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How to apply

Key Dates for 2024 Mid-Year Intake

Round 1

- Online Course Application Closing Date: 24 June 2024
- Project Preference Submission Closing Date: 28 June 2024

Round 2

- Online Course Application Closing Date:
- Project Preference Submission Closing Date:

Application Process

Step 1: Look for Projects and Contact Potential Supervisor(s)

You MUST make contact with potential supervisors either before or soon after submitting an online course application and reach at least a verbal agreement. Read through this helpful guide on how to look for projects and contact potential supervisor(s):

Step 2: Submit An Online Application

Step 3: Submit Project Preferences in Sonia

Ready to apply?
Exploring innate immune memory

Project Description:

Immune memory is a defining feature of the adaptive immune system, but activation of the innate immune system can also result in heightened responses to re-challenge. This adaptation has been termed "trained immunity", a de facto form of innate immune memory. Studies over the past few years have pointed to the broad benefits of trained immunity for host defence but have also suggested detrimental outcomes in chronic inflammatory disease, such as atherosclerosis. By inducing metabolic and epigenetic changes in haematopoietic stem cells (HSCs), trained immunity drives myeloid cell expansion and the sustained generation of monocytes with a "proinflammatory" phenotype.

Primary Supervisor: Dr Andrew Fleetwood

Primary Supervisor Contact: andrew.fleetwood@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health
Understanding how failures in cell metabolism and the immune system lead to heart failure following a heart attack

*Project Description:*

The heart is a highly metabolically active tissue that requires the efficient production, and ongoing supply, of energy in order to maintain optimal heart function and health. Mitochondria are the powerhouse of the cell, where declines in mitochondrial health and function caused by either genetic mutation or environmental stress, can lead to reductions in energy production and subsequently impact the functional capacity of the heart.

Indeed, one of the most common genetic conditions in humans is mitochondrial disease, which affects many tissues in the body, but often individuals suffer predominantly from heart related ailments. Unfortunately, little is known about the effects of mitochondrial dysfunction specifically in the heart, or why mitochondrial dysfunction in other tissues also leads to heart failure. Recent evidence suggests that mitochondrial dysfunction leads to activation of a specific arm of the immune system, which leads to excessive immune infiltration and subsequent heart failure. This project will use a novel mouse model exclusive to our laboratory to study the cellular and molecular drivers of mitochondrial cardiomyopathy, that may help identify new therapeutic targets, biomarkers and treatments for heart disease in humans.

*Primary Supervisor:* A/Prof Brian Drew  
*Primary Supervisor Contact:* brian.drew@baker.edu.au

*Honours places available:* 1  
*Master of BioMed places available:* 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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Targeting GasderminD, the pyroptosis mediator, as a novel therapeutic to reduce Type 2 diabetes-associated atherosclerosis.

*Project Description:*

Cardiovascular complications associated with Type 2 diabetes (T2D) lead to significant morbidity and mortality, for which standard treatment options are insufficient to halt or reduce this clinical burden. Recent clinical evidence from the successful CANTOS trial suggests that targeting the cytokine IL-1b lessens inflammation and reduces the burden of cardiovascular disease. IL-1b is matured on the NLRP3-inflammasome along with IL-18 and GasderminD, the pyroptosis (a specific form of cell death) regulating protein. Pyroptosis and release of detrimental cytokines is hypothesized to propagate cardiovascular disease. This proposal will investigate the role of pyroptosis in mediating diabetes-driven atherosclerosis in Type 2 diabetic mice.

*Primary Supervisor:* Prof Judy de Haan
Primary Supervisor Contact: judy.dehaan@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Epigenetic Reprogramming of Pancreatic Stem Cells to Insulin-Producing Beta-Cells**

**Project Description:**

Our research team has made substantial strides in demonstrating the viability of directing the differentiation of pancreatic stem cells into insulin-producing beta-cells via targeted epigenetic modifications. Our efforts have centred on the application of specific epigenetic drugs that influence Enhancer of Zeste Homolog 2 (EZH2)-mediated trimethylation of histone H3 at lysine 27 (H3K27me3). This precise manipulation is poised to enable the regeneration of deficient insulin cells in T1D patients, a transformational approach that shifts the therapeutic focus from symptomatic management to potential cure.

Our discoveries have been recognised on both national and international platforms, indicating the transformative potential of our research. Engaging in this project offers the Honours student an opportunity to delve into the frontiers of stem cell biology, epigenetics, and diabetes research, and to significantly contribute to a potential game-changing therapeutic approach in diabetes treatment.

Primary Supervisor: Prof Sam El-Osta

Primary Supervisor Contact: sam.el-osta@baker.edu.au

Honours places available: 2

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Type I interferon as a novel endogenous trigger of trained immunity**

**Project Description:**

Trained immunity is a form of innate immune memory resulting in a “high-alert” immune state. We will explore whether type I interferon can build immunological memory in vivo and whether this exerts harmful effects in the setting of chronic inflammation, such as atherosclerosis.

Primary Supervisor: Dr Andrew Fleetwood

Primary Supervisor Contact: andrew.fleetwood@unimelb.edu.au

Honours places available: 1
Identification of novel biomarkers for people with diabetes.

Project Description:
Blood and genetic and epigenetic materials and related data and consent are available from a range of observational studies and clinical trials of diabetes devices and drugs in people with type 1 or type 2 diabetes. These will be assessed to explore associates of concurrent and future health status and treatment effects. Student’s project will involve assessing clinical, biochemical and molecular biomarkers in skin, eye and blood vessel samples using advanced molecular biology assays: gene SNPs, telomere length, microRNAs, ‘-omics’ and mitochondria related markers.

Primary Supervisor: Prof Alicia Jenkins
Primary Supervisor Contact: Alicia.Jenkins@baker.edu.au
Honours places available: 2
Master of BioMed places available: 2
Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Mature AgeD pEople with Type 1 diabetes (MADE-IT T1D)

Project Description:
Type 1 diabetes affects about 132,000 Australians, with 2/3 being aged 40 yrs or older and 1/3 being 60 yrs or older. They are an understudies and under-resourced group of people. Audits and a cohort study and biobank with traditional and novel markers of blood and tissue health and their lived experience will be developed.

Primary Supervisor: Prof Alicia Jenkins
Primary Supervisor Contact: Alicia.Jenkins@baker.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Melbourne Vascular Tissue Repository (MeVTR)
Parkville Precinct Honours and Masters Project Handbook

**Project Description:**

An existent and expanding biobank of health-related data, blood and human heart and blood vessel tissue collected from adults undergoing heart disease provides an excellent resource to evaluate potential markers and mediators of cardiovascular disease.

The project will involve collection and annotating clinical samples, protocol development, production of transcriptome and proteome biobanks, and experimental assessments using these biobanks.

**Primary Supervisor:** Prof Alicia Jenkins

**Primary Supervisor Contact:** Alicia.Jenkins@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Platelet function in adults with and without type 1 diabetes**

**Project Description:**

Platelets are key to blood clotting and their aggregation is linked to heart attacks and strokes. Aspirin and other anti-platelet drugs can be protective, though it has been suggested that people with diabetes have platelets that are more resistant to such drugs. Detailed functional studies of platelets in fresh blood from well-characterised adults with and without type 1 diabetes will be performed.

**Primary Supervisor:** Prof Alicia Jenkins

**Primary Supervisor Contact:** Alicia.Jenkins@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Immune Mechanisms Responsible for Development of Checkpoint Mediated Myocarditis**

**Project Description:**

Immune checkpoint inhibitors (ICIs) have revolutionized cancer treatment by reactivating exhausted cytotoxic CD8+ T cells and enhancing their ability to eliminate cancer cells. However, combination therapies with anti-PD-1 and anti-CTLA-4 ICIs can lead to adverse effects such as myocarditis, which is inflammation of the heart that can cause extensive damage and is often fatal. Currently, there are no effective treatments for this condition, which
occurs in about 1-2% of cancer patients receiving ICI therapy. Myocarditis is strongly associated with the infiltration of CD4+ and cytotoxic CD8+ T cells, but the mechanisms involved are poorly understood.

To address this, the proposed study aims to generate a mouse model that mimics human myocarditis by transplanting melanoma or breast cancer tumors into mice and treating them with anti-PD-1 and anti-CTLA-4 antibodies. The study will investigate the mechanisms underlying the accumulation of cytotoxic CD8+ T cells in the heart, including the role of autoreactive CD8+ T cells and memory CX3CR1+ CD8+ T cells. The importance of innate versus adaptive immunity in mediating heart damage will also be examined.

The study will provide new insights into the mechanisms of checkpoint inhibitor myocarditis and shed light on the importance of CD4+ T cell help in mediating memory CX3CR1+ CD8+ T cell responses and innate immunity. Ultimately, the results of this study will be used to develop new therapies for this devastating heart disorder.

Primary Supervisor: Dr Tin Kyaw
Primary Supervisor Contact: Tin.Kyaw@baker.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Inhibiting Early Lymphocyte-Mediated Inflammation to Prevent Cardiomyocyte Loss in the Development of Myocardial Infarction-Induced Heart Failure**

**Project Description:**

Myocardial infarction, or heart attack, is a leading cause of death and can lead to heart failure due to loss of cardiomyocytes. Current treatments that unblock coronary arteries have increased patient survival, but heart failure remains a major problem. Stem cell therapies have been unsuccessful in replacing lost cardiomyocytes, and recent studies have shown that cytotoxic gamma delta T cells contribute to the large loss of cardiomyocytes following a heart attack. This project aims to prevent inflammatory cell death mediated by these gamma delta T cells and focus on preventing pyroptosis and necroptosis. Specifically, the project will investigate which subtype of gamma delta T cells are responsible for initiating inflammatory necrotic cell death modes, how they are attracted to ischaemic heart muscle, and how they are activated. The project will also focus on developing inhibitory NKG2D antibodies to prevent gamma delta T cell activation, which is expected to reduce cardiomyocyte loss during myocardial infarction and heart failure in humans. Such therapies would be administered at the time of infarction and have the potential to significantly improve patient outcomes.

Primary Supervisor: Dr Tin Kyaw
Primary Supervisor Contact: Tin.Kyaw@baker.edu.au
Honours places available: 1
Novel biomarkers for Cardiovascular Risk Prediction

Project Description:
Rupture of advanced atherosclerotic plaques within arteries of the heart are responsible for heart attacks, but the mechanisms are poorly. There are no therapies that specifically target plaque rupture. We have obtained new data that gamma delta T cells in atherosclerotic plaques may contribute to heart attacks. Atherosclerotic LDLR/- mice with high blood pressure develop atherosclerosis in coronary arteries within the heart and die from heart attacks, while in humans, high blood pressure is the largest risk factor for premature heart attacks. We will employ various immunological techniques, including mixed bone marrow chimeras to delete cytokines/cytotoxins from gamma delta cells in the mice, as well as spatial transcriptomics to define the molecular inflammatory/cytotoxic characteristics of gamma delta T cells within plaque. We will also use specific depleting antibodies to prevent heart attacks due to gamma delta T cells. This project is highly focused on gamma delta T cell immunology and atherosclerosis pathophysiology and may help prevent heart attacks in the future.

Primary Supervisor: Dr Tin Kyaw
Primary Supervisor Contact: Tin.Kyaw@baker.edu.au

Preventing Crosstalk Between Cytotoxic Memory CD8+ T Cells and Stressed Heart Cells in the Development of Stiff Hearts Caused by Fibrosis

Project Description:
High blood pressure (hypertension) and diabetes are both associated with poor heart function due to the stiffening of the heart caused by excessive collagen accumulation, known as cardiac fibrosis. This condition contributes significantly to heart failure and premature death, but there are currently no effective treatments available. Recent research has shown that cytotoxic memory CD8+ T cells play a role in initiating fibrosis in mice with high blood pressure. As the heart works harder due to the sustained stress of hypertension, it damages cardiomyocytes, which release DNA from their mitochondria. This DNA activates CD8+ T cells via a STING signaling cascade, causing them to attack the stressed cardiomyocytes and triggering a chain reaction resulting in cardiac fibrosis.
Our proposed therapeutic strategy aims to prevent cardiac fibrosis by inhibiting the release of DNA from mitochondria. Specifically, we will focus on the voltage-dependent anion channel (VDAC1) located on the outer mitochondrial membrane, as well as mitochondrial permeability transition pores, in order to prevent DNA release from stressed mitochondria and reduce the risk of cardiac fibrosis. We will conduct these studies using hypertensive mice and spontaneously hypertensive rats, which have blood pressure characteristics similar to humans. The results of this research will provide valuable insights into the development of novel therapies for cardiac fibrosis.

**Primary Supervisor:** Dr Tin Kyaw

**Primary Supervisor Contact:** Tin.Kyaw@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Revolutionized B Cell-Targeted Therapy to Prevent Heart Attacks**

**Project Description:**

Cholesterol lowering agents have been shown to reduce the incidence of heart attacks and strokes, the major causes of death. However, the incidence of death in survivors is high after a first heart attack. It is not clear which patients are at high risk. Also, there are no therapies that prevent a second or third heart attack/stroke, which are frequently fatal. We have strong evidence that B cells, in particular those that produce antibodies are largely responsible. Two projects are proposed to study B cells and their role in heart attack and stroke prevention.

Project 1 is aimed at demonstrating that B cells are producing specific (yet to be defined) pathogenic antibodies that accelerate atherosclerosis, a vascular disease due to high cholesterol that is responsible for heart attacks/strokes. This project involves basic B cell immunology and biochemistry studies using mouse models of heart attacks and atherosclerosis, along with mass spectrometry, immunological assays, molecular biology techniques, and molecular cloning and protein expression to identify the most important pathogenic antibodies. "Biomarker" ELISA antibody tests will be relatively inexpensive and able to identify patients who are at high risk for myocardial infarction.

Project 2 aims to develop novel therapies to prevent the second or third heart attack or stroke, with a focus on nanoparticle therapy. Two types of nanoparticles will be designed. 'Camouflaged' nanoparticles will have membranes on their surface, making them resemble follicular T cells. These nanoparticles will interact with germinal center B cells, preventing true follicular B cells from interacting and generating antibodies in the days after a heart attack. The second type of nanoparticle will be designed to release inhibitor siRNA molecules in the hypoxic (low oxygen) environment of germinal centers, preventing the generation of pathogenic antibodies after a heart attack. Nanoparticle technology is revolutionizing drug delivery and imaging in medicine.
Primary Supervisor: Dr Tin Kyaw

Primary Supervisor Contact: Tin.Kyaw@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

γδ T cells: their atherogenic actions and therapeutic potential in coronary atherosclerosis

Project Description:

We have previously shown that in established atherosclerosis, B cells produce pathogenic antibodies that enhance the progression of lesions towards the development of clinically significant plaques. Currently, there are no therapeutic interventions that specifically target B cells to suppress atherosclerosis. This project will focus on regulatory T cells that selectively suppress immune activity, specifically CD8+ regulatory T cells, whose suppressive actions are mostly focused on preventing B cells from producing pathogenic antibodies. They do not lead to severe immunosuppression and are defined as CD8+CD122hiLy49+ T cells.

The project will use immunological, cell culture, histological, biochemical, and genomic technologies, which include isolating CD8+ regulatory T cells, expanding them in cell culture, and adoptively transferring them into mice with atherosclerosis, to determine whether CD8+ regulatory T cells suppress the initial stages of atherosclerosis development or the progression of established atherosclerosis and to define their molecular mechanisms of action.

The project will produce high-impact results that will revolutionize our understanding of how regulatory T cells control atherosclerosis, a disease of blood vessels that is responsible for heart attacks and strokes. The project can be tailored for students focused on honors, MSc, and PhD degrees. Results will likely greatly increase our ability to prevent life-threatening major cardiovascular and cerebrovascular events after surgery, particularly in those with low numbers of CD4+ regulatory T cells.

Primary Supervisor: Dr Tin Kyaw

Primary Supervisor Contact: Tin.Kyaw@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Identification of additional markers of ferroptosis with mass spectrometry

Project Description:

Parkville Precinct Honours and Masters Project Handbook
Interrogate the role of ether lipids (with antioxidant properties) in ferroptosis and their potential to mediate and regulate the process in various biological settings.

**Primary Supervisor:** Prof Peter Meikle  
**Primary Supervisor Contact:** peter.meikle@baker.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Integration of population level ‘omics data to target cardiometabolic disease**

**Project Description:**

Development of a plasma lipid profiling test to enable the early detection of patients at increased risk of type 2 diabetes and coronary artery disease. In addition we will develop methods to monitor treatment. Identification of individuals prior to the development of disease will enable early intervention and will have a profound effect on the health of the Australian population.

**Primary Supervisor:** Prof Peter Meikle  
**Primary Supervisor Contact:** peter.meikle@baker.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Exploring the contribution of intrinsic lipids to immune cell development and function**

**Project Description:**

This project is focused on exploring how unique lipid signatures (lipidomes) of immune cells influence their function and/or development. The overarching goal is to identify ways to manipulate specific lipids to alter cell function in disease.

Over the past few years we have generated a new and exciting data set profiling the lipid compositions (lipidome) of 16 different human immune cells and the major mouse immune cell equivalents. This revealed striking diversity between various immune cells, particularly between the innate and adaptive immune system.

We are now exploring two overall questions: 1. Do specific lipids drive immune cell function? 2. How do the lipidomes of immune cells form as they develop from stem cells.
The specific project can be focused on either of the two questions above.

**Project 1:** Exploring the contribution of lipids sensitive to peroxidation which confer susceptibility to a specific form of cell death known as ferroptosis.

**Hypothesis:** Immune cells enriched in lipids that are sensitive to peroxidation undergo ferroptosis when exposed to ferroptotic agonists, while immune cells devoid in these lipids will be resistant.

This project will involve manipulating human and mouse immune cells in culture. Techniques to explore this question will be cell death assays via flow cytometry and assessment of lipid peroxidation by mass spectrometry. Mouse models will also be used to test this hypothesis in vivo and depending on the applicant (hons/PhD) will use mouse models to genetically modify the lipid composition or ferroptotic pathway of specific immune cells.

**Project 2:** Determining the contribution of particular lipids to immune cell development.

**Hypothesis:** Specific lipids are critical to the development of immune cells.

This project will determine the lipidomes of haematopoietic stem cells and how they change as these cells mature down specific lineages to form mature immune cells. Given we have identified a very unique signature in blood neutrophils (i.e. an enrichment in ether lipids), this project will first explore what happens when we delete an enzyme called glyceronephosphate O-acyltransferase (GNPAT – rate limiting enzyme for the production of ether lipids) specifically in stem cells and explore the neutrophil maturation pathway in the bone marrow and blood. We will also explore some functional properties of neutrophils such as inflammatory signalling in response to bacterial stimuli and phagocytosis. These experiments will be conducted in mice using flow cytometry to quantify cell population and examine the functional readouts.

**Primary Supervisor:** Prof Andrew Murphy

**Primary Supervisor Contact:** andrew.murphy@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Do short chain fatty acids prevent gut leakiness and enhanced haematopoiesis induced by a high salt diet?**

**Project Description:**

Our laboratory has discovered that a high salt diet promotes a breakdown of the intestinal barrier in the gut which causes activation of the immune system and changes within the bone marrow microenvironment, altering blood production. This project will explore the hypothesis that supplementation of butyrate, an anti-inflammatory short chain fatty acid, will prevent high salt diet-induced gut leakiness, immune cells activation and protect the bone marrow microenvironment from being destructed. This will allow for the retention of haematopoietic...
stem cells and normal blood production. This project will employ a variety of assays and experimental readouts to address this hypothesis and give the student a valuable insight into immune and stem cell biology within a highly successful world class research laboratory.

**Primary Supervisor:** Prof Andrew Murphy

**Primary Supervisor Contact:** andrew.murphy@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Exploration of lipids in immune cell function and development**

**Project Description:**

Lipids (also known as fats) have numerous roles in the functioning of our cells. For example, they make up the membranes that surround cells and create sub-cellular organelles, they provide energy and are involved in cell signalling. A major focus of our laboratory is in exploring how lipids affect immune cell function. Previous work in our lab has found that the lipid composition of different types of immune cells is distinct and that these differences result in cell-specific functionality. There are numerous on-going projects in our lab in relation to this work that focus on either fundamental cell biology or more translational applications. Current areas of research include exploring how the lipid composition of immune cells changes during activation and development, immune cell susceptibility to ferroptosis (a lipid-dependent form of cell death) and CAR T cells, a cancer therapy that uses patient derived T cells. The student will learn in a highly supportive environment and will be involved in a project with exciting outcomes.

**Primary Supervisor:** Prof Andrew Murphy

**Primary Supervisor Contact:** andrew.murphy@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Is ferroptosis involved in atherosclerotic plaque development**

**Project Description:**

Atherosclerosis, a leading cause of global mortality, arises from metabolic and inflammatory dysfunction. PUFA-lipid peroxidation, triggered by factors like oxidative stress, inflammation, and lipid metabolism abnormalities, is closely associated with ferroptosis in atherosclerosis.
Excessive PUFA-lipid peroxidation leads to ferroptotic cell death in arterial walls, promoting unstable plaque formation and disease progression. Additionally, ferroptosis stimulates inflammatory responses, exacerbating the arterial inflammatory environment. Targeting ferroptosis-related pathways and iron metabolism offers a potential therapeutic approach for mitigating atherosclerosis.

In this study, we seek to understand the link between PUFA abundance and ferroptosis susceptibility in atherosclerosis. We have generated three mouse models: Acsl4-/- (reduced PUFA synthesis), Ldlr-/- (encouraging atherosclerosis due to elevated cholesterol levels through a Western-type diet (WTD)), and Ldlr-/+ (causing atherosclerosis in diabetes through WTD feeding). Previously, we found that Acsl4-/- mice exhibited lower sensitivity to ferroptosis due to decreased PUFA-lipid levels. Bone marrow transplant will be performed to selectively delete Acsl4 in blood cells, key players of atherosclerotic development and progression. This will help us determine the impact of PUFA deficiency in blood cells on atherosclerosis. Additionally, we will use injection mouse models to pharmacologically induce or inhibit ferroptosis in atherosclerosis, assessing ferroptosis on various other cell types. Together, the experimental section will comprise of 5 aims. Within these aims we will initially explore PUFA levels and ferroptosis sensitivity in atherosclerosis. We will then be comparing whether modulating ferroptosis sensitivity genetically (modulating PUFA levels) and/or pharmacologically will affect atherosclerotic progression.

**Primary Supervisor:** Prof Andrew Murphy  
**Primary Supervisor Contact:** andrew.murphy@baker.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**mRNA therapy for cardiovascular diseases**

**Project Description:**

mRNA therapy has attracted major interest after the success of COVID-19 vaccination; we are designing and testing new mRNA therapeutics to be delivered via lipid nanoparticles for the transfection of endothelial cells and thus the treatment of cardiovascular diseases.

**Primary Supervisor:** A/Prof Xiaowei Wang  
**Primary Supervisor Contact:** xiaoweiw@unimelb.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health
Using molecular MRI to diagnose and treat thrombotic and inflammatory diseases

Project Description:

The use of small recombinant antibodies for diagnostic molecular imaging and targeted drug delivery is well-established in our lab. Magnetic resonance imaging (MRI) offers significant advantages: It is already a well-established clinical imaging technique and the equipment required is already available in most hospitals. It avoids the radiation associated with CT and PET imaging, and is thus an ideal technology for longitudinal studies and multiple follow-ups. MRI can provide whole-body imaging at a very high spatial resolution and has the capacity for accurate tissue characterisation, which is useful for accurate thrombus/inflammation imaging. This project would focus on small recombinant antibodies that bind to the activated platelets on thrombi and/or vascular cell adhesion molecule-1, which is one of the endothelial surface molecules most strongly and specifically up-regulated in inflammation. We propose to conjugate these antibodies to MRI contrast agents for molecular imaging. By adding drugs to the contrast agents, we will also be able to provide site-specific therapy. Therefore, we would use these recombinant antibodies for diagnosis imaging and targeted delivery of pharmacological treatment.

Primary Supervisor: A/Prof Xiaowei Wang

Primary Supervisor Contact: xiaoweiw@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Nanoparticles for molecular imaging and/or targeted delivery of drug and gene therapeutics

Project Description:

In our lab, we’re working on creating tiny particles that are safe for the body and can be used to image the diseased areas and carry medications. To achieve this, we are creating nanoparticles that are safe for the body and can be used to visualise and deliver medications. By incorporating contrast agents into these nanoparticles, we can make them visible on various imaging technologies, such as MRI or ultrasound scans. These particles can be loaded with drugs to increase their effectiveness or used to deliver genetic therapies. By targeting these particles to specific markers of atherosclerosis, we can explore new ways to diagnose and treat the disease simultaneously.

Primary Supervisor: A/Prof Xiaowei Wang

Primary Supervisor Contact: xiaoweiw@unimelb.edu.au

Honours places available: 1
Stimuli-responsive nanoparticles for controlled release of drug and gene therapeutics

Project Description:
Atherosclerosis, a chronic inflammatory condition, underlies most CVDs. Early detection, prevention, and regression of atherosclerosis are crucial in preventing devastating events such as heart attacks. To address this, we are creating nanoparticles that can respond to stimuli and release drugs or gene therapeutics in a controlled manner. These stimuli can be external factors like light or temperature, or internal factors like pH or enzymes present at the disease site. By designing nanoparticles that can sense these triggers, we can ensure that the therapies are released specifically at the affected areas, optimising their effectiveness while minimising off-target effects. In our lab, we are specifically focusing on integrating these stimuli-responsive properties into nanoparticles. We are engineering these particles to respond to factors like inflammation markers or disease-specific environments in order to trigger the release of therapeutic payloads. By incorporating drug or gene therapies into these nanoparticles, we can precisely deliver them to the desired location and ensure their timely release for maximum therapeutic benefit.

Primary Supervisor: A/Prof Xiaowei Wang
Primary Supervisor Contact: xiaoweiw@unimelb.edu.au

Targeted extracellular vesicles for the delivery of drug and gene therapeutics

Project Description:
This project aims to develop innovative extracellular vesicles designed to deliver therapeutic agents specifically to treat atherosclerosis. The targeting capability of these nanocarriers to atherosclerotic sites can be achieved either through the inherent ability of extracellular vesicles derived from activated platelets or endothelial cells to home in on these sites. We can also couple functional handles onto these extracellular vesicles to directly conjugate recombinant antibodies for more specific targeting. These targeted extracellular vesicles will be loaded with therapeutic molecules such as drugs and/or mRNA to stabilise atherosclerotic plaques and effectively reduce inflammation.

Primary Supervisor: A/Prof Xiaowei Wang
International Consortium Study Investigating DNA Methylation and Risk of Diabetic Complications

Project Description:

Vascular complications remain the major cause of mortality and morbidity in diabetes with increasing evidence that prior glycaemic exposure is a major determinant of susceptibility and progression of these disorders. Most individuals with diabetes have good health outcomes. However, many others do not. Despite the availability of effective therapies, diabetes remains the leading cause of cardiovascular disease (CVD), amputation, renal impairment and vision loss in adults. It is not simply poor metabolic or blood pressure control, as even with intensive intervention and dedicated compliance, complications still occur. Furthermore, it is not simply having the wrong genes, as genome wide association studies have demonstrated that the genetic code explains only a fraction of the variability between those individuals with and without complications. The most likely explanation is that there is a complex interaction between the cellular environment and genes. We are interested in exploring epigenetic interactions which we hypothesize are an important determinant for the development and progression of vascular complications in individuals with diabetes. We hypothesise that DNA methylation contributes to the programming for the development and progression of diabetic vascular complications. We have new projects on offer in collaboration with international consortiums to investigate methylation protection and disease risk. The generalisability of DNA methylation change will be assessed from the following diabetes registries. **Denmark** Steno Diabetes Center Copenhagen (SDCC) **Finland** Finnish Diabetic Nephropathy Study (FinnDiane). **Hong Kong** Hong Kong Institute of Diabetes and Obesity (HKIDO). **Thailand** Theptarin Diabetes Clinic (TRH). Expected Outcomes of PhD Projects 1. Contemporary epigenetic training, support and education using national and international diabetes registries. 2. Differentially methylated genes associated with Diabetic Complications (DCN) represent novel and commercially viable biomarkers of susceptibility, progression and peripheral tissue protection. 3. Identify rapid progressors for whom more aggressive current treatment regimens should be implemented. 4. Major opportunities for publication growth and broadening DCN invention, technology and commercial IP. 5. Enhance gender equality and inclusion of ECS while diversifying the future fund base beyond the program.

Primary Supervisor: Prof Sam El-Osta

Primary Supervisor Contact: sam.el-osta@baker.edu.au

Honours places available: 1

Master of BioMed places available: 0
**Set7 methyltransferase as a target to reduce the burden of diabetic complications**

**Project Description:**

Diabetic complications remain the major cause of morbidity and mortality and this is primarily attributed to the damaging effects of hyperglycaemia. The complications often persist and may progress despite improved glucose control, probably as a result of prior episodes of hyperglycaemia. Results from The Diabetes Control Complications Trial (DCCT) and the subsequent Epidemiology of Diabetes Interventions and Complications (EDIC) study have revealed that the deleterious end-organ effects that occurred in both conventional and intensified glycaemic control groups continued to operate more than 10 years after the patients had returned to normoglycemia. This phenomenon has now been confirmed in type 2 diabetes in a follow up report from the United Kingdom Prospective Diabetes Study –UKPDS indicating that glucose is an important factor not only for microvascular, but also, diabetes related macro-vascular disease. These studies suggest that the injurious effects of exposure to high glucose levels persist for years after better treatment, a phenomenon typically referred to as “hyperglycaemic memory”. A molecular explanation for this phenomenon has remained elusive although it has recently been postulated that certain epigenetic pathways whereby glucose has sustained effects on key molecular processes to promote gene activation may explain, at least in part, metabolic memory. Since then, studies by our group have emphasized the role of histone modifications in hyperglycaemic memory and diabetic complications. In particular, in vitro and subsequent in vivo studies have identified that glucose induced activation of a particular histone methyl transferase, Set 7, appears to be critical in modulating gene-activating events implicated in vascular inflammation and renal fibrosis. This is relevant to diabetic complications since these pathological processes play a major role in diabetes associated atherosclerosis and nephropathy. In this project, we plan to further build on our teams findings suggesting that Set7 is a target to develop new reno- and vaso-protective therapies in diabetes. It is planned to firstly further define the role of Set7 in diabetic renal disease and in particular to determine if this enzyme is also playing a key role in profibrotic pathways. Secondly, it remains unknown as to how glucose activates Set7. Putative mediators of end-organ injury in diabetes such as reactive oxygen species (ROS), primarily of mitochondrial origin and intermediates of the advanced glycation pathway such as the -carbonyl, methylglyoxal (MGO) appear to play a role and we the project is designed to investigate this in appropriate preclinical models. Finally, to determine if Set7 is playing a key role in diabetic complications it will be necessary to inhibit this enzyme, initially using a conditional Set7 KO mouse that has been generated for us and subsequently using a new generation of Set7 inhibitors that are currently being characterized in the laboratory for clinical development. Hypothesis and Project Aims

We hypothesize that the Set7 methyltransferase is a target to reduce the burden of diabetic vascular and renal complications. The specific aims of the project include;

1. To further define Set7 as a key modulator of macrovascular and renal injury by identifying key genes that are modulated as a result of glucose induced Set7 mobilisation.
2. To characterize the key stimuli, both metabolic and haemodynamic, in the diabetic milieu which promote Set7 mobilisation.

3. To specifically target Set7, using molecular and pharmacological approaches, using in vivo models of diabetic complications.

**Primary Supervisor:** Prof Sam El-Osta

**Primary Supervisor Contact:** sam.el-osta@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 0

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Pancreas regeneration for diabetes cure**

**Project Description:**

The development of diabetes involves pathogenetic processes that either destroy the β-cells of the pancreas or result in resistance to insulin action. Type 1 diabetes (T1D) is an autoimmune disease that selectively destroys insulin producing β-cells in the pancreas. Even though symptoms usually do not appear before 80% of the β-cell mass has been destroyed, absolute destruction of these cells leads to the dependence on exogenous insulin administration for survival. In patients with Type 2 diabetes (T2D), insulin is either produced in insufficient quantities so the response to insulin is weak or it is produced in normal amounts, but the target organs become insulin resistant. Two solutions aimed at replacing the damaged β-cell mass in diabetic patients exist, such as whole pancreas or islets transplantation. Although efficient, these therapies face the shortage of organ donors together with the associated side-effects of immunosuppressive drugs. Consequently, current research focuses on the replacement of the lost β-cell in diabetic patients using several approaches and cell sources. A potential source of β-cells was previously demonstrated by our team with the discovery of α-cell plasticity and the ability of α-cell to convert into insulin-producing cells by cell reprogramming. More recently, and equally important was the team’s finding that the α- to β cell regeneration observed induces the re-expression of pancreas progenitors in ductal cells and their differentiation into insulin producing cells is a result of the removal of an epigenetic barrier, published recently in Regenerative Medicine (https://www.nature.com/articles/s41536-021-00119-1). This project aims to establish new protocols and identify chemical compounds that trigger pancreas regeneration for curing diabetes.

**Primary Supervisor:** Prof Sam El-Osta

**Primary Supervisor Contact:** sam.el-osta@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 0

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health
Identification of additional markers of ferroptosis using mass spectrometry

Project Description:

Ferroptosis is a specific form of cell death mediated by the accumulation of oxidised lipids. Several studies have highlighted this important process in relation to multiple diseases including cancer and neurodegeneration. While the biological mechanisms of lipid oxidation have been demonstrated to be a key factor, measurement of these lipid species is complicated in an in vivo setting. This project aims to identify and develop new ways of measuring molecules related to ferroptosis, using a combination of controlled cell culture experiments and mass spectrometry assays. The assays developed will then be used to interrogate the role of ether lipids (with antioxidant properties) in ferroptosis and their potential to mediate and regulate the process in various biological settings.

Primary Supervisor: Prof Peter Meikle

Primary Supervisor Contact: peter.meikle@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Validation of 4D Flow with Exercise using CMR

Project Description:

Cardiac magnetic resonance imaging (CMR) is a powerful tool for assessing heart function. Advanced CMR techniques include functional assessment during exercise, and three dimensional flow assessment over the cardiac cycle. We aim to assess the validity of 4D flow during exercise, at low, medium and high intensity in a group of trained athletes.

Primary Supervisor: Dr Ben Costello

Primary Supervisor Contact: ben.costello@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Targeting Pyroptosis to improve diabetic cardiovascular disease.
Project Description:

Cardiovascular complications associated with Type 2 diabetes (T2D) lead to significant morbidity and mortality, for which standard treatment options are insufficient to halt or reduce this clinical burden. Recent clinical evidence from the successful CANTOS trial suggests that targeting the cytokine IL-1b lessens inflammation and reduces the burden of cardiovascular disease. IL-1b is matured on the NLRP3-inflammasome along with IL-18 and GasderminD, the pyroptosis (a specific form of cell death) regulating protein. Pyroptosis and release of detrimental cytokines is hypothesized to propagate cardiovascular disease. This proposal will investigate the role of pyroptosis in mediating diabetes-driven cardiomyopathy.

Primary Supervisor: Prof Judy de Haan

Primary Supervisor Contact: judy.dehaan@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Developing unique gene therapy tools to treat the failing heart

Project Description:

This project will take advantage of new technologies that have enabled the rapid development of new therapeutic techniques to treat chronic conditions using gene therapy. This includes technologies such as mRNA therapeutics, lipid nanoparticles and CRISPR. This project will focus on the use of these technologies to treat myocardial infarction and heart failure.

Primary Supervisor: A/Prof Brian Drew

Primary Supervisor Contact: brian.drew@baker.edu.au

Honours places available: 2

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

A novel approach in improving lipidomics throughput for population profiling

Project Description:

Lipids are key biological molecules essential to life. Lipidomics is the characterisation and study of the complete lipidome of a biological system (fluid, cell, tissue, organism). In humans, plasma is an easy to obtain bio-fluid where lipids have been demonstrated to be perturbed in various disease settings. Diseases can affect everyone differently, in order better understand the relationship between lipids and disease, larger population studies are needed. Clinically
related studies in the field have been limited, owing to the limitations in the rate where plasma samples can be profiled in a comprehensive manner. This study aims to generate a novel approach in comprehensive lipidomic profiling using high resolution mass spectrometry approaches in conjunction with computational biology. Students should be technology/computation oriented.

Primary Supervisor: Prof Peter Meikle

Primary Supervisor Contact: peter.meikle@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Development and validation of a high throughput clinical lipidomics platform

Project Description:

The Metabolomics Group at the Baker Institute studies the role of lipid metabolism dysregulation in the development and progression of diseases such as type 2 diabetes, cardiovascular disease and Alzheimer’s disease. To enable this work, we have developed world-class technology which allows us to measure hundreds of different lipids within biological samples through the use of HPLC and tandem mass spectrometry. We are now in the process of translating these research-based protocols for use in a clinical setting, forming the Clinical Lipidomics Platform. The Clinical Lipidomics Platform will comprise two recently developed research capabilities working in concert and translated to a clinical setting. Firstly, from a single blood spot or plasma sample, currently available liquid chromatography-mass spectrometry (LC-MS) technology will be employed to measure the concentration of several hundred clinically relevant lipid biomarkers in the patient’s blood; those found to be closely associated with disease outcomes. Secondly, using the resultant data, artificial intelligence (AI) based statistical modelling will be employed to determine the patient’s overall metabolic health, presented as a series of easily interpreted Metabolic Risk Scores, and subsequently used by clinicians and patients to predict future disease (Figure 1). Translating our current research protocols for the clinical platform will require the development of several different components, including a sample collection pipeline, robotic automation of sample processing, LC-MS/MS method development, automation of data collection and analysis, artificial intelligence and statistical modelling as well as a clinical interface to communicate results effectively with clinicians. Once established we will validate the platform using population and clinical cohorts as well as real-time testing of patients attending cardiac clinics. This project is suitable for a PhD or Masters student, who will work within the Metabolomics Group to help adapt our mass-spectrometry technology for a clinical setting.

Primary Supervisor: Prof Peter Meikle

Primary Supervisor Contact: peter.meikle@baker.edu.au

Honours places available: 1
Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Integration of population level 'omics' data to target cardiometabolic disease

Project Description:
Cardiometabolic diseases represent the number one cause of death in the world, encompassing cardiovascular disease (CVD), type 2 diabetes (T2D), non-alcoholic fatty liver disease (NAFLD), chronic kidney disease, and others. Dysregulation of lipid metabolism is intimately linked to the aetiology, progression, and sequelae of this collection of diseases. The Metabolomics Laboratory, at Baker Heart and Diabetes Institute, has developed a state-of-the-art lipid profiling methodology. Capable of measuring over 800 lipid species from less than a drop of blood, our lipid profiling has been used to improve the detection of people at risk of a large spectrum of conditions, including CVD, T2D, cancer, and Alzheimer’s disease. To further drive innovation in the field, we are integrating lipidomic and genomic data. Using novel statistical techniques, we aim to identify and evaluate the causal role of lipid metabolic pathways in cardiometabolic disease. With over 50,000 clinically relevant human samples already profiled, an exciting opportunity exists to identify new targets to prevent cardiometabolic diseases. This project is suitable for an Honours or PhD student and will focus on bioinformatic/statistical modelling with human clinical/population cohorts to investigate the relationship between lipid metabolism and cardiometabolic diseases.

Primary Supervisor: Prof Peter Meikle

Primary Supervisor Contact: peter.meikle@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Plasmalogen modulation as a therapeutic approach for fatty liver disease

Project Description:
Plasmalogens are glycerophospholipids that are present in numerous mammalian tissues and can act as a natural antioxidant (1). Lipidomic profiling of multiple populations and clinical cohorts has identified decreased levels of plasmalogens to be associated with aging and obesity (2) as well as prediabetes and type 2 diabetes (3). Modulation of plasmalogens can be achieved by oral administration of their metabolic precursors, naturally occurring compounds known as alkylglycerols or by suppressing the activity of plasmalogen catabolising enzyme, TMEM86B. Plasmalogen modulation has reported to suppress diseases related to oxidative stress such as atherosclerosis (4). However, the capacity of plasmalogen modulation to...

Primary Supervisor: Prof Peter Meikle

Primary Supervisor Contact: peter.meikle@baker.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Exploring how a high salt diet promotes bone destruction through immune cell activation

Project Description:

Diets rich in salt have been linked to bone pathologies. This has generally been attributed to mineral exchange, causing weaker bones. However, our group hypothesized that this process is biologically driven. We have made initial discoveries to show that specific immune cells are produced and activated by a high salt diet that is linked with bone destruction. This project will focus on the novel mechanisms contributing to this discovery. Specifically, this project will determine how the immune cells interact and activate osteoclasts within the bone and will explore where these immune cells are first activated. We anticipate these findings being important across several age groups and will explore ways to offset these detrimental effects of high salt intake. The student will be exposed to a world class research environment and cutting-edge techniques, with excellent supervision. Techniques will include flow cytometry, sectioning of tissues (including bones), immunofluorescence, micro CT and multiphoton microscopy.
Exploring how diabetes causes increased proliferation of haematopoietic stem cells carrying a mutation in DNMT3A

Project Description:
Clonal haematopoiesis of indeterminant potential (CHIP), caused by somatic mutations in haematopoietic stem cells (HSCs) causes a growth advantage in these cells causing them to outcompete non-mutated HSCs. CHIP was commonly thought to be a prerequisite to leukaemia, the disease ultimately responsible for death in these individuals. However, it was recently shown that people with CHIP more frequently die of cardiovascular disease. Interestingly, there is an association with CHIP and diabetes, but this has not been explored experimentally. We discovered that diabetes enhances the proliferation of HSCs carrying the most common mutation in CHIP (DNMT3A). This project will explore mechanism behind this using a variety of unique animal models and experimental techniques. This project will give the student a valuable insight into stem cell biology within a highly successful world class research laboratory.

Primary Supervisor: Prof Andrew Murphy
Primary Supervisor Contact: andrew.murphy@baker.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

Do short chain fatty acids prevent gut leakiness and enhanced haematopoiesis induced by a high salt diet?

Project Description:
Our laboratory has discovered that a high salt diet promotes a breakdown of the intestinal barrier in the gut which causes activation of the immune system and changes within the bone marrow microenvironment, altering blood production. This project will explore the hypothesis that supplementation of butyrate, an anti-inflammatory short chain fatty acid, will prevent high salt diet-induced gut leakiness, immune cells activation and protect the bone marrow microenvironment from being destructed. This will allow for the retention of haematopoietic
stem cells and normal blood production. This project will employ a variety of assays and experimental readouts to address this hypothesis and give the student a valuable insight into immune and stem cell biology within a highly successful world class research laboratory.

**Primary Supervisor:** Prof Andrew Murphy

**Primary Supervisor Contact:** andrew.murphy@baker.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Diagnosis and therapy of inflammatory diseases using molecular ultrasound imaging**

**Project Description:**

With steadily increasing health care expenses, a promising translational imaging application using ultrasound can fulfil the need for a cost-effective and non-invasive diagnostic tool. This project aims to investigate whether VCAM-1 targeted microbubbles will locate inflamed vessels using molecular ultrasound imaging, thereby providing a better diagnostic technology.

**Primary Supervisor:** A/Prof Xiaowei Wang

**Primary Supervisor Contact:** xiaoweiw@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Baker Heart and Diabetes Institute, Department of Cardiometabolic Health

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**Biomedical Engineering and Florey Institute**

**Decoding visual input in semantic space**

**Project Description:**

Brain computer Interfaces offer hope of rehabilitation for people with paralysis. However, one major drawback of the state of the art BCIs are that they are slow. Recent work has shown the feasibility semantic space decoding to visual stimuli. Using deep learning such as the natural language processing model, we can create a decoder that can generalize natural scenes within novel visual stimuli. Using data obtained from electrocorticography and the stentrode in an pre-clinical model we can develop a practical brain-machine interface with the ability to decode thought directly. In this project we aim to decode vector representations of scenes within the semantic space to assess data from a stentrode can be used to decode semantic representations of visual space.
**Primary Supervisor:** Dr Sam John  
**Primary Supervisor Contact:** sam.john@unimelb.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 0  
**Department:** Biomedical Engineering and Howard Florey Building

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**Burnet Institute**

**Discovering the mechanisms and targets of immunity against malaria**

**Project Description:**
Conduct immunologic assays to understand the mechanisms of protective immunity to malaria and identify key targets. This knowledge will be used to inform vaccine development.

**Primary Supervisor:** Prof James Beeson  
**Primary Supervisor Contact:** james.beeson@burnet.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Burnet Institute

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**Development of novel vaccines against malaria**

**Project Description:**
This project is suitable for a student with a keen interest in humoral and cellular immunology and vaccine development.

**Primary Supervisor:** Prof James Beeson  
**Primary Supervisor Contact:** james.beeson@burnet.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 0  
**Department:** Burnet Institute
Discovering the targets of drugs that stop malaria parasites invading red blood cells

**Project Description:**

This project will involve discovering the mechanism of action of several compounds that inhibit the invasion of human red blood cells by malaria parasites. The protein targets of the inhibitory compounds will be discovered in parasites along with the role the target proteins play during the invasion process.

**Primary Supervisor:** Dr Paul Gilson

**Primary Supervisor Contact:** paul.gilson@burnet.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Burnet Institute

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Infectious diseases epidemiology, modelling and public health research: Ending AIDS, eliminating hepatitis B and hepatitis C, and controlling COVID-19 as public health threats in Australia and globally.

**Project Description:**

The Burnet Institute is a global leader in research contributing to efforts to end AIDS and eliminate hepatitis B and hepatitis C as public health threats by 2030. With a particular focus on key populations and health equity, the Burnet Institute is undertaking a series of projects that aim to reduce the transmission or improve the management of blood borne viruses in populations including gay and bisexual men, people who inject drugs, migrants and refugees, female sex workers and young people. In response to the COVID-19 pandemic, the Burnet is undertaking work to reduce the ongoing impact of COVID-19 on the community including long-COVID. Opportunities are available for people to undertake honours projects in population health and international development related to blood borne viruses and COVID-19. Fields of study include health promotion, epidemiology, quantitative and qualitative research methods, implementation science, mathematical modelling, social network modelling and phylogenetics. There are a number of specific projects available 1) examining the behaviours that put people at risk of a blood borne virus infection, 2) measuring the impact of community based point of care testing in HIV, hepatitis B and hepatitis C and 3) examining how to increase HIV, hepatitis B and hepatitis C treatment uptake in community settings, 4) measuring the impact “treatment as prevention” for HIV and HCV on reducing disease incidence, 5) examining community understanding and attitudes to COVID-19. Opportunities exist for research using quantitative and qualitative methods, or a mixed methods approach as well as mathematical and social network models, human centred design and health promotion. The includes both de-novo projects or working on a project that sits alongside an existing Burnet project to answer a research question of particular interest to the applicant.

**Primary Supervisor:** Prof Margaret Hellard

**Primary Supervisor Contact:** margaret.hellard@burnet.edu.au
Sex, drugs and rock’n’roll: Young people and risk behaviours

Project Description:
Every year, we conduct an online survey with young people, asking about social media use, sexual health and behaviour, alcohol and other drug use, mental health and other risks and behaviours. In this project the student will use the data collected to investigate patterns of risk behaviours and health outcomes in young people.

Primary Supervisor: Dr Megan Lim

Primary Supervisor Contact: megan.lim@burnet.edu.au

Honours places available: 1
Master of BioMed places available: 1

Department: Burnet Institute

Deveoping mRNA vaccines for malaria

Project Description:

Primary Supervisor: Prof James Beeson

Primary Supervisor Contact: james.beeson@burnet.edu.au

Honours places available: 1
Master of BioMed places available: 1

Department: Burnet Institute

Florey Institute of Neuroscience and Mental Health

Biophysics of leaky HCN ion channels

Project Description:
The hyperpolarisation-activated, cyclic nucleotide-gated (HCN) channel, opens and conducts positively charged ions when the transmembrane voltage is negative on the inside. Several
variants in the HCN1 subtype channel have been reported in patients with severe epilepsy. Functional analyses of these variants revealed a converging functional impact of ‘leaky’ channels, which remain open and conduct ions at membrane voltages in which the channels are meant to be closed. Our goal is to elucidate HCN1 channel function at the molecular scale using naturally occurring variants as novel functional tools. Successful applicants will have the opportunity to learn and operate two-electrode voltage clamp, voltage clamp fluorometry (which measures channel movement in real-time), electrophysiological analysis, Xenopus oocyte handling/injections, molecular biology, and be involved in manuscript preparation.

**Primary Supervisor:** Prof Christopher Reid

**Primary Supervisor Contact:** christopher.reid@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health

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**Modelling severe childhood epilepsy using stem cell derived models**

**Project Description:**

Epilepsy is a common neurological disorder with a third of patients not responding to currently available treatments. To better understand the underlying mechanisms, our lab is developing and analysing disease models for genetic forms of epilepsy derived from patient induced pluripotent stem cells.

**Primary Supervisor:** A/Prof Snezana Maljevic

**Primary Supervisor Contact:** snezana.maljevic@florey.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health

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**Deep-learning based tracking of behaviour in preclinical models for mental illness**

**Project Description:**

Identifying the disrupted neural mechanisms that underlie complex mental illnesses like schizophrenia and mood disorders remains a challenge for the development of novel effective treatments. The ability to to measure and control behaviour in preclinical models, using automated behavioural systems while recording real-time neural activity provides advanced experimental approaches to tackle this challenge. Combining these approaches with novel tools for pose estimation with deep learning now allows training of deep neural networks to
Can we achieve precise medication use in people living with Alzheimer’s disease?

Project Description:

Alzheimer’s disease (AD) is the most common form of dementia, affecting 1 in 9 people >65 years. AD is featured by progressive neuron loss in the brain and decline in cognitive function. However, recent evidence suggests that AD may also affect peripheral organs. In line with this, we have for the first time demonstrated that the expression and function of drug transporters and metabolising enzymes in the peripheral organs are altered in AD mouse models, leading to altered drug disposition. Some of these changes have been validated in AD human tissues, however, if drug disposition is affected in people with AD is yet to be determined.

Polypharmacy, or the use of multiple medications, is prevalent in older populations and people with AD are prescribed 5-10 more medications than their peers. This heightened polypharmacy places people with AD at a greater risk of adverse drug reactions (ADRs), particularly if the disease alters the drug disposition. For nearly all medications, medical practice is based on single disease guidelines derived from clinical trials that do not include people with AD. If drug disposition is altered in AD, a standard dose may produce unexpected therapeutic outcomes (e.g. increased risk of ADRs) in people with AD. People with cognitive impairment are also less likely to report ADRs, which presents an additional challenge in caring for people with AD and is likely to lead to suboptimal healthcare outcomes.

In this project, we will use high-throughput proteomics to profile drug transporter and drug metabolising enzyme expression in AD and non-AD human tissues, leading to the development of a physiologically based pharmacokinetic models for dose adjustment in people with AD. These models will be validated using plasma samples collected via Australian Imaging, Biomarker & Lifestyle (AIBL) study of aging. The ultimate goal of this research program is to achieve precise medication use in people with AD.

Primary Supervisor: Dr Nicholas Pan

Primary Supervisor Contact: yijun.pan@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1
Can we identify novel biomarkers for early detection of Alzheimer’s disease (AD) by targeting the brain-draining lymph nodes?

**Project Description:**

Alzheimer’s disease (AD) affects >55 million people globally, placing a heavy socioeconomic burden on all countries. The majority of clinical trials for the treatment of AD have reported minimal benefits. One of the major reasons was that the recruited patients were at late disease stage with irreversible damage to the brain. They have also shown that better therapeutic outcomes can be achieved in earlier AD stage.

Scientists have identified antibodies uniquely present in people diagnosed with AD; however, these antibodies were discovered at the late stage of AD, and are less useful for early detection. We believe that specific antibodies are produced during preclinical AD, and the identification and detection of these antibodies could help determine if a person will develop AD and allow for early treatment to stop disease progression.

Recently lymphatic vessels were discovered that drain fluid, waste products and immune cells from the brain to lymph nodes in the neck. Within the lymph node the activation of specialized immune cells leads to the production of a variety of antibodies. In this project, we will screen for antibodies that are uniquely produced in the lymph nodes of pre-symptomatic AD mice (vs. non-AD mice). As these antibodies will eventually distribute into the blood, sensitive assays will subsequently be developed to detect the antibodies in the blood. The project will demonstrate the feasibility of detecting preclinical AD before the onset of symptoms using a blood test that can be trialed and validated in humans in the future. Once this approach is approved for clinical use, clinicians will be able to determine if a person is at risk of developing AD based on blood test results. If one is at risk, early intervention can be initiated to prevent or even cure AD, and a better therapeutic outcome and quality of life is expected.

**Primary Supervisor:** Dr Nicholas Pan

**Primary Supervisor Contact:** yijun.pan@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health
There is a considerable body of literature on associations between type 2 diabetes (T2D) and Alzheimer’s disease (AD). It has been calculated in a meta-analysis that individuals with T2D were 39% more likely to develop AD than non-diabetics. Pathophysiologically this relationship between T2D and AD has not been completely elucidated. Insulin resistance in T2D has been shown to exacerbate directly amyloid and tau pathologies, and their shared pathophysiological traits of synaptic dysfunction, inflammation, and autophagic impairments. In this study, we aim to determine if a genetic link exist between AD and T2D to improve our understanding of the shared pathways. The students will have access to the genetics data collected via The Australian Imaging, Biomarker & Lifestyle Flagship Study of Ageing (AIBL), and will be provided training on genetic analysis.

**Primary Supervisor:** Dr Nicholas Pan

**Primary Supervisor Contact:** yijun.pan@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health

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**Exploring the role of fatty acid-binding proteins in microglia immunometabolism**

**Project Description:**

Microglia are the resident immune cells in the central nervous system (CNS). They interact with the CNS microenvironment through different molecules such as chemokines, cytokines, and trophic factors which, in turn, modulate microglia activities converting the homeostatic microglia into activated microglia (broadly defined as proinflammatory and anti-inflammatory) and vice versa. By transforming between a spectrum of phenotypes, microglia can clear cell debris through phagocytosis, stimulate repair and regeneration of neurons, and maintain the homeostasis in the CNS. The microglia immune phenotype transformation is supported by cellular metabolism reprogramming. Given the tight relationship between immune function and metabolism in microglia, they are often collectively referred to as immunometabolism. Fatty acid-binding proteins (FABPs) are a family of intracellular proteins involved in cell metabolism. We have confirmed the presence of FABP3, 4, and 5 isoforms in microglia, however, their roles in the microglia are not clearly defined. In this project, we will use CRISPR-Cas9 genome editing, in vivo cross linking, proteomics, single-cell RNA sequencing, automated high throughput metabolism profiling, magnetic activated cell sorting, transgenic mouse models and human microglia to explore the roles of FABPs in microglia immunometabolism, and potential involvement in neurodegenerative diseases.

**Primary Supervisor:** Dr Nicholas Pan

**Primary Supervisor Contact:** yijun.pan@unimelb.edu.au

**Honours places available:** 1

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**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health

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**Using novel animal models to investigate mechanisms underlying epilepsy**

**Project Description:**

Epilepsy is characterised by recurrent seizures and sometimes neurodevelopmental delays and premature death. Epilepsy can be caused by genetic factors (ion channels, transcription factors), brain trauma or infection. The project will utilise animal models to determine the cellular and molecular basis of genetic epilepsy using a range of techniques from animal behaviour to in vivo (EEG) and ex vivo surgery and electrophysiology (patch-clamping) techniques, which the student will have the opportunity to learn. Based on knowledge of the disease process, new therapeutic strategies will also be tested on these mouse models.

**Primary Supervisor:** Prof Christopher Reid

**Primary Supervisor Contact:** christopher.reid@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health

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**Investigating cardiac mechanisms underlying sudden death in epilepsy**

**Project Description:**

This is an exciting pilot study that will record brain and heart electrophysiology using an optimised video-electrocorticography-electrocardiogram (vECoG-ECG) in a mouse model of epilepsy to study the additive impact of drug-induced QT prolongation and seizure on sudden death risk. The mouse model also provides an opportunity to test cardio-protective strategies on sudden death risk. Successful applicants will have the opportunity to join a friendly team and perform ECoG-ECG surgery/recording/analysis, mouse handling/injections, behavioural studies and be involved in manuscript preparation.

**Primary Supervisor:** Dr Ming Soh

**Primary Supervisor Contact:** mingshiuan.soh@florey.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Florey Institute of Neuroscience and Mental Health
Environmental risks for early brain development

Project Description:
We study neurogenesis using stem cell derived models to understand changes that happen in the presence of disease causing variants or environmental challenges. The approach involving stem cell handling, neural differentiations and imaging techniques, provides insights into the processes involved in neural tube formation that can be impacted in neurodevelopmental disorders.

Primary Supervisor: A/Prof Snezana Maljevic
Primary Supervisor Contact: snezana.maljevic@florey.edu.au
Honours places available: 1
Master of BioMed places available: 0
Department: Florey Institute of Neuroscience and Mental Health

Elucidating molecular signalling pathways controlled by anti-inflammatory steroids

Project Description:
Steroids (glucocorticoids) are widely used to treat the chronic inflammation and pain associated with many diseases such as rheumatoid arthritis and osteoarthritis. Unfortunately, there are side effects associated with usage of glucocorticoids in such diseases. Our previous genomic experiments have provided a number of exciting candidate genes that may be involved in inflammatory functions. In this project you will investigate molecular signalling pathways that lead to activation of transcription factors that lead to differential expression of glucocorticoid-controlled genes in inflammatory conditions. Enhancing our understanding of molecular signalling pathways that are governed by glucocorticoids may lead to improved clinical therapies with minimal side effects.

Primary Supervisor: A/Prof Adrian Achuthan
Primary Supervisor Contact: aaa@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital
Molecular signalling pathways controlling gene expression during chronic disease progression

Project Description:

Inflammation is now known to be associated with many chronic diseases such as arthritis, cancer, Alzheimer’s disease, obesity, diabetes and heart diseases. This project aims to understand molecular signalling pathways controlling the expression of genes critical for the progression of such diseases. In this project you will explore in molecular terms how a particular inflammatory cell type (macrophage/dendritic cell) can adapt to provide a pro-inflammatory environment with consequences for persistence or otherwise of these significant diseases. More specifically you will investigate how transcription factors control the expression of pro-inflammatory and anti-inflammatory cytokines. Elucidation of these molecular pathways will lead to the development of novel therapies.

Primary Supervisor: A/Prof Adrian Achuthan

Primary Supervisor Contact: aaa@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

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Roles of mammary adipose macrophages in breast cancer

Project Description:

Mammary adipose forms the large fraction of breast tumour microenvironment (TME). Macrophages, in particular tumour associated macrophages, are known to promote immune suppression to promote cancer growth. In the last decade, immune checkpoint inhibitors have revolutionised cancer therapy. However, this approach has had only limited success in breast cancers. While immune checkpoint inhibitors boost anti-tumour immune cells, immune suppression in TME could dampen this process. In this project, you will explore the role of mammary adipose macrophages and their response to immune checkpoint inhibitors.

Primary Supervisor: A/Prof Adrian Achuthan

Primary Supervisor Contact: aaa@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

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The role of Critical Signalling Pathways in Glioblastoma Mediated Immunosuppression
Project Description:

The most severe form of brain cancer, Glioblastoma Multiforme is extremely lethal, with the average survival time of less than 12 months after diagnosis. Glioblastoma cells are generally highly proliferative, invasive. Recent evidence suggests that their micro-environment contains factors that suppress anti-tumour immune responses. However, the role of glioblastoma cell signalling in promoting an immunosuppressive environment is not well known. This project will evaluate the role of critical glioblastoma-promoting signalling pathways in promoting immunosuppression. Specifically, we will identify key immunosuppressive factors/cytokines secreted by glioblastoma cells and evaluate their role in blocking immune cell function (activation and killing activity).

Primary Supervisor: A/Prof Adrian Achuthan

Primary Supervisor Contact: aaa@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

Brainwave and Electrophysiological Biomarkers of Cognition Enhancing Drugs

Project Description:

Several drugs are able to improve cognitive performance quite considerably in animal models, and to some extent in humans. They are known as "nootropics". This project aims to study how brain wave patterns in mice change with these drugs, both to understand how they work, as well as to find biomarkers to identify such agents. It will involve training mice to perform simple memory and other cognitive tasks, and to record their brain signals before and after drug administration. We will initially use simple double "depth" electrodes, but will progress to multielectrode arrays and miniscopes later in the project. This is a fantastic opportunity to get into modern cognitive neuroscience and discover some really neat things! Suitable for Honours, Masters and PhD.

Primary Supervisor: Dr Chris French

Primary Supervisor Contact: frenchc@unimelb.edu.au

Honours places available: 2

Master of BioMed places available: 0

Department: Dept of Medicine - Royal Melbourne Hospital

Can we Fix Dementia with Deep Brain Stimulation?
Project Description:
"Lewy Body Dementia" is the second most common form of dementia after Alzheimer's disease, but we don't understand how it damages patients' ability to think and function. We suspect that part of the problem is that the brain goes "out of sync" like a misfiring engine, that is, has problems of signal timing. In an animal model, we want to see if we can detect signs of damaged brain signal synchronization, and see if we can improve or fix this either with drugs or a kind of "brain pacemaker". If we can show these treatments work in the animal model, it could lead to major improvements in therapies for these patients. Deep brain stimulation is incredibly effective for some neurodegenerative conditions such as Parkinson's disease. Despite the success of this technique, little is actually known about how it works. The first half of this project involves implanting stimulation electrodes into the brains of mice, and looking for the changes in neuron firing as well as brain rhythms that result from stimulating particular areas of the brain. The second part is to see if the performance of animals with impaired cognition can be improved with brain stimulation. Check out https://ndl-lab.org/home.

Primary Supervisor: Dr Chris French
Primary Supervisor Contact: frenchc@unimelb.edu.au
Honours places available: 2
Master of BioMed places available: 0
Department: Dept of Medicine - Royal Melbourne Hospital

Effects of Drugs on Cognition-Related Brain Wave Signals in the Rat

Project Description:
In this project, signals related to cognitive processing, including gamma frequency oscillations and place cells will be recorded with microelectrode arrays. The effects of antipsychotic drugs and some related compounds, including potassium and sodium channel modulators, will be examined.

Primary Supervisor: Dr Chris French
Primary Supervisor Contact: frenchc@unimelb.edu.au
Honours places available: 2
Master of BioMed places available: 0
Department: Dept of Medicine - Royal Melbourne Hospital

Effects of Drugs on Cognition-Related Brain Wave Signals in the Rodents

Project Description:
It is increasingly recognised that the rhythmic signals recorded with the electroencephalogram (EEG), or “brain waves” are not just the “noise” of neural activity, but are probably frequency specific channels for cognition related signalling, including memory encoding. High frequency (“gamma”) brain wave activity has been associated with cognitive activity in humans and animals, and is disrupted in psychosis and schizophrenia. A largely neglected area of study in this area is the role of voltage-gated ion channels that have a significant role in the generation of neuronal and network rhythmicity. In this project, signals related to cognitive processing, including gamma frequency oscillations and place cells will be recorded with microelectrode arrays. The effects of antipsychotic drugs and some related compounds, including potassium and sodium channel modulators, will be examined. This project has considerable potential to reveal how psychoactive drugs work at the whole brain level, and provide clues for better therapies. Check out https://ndl-lab.org/home.

**Primary Supervisor:** Dr Chris French

**Primary Supervisor Contact:** frenchc@unimelb.edu.au

**Honours places available:** 2

**Master of BioMed places available:** 0

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Electrophysiological Properties of Human Brain Neuronal Tissue**

**Project Description:**

Almost all electrophysiological observations of neural normal function, drug responsiveness and abnormal states such as epilepsy in have been performed on rodent brain tissue. It is becoming clear, however, that human tissue has significant differences from rodent brain. This project presents an almost unique opportunity to study human brain tissue at the single neuron and network level by utilising tissue taken in the course of neurosurgical procedures. Individual neurons are prepared by enzymatic dissociation, and recorded with patch electrodes. Network properties are recorded using intact brain slice. For this project, the main aims are to identify the properties of voltage gated ion channels, in particular sodium and potassium currents. An area of special interest is the HERG channel subtype, which is likely to play an important role in brain function, but almost completely uncharacterised in any neural system. Check out https://ndl-lab.org/home.

**Primary Supervisor:** Dr Chris French

**Primary Supervisor Contact:** frenchc@unimelb.edu.au

**Honours places available:** 2

**Master of BioMed places available:** 0

**Department:** Dept of Medicine - Royal Melbourne Hospital
How to anti-epileptic drugs work?

Project Description:

Despite many years of use and research, it is still not clear how even some of the oldest forms of antiepileptic drugs (AED’s) work. What is known is generally based on the effects of these compounds on single neurons, rather than examining how activity of the whole inter-connected neural network of the mammalian CNS is modulated. This project involves studying the effects of AED’s at several levels of organization of the CNS – single channel (voltage-gated sodium, potassium and calcium channels), single neuron, principal neuron/interneuron dynamics, as well as glial cell effects. Patch clamp techniques are used for recording dissociated neuron and neurons in the intact brain slice, and these observations will be extended with high-speed calcium imaging with conventional microscopy as well as multiphoton techniques. This project affords excellent opportunities for skill development in electrophysiology, pharmacology, advanced microscopy and computational neuroscience as well as conference presentation and publication opportunities. Check out https://ndl-lab.org/home.

Primary Supervisor: Dr Chris French

Primary Supervisor Contact: frenchc@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 0

Department: Dept of Medicine - Royal Melbourne Hospital

Massively Parallel Optical Imaging of Cognition Events in Neuronal Networks in Freely Behaving Mice

Project Description:

We have recently implemented for the first time in Australia the “miniscope” technique (see http://miniscope.org/index.php/Main_Page, and see our setup in https://ndl-lab.org/), in which we put small fluorescent microscopes into mouse brains and observe the activity of hundreds of neurons over many months while the animal is performing cognitive tasks such as memory encoding. We can also see the direct effects of cognition-affecting drugs such as antidepressants and antipsychotics in real time to correlate with neuronal network activity, allowing a whole new level of analysis and comprehension of brain phenomena. This is super neat. This project has several streams – it can be implemented for epilepsy, drug testing, dementia models, MS models etc. We would like to set up an epilepsy related project with miniscopes as an Honours/Masters/PhD project.

Primary Supervisor: Dr Chris French

Primary Supervisor Contact: frenchc@unimelb.edu.au

Honours places available: 1
Sodium Channels in Epilepsy

Project Description:
This project is to study voltage-gated sodium channels, membrane proteins that are the basis of almost all electrical signaling in the nervous system, and so of the greatest significance in normal function, as well as disease states including epilepsy.

Primary Supervisor: Dr Chris French
Primary Supervisor Contact: frenchc@unimelb.edu.au
Honours places available: 2
Master of BioMed places available: 0
Department: Dept of Medicine - Royal Melbourne Hospital

Stentrode: Tissue Response to Endovascular Stimulation

Project Description:
Tissue response influences the effectiveness of the bioelectric implants. The aim of this project is to evaluate the Acute and chronic histological, macroscopic changes due to endovascular electrical stimulation to the surrounding blood vessels.

Primary Supervisor: Dr Sam John
Primary Supervisor Contact: sam.john@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 0
Department: Dept of Medicine - Royal Melbourne Hospital

Linking brain activity to behaviour: neural oscillations and cognition

Project Description:
How do brain waves control cognitive processes? Using a combination of in vivo electrophysiology and sophisticated cognitive paradigms of working memory and attention,
coupled with genetically modified mice, this project will record brain waves (local field potentials) and single unit activity during cognitive performance.

**Primary Supervisor:** A/Prof Nigel Jones

**Primary Supervisor Contact:** nigel.jones@monash.edu

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**The role of microglial cells in epilepsy**

**Project Description:**

Brain inflammation appears to play a critical role in the pathogenesis of epilepsy. A major cell type involved in inflammatory cascades are the microglial cells – brain-resident immune cells that become activated after epileptogenic brain injuries. Despite years of research in this area, a clear role of microglia in epilepsy development has not been established. This is partly due to the dynamic nature in which these cells get activated. The function of these cells can oscillate between different phenotypes that are associated with the release of either pro- or anti-inflammatory mediators. Therefore, depending on the stage after initial epileptogenic brain injury, their activation may promote brain repair processes or conversely accelerate the epilepsy development. This project will utilise animal models to identify the role of microglia at different stages of epilepsy development. This will be achieved by pharmacologically eliminating microglia at different timepoints following induction of epilepsy, and evaluate the relevant epilepsy outcomes by electrophysiological, molecular, immunofluorescence imaging and techniques.

**Primary Supervisor:** A/Prof Nigel Jones

**Primary Supervisor Contact:** nigel.jones@monash.edu

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Using light to control brain activity**

**Project Description:**

This project will use laser light to inhibit and activate a specific class of brain cell in mice, and observe how these impacts working memory.

**Primary Supervisor:** A/Prof Nigel Jones
Inflammatory cytokines involved in obesity and osteoarthritis

Project Description:
Osteoarthritis (OA) is a most common form of arthritis and is associated with many risk factors, for example, obesity. Inflammatory cytokines have been implicated in facilitating OA progression. This project will use animal models of OA to identify a novel potential therapeutic target(s) for treating OA symptoms (i.e. pain).

Primary Supervisor: Dr Kevin Lee
Primary Supervisor Contact: mingchinl@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital

T cell function as a determinant of blinatumomab efficacy in B-ALL

Project Description:
The CD3/CD19 bispecific T cell engager blinatumomab (blin) is effective for the treatment of relapsed or refractory B cell acute lymphoblastic leukaemia (B-ALL). Total CD8 T cell numbers at the time of treatment have been associated with a higher likelihood of response. However, studies have not explored if patient T cell function has an impact on therapeutic efficacy. We hypothesise that response to blin will be dependent on pre-treatment T cell function.

Primary Supervisor: Prof David Ritchie
Primary Supervisor Contact: david.ritchie@mh.org.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital
Understanding how immune cell function is impacted by novel therapies in patients with B cell malignancies

Project Description:
In recent years, new non-chemotherapy based small molecule inhibitors such as Venetoclax and Ibrutinib have been shown to offer improved outcomes in patients with B cell malignancies. Our existing data has demonstrated that these therapies have a significant impact on patient immune function when used long term which will be explored further in this project.

Primary Supervisor: Prof David Ritchie
Primary Supervisor Contact: david.ritchie@mh.org.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital

Systematic Endoscopic Staging of Mediastinum to determine Impact on radiotherapy for locally advanced lung Cancer (SEISMIC): an international multi-centre cohort study

Project Description:
Lung Cancer remains the most common cause of cancer death in Australia & the western world. Non-small cell lung cancer (NSCLC) comprises 87% of all lung cancers, and of these over 25% are diagnosed with locally advanced disease – defined by involvement of mediastinal lymph nodes (LN). The SEISMIC study aims to identify the optimal method for mediastinal LN and planning of radiation therapy fields.

Primary Supervisor: A/Prof Daniel Steinfort
Primary Supervisor Contact: Daniel.Steinfort@mh.org.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital

Development of malaria transmission blocking drugs.

Project Description:
Our laboratory investigates the cellular mechanisms underpinning malaria parasite transmission and disease. We investigate the novel banana shaped sexual stages of Plasmodium falciparum, focused on understanding their unique biology and how this
contributes to transmission. We are interested in developing and testing drugs and vaccines that may block transmission of the parasite from infected humans to Anopheles mosquitoes.

**Primary Supervisor:** Dr Matthew Dixon

**Primary Supervisor Contact:** matthew.dixon@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Malaria: going bananas for sex**

**Project Description:**

The malaria parasite Plasmodium falciparum undergoes a remarkable transformation that allows asexual stage multiplication in a human host and sexual reproduction in a mosquito vector. Gametocyte maturation represents a ‘bottle neck’ in the parasite’s development; inhibition of this process would ablate disease transmission. This transformation sees an amoeboid shaped asexual stage parasite morph into a banana shaped sexual stage parasite, which is essential to disease transmission.

Despite the importance of this stage of the parasite we understand very little about its unique biology. This unique shape is driven by the assembly of a membrane complex termed the inner membrane complex and the elaboration of a dense microtubule cytoskeleton that drives the unique gametocyte shape. In this project we are interested in determining the cellular and molecular players driving this shape change and how this influences survival within the host and mosquito transmission.

**Primary Supervisor:** Dr Matthew Dixon

**Primary Supervisor Contact:** matthew.dixon@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Global coagulation assays and molecular spectroscopy as novel biomarkers for coagulation risk prediction**

**Project Description:**

Blood coagulation remains one the most enigmatic of essential physiological processes and is a major determinant of health and disease. Pathological thrombosis is a major cause of death and morbidity across a wide spectrum of diseases and patients. While a plethora of anti-
thrombotic drugs are now available, a fine balance needs to be achieved between the prevention of thrombosis in individuals and the risk of bleeding complications. Indeed, one also needs to define, accurately, people who are most risk and who may best benefit from such interventions.

Current risk assessment models and blood tests do not accurately predict individual risk of thrombosis. Risk estimation of thrombosis and bleeding, at an individual level is performed only crudely, and implies that a proportion of patients with thrombosis, are either over or undertreated, leading to high lifetime risks of both recurrence and bleeding. It is therefore necessary to individually classify patients, accurately, with respect to thrombotic and bleeding risk, and subsequently determine who will benefit from anticoagulant treatment and who will be unnecessarily exposed to its risks.

We therefore require a model which assesses the various determinants of the coagulation cascade, including the structural basis of the clot formation, the coagulability of blood and the cellular (endothelial, platelet, immune) dysfunctional components, that contribute to this process.

“Global” coagulation assays such as thrombin, fibrin and plasmin generation assays are blood tests with the unique capacity to assess the “whole blood clotting” capacity of an individual while endothelial biomarkers such as tissue factor pathway inhibitor and inflammatory markers can help to identify endothelial dysfunction. We have previously demonstrated that the addition of global coagulation assays and endothelial biomarkers to clinical surrogate markers are superior to clinical markers alone in identifying diabetes complications and subsequent thrombotic events in patients with chronic kidney disease. This paradigm extends to a variety of other diseases as well.

Molecular Spectroscopy (Raman Scattering and Infra-Red Absorption) is a sophisticated method of assessing individual molecular structure, and is particularly useful in the identification of complex molecules in complex biological tissues such as blood. The advantage of Molecular Spectroscopy is that the technique does not need any molecular labelling, and can be performed on clinical samples without destroying them. Raman and Fourier Transform InfraRed Spectroscopy (FTIR) provide a “fingerprint” of the molecular structure, leading to the discovery and identification of complex structural molecules and their conformational variants.

In this project we propose to perform global coagulation assays and endothelial biomarkers on healthy control populations and populations at high risk of coagulation such as those with cardiovascular disease or risk factors, previous venous thromboembolism and malignancies). We will also test the patients plasma using Raman and FTIR spectroscopy to identify and build a library of spectral signatures within each of the high risk patient categories and compare that with healthy controls. A Machine Learning approach shall be used to determine the principal components that determine variance, in each of these categories so as to define the threshold for accurate classification within each class.

In combination, the combination of global coagulation assays and endothelial biomarkers with spectral biomarker signatures will provide a multi-modality approach which may strengthen our ability to predict individualised future thrombotic risks and allow for early intervention with reduction in the burden of disease.
Primary Supervisor: Assoc Prof Prahlad Ho

Primary Supervisor Contact: prahlad.ho@nh.org.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

Matricellular proteins in Kidney Fibrosis

Project Description:

Matricellular proteins are a broad class of regulatory proteins synthesised in response to injury. Their significance is poorly understood in part because we know little about the time course and spatial distribution of their expression. This histochemical laboratory study will elucidate that in kidney disease.

Primary Supervisor: A/Prof. Tim Hewitson

Primary Supervisor Contact: tim.hewitson@mh.org.au

Honours places available: 1

Master of BioMed places available: 0

Department: Dept of Medicine - Royal Melbourne Hospital

Long-term outcomes of coronary artery manipulation in adult congenital heart disease

Project Description:

The population of adults with congenital heart disease is growing and ageing rapidly with increasingly recognised prevalence of acquired heart disease. This project aims to determine the impact of coronary artery manipulation (surgery) on the premature development of coronary artery disease in the adult congenital heart disease population.

Primary Supervisor: Dr Melissa Lee

Primary Supervisor Contact: melissa.lee1@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 0

Department: Dept of Medicine - Royal Melbourne Hospital
Cardiovascular fitness in adult congenital heart disease: can CPET predict poorer outcomes?

Project Description:

There is a growing population of adults living with congenital heart disease. As such, they are subject to an increasing prevalence of acquired cardiac and non-cardiac comorbidities. This project aims to determine whether cardiovascular fitness, as assessed by cardiopulmonary exercise testing (CPET), can be used as a predictor of poorer outcomes in the adult congenital heart disease population.

Primary Supervisor: Dr Phillip Naimo
Primary Supervisor Contact: naimop@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 0
Department: Dept of Medicine - Royal Melbourne Hospital

DNA METHYLATION IN FABRY DISEASE

Project Description:

Variation in DNA methylation can alter disease phenotype, including onset, severity, and course. Fabry disease is caused by mutations in GLA, the X-linked gene encoding the enzyme α-galactosidase A. It most commonly affects heart, kidney, skin and peripheral nervous system, but severity varies widely, even within families. This study will explore the methylome of subsets of Fabry patients and correlate findings with metrics of organ involvement and levels of biomarker, all of which are prospectively collected and recorded. Assays will be done commercially, but the student will assist in blood collection and delivery to the lab, and will have direct patient contact.

Primary Supervisor: A/prof Kathleen Nicholls
Primary Supervisor Contact: kathy.nicholls@mh.org.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Medicine - Royal Melbourne Hospital

Studies in Fabry Disease

Project Description:
Variation in DNA methylation can alter disease phenotype, including onset, severity, and course. Fabry disease is caused by mutations in GLA, the X-linked gene encoding the enzyme α-galactosidase A. It most commonly affects heart, kidney, skin and peripheral nervous system, but severity varies widely, even within families. This study will explore the methylome of subsets of Fabry patients and correlate findings with metrics of organ involvement and levels of biomarker, all of which are prospectively collected and recorded. Assays will be done commercially, but the student will assist in blood collection and delivery to the lab, and will have direct patient contact. Effect of specific therapies on hearing loss in Fabry disease. Effect of specific Fabry disease therapies on corneal deposits. The first year of de novo therapy with ERT, Migalastat or gene therapy in Fabry Disease – impact on patient and disease.

**Primary Supervisor:** A/prof Kathleen Nicholls  
**Primary Supervisor Contact:** kathy.nicholls@mh.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Improving antimicrobial stewardship - still a priority in Australia**  
**Project Description:**  
Older people are especially vulnerable to antimicrobial resistant infections. As recommended by the World Health Organization (WHO), it is critical that antimicrobial stewardship (AMS) programs are effectively implemented. The aim of this timely and important project is to investigate the quality of AMS policies and procedures in residential aged care. The successful student will be working with an internationally renowned team.

**Primary Supervisor:** Prof Joanne Tropea  
**Primary Supervisor Contact:** joanne.tropea@mh.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Measuring Efficiency in Cancer Care - an exploratory analysis of how well our systems are delivering care for our breast cancer patients**  
**Project Description:**

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Measuring Efficiency in Cancer Care is an exploratory analysis of efficacy of breast cancer care delivery at a large Melbourne public breast service. We will calculate an efficiency score based on a novel 8 core metric which reflects if we are delivering optimal, equitable care. This is a global first for a comprehensive patient-centred tool measuring outcomes in cancer care, and it will inform both local practice but also how to develop data-driven learning systems in cancer care more widely.

**Primary Supervisor:** Prof Christobel Saunders

**Primary Supervisor Contact:** christobel.saunders@unimelb.edu.au

**Honours places available:** 2

**Master of BioMed places available:** 2

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Prognosis of subsolid pulmonary nodules**

**Project Description:**

Pulmonary nodules, including subsolid pulmonary nodules, are increasingly being detected incidentally and can represent early lung cancer, many of which may be indolent in nature. To our knowledge there have not been any controlled trials that have compared active surveillance of subsolid nodules with early resection. This project will involve gaining significant skills in evidence synthesis and evaluation as part of a Cochrane systematic review team, as well as conducting a restrospective observational study of subsolid pulmonary nodule management at the Royal Melbourne Hospital.

**Primary Supervisor:** A/Prof Renee Manser

**Primary Supervisor Contact:** Renee.Manser@mh.org.au

**Honours places available:** 1

**Master of BioMed places available:**

**Department:** Dept of Medicine - Royal Melbourne Hospital

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**Let’s CHAT dementia project: optimising detection and management of cognitive impairment and dementia in Aboriginal and Torres Strait Islander People attending primary care**

**Project Description:**

The risk of developing dementia is 3-4 times higher in First Nations Peoples of Australia. The Let’s CHAT dementia project is a Stepped wedge RCT that has collaborated with 12 Aboriginal health services nationwide, to address ways to optimise brain health and improve management
of those with dementia. As part of the 4 year project, information has been collected through 6 monthly audits (approx. 1100) and comprehensive assessment in approximately 80-100 participants. This project involves exploring the data base for the quantitative and qualitative factors that contribute to a model of care that optimises detection and management of cognitive impairment and dementia in Aboriginal Primary Health Care Services. The database is rich with detailed data that can be used to explore various health associations in older First Nations People, to contribute to improving health outcomes. These include: relationship of cognitive impairment with quality of life and well-being; relationships of sarcopenia and frailty with function and other potential projects. We encourage Aboriginal and Torres Strait Islander students to apply.

**Primary Supervisor:** A/Prof Dina LoGiudice  
**Primary Supervisor Contact:** dina.logiudice@mh.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** Dept of Medicine - Royal Melbourne Hospital

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**An online insomnia intervention for brain tumour patients (SHUTi) - a feasibility study to test its acceptability and usefulness in a brain tumour cohort. (Prof Kate Drummond; Dr Verena Schadewaldt)**

**Project Description:**

SHUTi is a validated online behavioural 6 week program to manage and improve insomnia. It will be offered through our newly developed online platform for people affected by brain tumours, called Brain Tumours Online. SHUTi will be offered to those who suffer from insomnia. The AIM of this study is to identify the feasibility of SHUTi for a cohort of brain tumour patients who suffer from insomnia. A pre- and post standardised survey will establish changes in the participant's sleep pattern. In addition feedback from interviews with participants will support the survey data to establish feasibility of SHUTi in preparation for an RCT.

**Primary Supervisor:** Prof Kate Drummond  
**Primary Supervisor Contact:** kjd@unimelb.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 0  
**Department:** Dept of Medicine - Royal Melbourne Hospital
A supportive online community for brain tumour patients, carers and health care professionals - creation and analysis of social media content (Prof Kate Drummond; Dr Mahima Kalla; Dr Kara Burns)

Project Description:

Brain tumour patients and their families are socially and physically isolated and in particular those living in rural areas lack access to peer support. Our team of patients, carers, health care professionals, digital health experts and digital product developers have developed an online platform for people affected by brain tumours, called Brain Tumours Online. This platform offers those affected by brain tumours a safe and closed space to connect with their peers and share stories and experiences. They can connect through chats, reading or posting stories, contacting peers or health professionals and joining online Q &A sessions. The AIM of this study is to assist with the co-creation of the content posted within the online community and conduct an analysis of the social media content. This will facilitate the evaluation of how participants engage and use the online community and will provide the basis for improving the online community.

Primary Supervisor: Prof Kate Drummond

Primary Supervisor Contact: kjd@unimelb.edu.au

Honours places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

Investigate the implementation process including barriers and enablers of a digital health platform - a process evaluation (Prof Kate Drummond; Dr Verena Schadewaldt; Dr Mahima Kalla; Prof Meinir Krishnasamy)

Project Description:

Our team of patients, carers, health care professionals, digital health experts and digital product developers have co-designed an online platform for people affected by brain tumours, called Brain Tumours Online. The platform offers trusted information, connection with peers and health professionals and access to self-help tools (online interventions). The platform will be evaluated in a cohort of 300 patients, carers and health professionals across four Victorian health services and brain cancer organisations. The AIM of this study is to specifically investigate the implementation process and identify barriers and enablers in preparation for implementing the platform across more health services and make it available to all Australians affected by brain tumours. The methodology will be guided by process evaluation theory and comprises qualitative and quantitative data analysis methods.

Primary Supervisor: Prof Kate Drummond

Primary Supervisor Contact: kjd@unimelb.edu.au

Honours places available: 1

Parkville Precinct Honours and Masters Project Handbook
Interventions to reduce medication errors in hospitalised older patients: a systematic review

Project Description:
In this project, we will compare the effectiveness of different interventions in reducing prescribing, dispensing and administration medication errors in hospitalised older patients. The systematic review will examine and analyse the types of interventions to determine effectiveness in reducing medication errors and patient harm, which clinicians and policymakers could use for implementation in hospital settings. New directions for future research will be identified for interdisciplinary collaborative approaches involving doctors, pharmacists, nurses, and nurse practitioners. Students will gain skills in searching of library databases, extraction of relevant data from research papers, conduct of meta-analysis and display of data using forest plots, synthesis of findings, writing results for journal publication, and identifying implications for practice and policy. Results will also be disseminated to key policymakers and health professionals to enable implementation in practice and set initiatives for further research.

Primary Supervisor: Prof Elizabeth Manias

Primary Supervisor Contact: emanias@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Medicine - Royal Melbourne Hospital

Textbook outcomes in liver transplantation

Project Description:
Textbook outcome (TO) was first described in 2012 as the “perfect hospitalization” after colon cancer resection and has alternatively been reported to characterize an “ideal postoperative course.”. Therefore TO is a composite outcome metric that incorporates quality across multiple domains of performance.Though the definition of TOs varies by the specific procedure and, it frequently includes measures of morbidity, mortality, length of stay (LOS), and readmission. More extended definitions include intraoperative parameters such as operative time, need for blood transfusions, and disease or procedure-specific outcomes such as anastomotic leak, and need for postoperative interventions.TO after liver transplantation remains elusive with only few reports in the literature worldwide and no national study has been performed addressing Australian outcomes. The primary aim of this audit is to determine the incidence of
TO after OLTx at Austin health using an expert consensus definitions. The secondary aims are to determine the characteristics that will predict TO and to determine the patient-specific, disease-specific and procedure-specific factors that are associated with TO.

**Primary Supervisor:** A/Prof Marcos Perini

**Primary Supervisor Contact:** marcos.perini@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:**

**Department:** Dept Of Medicine - Royal Melbourne Hospital/Austing Health

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**Genetic Diagnosis of Children with Vascular Anomalies for a Therapeutic Clinical Drug Trial**

**Project Description:**

Our understanding of the genetics of vascular anomalies is rapidly advancing but remains incompletely understood. An inherited germline mutation may lead to a predisposition to developing vascular anomalies, with a ‘second hit’ somatic mutation occurring within the affected tissues. In other sporadic cases a somatic variant alone arising in the affected tissue at low frequency during early development may be sufficient to cause the vascular anomaly. The Vascular Anomaly Clinic at RCH has a large cohort of patients with a wide variety of vascular anomalies, including those associated with overgrowth syndromes. Most of these patients are sequencing naïve.

Analysis of DNA from blood may not identify a mutation in individuals with vascular anomalies, however sequencing tissue extracted from surgical specimens may identify the causative variant. Technologies such as high-depth sequencing or droplet digital PCR are key in detecting and quantifying mosaic variants in various tissues. Patients in whom appropriate variants are identified will be eligible for enrolment in our new 5-year MRFF-funded Rare Cancers Rare Diseases Unmet Needs (RCRDUN) Clinical Trial of targeted therapies for vascular anomalies commencing in 2022.

**Aims:**

1. To perform high depth gene panel or exome sequencing, or sensitive droplet digital PCR, to detect germline or somatic variants in individuals from large families with multiple affected individuals, sporadic cases, or those with atypical clinical presentations, in order to identify causative mutations in known and novel genes.

2. To gain hands-on experience with current genomic technologies and understand appropriate application, strengths and limitations of these technologies.

3. To understand the pathway from the clinic, through the laboratory process, to molecular diagnosis and back to the bedside, culminating in clinical trial of targeted drug therapies for patients with severe disease intractable to standard care.
Methodology:

1. Recruitment of families with multiple affected individuals (estimate ~15 families) and sporadic cases without family history (estimate ~30 individuals).

2. Application of current genomic testing technologies to these families and individuals using paired DNA samples extracted from lymphocytes and from surgical tissue to identify causative mutations.

This project provides the opportunity to work in an established multidisciplinary clinical and laboratory research team with clinical trial expertise. In addition to clinical experience and laboratory techniques, the development of project management, sample coordination and communication skills will be fostered.

**Primary Supervisor:** A/Prof Michael Hildebrand

**Primary Supervisor Contact:** michael.hildebrand@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept Of Medicine - Royal Melbourne Hospital/Austing Health

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**Mobile Health App use by a diverse sample of Australians with lived experience of Multiple Sclerosis**

**Project Description:**

Conduct an on-line mixed-methods survey to understand how different social contexts of people living with MS might affect their engagement with mobile health applications. For example, caring responsibilities, family and support structures, flexible working arrangements etc. - To identify healthcare journey “pain points” amenable to digital health solutions. To assess the quality of available apps currently used by people with MS. The student will learn to work with REDCap (remote data capture) and data analysis, with an opportunity for publication. The findings will inform the future co-design of a mobile application to monitor disease activity and progression between neurologist visits.

**Primary Supervisor:** Dr Maya Panisset

**Primary Supervisor Contact:** maya.panisset@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine, Royal Melbourne Hospital

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**Reliability and Variability of remote monitoring of walking in people with Multiple Sclerosis using mobile technology**

**Project Description:**
Aims: To assess the reliability of mobile-based measures of balance and walking quality. To compare the variability in balance and walking quality between healthy controls and pwMS. To explore patient reported factors that may affect variability in balance and walking quality. This study will involve direct and indirect assessment of walking quality in people with Multiple Sclerosis, using novel measures calculated from inertial sensors. The student will learn to work with REDCap (remote data capture) and data analysis, with an opportunity for publication.

**Primary Supervisor:** Dr Maya Panisset

**Primary Supervisor Contact:** maya.panisset@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Medicine, Royal Melbourne Hospital

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**Department of Obstetrics and Gynaecology - RWH/Mercy**

**Guiding the creation of national guidelines in CAYA Oncofertility**

**Project Description:**

The Fertility Preservation Taskforce is working with the Australia and New Zealand Consortium on Paediatric Oncofertility (ANZCO) on creating national guidelines for use in ANZCHOG paediatric oncology centres around Australia and New Zealand.

**Primary Supervisor:** A/Prof Yasmin Jayasinghe

**Primary Supervisor Contact:** yasmin.jayasinghe@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Guiding the creation of national guidelines in CAYA Oncofertility**

**Project Description:**

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**Primary Supervisor:** A/Prof Yasmin Jayasinghe

**Primary Supervisor Contact:** yasmin.jayasinghe@unimelb.edu.au

Parkville Precinct Honours and Masters Project Handbook
Understanding the membrane proteome of amniotic fluid extracellular vesicles

Project Description:
The project aims to use proteomics to characterize membrane proteins of extracellular vesicles (EVs). Amniotic fluid is rich in EVs from virtually all fetal cells and EVs carry a protein barcode of its cell type of origin. Researchers are interested in separating EVs according to their origin, especially for biomarker discovery purposes. However, no robust methods exist so far. Understanding and characterizing the membrane proteome will enable sorting EVs according to the expression of cell-specific membrane proteins. Therefore this project will be an essential first step towards the translational goal of identifying novel fetal diagnostic markers.

Primary Supervisor: Dr Ishara Atukorala

Primary Supervisor Contact: ishara.atukorala@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 0

Department: Dept of Obstetrics and Gynaecology - RWH/Mercy

ECLIPS: The effect of CPAP nasal interface on physiologic stability of the preterm infant

Project Description:
Preterm infants often have breathing difficulties due to immaturity of their lungs, airways and respiratory centre of the brain. As a result, they frequently require respiratory support. Continuous positive airway pressure (CPAP) is commonly used. It involves the provision of pressure to the upper airway via a nasal interface. Many centres alternate between nasal mask and binasal prong interfaces to deliver CPAP in preterm infants to avoid pressure injuries to the skin and nasal mucosa. Anecdotally, nurses observe that infant stability may differ when one interface is used compared with the other. Achieving physiologic stability, by limiting periods of hypoxia and hyperoxia, is important. In preterm infants, both hypoxic and hyperoxic events are associated with increased morbidity and mortality. Periods of low oxygen saturations and low heart rate are associated with poorer neurodevelopmental outcomes in preterm infants. Furthermore, there is also concern about hyperoxia which is associated with free radical generation and adverse outcomes. To date, there is little evidence regarding the impact of different nasal CPAP interfaces on the physiologic stability of preterm infants.
The objective of this study is to evaluate the effect of nasal mask versus binasal prong interfaces on the physiologic stability of preterm infants on CPAP support, during routine practice of alternating interfaces. An open-label cross-over trial will be conducted in the neonatal intensive care unit at the Royal Women’s Hospital in Melbourne, Australia.

**Primary Supervisor:** Dr Elizabeth Baker  
**Primary Supervisor Contact:** elizabeth.baker2@thewomens.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 0  
**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Acupuncture for IVF: Systematic review and meta-analysis**

**Project Description:**

One out of every seven couples experiences subfertility, prompting many to explore assisted reproductive technology, such as IVF, for solutions. Despite the growing interest in acupuncture as a complementary approach to IVF, its integration with IVF continues to spark debate. This project will involve a systematic review to compile evidence from randomised trials to assess the efficacy and safety of acupuncture as an add-on to IVF cycles.

The student will learn techniques in performing a literature search, screening for studies, extracting data, conducting meta-analysis and interpreting results. As the project does not require data collection from humans, the student can progress through this review at their own pace and remotely if they so wish.

**Primary Supervisor:** Dr Sarah Lensen  
**Primary Supervisor Contact:** sarah.lensen@unimelb.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 0  
**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Platelet-rich plasma for IVF: Systematic review and meta-analysis**

**Project Description:**
One out of every seven couples experiences subfertility, prompting many to explore assisted reproductive technology, such as IVF, for solutions. Despite the growing interest in 'add-ons' to IVF cycles, many are not proven to increase the chance of pregnancy or be safe to use. One such 'add-on' is platelet-rich plasma. This project will involve a systematic review to compile evidence from randomised trials to assess the efficacy and safety of platelet-rich plasma as an add-on to IVF cycles.

The student will learn techniques in performing a literature search, screening for studies, extracting data, conducting meta-analysis and interpreting results. As the project does not require data collection from humans, the student can progress through this review at their own pace and remotely if they so wish.

**Primary Supervisor:** Dr Sarah Lensen

**Primary Supervisor Contact:** sarah.lensen@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 0

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**The best method to convey IVF success rates to patients: a randomised experiment**

**Project Description:**

Our team is developing a new evidence-based website to help IVF patients understand the evidence base for different IVF options. We are constantly undertaking research to test different ways of presenting the information to best ensure it is understood and relevant to IVF patients.

This project will involve developing 1-4 different versions of an information leaflet, and testing these with IVF patients to establish which perform better. The student will be involved in designing the study (if they wish) - including the different leaflets, the questionnaires to test for comprehension and information satisfaction, recruiting participants, and analysing and interpreting results.

**Primary Supervisor:** Dr Sarah Lensen

**Primary Supervisor Contact:** sarah.lensen@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 0

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**How accurate are we delivering intravenous fluids and medications into babies in NICU?**

**Project Description:**

Parkville Precinct Honours and Masters Project Handbook
Preterm and term babies cared for in the neonatal intensive care unit (NICU) require accurate delivery of intravenous medications, fluid and parenteral nutrition as an essential part of their care. With patients as small as 400 grams, the infusion rates are very low with often multiple infusion pumps delivering simultaneously at different rates. The IV pumps used are usually designed for higher infusion rates.

We have developed a bench top model that allows us to test the accuracy of delivery and mixing of multiple infusions at the low rates used in newborns. Infusions are set up, multiple fluids delivered and a fraction collection system and photometric determination system using colour dyes in the solutions allows us to explore the effects of infusion rates, different infusion set-ups and viscosity of solutions. In preliminary work, we noted that some of the assumptions about the delivery of fluids do not align well with how these fluids are delivered in reality.

This project will expand on this work and develop a number of clinically relevant scenarios to test current infusion pumps in the benchtop model, observe infusion scenarios in the Royal Women’s Hospital NICU and explore if innovative pump designs could improve fluid delivery.

**Primary Supervisor:** A/Prof Christiane Theda

**Primary Supervisor Contact:** Christiane.Theda@thewomens.org.au

**Honours places available:** 1

**Master of BioMed places available:** 0

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Exploring Neonatal Medical Device Opportunities in the Neonatal Intensive Care Unit (NICU)**

**Project Description:**

This Honour’s research project aims to help address the critical gap in paediatric and neonatal medical device development. Currently, only a mere 15% of FDA-approved medical devices are intended for paediatric use, with an even smaller fraction tailored for neonatal patients. Focusing on the Neonatal Intensive Care Unit (NICU), this project seeks to identify unaddressed clinical needs and catalyse the creation of novel medical devices. Through literature reviews, guideline assessments, clinician interviews, and observations in NICU the project will not only enhance students’ understanding of medical device development but also provide insights into effective clinical needs identification and translation into practical solutions. A pivotal aspect of this research involves crafting a comprehensive patient journey map, tracing the course of neonates’ NICU experience. This map, constructed through observations in NICU and interviews, will shed light on critical points where medical interventions could significantly impact patient outcomes. The project’s primary outcome will be the identification of key unmet clinical needs, derived from the patient journey map, thus laying the groundwork for potential device innovations. By engaging in this Honour’s research, students will gain a deep understanding of the medical device development process, learn to discern the attributes of
successful medical devices, and grasp the intricacies of clinical needs recognition. Furthermore, they will contribute to a crucial endeavour, potentially driving the creation of innovative solutions that can improve the lives of neonatal patients.

**Primary Supervisor:** A/Prof Christiane Theda

**Primary Supervisor Contact:** Christiane.Theda@thewomens.org.au

**Honours places available:** 1  
**Master of BioMed places available:** 0

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Investigating mechanisms of antibiotic resistance**

**Project Description:**

Antibiotic resistance is a substantial and growing problem. Our laboratory is investigating mechanisms of antibiotic resistance in Mycoplasma genitalium, a common sexually transmitted bacterial pathogen. Infection with M. genitalium causes urethritis in men and can lead to reproductive complications for women. The project will use molecular methods including high-throughput sequencing, quantitative PCR, and digital PCR, in combination with culture procedures (broth and cell lines), to investigate the mutations that contribute to antibiotic resistance, and how these mutations arise. Moreover, the activity of novel compounds against M. genitalium may be tested. Developments in this area will contribute to our understanding of treatment failure and may contribute to improvements in diagnostics and therapeutic approaches.

**Primary Supervisor:** Dr Gerald Murray

**Primary Supervisor Contact:** gerald.murray@mcri.edu.au

**Honours places available:** 2  
**Master of BioMed places available:** 1

**Department:** Dept of Obstetrics and Gynaecology - RWH/Mercy

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**Fertility preservation in children with cancer**

**Project Description:**

One in 900 children is a cancer survivor. Cancer treatment can significantly affect future fertility. Determining an accurate risk assessment helps in counseling families considering fertility preservation procedures. We have one of the largest registries of paediatric cancer patients, from which we can research risk factors, counseling and effectiveness of procedures.

**Primary Supervisor:** A/Prof Yasmin Jayasinghe
Fertility preservation in children with cancer

Project Description:
One in 900 children is a cancer survivor. Cancer treatment can significantly affect future fertility. Determining an accurate risk assessment helps in counseling families considering fertility preservation procedures. We have one of the largest registries of paediatric cancer patients, from which we can research risk factors, counseling and effectiveness of procedures.

Primary Supervisor: A/Prof Yasmin Jayasinghe
Primary Supervisor Contact: yasmin.jayasinghe@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Obstetrics and Gynaecology - RWH/Mercy

Management and outcomes for "ultra-prem" infants: a secondary analysis of the PLUSS randomised controlled trial.

Project Description:
The PLUSS trial was an international RCT of intratracheal budesonide for extremely preterm infants to increase survival free of bronchopulmonary dysplasia. The primary manuscript is being submitted for publication. The trial included over 1000 tiny babies and there are several opportunities for important secondary analyses. The Honours student will be guided to plan, analyze and write a secondary analysis during their year with the Newborn Research team, and have the opportunity to embed themselves in the other clinical and research activities of the unit.

Primary Supervisor: Professor Brett Manley
Primary Supervisor Contact: brett.manley@thewomens.org.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Obstetrics and Gynaecology - RWH/Mercy
PRESCIENT: a global study aiming to build tools to predict psychosis onset in young people

Project Description:

Schizophrenia is a serious mental illness associated with significant health, social, and economic concerns, and it is one of the top 15 leading causes of disability worldwide. Young people may start to show signs of risk for psychosis months or even years before they receive a diagnosis. Being able to identify people who are at clinical high risk can help clinicians treat people early before their symptoms worsen. It can also help researchers understand who is likely to develop schizophrenia, who is likely to develop other mental health conditions, and who is unlikely to experience longer-term issues. At Orygen, we are leading the largest study in the world to look for measurable indicators of illness, known as biomarkers, that can help to predict the likelihood that a person will progress to psychosis and other health outcomes. Once we have identified these biomarkers, they will be translated clinically and used in drug development pipelines. We are currently focussed on clinical, brain EEG, brain MRI, speech, and digital biomarkers. Our methods include machine learning approaches in addition to methods from dynamic systems theory. We work with global collaborators to achieve these aims within international teams. Students on the projects will learn how to identify biomarkers using advanced methods and how these results may integrate into large-scale international studies. There will be opportunities to continue in the projects after the end of the masters or honours project.

Primary Supervisor: Dr. Domonic Dwyer

Primary Supervisor Contact: dominic.dwyer@orygen.org.au

Honours places available: 2

Master of BioMed places available: 2

Department: OrygenCentre for Youth Mental Health

Epigenetics as a predictor of mental illnesses: discovering methylomic subgroups for future treatments

Project Description:

Mental illnesses are known to be the result of complex interactions between genes and the environment. Such interactions are thought to be partially mediated by epigenetic changes that switch genes "on" or "off". These switches can be detected in methylomic profiles, which have been detected to be abnormal in some individuals with mental illness and may be treatable in the future through targeted therapies. The aim of this project is to look into whether subgroups of individuals can be found with particularly high epigenetic burden for future targeted therapies. The students will use existing datasets to achieve this and will collaborate with
international colleagues in Germany (Zi Mannheim; Prof. Schwarz). The detection of epigenetic risk subgroups will lead the field towards greater understanding and more precise treatments for mental illness.

**Primary Supervisor:** Dr. Domonic Dwyer  
**Primary Supervisor Contact:** dominic.dwyer@orygen.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** OrygenCentre for Youth Mental Health

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**Implementing precision medicine approaches for youth mental health**

**Project Description:**

Schizophrenia is a serious mental illness associated with significant health, social, and economic concerns, and it is one of the top 15 leading causes of disability worldwide. Young people may start to show signs of risk for psychosis months or even years before they receive a diagnosis. At Orygen, we have developed treatments to potentially prevent the onset of psychosis and schizophrenia. However, they are only effective approximately 50% of the time. Precision medicine techniques are needed to match young people at risk of psychosis to the therapies that they will specifically respond to. In this project, the student will build on existing methodological work to identify subgroups of young people at-risk of psychosis who respond to different treatments. The subgroups will be identified using clinical, cognitive, and brain imaging data. This work will contribute to the establishment of precision psychiatry.

**Primary Supervisor:** Dr. Domonic Dwyer  
**Primary Supervisor Contact:** dominic.dwyer@orygen.org.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** OrygenCentre for Youth Mental Health

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**Individualised neurocognitive and neuroimaging trajectories in individuals at high risk for psychosis: predictors of trajectories and implications for outcomes**

**Project Description:**

There is a large degree of heterogeneity in terms of cognitive and neuroimaging profiles and trajectories observed in individuals with psychosis. However, it is unclear whether these profiles are driven by specific risk and protective factors. Furthermore, the relevance for these different profiles for later outcomes, including transition to first-episode psychosis, persistence
or remission of ultra high risk status, diagnosis of other non-psychotic psychiatric disorders, and social and occupational functioning. This study will identify individualised neuroimaging and cognitive trajectories, determine the risk and protective factors that drive them, and investigate the implications of these trajectories for later outcomes.

**Primary Supervisor:** Dr Cassandra Wannan  
**Primary Supervisor Contact:** wannanc@unimelb.edu.au  
**Honours places available:** 1  
**Master of BioMed places available:** 1  
**Department:** OrygenCentre for Youth Mental Health

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**Using machine learning tools in psychiatric primary care to prevent psychosis**

**Project Description:**

Schizophrenia is a serious mental illness associated with significant health, social, and economic concerns, and it is one of the top 15 leading causes of disability worldwide. Young people may start to show signs of risk for psychosis months or even years before they receive a diagnosis. At Orygen, we founded the largest primary care network in the world for youth mental illness and risk states called ‘headspace’. Over 130 sites around Australia assess thousands of young people with a range of mental health challenges. We also devised a way to determine if young people were at-risk of psychotic illnesses, like schizophrenia, that can lead to lifelong disability, but our tools are not precise enough and new approaches are needed. In this project, we will use machine learning methods to predict psychosis onset in individuals who are at-risk of psychosis using clinical data from headspace sites with the aim to translate the tools clinically through our national infrastructure. Achieving this translational goal will change care for thousands of young people and may lead to the prevention or delay of illness. The projects will involve learning and applying translational machine learning methods and implementation science approaches using pre-existing data. There will also be the opportunity to develop predictive models using clinical, brain, social, or digital biomarker data from some of the largest studies in this field globally we are currently leading (e.g., see https://www.ampscz.org/).

**Primary Supervisor:** Dr Domonic Dwyer  
**Primary Supervisor Contact:** dominic.dwyer@orygen.org.au  
**Honours places available:** 2  
**Master of BioMed places available:** 2  
**Department:** OrygenCentre for Youth Mental Health
Brain age prediction to identify white matter abnormality in early psychosis

Project Description:

By applying machine learning approaches on neuroimaging data, we can accurately predict brain age in healthy individuals. The difference between predicted brain age and chronological age has been shown to predict the risk of various diseases and neurological conditions. For example, schizophrenia, epilepsy, and diabetes have all been shown to make the brain appear older. The goal of this project is to use a particular type of advanced neuroimaging tool (diffusion MRI) to predict brain age. Diffusion MRI is valuable for probing the brain’s white matter architecture. The project will examine whether brain age predicted using this tool will help to identify early psychosis, which is known to be characterised by changes to the brain’s white matter connectivity. The project will make use of large neuroimaging datasets, and is best suited to students with an interest in brain imaging, clinical neuroscience, and machine learning.

Primary Supervisor: Dr Remika Mito
Primary Supervisor Contact: remika.mito@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Psychiatry - Royal Melbourne Hospital

Modelling the human brain’s complex wiring

Project Description:

The human brain consists of billions of neurons, which communicate through a hugely complex system of connections. We still do not have a clear understanding of how these connections develop and change over the lifespan in humans, due the sheer complexity of these microscopic connections. Advanced brain imaging tools, and in particular, diffusion-weighted imaging (diffusion MRI), allow us to model the brain’s complex wiring. The goal of this project is to use diffusion MRI datasets to model the brain’s wiring over the human lifespan. The project will make use of large neuroimaging datasets and implement machine or deep learning approaches. The project is best suited to students with an interest in brain imaging, clinical neuroscience, and machine learning.

Primary Supervisor: Dr Remika Mito
Primary Supervisor Contact: remika.mito@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Synthesising, dismantling and optimising cognitive interventions

Project Description:

Our group is a world leader in research synthesis of cognitive interventions across the lifespan and brain disorders. Using large datasets from hundreds of clinical trials, we use cutting-edge meta-analysis techniques to identify the active ingredients and core components of interventions, and define the most effective intervention and treatment strategies for different populations of individuals. We produce robust evidence and high-impact publications that that have influenced changes in both policy and clinical practice. Our group offers a range of projects (Honours to PhD), with a particular interest in ageing (older adult populations), neurodegenerative disorders (e.g., multiple sclerosis), psychiatric disorders (e.g., depression) and cancer.

Primary Supervisor: Dr Amit Lampit

Primary Supervisor Contact: amit.lampit@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital

Animal models of Brain Development assessed using MRI

Project Description:

A newly commenced Program Grant aims to map brain-structure-function relationships and molecular signatures across developmental stages in the mouse, as measured through novel neuroimaging techniques and microscopy. The aim of the current project is to model hippocampal structure in the mouse brain using a combination of structural and spectroscopy neuroimaging techniques, and to determine whether differences are present between age groups.

Primary Supervisor: Prof Christos Pantelis

Primary Supervisor Contact: cpant@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital
Cognition and brain connectivity in psychosis

Project Description:

The aim of this project is to determine whether impairments in episodic memory, attentional set-shifting, and spatial working memory are related to disrupted brain connectivity (as measured by MRI-derived structural covariance; see Wannan et al, 2019) in key regions associated with performance on these tasks in individuals with first-episode psychosis.

Primary Supervisor: Prof Christos Pantelis

Primary Supervisor Contact: cpant@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital

Ferroptosis in Schizophrenia

Project Description:

Schizophrenia is a debilitating mental illness that disrupts the functioning of the mind, with onset typically occurring in young adulthood. Impairments in certain cognitive functions, such as working memory, are core features of Sz, which are not addressed for existing drug targets. Our general hypothesis is that schizophrenia is a complex disease resulting from a loss-of-function of key pathways that govern neurodevelopment, neurotransmission, intracellular redox state and synaptic connectivity. Our data indicate that iron is elevated in the orbitofrontal cortex in post mortem brain samples from individuals with schizophrenia relative to age- and sex-matched controls. We propose that a rise of cytosolic iron is upstream of key lesions associated with negative and cognitive symptoms of schizophrenia, including neuronal development (e.g., parvalbumin-interneurons and synaptic pruning), neurotransmission (e.g., GABAergic and glutamatergic pathways), as well as iron homeostasis, antioxidant defence (e.g., haem oxygenases), and ferroptosis (e.g., an iron-dependent pathway for lipid peroxidation recently associated with loss of parvalbumin-interneurons). The project aims to investigate the status of proteins involved in iron metabolism as well as levels of markers of oxidative stress.

Primary Supervisor: Prof Christos Pantelis

Primary Supervisor Contact: cpant@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital
Multinuclear MRI biomarkers in schizophrenia

Project Description:

Schizophrenia is a debilitating neuropsychiatric disorder characterised by positive symptoms (delusions, hallucinations), negative symptoms (lack of motivation, poverty of speech), cognitive deficits and impaired social and occupational functioning. The aetiology of schizophrenia remains unknown and the mechanisms underlying the pathogenesis of schizophrenia are poorly understood. Previous studies have identified altered brain metabolism as one of the putative mechanisms contributing to schizophrenia, partly due to neuroinflammation and pathological oxidative processes. However, there is a paucity of research investigating oxidative and neuroinflammatory processes in the brain in vivo. Sodium (23Na) MRI is an emerging metabolic imaging technique that employs ultra-high field MRI (7T and above) to characterise tissue sodium content, and together with iron (1H) MRI provides an invaluable tool to investigate brain structure and chemical composition in the living brain. By employing advanced multivariate statistical techniques, this program of work aims to combine complementary information from clinical, cognitive and biological data in order to identify unique patterns of cognition and structural changes associated with schizophrenia.

Primary Supervisor: Prof Christos Pantelis

Primary Supervisor Contact: cpant@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital

Neurodevelopmental trajectories and biopsychosocial risk factors in autism and schizophrenia

Project Description:

Children with neurodevelopmental disorders often have worse outcomes than typically developing children on a range of measures, including education, mental health, social dysfunction, vocational achievement, and conduct problems. Furthermore, overlap between the symptoms of many neurodevelopmental disorders, along with intra-illness heterogeneity, results in frequent misdiagnosis, ineffective treatment, and increased disability in affected children. There is therefore an urgent need to identify biopsychosocial markers that characterise specific neurodevelopmental disorders and impact on illness severity and outcomes. The key aims of our research are therefore to (1) map the developmental trajectories of cognition, behaviour, and brain structure and function in autism-spectrum disorder (ASD) and schizotypal disorder of childhood (SDC) over critical periods of brain development, and (2) identify the candidate biopsychosocial risk/resilience markers that might impact these trajectories and illness outcomes. Our work will consider a range of biopsychosocial markers,
including genetics, inflammation, clinical profiles, early life stress and physiological stress reactivity, and psychosocial indices such as socioeconomic status and parenting styles.

**Primary Supervisor:** Prof Christos Pantelis

**Primary Supervisor Contact:** cpant@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Psychiatry - Royal Melbourne Hospital

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**Ubiquitin Proteasome System in Schizophrenia**

**Project Description:**

The ubiquitin-proteasome system (UPS) is a master regulator of neural development and the maintenance of brain structure and function. It influences neurogenesis, synaptogenesis and neurotransmission by determining the localization, interaction and turnover of scaffolding, presynaptic and postsynaptic proteins. Moreover, UPS signalling transduces epigenetic changes in neurons independent of protein degradation and as such dysfunction of components and/or substrates of this system have been linked to a broad range of brain conditions. Although links between UPS dysfunction and neurodegenerative disorders have been known for some time, only recently have similar links emerged for neurodevelopmental disorders, such as schizophrenia. We and others have found that different components of the UPS are dysregulated in schizophrenia. The project aims to investigate whether specific poly-ubiquitin changes are altered in brain samples from individuals with schizophrenia.

**Primary Supervisor:** Prof Christos Pantelis

**Primary Supervisor Contact:** cpant@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Dept of Psychiatry - Royal Melbourne Hospital

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**Characterizing brain-body relationship with respect to biological aging in elderly population**

**Project Description:**

This project aims to comprehensively characterize patterns of aging in various human biological systems including the brain and other organ systems such as the cardiovascular, respiratory and skeleton systems, and to understand the relationship between the brain and the body with respect to the aging trajectory and health outcomes.
Decoding neural mechanisms underpinning human cognition in health and disease using machine learning

Project Description:
This project aims to understand the neural mechanisms underpinning higher-order cognitive function in humans. This student will be guided in using state-of-the-art neuroimaging techniques and machine learning to decipher the complex network of brain circuits that give rise to individual variation in cognition in healthy adults as well as abnormal brain changes associated with cognitive decline in neurodegenerative diseases such as Alzheimer’s disease and mild cognitive impairment.

Primary Supervisor: Dr Ye Tian
Primary Supervisor Contact: ye.tian2@unimelb.edu.au
Honours places available: 1
Master of BioMed places available: 1
Department: Dept of Psychiatry - Royal Melbourne Hospital

Markers in Neuropsychiatric Disorders (MiND) study

Project Description:
The Markers in Neuropsychiatric Disorders (MiND) aims to study whether neurofilament light and other biomarkers, clinical, cognitive, imaging and other markers can improve diagnosis, prognostication, care and treatment, and health economic outcomes, for people with cognitive, neuropsychiatric and neurological symptoms. By studying a broad range of symptoms and conditions, from neurodegenerative dementias such as Alzheimer disease and behavioural variant frontotemporal dementia, to many other neurological and neurodegenerative disorders, to schizophrenia and other severe psychiatric illnesses, the MiND study ultimately aims for clinical translation such as a screening blood test and precision care use of biomarkers and other markers, to improve outcomes for patients, their families, clinical trials and healthcare systems.

Primary Supervisor: Prof Dennis Velakoulis
Brain stimulation for mental health disorders

Project Description:
Noninvasive brain stimulation (NBS) is an established treatment for individuals with depression who have not responded to pharmaceutical or behavioral therapies. Recent work indicates that treatment outcomes can be enhanced by selecting and personalizing the stimulation target according to brain connectivity. This project aims to develop new knowledge in this research area.

Primary Supervisor: Dr Robin Cash

Primary Supervisor Contact: robin.cash@unimelb.edu.au

Honours places available: 2
Master of BioMed places available: 0
Department: Dept of Psychiatry - Royal Melbourne Hospital

Understanding brain circuits involved in psychiatric and mental health disorders

Project Description:
This project will focus on gaining new insights into the neurobiology of mental health disorders using neuroimaging data. There is flexibility as to which condition you wish to focus on, e.g. depression, anxiety, borderline personality disorder or also pain.

Primary Supervisor: Dr Robin Cash

Primary Supervisor Contact: robin.cash@unimelb.edu.au

Honours places available: 1
Master of BioMed places available: 0
Department: Dept of Psychiatry - Royal Melbourne Hospital

A dynamic neural systems model of fear and safety learning in humans
Project Description:
The flexible control of fear in humans is supported by large-scale brain systems that mediate the learned discrimination of threat and safety signals. Within these systems, functionally opposing roles have been identified for subregions of the medial frontal cortex consistent with the selective processing of positive versus negative affective stimuli. Informed by our recent work, the current project will test key predictions regarding the neural dynamics of these brain systems and subregions in relation to their functional interactions. It will examine how these relationships i) shape individual differences in the affective processing of threat and safety signals, and ii) are influenced by state and trait measures of anxiety risk. To do so, a large non-clinical sample of participants (18 to 45 years of age) will be recruited and assessed with functional magnetic resonance imaging (fMRI) and two experimental tasks designed to evoke fear and safety learning. Functional neural network interactions will be examined via dynamic causal modeling. This study will lay the foundations for an advanced neural systems account of adaptive fear processing in the human brain and will have direct implications for the neuroscientific study of clinical anxiety disorders, including their treatment.

Primary Supervisor: Prof Ben Harrison

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital

The impact of early life stress on neurodevelopmental trajectories across different mental health diagnoses in children

Project Description:
Over the past several decades there has been a growing understanding that exposure to early life stress is also associated with adverse mental health outcomes. However, while it is clear that psychosocial stress is a risk factor for many mental health disorders, it is less clear whether particular types of stressors are more strongly associated with particular diagnoses, or whether these stressors represent a general, non-specific, risk factor for poorer health outcomes. Furthermore, the impact of early life stress on brain and cognitive development across mental health diagnoses is currently unclear. The broad aims of this research are therefore to (1) identify early life stressors that ‘hang together’ in a large longitudinal sample of children and adolescents, (2) determine the prevalence of these stressors across neurodevelopmental and psychiatric disorder diagnoses, (3) examine the impact of different stressors on brain development trajectories across diagnoses, and (4) examine the impact of different stressors on cognitive trajectories across diagnoses. Students will focus on select aims depending on their degree (honours, Masters, PhD). This study will utilise data from the ABCD Study, a large multi-site longitudinal study of more than 11,000 children.

Primary Supervisor: Dr Cassandra Wannan
Ultra-high field neuroimaging of transdiagnostic mental health symptoms

Project Description:
Recent studies have illustrated poor reliability between correlations of psychopathology and neuroimaging parameters, including resting-state and structural measures, commonly used in the field. Fortunately, “ultra-high field” (UHF) magnetic resonance imaging shows much greater capacity in characterising structural and functional alterations common across mood and anxiety disorders, due to its vastly improved anatomical resolution and signal mapping capabilities. By identifying which neurobiological features are specific to and common between mental health disorders, this work will aid to improve our conceptualisations of these conditions. This project aims to investigate transdiagnostic mental health symptoms, including maladaptive rumination, distress, and emotional arousal, using UHF imaging to better characterise the neurobiological basis of these symptoms across diagnoses.

Primary Supervisor: Prof Ben Harrison

Primary Supervisor Contact: habj@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Dept of Psychiatry - Royal Melbourne Hospital

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Department of Radiology – Royal Melbourne Hospital

Quantitative imaging in dementia

Project Description:
The aim of this study is to explore the utility of advanced MR imaging approaches in detecting early dementia.

Primary Supervisor: Prof Patricia Desmond

Primary Supervisor Contact: Patricia.Desmond@mh.org.au

Honours places available: 1

Master of BioMed places available: 1
**Department:** Department of Radiology - Royal Melbourne Hospital

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**Improve the diagnostic prediction of imaging measures in dementia and epilepsy**

**Project Description:**

The aim of this study is to study the impact of neuroimaging tools driven by machine learning on clinical diagnosis in dementia and epilepsy.

**Primary Supervisor:** Dr Vijay Venkatraman

**Primary Supervisor Contact:** vijay.venkatraman@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Department of Radiology - Royal Melbourne Hospital

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**Multimodal imaging measures to improve dementia diagnosis**

**Project Description:**

The aim of this study is to study the influence morphological and longitudinal measures to improve dementia diagnosis.

**Primary Supervisor:** Dr Vijay Venkatraman

**Primary Supervisor Contact:** vijay.venkatraman@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Department of Radiology - Royal Melbourne Hospital

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**Department of Surgery – Royal Melbourne Hospital**

**Investigating the link between phenotype change and treatment resistance in prostate cancer**

**Project Description:**

The development of resistance to androgen (male sex hormone) deprivation therapy (ADT), the primary treatment for aggressive prostate cancer, is not clearly understood. Our phylogenetic
analyses of resistant tumours demonstrate no significant tumour evolution or clonal/subclonal selection with therapy, supporting the concept that resistant tumours are “hardwired” to survive in the castrate environment. We have previously found no mutation or structural variant consistently shared between resistant tumours at any of the gene/pathway/ontology levels, and no evidence of previously characterised genomic drivers of resistance. We have performed whole genome and RNA sequencing on paired pre- and post-treatment tumour samples obtained from high-risk patients undergoing profound androgen suppression for 6 months before prostatectomy, in whom clinical responses ranged from complete involution to no effect. Transcriptional profiling indicated that resistant cells undergo a phenotypic reprogramming in response to therapy that may be important for cellular survival, and suggests that these changes are regulated by alterations in post-translational histone modifications. This raises the possibility that hardwired resistance is epigenetically, and not genomically mediated. Our data from patient-derived tumours grown in androgen-deprived conditions support the concept that cancer cells adapt to castration though histone mediated transcriptional reprogramming and development of a stem cell–like phenotype. This project will involve establishing an organoid model of prostate cancer and investigating the effect of perturbing key nodes in this adaptive process.

**Primary Supervisor:** A/Prof Niall Corcoran

**Primary Supervisor Contact:** con@unimelb.edu.au

**Honours places available:** 1

**Master of BioMed places available:** 1

**Department:** Department of Surgery - Royal Melbourne Hospital

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**Examining Pro-tumorigenic Cross-talk between Brain Tumour Cells, Astrocytes and Immune cells.**

**Project Description:**

Glioblastoma is the most severe form of brain tumour and is currently incurable with an average survival rate of only 12-15 months post diagnosis. This poor survival rate is largely due to the highly invasive and highly immunosuppressive nature of these tumours. However, the complete mechanisms used for tumour cell invasion and immune escape and the key interactions and cross-talk (via growth factor, cytokine and chemokine secretion) between glioblastoma cells, local astrocytes and the immune cell population is not fully understood. Our lab has a major focus to gain a better understanding of these glioblastoma-induced mechanisms and how we can overcome these mechanisms to reduce glioblastoma progression. This Honours project seeks to specifically explore the key proteins secreted by glioblastoma cells, astrocytes and immune cells that are responsible for glioblastoma invasion and reduced immune cell activity using healthy donor and glioblastoma patient samples and patient derived cell lines. Furthermore, this project has the scope to evolve into a PhD project pending the ability of the incumbent student and grow into a larger research project involving key members of the Melbourne cancer research community.
Primary Supervisor: Dr Rod Luwor

Primary Supervisor Contact: rluwor@unimelb.edu.au

Honours places available: 1

Master of BioMed places available: 1

Department: Department of Surgery - Royal Melbourne Hospital