life course.

Exploring Place-Based School-Service Integration Models for Child Mental Health Through the MHiPS Initiative

Prof. Amanda Wood
Amanda.wood@mcri.edu.au

A/Prof. Simone Darling
Simone.darling@mcri.edu.au

Dr. Georgia Dawson
Georgia.dawson@unimelb.edu.au

The Mental Health in Primary Schools (MHiPS) initiative is a transformative, statewide reform embedding mental health leadership and capability into over 1,800 Victorian government primary schools, and scaling to Queensland. As MHiPS shifts the dial toward earlier, school-based mental health support, a critical element to its impact is understanding how schools can effectively connect with local community services to provide coordinated, equitable, and sustainable care to optimise and coordinate the systems that influence children's mental health.

This PhD project will explore place-based models of school-service integration, investigating how existing models are structured, how they function in practice, and their impact on children, families, and educators. The study will build on MHiPS as a backbone platform, examining how different communities have approached the challenge of connecting education with broader systems of care, what factors are most critical to a successful school-service model and how MHiPS can evolve to address this gap.

Assessing the Relative Contributions of Heritable and Environmental Influences Using GenV's Family-Based Cohort

Prof. Richard Saffery
richard.saffery@mcri.edu.au

Katherine Lange
katherine.lange@mcri.edu.au

A/Prof. Shuai Li
shuai.li@unimelb.edu.au

Dr. Jing Wang
jing.wang@mcri.edu.au

Family-based designs are key to understanding causality, particularly in genetic epidemiology. Generation Victoria (GenV) includes over 710 twin pairs, 8 sets of triplets, ~1000 sibling pairs and ~3000 parents of these children - in total, over 6000 family-based participants embedded within Australia's largest and most diverse whole-population birth and parent cohort (>120,000). This PhD will harness this rare resource to study the relative genetic and environmental drivers of major childhood outcomes including allergy, infection, and growth. By comparing monozygotic twins, dizygotic twins, siblings and singletons, and drawing on rich linked health and other data, the student will generate insights with direct relevance to population health, policy and practice. This PhD would suit students with an interest in genetic or causal epidemiology, population health and data science.

Causal Effects of Maternal Health Conditions During Pregnancy on Child Outcomes to Age 3Y in GenV

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Dr. Amy Walsh
amy.walsh@mcri.edu.au

Maternal physical and mental health during pregnancy can shape early life outcomes, but causal pathways remain unclear. This PhD will use GenV's whole-of-state cohort (>120,000) to investigate how maternal conditions - both pregnancy-specific (eg preeclampsia, gestational diabetes) and general (eg depression, asthma) - affect health and development to age 3y. Drawing together statewide administrative, clinical records and survey data for mothers and children, the student will advance extraction of clinical data and case definitions of important maternal and child conditions within the GenV resource.

Using causal inference and family-based methods to examine outcomes to age 3y such as growth, infection, allergy, sleep, and emotional development, the project will address confounding and explore the role of multimorbidity, services, and social factors.

This PhD suits exceptional students interested in causal epidemiology, maternal-child health, data science and early prevention.

Health and Economic Impacts of Maternal Health and Conditions in Pregnancy in GenV

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Dr. Amy Walsh
amy.walsh@mcri.edu.au

Maternal conditions during pregnancy may drive early health system use and costs for children, but the burden and patterns are not well understood. Using GenV's linked health and administrative data, this PhD will quantify how maternal conditions - both pregnancy-specific (eg preeclampsia, gestational diabetes) and general (eg depression, asthma) - impact children's health service use, hospitalisations, and medication to age 3y. It will explore variation by condition, multimorbidity, and social and geographic factors, providing evidence for service planning and prevention.

This PhD will suit exceptional students with interests in health economics, population health, maternal-child health and policy impact.

Implementing Measurement of Core Outcomes for Child Deafness

Valerie Sung
valerie.sung@rch.org.au

Stephanie Best
stephanie.best@unimelb.edu.au

Children who are deaf and hard of hearing experience challenges in their communication, development, quality of life, adult opportunities and service needs, much more so than children who are not deaf. This is despite Australia's investments in universal newborn hearing screening (UNHS), offering, in principle, every child who is deaf or hard of hearing free and early access to hearing screening, diagnosis, and support, including hearing devices, cochlear implantation and early intervention programs. Such challenges may be due to ineffective or inequitable access to supports, interventions and services. Addressing these needs demands coordinated multi- and inter-disciplinary approaches to streamlined data collection into a national system that can be used for research and health system improvements through an enduring Learning Health System.

The Australian National Child Hearing Health Outcomes Registry (ANCHOR) is being built as a national data system and research platform to collect and connect child hearing health information, to drive better care and give all children who are deaf or hard of hearing the opportunities to live healthy, fulfilled lives. As part of the ANCHOR program, a national Core Outcomes Set will be determined by the beginning of 2026.

This PhD opportunity aims to define the suite of measures for the national Core Outcomes Set, and implement their collection in different child hearing health services using rigorous implementation science methodology.

Longitudinal and Secular Trends in Outcomes for Adolescents Who Are Deaf or Hard of Hearing

Valerie Sung
valerie.sung@rch.org.au

Jing Wang
jing.wang@mcri.edu.au

The last 25 years have seen significant changes to methods of detection, intervention and services available to children born in Victoria who are deaf or hard of hearing. Universal newborn hearing screening, early intervention and cochlear implantation have revolutionised the opportunities for deaf and hard of hearing children, but their language and learning at school entry still lag behind their hearing peers.

Much less known is the quality of life, educational, social and vocational outcomes of teenagers identified through newborn hearing screening. The VicCHILD (Victorian Childhood Hearing Longitudinal Databank) study began in 2011/12, inviting all children born in Victoria with a permanent hearing loss from 2005 onwards into the study, with continuous follow ups of children aged 5-7 years and 10-12 years and proposed follow up at ages 17-18 years. With VicCHILD now running for more than 20 years, there is an opportunity to examine the outcomes of teenagers who are deaf or hard of hearing - this fills a critical gap in the international literature.

We seek an outstanding doctoral researcher to examine longitudinal outcomes and secular trends in outcomes for adolescents who are deaf or hard of hearing born in Victoria over the last 25 years.

This project would be suitable for an outstanding PhD or DPsych scholar, most likely from a paediatric, public health, speech pathology, audiology, or psychology background. The aim of the thesis is to understand the long-term benefits of universal newborn hearing screening, and of any subgroups that may benefit differentially.

The GenSLEEP Trial: Improving Sleep to Reduce Cardiovascular and Mental Health Risk at Age 5Y

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Prof. Raghu Lingam
raghu.lingam@unsw.edu.au

Short or fragmented sleep is a neglected pillar of cardiovascular (CV) and mental health. Generation Victoria (GenV) provides an unprecedented platform to test scalable early-life interventions at population level. This PhD student will lead GenSLEEP, a pragmatic 'large simple trial' embedded in GenV, to evaluate whether a brief nudge to bring forward bedtimes at age 5 can improve sleep and thereby reduce CV and mental health risk. As part of the trial, the student will assist with measuring phenotypic outcomes (BMI z-score, physical activity) in GenV's Early School Wave and accessing large-scale linked data (school nurse surveys during prep grade, phonics outcomes in Year 1) to generate policy-relevant evidence for prevention.

This PhD is for an exceptional student with relevant background (eg clinical, nutrition, activity, sports, public health) and a passion for improving child and population health through real-world trials. Top-up Director's Scholarship may be available.

Life's Essential 8: the GenHEART Platform Trial to Reduce Population Cardiovascular Disease (CVD)

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Prof. Raghu Lingam
raghu.lingam@unsw.edu.au

GenV will soon launch GenHEART, a multi-arm, multi-stage platform for CVD prevention trials in its state-wide birth and parent cohort (>120 000). This PhD places you at the centre of its creation.

Your role:

- Develop advanced skills in platform trial design, randomisation algorithms, decision rules.
- Community and stakeholder engagement to ensure equity, cultural safety and real-world fit.
- Design and pilot child and adult CV phenotypes for the GenV's Early School Wave (ESW, 2028-30), forming GenHEART's common baseline/outcome set.
- Contribute to planning and delivery of the ESW.
- Help drive one GenHEART trial, overseeing ethics, data capture and interim analysis.

Expected outputs: an operational platform; pilot data to activate multiple arms; methodological and clinical papers.

This PhD is for outstanding candidates (eg clinical, public health, implementation science) passionate about CV prevention, pragmatic trials and health equity. Top-up Director's Scholarship may be available.

Climate and Environment in GenV

A/Prof. Suzanne mavoa
suzanne.mavoa@mcri.edu.au

Prof. Melissa Wake
melissa.wake@mcri.edu.au

Where we live matters for our health. Generation Victoria (GenV), Australia's largest-ever birth and parent cohort (~125,000 participants), is ideally suited to answering questions and finding solutions related to environmental exposures and child and adult health, development and wellbeing. GenV offers opportunities for exceptional students to answer important health questions relating to a range of environmental exposures (eg climate, pollution, green space, neighbourhood design, walkability, housing, indoor environments). There are also opportunities to tackle problems related to measurement of environmental exposures using different technologies (eg GIS, remote sensing, GeoAI, geospatial data science, environmental monitoring, wearables). For example, using remote sensing and GIS to help build our geospatial platform of high-resolution indicators, or leading the design and piloting of environmental monitoring for GenV's Early School Wave.

Will suit exceptional students with interests in climate, environment and social determinants of health and/or geospatial data science and GIS. Top-up Director's Scholarship may be available.

GenNOISE: A Whole-Population Study of Noise and Hearing in Childhood and Pre-Midlife

Dr. Jing Wang
jing.wang@mcri.edu.au

A/Prof. Suzanne Mavoa
Suzanne.mavoa@mcri.edu.au

Hearing loss has lifelong impacts on learning, wellbeing, social participation and (in seniors) cognitive decline and mental illness. Environmental noise not only affects wellbeing but is a key driver of hearing loss and may amplify its effects. Yet we lack population-level data to identify when, where, and for whom noise and hearing loss prevention efforts should be targeted.

Generation Victoria (GenV), Australia's largest-ever birth and parent cohort, offers a one-off opportunity to study these issues in its statewide Early School Wave (50,000+ children, 75,000 parents) in 2028-30.

This PhD will help (1) design and test a cutting-edge, integrated suite of scalable, noise and hearing measurements, and (2) examine how different noise sources (e.g. schools, leisure, transport) differentially affect hearing and wellbeing across priority population groups.

Will suit exceptional clinical, epidemiology, biomed, biotech or public health students. Top-up Director's Scholarship may be available.

Stem Cell Medicine

Analysis of Spatial Data in Congenital Heart Diseases

Prof. Mirana Ramialison
mirana.ramialison@mcri.edu.au

Dr. Hieu Nim
hieu.nim@mcri.edu.au

Congenital heart disease affects 1 in 100 babies, while no cure currently exist, surgery in early weeks of life is usually required generating a great burden for the babies and their families. Most of the aetiology of congenital heart disease remains unknown. Spatial gene expression patterns are critical to understand how the heart develops and what underlying genetic patterns are behind heart malformation. High-throughput spatial temporal data have been recently generated with spatial transcriptomics technologies. Capitalising on these rich datasets, we aim to build a custom analysis workflow in which the cells are profiled with precise spatial gene expression information. The student will provide fundamental contribution to of this project, by: (1) analysing the spatial and single-cell RNA-seq datasets; (2) cross-validating the pattern in independent datasets and (3) associating observed spatial patterns with known literature in congenital heart disease.

The outcome of this project is to discover novel genetic causes for congenital disease to improve the diagnostic and subsequent treatment of heart defects.

Skills focus: proficiency in one programming language (e.g. Matlab, R, Python), basic understanding of cell and development biology, simulation, data visualisation, bulk / single-cell RNA-sequencing analysis.

Laboratory Links:

https://ramialison-lab.github.io/index.html

Infection, Immunity and Global Health

Off-Target Effects of BCG Vaccination on Allergic and Infectious Disease in Adults

Prof. Nigel Curtis
Nigel.Curtis@rch.org.au

Dr. Nicole Messina
nicole.messina@mcri.edu.au

Interested in being part of the largest BCG vaccine trial of its kind worldwide?

In addition to protecting against its target disease, tuberculosis, the Bacillus Calmette-Guérin (BCG) vaccine has beneficial off-target ('heterologous' or 'non-specific') effects on human health. This includes reducing all cause infant mortality, likely by protecting against non-mycobacterial infectious diseases. Studies also suggest the BCG vaccination protects against allergic disease in children.

The BRACE trial is an international RCT of 6828 healthcare workers across 36 sites in five countries. This trial aims to determine if BCG vaccination reduces the impact of COVID-19 and other respiratory diseases. In addition to data on respiratory illness, data were collected on other non-respiratory infections, and allergic and autoimmune disease.

Using data collected from participants in the BRACE trial you will investigate the clinical off-target effects of BCG on non-respiratory infections, allergic and autoimmune disease in adults. Moreover, you will identify factors which influence the off-target effects of BCG. In this project you will have the opportunity to combine clinical findings with existing immunological data from the BRACE trial.

The findings of this project will provide important insights into the off-target effects of BCG vaccination in adults and the factors that influence these responses.

The Infectious Diseases Laboratory is located at the Murdoch Children's Research Institute, part of the Melbourne Children's Campus, which also includes the Royal Children's Hospital and the University of Melbourne.

Immune Mechanisms Driving Treatment Failure Following Treatment for Food Allergy

Mimi Tang
mimi.tang@mcri.edu.au

Sarah Ashley
sarah.ashley@mcri.edu.au

Food allergies are a global health burden with a severe impact on quality of life. Currently there is no cure. A long-term treatment solution will improve quality of life and prevent deaths.

Treatments in development have been shown to induce remission of allergy. Peanut oral immunotherapy (OIT) is effective at inducing desensitisation but only induces remission in a subset of patients. Our previous work, enabled us to identify key pathways linked to treatment success (remission). We now aim to extend this work by characterising immune mechanisms leading to failure to achieve remission (desensitisation without remission). The distinction is critical to our understanding of the pathways supporting long-term redirection of the underlying allergy. Furthermore, we are one of the few groups internationally who are set up to achieve this. Our biosamples are internationally unique, with long-term patient outcomes complete up to 5-years post-treatment.

To achieve this, the student will use a systems biology approach which harnesses gene expression techniques combined with computational approaches to map changes to gene-gene communication networks.

These findings will generate important information which could differentiate pathways leading to treatment failure from those leading to treatment success.

Defining the biology underpinning desensitisation without remission will enable development of a long-term treatment solution for patients with food allergy.

Blood samples have already been collected and are immediately available the project.

This research represents an exciting opportunity to address a major knowledge gap.

Determining the Interaction of Air Pollution and Pneumonia in Mongolia

A/Prof. Claire von Mollendorf
claire.vonmollendorf@mcri.edu.au

Prof. Catherine Satzke
catherine.satzke@mcri.edu.au

Prof. Kim Mulholland
kim.mulholland@mcri.edu.au

The project aims to determine associations between air pollution exposure (incl. individual pollutants) for all pneumonia, pneumococcal carriage, pneumococcal pneumonia and viral infections in hospitalised adults and children, and for cardiovascular disease in adults in Mongolia.

In addition, the project will investigate the potential impact of policies to reduce air pollution, including current measures and provide a baseline against which future improvements can be measured.