THE UNIVERSITY OF MELBOURNE

2027 Parkville Precinct - Project Handbook

Honours and Master of Biomedical Sciences Projects
Melbourne Medical School

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How to Apply:

Key Dates for 2027 Start Year Intake

Round 1

- System open to prospective students for preferencing: **Monday, 10 August 2026**
- Project Preference Submission Closing Date: **Saturday, 31 October 2026**

Round 2

- Round 2 Application **closing date** (unless course filled prior) **Friday, 08 Jan 2027**

Application Process

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

You **MUST** contact 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

Start your application here

Further Information:

Parkvile Precinct – RMH Honours and Masters Expo

Find out more about Honours and Masters study options at the
Parkville Precinct RMH Honours and Masters Expo for study in 2027!

Prospective students will have the opportunity to hear from our Academic staff,
find out about entry requirements and the application process.

Date: Thursday 20 August

Venue: Kenneth Myer Building Entrance Foyer

Time: 4.00pm – 6:00pm

Register Here

Parkvile Princit – RMH Honours and Masters Program Information Session and Q&A

Find out more about Honours and Masters study options at the
Parkville Precinct RMH Honours and Masters Online Information Session
Prospective students will have the opportunity to hear from our Academic Staff,
find out about entry requirements and the application process.

Date: Tuesday 15 September

Time: 12.00 -1.00 pm

Register Here

Still have questions?

- Contact the MDED Admissions Team here

Baker Heart & Diabetes Institue

Multi-omics, machine learning and the heart - deciphering the complexity of the heart

Project Description:

In this project, we will use our advances in subcellular biology, proteomics and machine learning methods to target specific organelles and their molecular landscape in the heart. This knowledge is based on significant proteomic and lipidomic data, tissue subcellular biology, and AI-based tools to focus on specific niches remodelled during heart attack. This project has the scope (dependent on the applicant) to (i) advance applied mass spectrometry technology, (ii) develop informatic tools applied to such knowledge, and (iii) apply molecular tools to target and validate specific molecular alterations. The scope of the project leverages advances, cutting-edge technologies with academic collaborative networks and industry partnerships. Achieving this translational goal will enable a refinement in how the heart and specific regions within cells are altered and remodelled during heart attack, and lead to regenerative approaches in how we target and remodel the cardiac niche for heart repair.

Primary Supervisor: Professor David Greening

Primary Supervisor Contact: david.greening@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Enhancing functional cardiac lipid nanoparticles

Project Description:

Lipid nanoparticles (LNPs) are synthetic lipid-based delivery systems widely used for therapeutic nucleic acid delivery due to their enhanced stability, biocompatibility, cellular uptake efficiency, and scalable manufacturing capacity. Importantly, LNP technologies have demonstrated significant translational success in nucleic acid therapeutics, highlighting their potential as delivery platforms for regenerative medicine applications. Extracellular vesicles possess significant cardiac repair potential but remain limited in their therapeutic potency. This study aims to investigate the key molecular drivers of EV-LNP hybrid vesicles through functional and quantitative proteomic analyses. Understanding how EV-LNP hybridisation modulates intercellular signalling may identify novel strategies to enhance vascular repair and cardiac regeneration following heart attack.

Primary Supervisor: Professor David Greening

Primary Supervisor Contact: david.greening@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Phosphorylation-based signalling networks in the heart

Project Description:

Protein phosphorylation is one of the most important and central regulatory mechanisms of cell and organ signalling pathways. The dynamic and reversible phosphorylation of proteins, regulated by kinases and phosphatases under the control of complex signalling networks, modulates protein activity, binding interactions and subcellular localisation, that constitutes a critical regulatory network dictating cardiac contractility, metabolism, and cell survival

Understanding the precise spatiotemporal landscape of protein phosphorylation is critical for developing the next generation of heart failure therapeutics. Traditional systemic kinase inhibitors often fail due to off-target toxicities; because kinases like PKA and CaMKII govern diverse cellular processes, blanket inhibition disrupts essential physiological functions.

This study will explore mapping distinct temporal windows and localized pools to design targeted interventions—offering new insights into the temporal landscape of phosphorylation in the heart and the concept design of highly precise, microdomain-specific therapy while leaving global cellular signaling intact.

Primary Supervisor: Professor David Greening

Primary Supervisor Contact: david.greening@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Elucidating the Molecular Mechanisms of Calcific Aortic Valve Disease

Project Description:

This project is aligned with a recently awarded Category 1 research grant and provides an excellent opportunity to receive training in basic cell and molecular biology techniques such as immunoblotting, flow cytometry, fluorescence/confocal microscopy, intravital microscopy, in addition to tissue engineering and organ-on-a-chip. The student will join a skilled team of nationally and internationally recognised researchers in the fields of vascular biology and cardiovascular diseases and contributes to high-impact projects.

Calcific Aortic Valve Disease (CAVD) is a common cause of mortality and morbidity, with severe calcified aortic valve stenosis (AS) affecting between 2.9 to 3.4% of elderly patients in developed countries. Without treatment, symptomatic, severe AS results in rapid deterioration and death with approximately 50% mortality within two years of diagnosis.

Due to our limited understanding of the mechanisms that drive the progression of AS, there is no treatment for calcified aortic valve other than surgical or transcatheter valve replacement. Despite substantial advances in surgical and transcatheter aortic valve replacement, severe AS continues to carry a poor prognosis, with a 3-fold increased risk of mortality within 5 years.

This multidisciplinary project will utilise a newly bioengineered aortic valve model that mimics features of early and late stages of CAVD to enable systematic pathomechanistic studies.

We are looking for students with a very good degree in a Biomedical Sciences and an aptitude for experimental work.

Primary Supervisor: A/Prof Sara Baratchi

Primary Supervisor Contact: sara.baratchi@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 0

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 2

Master of BioMed places available: 0

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 0

Master of BioMed places available: 2

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 Centre 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 0

Master of BioMed places available: 2

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 hyperglycemia. 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 0

Master of BioMed places available: 2

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 0

Master of BioMed places available: 2

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 2

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Melbourne Vascular Tissue Repository (MeVTR)

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Care of Mature Aged Adults with Type 1 diabetes (MADE-IT T1D)

Project Description:

Of Australia's 135,000 people with Type 1 diabetes, over 2/3 are aged 40 years and over and 1/3 are already aged 60 years or over. Whilst there are many guidelines and services for the care of children and young adults with Type 1 diabetes, that of middle-aged and older people are lacking. The team is developing a program of resources to guide healthcare professionals and people living with Type 1 diabetes and their family members / carers as to how to live long and well. This includes books and on-line resources. The student will contribute to articles for healthcare professional, lay people and digital resources. Publications and conference presentations are likely.

Primary Supervisor: Prof Alicia Jenkins

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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 tumours 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 auto-reactive 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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 signalling 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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 centre 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Characterising myeloperoxidase oxidation on lipids and lipoproteins

Project Description:

A central process in our innate immune system is the ability of neutrophils to react to acute inflammatory stimuli and, when necessary, mount a defence against foreign pathogens, including bacteria. Such a response often leads to the production of reactive molecules through the action of myeloperoxidase (MPO). Among the compounds generated by MPO is hypochlorous acid, a cytotoxic oxidant deployed to eliminate bacteria. Hypochlorous acid is known for causing oxidative damage to nearby tissues, particularly noted for its high reactivity with lipids. This project, suitable for a honours, masters or PhD student, seeks to identify and characterise lipids generated from myeloperoxidase induced oxidation, across a broad spectrum of lipid classes using mass spectrometry, with the goal of understanding their subsequent effects on cellular stress and death.

Primary Supervisor: Dr Kevin Huynh

Primary Supervisor Contact: kevin.huynh@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Development and validation of a high throughput clinical lipidomics platform

Project Description:

An innovative research initiative aimed at translating world-class laboratory protocols into a clinical setting. This research, suitable for a Masters or PhD student, strives to create an integrated system combining LC-MS/MS technology and statistical modelling to predict future disease by assessing patients' metabolic health based on lipid biomarker profiling.

Primary Supervisor: Prof Peter Meikle

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Modulating Plasmalogens Lipids to Protect the Heart

Project Description:

Heart attacks (myocardial infarction; MI) remain a leading cause of global mortality. Heart attacks cause ischemic damage that arise from the reduction of blood flow to the heart, resulting in cell death. While the most effective clinical intervention for MI is to allow for the prompt restoration of blood flow (reperfusion) via stenting or vessel bypass grafting, this often resulting in additional heart damage caused when blood supply returns to the heart tissue. Collectively this is termed ischemia reperfusion (IR) injury. There are no current therapies to address this, highlighting an urgent need for novel treatments that reduce damage and enhance recovery

Primary Supervisor: Prof Peter Meikle

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 0

Master of BioMed places available: 1

Defining the lipidomic landscape across postnatal development and ageing

Project Description:

Lipids are essential regulators of membrane structure, cellular signalling, metabolism, and immune function. Although lipid composition undergoes extensive remodelling throughout postnatal development and ageing, age-related changes across tissues and immune cell populations remain poorly understood. This project aims to define the lipidomic landscape across the lifespan by profiling blood, lymphoid tissues, immune cells, and major organs from mice at key developmental and ageing stages using mass spectrometry-based lipidomics. Particular emphasis will be placed on plasmalogens and other ether lipids because of their roles in membrane biology, oxidative stress, and immune function. The resulting dataset will provide a valuable reference for understanding lipid metabolism across the lifespan, identify pathways associated with immune maturation and ageing, and support future lipid-targeted strategies to promote healthy ageing.

Primary Supervisor: Prof Peter Meikle

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Role of Ether lipids in lymphocyte biology and function

Project Description:

Lymphocytes, particularly T and B cells, are essential for adaptive immunity, immunological memory, and immune homeostasis. Although cellular lipid composition is increasingly recognised as a regulator of immune cell signalling, metabolism, and survival, the role of ether lipids in lymphocyte biology remains poorly understood. This project aims to define the role of ether lipids, particularly plasmalogens, in lymphocyte development, function, and stress adaptation using cellular models integrated with lipidomics, immunophenotyping, and molecular analyses. The findings will provide fundamental insights into how ether lipid metabolism regulates lymphocyte biology and inform future therapeutic strategies to improve immune function during ageing and disease.

Primary Supervisor: Prof Peter Meikle

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Revolutionizing Disease Prediction and Management through Plasma Lipidomic Profiling

Project Description:

In this groundbreaking project, you will be instrumental in driving forward the science of precision medicine through the lens of lipidomics. Your work will focus on identifying and validating novel lipid biomarkers. This crucial step is the backbone of personalized medicine, enabling the development of tailored diagnostic and therapeutic strategies. You will learn to navigate the complexities of biomarker research, from discovery through to validation. This involves applying bioinformatics and statistical analysis to translate raw data into actionable insights, a skill highly valued in both academic and industry settings.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Unlocking the Secrets of Cardiometabolic Diseases through Multi-Omic Integration

Project Description:

An opportunity for students to contribute to groundbreaking research integrating multi-omic data to revolutionise our understanding of cardiometabolic diseases. Ideal for a bioinformatics-oriented Masters or PhD student, this work will involve bioinformatics and statistical modelling to uncover causal lipid metabolic pathways in cardiometabolic diseases, potentially identifying new therapeutic targets.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Do shorty 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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.

Primary Supervisor: Prof Andrew Murphy

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Novel effects of GLP-1 agonists in people with type 2 diabetes

Project Description:

GLP-1 agonists are new drugs used for the treatment of type 2 diabetes. Importantly, they show improvements not only in glucose control, but also with respect to cardiovascular disease risk. They are also popular for their weight loss effects, including among people without diabetes. Nevertheless, emerging data indicates that they may also have some other unintended consequences, including weight loss-related muscle mass loss and adverse effects on the eyes.

This is a clinical research project involving analyses of data from the PREDICT study (https://baker.edu.au/research/clinical-trials/diabetes-complications). PREDICT is a cohort with a broad range of measurements relevant to diabetes and its complications (baseline and 5-year follow-up). The aim of this project is to compare the trajectory of muscle function, eye disease, and related outcomes, among people treated with GLP-1 agonists vs. other drugs. Applicants should have an interest in developing data analysis and epidemiology skills.

Primary Supervisor: Dr Julian Sacre

Primary Supervisor Contact: julian.sacre@unimelb.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed 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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Biologic Aging in Vascular and Systemic Tissues

Project Description:

Existent and being collected human and animal tissues from diabetic and non-diabetic subjects will be used to evaluate molecular, protein and epigenetic markers of biologic aging. These changes are implicated in the pathogenesis of long-term diabetes complications and are likely treatment targets.

Some models will test interventions. Techniques will include RT-PCR, digital PCR and immunohistochemistry / Western blots. Conference presentations and publications are likely.

Primary Supervisor: Dr Michael Huang

Primary Supervisor Contact: michael.huang@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 2

Master of BioMed places available: 1

Platelet function in people with and without diabetes

Project Description:

Blood clotting is implicated in the pathogenesis of the eye, kidney and heart complications of diabetes, yet knowledge of blood clotting and its treatment in people with diabetes is lacking, particularly for people without clinically evident complications. In this project blood will be collected from adults with and without Type 1 and Type 2 diabetes, and platelets and white blood cells will be prepared. These cells will be evaluated in tests of platelet clotting, anti-platelet drug resistance, and cell respiration and mitochondrial function. Publications and conference presentations are likely.

Primary Supervisor: Dr Michael Huang

Primary Supervisor Contact: michael.huang@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Developing novel methodologies to measure micro and nanoplastics in the body

Project Description:

The overarching goal of this project is to develop new methodologies to accurately measure the biodistribution of micro and nanoplastics (MNPs). Our hypothesis is that MNPs, after entering the circulatory system, accumulate in specific tissues, including the liver, heart, and lungs, where they induce a pro-inflammatory response and cellular damage. Developing precise detection methods for various types and sizes of MNPs will enable a better understanding of their distribution patterns, accumulation, and potential long-term effects on health.

To address these issues, this project will aim to develop several alternate, complimentary approaches for biodistribution analysis including: (i) pyrolysis gas chromatography mass spectroscopy (pyGCMS); (ii) Raman microscopy, utilizing distinct vibration spectra produced by MNPs for cellular resolution imaging of uptake; (iii) monoclonal antibody development, for specific detection of various plastic types in immuno-based assays (testing of antibodies only, development is outsourced); (iv) MNP labelling, using internal and external fluorescent dyes.

We expect to identify the major organ systems where MNPs accumulate, providing critical insights into the biodistribution of various particle types. We anticipate that distinct MNP types will preferentially accumulate in specific organs, such as the liver or spleen, which will inform future studies on the long-term pathological effects of MNP exposure. These data will be invaluable for understanding the health impacts of chronic MNP exposure and will lay the groundwork for future research into mitigating MNP-induced damage in affected organ systems. The project will involve optimising protocols, using complex machines and equipment.

Primary Supervisor: Dr Alexander Pinto

Primary Supervisor Contact: alex.pinto@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

New mRNA drugs to treat heart attacks and heart failure

Project Description:

Cardiac fibrosis is a key contributor to the progression of heart failure after heart attacks. Recent discoveries in our lab have identified novel cell populations that emerge in response to cardiac injury or stress and actively drive fibrotic remodelling. Despite this insight, current strategies lack the ability to selectively target and inhibit these pro-fibrotic cells.

The rapid advancement of mRNA technologies—highlighted by their success in vaccine development during the COVID-19 pandemic—offers a promising therapeutic avenue. mRNA therapeutics are highly adaptable, with tuneable features that can be engineered for cell-specific delivery and activity.

In this project, we will leverage single-cell genomics to inform the design of engineered mRNA constructs with elements that confer specificity to pro-fibrotic cardiac cells. These constructs will be tested for their ability to selectively target and modulate fibrotic responses following heart injury.

This project is ideal for students interested in:

- mRNA technology and therapeutic design
- Single-cell genomics
- Animal models of disease
- High-dimensional cytometry and advanced microscopy
- Translational drug development

Primary Supervisor: Dr Alexander Pinto

Primary Supervisor Contact: alex.pinto@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Assessing cardiometabolic and cardiac cellular impacts of micro and nanoplastic exposure.

Project Description:

The presence of micro and nanoplastics (MNPs) in plaques is associated with increased vascular disease and risk of stroke, heart attack and death. MNPs have been found in human blood, and vascular and heart tissue. By using single cell RNA-seq and carefully isolating and sequencing genes from the different cell types of the heart, we have gained a comprehensive overview of cardiac responses to MNPs. Our preliminary analysis shows substantial changes in abundance of subpopulations and gene expression including in fibroblasts, cardiomyocytes (CMs) and endothelial cells (ECs). Gene ontology (GO) analysis of ECs indicate upregulation of genes related to fibrosis, which is associated with impaired heart function. This project would complete the comprehensive analysis of this data, as well as lipidomic data. New data will also be collected on metabolic changes due to MNP exposure in mice, including body composition and behaviour changes.

This project will provide the first systematic analysis of potential cardiotoxic and metabolic effects of heterogenous MNPs produced from raw plastic. Metabolism data combined with scRNA-seq studies will provide an agnostic high-resolution overview of the cardiometabolic stress response to MNPs, paving the way for risk reduction strategies and therapeutic interventions. This project will involve bioinformatics, data analysis, animal models, lipidomics, and metabolic profiling.

Primary Supervisor: Dr Alexander Pinto

Primary Supervisor Contact: alex.pinto@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

New methods to regenerate the mammalian heart

Project Description:

The primary driver of disease following myocardial infarction (MI)—also known as heart attack—is the death of cardiac muscle cells (cardiomyocytes) and their replacement by scar tissue. The ultimate goal of cardiac regenerative medicine is to restore these lost cardiomyocytes and thereby restore heart function. In the past decade, much excitement has been generated by the discovery that cardiac support cells called fibroblasts can be reprogrammed in vitro or within the damaged heart itself to generate cardiomyocytes. However, inefficiency of fibroblast-to-cardiomyocyte reprogramming, and reprogrammed cardiomyocytes exhibiting undesirable characteristics remain key challenges that must be overcome for the clinical application of this technology.

Using single-cell genomics we have recently identified multiple regulatory genes that may be manipulated to enhance fibroblast-to-cardiomyocyte reprogramming. In this project, these regulatory genes will be tested to study their effect on cellular reprogramming. The project will involve animal procedures, microscopy, flow cytometry and application of bioinformatics.

Primary Supervisor: Dr Alexander Pinto

Primary Supervisor Contact: alex.pinto@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Decoding the molecular architecture of cardiovascular disease

Project Description:

Cardiovascular disease reflects metabolites acting together through shared metabolic pathways, not individual biomarkers in isolation. Conventional machine learning ignores that structure, treating each metabolite as an independent feature and producing models that work well, but explain little. This project takes the opposite approach: it builds pathway-informed models in which the latent factors are constrained to correspond to known genes, enzymes and reactions, so the signatures the model learns can be read as biology rather than as opaque weights. Working with the large omics datasets, the student will derive pathway-anchored molecular signatures, test which are associated with cardiovascular disease and heart failure. This project sits at the intersection of machine learning, multi-omics, and cardiovascular biology, offering the opportunity to discover new disease mechanisms.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

When biology breaks the textbook: decoding unexpected gene–lipid relationships

Project Description:

Pathway databases present lipid metabolism as a tidy chain of genes, enzymes, and reactions, but real biology keeps refusing to cooperate. Our previous results have highlighted where genetic variants produce a pattern of lipid associations that its cannot be explained by a genes canonical function. This project sets out to understand what the gene is actually doing. The student will combine human genetic associations with state-of-the-art regulatory variant-effect and protein-structure prediction (AlphaGenome, AlphaFold), tissue expression and curated metabolic networks (KEGG, Reactome) to reconstruct plausible mechanisms. This is scientific detective work at the frontier of genomics, AI, and metabolic biology, with the potential to uncover previously unknown gene functions and rewrite an incomplete piece of the lipid-metabolism textbook.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Functional Characterization of the Gut Microbiome's Genetic Capacity to Produce Cardiovascular-Linked Metabolites in Type 2 Diabetes

Project Description:

A meaningful fraction of the circulating metabolite biomarkers implicated in cardiovascular risk (e.g. trimethylamine, short-chain fatty acids, secondary bile acids) are produced and/or modified by the gut microbiome. This project asks whether the gut microbiomes of people with type 2 diabetes (T2D) carry an enriched genetic capacity to synthesise these metabolites relative to controls. It combines two resources: (i) the publicly available Curated Metagenomic Data resource, which provides harmonised species and gene-family and pathway abundances across established T2D and control cohorts; and (ii) an internal, human-gut-enriched bacterial annotated genome catalogue to support enzyme-level capacity mapping onto community composition. Analyses will adjust for key confounders, including age, sex, and antibiotic and metformin exposure, with additional covariates considered as appropriate. The deliverable is a ranked, genome-resolved table of T2D-altered metabolic capacities mapped to their circulating metabolite products, a mechanistic annotation layer flagging which circulating metabolite biomarkers plausibly have a gut-microbial origin.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 0

Systematic Review and Meta-Analysis of Circulating Omics Biomarkers for Cardiovascular Disease in Type 2 Diabetes

Project Description:

Traditional risk factors explain only ~62% of the excess cardiovascular disease (CVD) risk in type 2 diabetes (T2D), leaving a substantial fraction of risk unexplained by current clinical tools. This project synthesises what has already been discovered within that residual risk, through a protocol-driven review of published circulating omics data associations with CVD in people with T2D. For each reported biomarker, a standardised effect estimate, cohort context, platform, outcome definition and covariate adjustment will be reported. This catalogue will serve as a citable “state of the field” synthesis, and a reusable novelty benchmark against which newly discovered candidate markers can be immediately classified as replicating established biology or representing a new signal. Where a given biomarker is reported by enough comparable studies, random-effects meta-analysis will generate summary estimates. As a methodological sub-study, risk-of-bias appraisal will be performed both manually and via an AI-assisted (large language model) workflow, with agreement between the two compared.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 0

Integrative multi-omics approach to uncover female-specific cellular and molecular drivers of cardiac remodelling associated with hypertension

Project Description:

Hypertension is a major modifiable risk factor for cardiovascular disease and remains a leading contributor to morbidity and mortality worldwide. Although hypertension affects both men and women, growing evidence suggests that its biological drivers, clinical presentation, and long-term consequences may differ by sex. In women, hypertension risk is influenced by complex interactions between genetic susceptibility, hormonal regulation, vascular function, immune responses, metabolic factors, and life-course events such as pregnancy and menopause. Despite this, many studies and treatment approaches have historically been based on mixed or male-dominant populations, which may overlook female-specific biological pathways. Understanding the genetic, molecular, and cellular drivers of hypertension in women could help explain why some women develop hypertension earlier, experience more severe cardiovascular consequences, or respond differently to treatment. This knowledge is essential for improving risk prediction, identifying new therapeutic targets, and developing more precise prevention and treatment strategies tailored to women's cardiovascular health. This project will use a systems genomics approach to investigate the biological mechanisms underlying cardiac remodelling associated with hypertension in women. The student will integrate publicly available and in-house single-cell omics datasets to uncover disease-associated genes, pathways and cardiac cell types involved in hypertensive cardiac remodelling, particularly in women.

Primary Supervisor: Dr Corey Giles

Primary Supervisor Contact: corey.giles@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Impact of milk bank processing on the donor milk lipidome

Project Description:

Early-life nutrition shapes lifelong health and disease risk. By investigating how milk bank processing alters the lipid composition of donor milk, you will contribute to research aimed at improving nutrition for some of the most vulnerable infants in our healthcare system. Join a dynamic, multidisciplinary team working at the interface of analytical chemistry, metabolism, and neonatal health

Primary Supervisor: Dr Alexandra Geroge

Primary Supervisor Contact: alexandra.george@baker.edu.au

Project Site: Baker Heart & Diabetes Institute

Honours places available: 1

Master of BioMed places available: 1

Burnet Institue

Developing mRNA vaccines for 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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

Discovering how the malaria parasite creates a protective niche in human red blood cells

Project Description:

Malaria remains a major global health burden causing hundreds of millions of debilitating infections per year that tragically result in nearly half a million deaths. The mosquito borne Plasmodium parasites which cause malaria, invade and grow inside in human red blood cells (RBCs). RBCs are ideal places for parasite to live because there are lots of them, they are relatively invisible to the immune system, and they can be taken up by mosquitoes to be transmitted to others. The disadvantages are that RBCs are small, nutrient poor and their quality is monitored by the spleen where parasite infected RBCs are destroyed. For these reasons parasites extensively modify their RBCs to obtain supplementary nutrients and to avoid passage through the spleen.

Parasites modify their RBCs by exporting hundreds of proteins into the RBC compartment which surrounds the parasite. Exported proteins gain entry to the RBC compartment by passage through a protein translocon channel called PTEX. Exported proteins contain a molecular barcode called a PEXEL motif that is scanned within the parasite and by PTEX outside the parasite. There are many steps during the export journey which are poorly understood, and this project seeks to address this by using different PEXEL proteins which either remain trapped inside or just outside the parasite or are fully exported into the RBC compartment. The PEXEL reporters will contain a TurboID biotinylation enzyme which will tag nearby proteins allowing us to determine the factors that assist the PEXEL reports to be exported out of the parasite and into the RBC. This project could help inform the development of new drugs that prevent parasites from successfully infecting human RBCs.

Skills that will be acquired during this project include parasite cell culture, immunofluorescence microscopy, protein export assays and mass spectrometry.

Primary Supervisor: A/Prof Paul Gilson

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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

Discovering the targets of drugs that stop malaria parasites invading red blood cells

Project Description:

Malaria caused by Plasmodium falciparum parasites, remains a major global health problem with about 40 per cent of the world€™s population at risk of infection. Although there have been major reductions in disease impact over the last 10 years due to increased malaria control, this downward trajectory has recently stalled. Of particular concern is the global spread of parasites resistant to frontline artemisinin

combination therapies. This emphasizes a critical need to discover new drugs with novel targets to fight malaria.

Malaria is caused by large scale parasite infection of the body€™s red blood cells (RBCs). We are particularly interested in how parasites invade RBCs because if this could be stopped then the parasite infection could be arrested. There are probably hundreds of proteins involved in invasion and the most obvious players have been studied. To identify novel invasion proteins and to understand their roles we propose to screen drug libraries against parasites to find those that kill parasites and determine how potent they are. We will then determine if these growth inhibitory drugs act by blocking parasite invasion of human RBCs. The drug will be used as tools to better understand invasion using two main approaches. 1) Live cell video microscopy will be used observe drug -treated parasites as they try to invade RBCs so we can determine which invasion step is being blocked. 2) Select for parasite resistance to the compounds and then identify the mutations responsible in the target gene of the tool compound. If the tool compounds have a unique and interesting mechanisms of action they could be developed into future antimalarial dugs.

Skills acquired during this project will be in cell culture, advanced microscopy and AI analysis, genomics and molecular biology.

Primary Supervisor: A/Prof Paul Gilson

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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

Developing a futureproof Malaria Rapid Antigen Test (MRAT).

Project Description:

This project seeks to develop a malaria rapid antigen test that is highly sensitive and cannot be evaded by the parasites.

Primary Supervisor: A/Prof Paul Gilson

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

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

Antibody biomarkers of pathogen and vector exposure for improved malaria surveillance

Project Description:

Malaria is a leading cause of global morbidity and mortality. Efforts to eliminate malaria are constrained by a lack of highly sensitive surveillance tools and approaches to accurately detect malaria transmission

throughout exposed populations. Serosurveillance is a strategy for monitoring malaria exposure and transmission by measuring the host antibody response to the causative pathogen and/or transmitting vector.

This project will focus on identification and evaluation of antibody responses to both parasite (malaria causing Plasmodium spp.) and vector (malaria transmitting Anopheles spp. mosquitoes) candidate biomarkers to monitor ongoing transmission of malaria and the efficacy of malaria interventions. Students will quantify host antibody dynamics following mosquito exposure and malaria infection to identify candidate parasite and vector serosurveillance biomarkers. This project will also explore sentinel and high-risk surveillance populations living in malaria endemic settings to test these approaches for monitoring ongoing malaria transmission in these regions. Expansion into other vector borne diseases may also be pursued.

The project will combine laboratory-based research, including immunoassays (e.g. ELISA) and molecular techniques (e.g. quantitative PCR) in large cohort studies conducted in malaria endemic populations, with statistical analyses. This project is suited to students with a keen interest in infectious diseases, immunology, epidemiology, and public health. Specific techniques could be tailored to meet the students interests and background.

Primary Supervisor: Professor Freya Fowkes

Primary Supervisor Contact: freya.fowkes@unimelb.edu.au

Project Site: Burnet Institute

Honours places available: 1

Master of BioMed places available: 1

Department of Clinical Pathology, Victorian Comprehensive Cancer Centre (VCCC)

Deaminase mutations and the implications for cancer development and treatment
Project Description:

The family of adenosine and cytosine deaminases acting on DNA and RNA (ADARs) during transcription play important roles in cancer development and disease and including the ability of a patient to benefit from immunotherapy. In this project we will use machine learning methods to uniquely define key deaminase signatures and use these to improve our understanding why some non-small cell lung carcinoma (NSCLC) patients gain a clinically sustainable benefit from first-line immunotherapy, and others don't. (Data from Samsung in Korea and CGFL France partnerships will be used.)

Primary Supervisor: Dr Robyn Lindley

Primary Supervisor Contact: robyn.lindley@unimelb.edu.au

Project Site: Department of Clinical Pathology, Victorian Comprehensive Cancer Centre (VCCC)

Honours places available: 0

Master of BioMed places available: 2

Department of Infectious Diseases

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 mosquitos.

Primary Supervisor: Dr Matthew Dixon

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

Project Site: Department of Infectious Diseases

Honours places available: 1

Master of BioMed places available: 0

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

Project Site: Department of Infectious Diseases

Honours places available: 1

Master of BioMed places available: 0

Department of Medicine, Royal Melbourne Hospital

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

Project Site: Department of Medicine, Biomedical Engineering and Howard Florey

Honours places available: 1

Master of BioMed places available: 1

Neuroimaging of the microvasculature in stroke patients with the no-reflow phenomenon

Project Description:

The no-reflow phenomenon is a newly-described condition in ischemic stroke patients where blood fails to reperfuse the downstream brain tissue despite resolution of the upstream vascular obstruction. Understanding this phenomenon will provide a pathway to develop new treatments for ischemic stroke.

This project aims to apply advanced microvascular brain perfusion imaging analysis to patients with no-reflow to establish novel neuroimaging biomarker of this condition. This may help develop new diagnostic tools for no-reflow that may be applied to clinical practice and research.

Primary Supervisor: Dr Felix Ng

Primary Supervisor Contact: ng.f@unimelb.edu.au

Project Site: Department of Medicine, Melbourne Brain Centre at Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 2

Master of BioMed places available: 1

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 treatments including small molecule inhibitors (such as venetoclax and ibrutinib) and immunotherapies (such as bispecific antibodies and CAR-T cells) have emerged as novel treatment options resulting in improved outcomes for patients with B cell malignancies. Our existing data has demonstrated that small molecule inhibitors have a significant impact on patient immune function, while immunotherapies are reliant on effective patient immune function. This project will explore the relationship between immune function and therapeutic efficacy to improve treatment outcomes.

Primary Supervisor: Prof David Ritchie

Primary Supervisor Contact: david.ritchie@mh.org.au

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 2

Master of BioMed places available: 2

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 heathy 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

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

DNA Methylation as a determinant of phenotype in an X linked disease

Project Description:

In this project DNA methylation will be assayed and compared with disease phenotype in patients with Fabry disease, and X linked genetic disorder for which RMH is the coordinating Victorian treatment centre. This project is suitable for an honours student, and in combination with additional studies in Fabry disease is suitable also for Masters project in Biomedicine or Science

Primary Supervisor: A/Prof Kathleen Nicholls

Primary Supervisor Contact: kathy.nicholls@mh.org.au

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Effect of Specific Disease Therapy on the Lipid Profile of Patients with Fabry Disease

Project Description:

Fabry disease is a rare X-linked genetic disorder of sphingolipid metabolism in which deficiency of the enzyme alpha-galactosidase results in multisystem disease manifestations including premature stroke, cardiomyopathy and chronic kidney disease. Untreated patients are reported to have elevated HDL and normal LDL, but most treating physicians treat Fabry patients to high-risk target lipid levels, usually with statins. Rmh records contain over 20 years of serial annual basic lipid profiles in over 150 Fabry patients, including over 40 patients treated with enzyme replacement and 20 patients treated with chaperone

therapy. This study aims to analyse lipid profiles before and after specific disease therapies, capturing age, sex, statin or other lipid therapies, and status re specific therapy. Research questions are:

1. IS there evidence of abnormal lipid profile in untreated Fabry patients? Are mean lipid levels the same as the general population?

2. How many patients are accessing statin or other lipid therapies?

3. What is the effect of enzyme replacement on lipid profile of FAbry patients?

4. What is the effect of specific chaperone molecule therapy on lipid profile of FAbry patients?

Primary Supervisor: A/Prof Kathleen Nicholls

Primary Supervisor Contact: kathy.nicholls@mh.org.au

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Symptomatic Impact of ADPKD in an Australian cohort

Project Description:

Autosomal Dominant Polycystic Kidney Disease (ADPKD) is the most common genetic renal disease, with a prevalence of 1 in 1000 people. International expert consensus has identified several areas within the clinical care of patients with ADPKD which have been under-researched and poorly documented (1). These include

i) Assessment of physical and psychological burden of disease

ii) Effects on sleep pattern, including the effects of pain or discomfort

iii) The type and temporal pattern of proteinuria in relation to disease progression

iv) The effects of gender on disease progression, including the effects of multiple pregnancies and use of exogenous oestrogens and progestogens

v) Attitudes to genetic testing, including place of preimplantation genetic diagnosis.

This study is designed to address these areas via the following related research questions:

i) What is the impact of ADPKD on patients' Quality of life, across the stages of CKD?

ii) How common and severe is pain experienced in ADPKD?

iii) Is sleep pattern normal in ADPKD? At what stage of renal enlargement or CKD does it occur?

iv) At what stage of CKD is proteinuria usually present in ADPKD, and is the pattern glomerular or tubular?

v) Are female patients being advised by their medical teams on effects of pregnancy and hormonal contraception?

vi) How do patients with ADPKD assess their own medical literacy re genetic aspects of the disease?

METHODS –

Patients will be identified via departmental database and Melbourne Health EMR. In addition, patients will be invited to participate via the PCKD patient support group.

Research Q 1. Using the Monash University AQol8D questionnaire, the responses of ADPKD patients across 8 domains will be quantified relative to Australian normative data.

https://www.aqol.com.au. Any changes identified from Au norms for age and gender will be assessed in relation to CKD stage and renal size.

Research Q2- Assessment of pain burden will utilise standardised questionnaires including the McGill pain questionnaire https://www.sralab.org/sites/default/files/2017-07/McGill%20Pain%20Questionnaire%20%281%29.pdf

Q3 Sleep in ADPKD - 3. Is sleep pattern normal in ADPKD? At what stage of renal enlargement or CKD does it occur? (Pilot study using wearables in 12 patients with abdominal distension from cysts)

Q4 Analysis of U PCR and U ACR over time

Q5 Female patients will be surveyed re their experiences re counselling on use of hormones for contraception or replacement and their pregnancy history, using digital focus group participation with thematic qualitative analysis.

Q6 Attitudes of patients to genetic testing for ADPKD - will also utilise digital focus group participation with thematic qualitative analysis. Draft Qs will include

i) Are you aware that genetic testing for ADPKD is available?

ii) Is this something you would want to access for yourself? For your children?

iii) If you accessed / wish to access, how would you use that information?

iv). Do you think that the familial nature of polycystic disease has affected your family life? In what ways?

v). If you were planning pregnancy now, would you want to have IVF and embryo selection to avoid having a child with ADPKD?

Primary Supervisor: A/Prof Kathleen Nicholls

Primary Supervisor Contact: kathy.nicholls@mh.org.au

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Department of Medicine, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

A New Therapeutic Approach for Diabetes and Obesity

Project Description:

Metabolic diseases such as obesity and diabetes are major health concerns worldwide, with Australia being one of the most affected countries. We are interested in studying the underlying mechanisms that contribute to the development of these metabolic disorders. A deeper understanding of the pathophysiology of obesity and diabetes will help us develop more effective therapeutic approaches for these diseases.

Specifically, our research program focuses on the discovery and fundamental biology of key moleculesâ€”salt-inducible kinasesâ€”that play crucial roles in the regulation of energy homeostasis, beta-cell biology, and glucose and lipid metabolism. These molecules are currently being pursued across the pharmaceutical sector as promising drug targets for chronic inflammatory diseases.

We have developed a sophisticated suite of research tools, including several novel transgenic mouse models, to determine the precise role of these molecules in metabolic regulation. As part of our laboratory, you will receive multidisciplinary training from experts in biochemistry, cell biology, metabolic physiology, and preclinical studies.

Primary Supervisor: Dr Kim Loh

Primary Supervisor Contact: kloh@svi.edu.au

Project Site: Department of Medicine, St Vincent's Institute of Medical Research

Honours places available: 1

Master of BioMed places available: 1

Glucose variability among patients receiving haemodialysis for kidney failure

Project Description:

Haemodialysis, the most common form of dialysis for kidney failure, causes physiological shifts that contribute to blood glucose fluctuations. These fluctuations complicate glycaemic management and can lead to poor outcomes. This study aims to: (1) Assess glucose variability in haemodialysis patients using Continuous Glucose Monitoring (CGM), (2) Compare CGM data with point-of-care capillary glucose testing. Although CGM has been embraced for people with Type 1 Diabetes, evidence supports its broader use in haemodialysis patients to better understand and manage glucose fluctuations. This study will provide insight into glucose patterns in dialysis patients both with and without diabetes, guiding more precise and effective glycaemic control strategies.

Primary Supervisor: Prof Karen Dwyer

Primary Supervisor Contact: dwyerk@unimelb.edu.au

Project Site: Department of Medicine: Nephrology, Royal Melbourne Hospital - City

Honours places available: 1

Master of BioMed places available: 0

Utility of continuous glucose monitoring in the first month post renal transplantation

Project Description:

Kidney transplantation is the preferred treatment for people with kidney failure offering the best quantity and quality of life. However, transitioning to life with a kidney transplant poses a stress to the patient's metabolism in part related to the enormity of the surgical procedure and the medications required to prevent transplant rejection. Diabetes arising after kidney transplantation is common. This study will use continuous glucose monitoring to provide novel insight into glucose patterns in transplant recipients in the first month after transplantation.

Primary Supervisor: Prof Karen Dwyer

Primary Supervisor Contact: dwyerk@unimelb.edu.au

Project Site: Department of Medicine: Nephrology, Royal Melbourne Hospital - City

Honours places available: 1

Master of BioMed places available: 1

Peri-menopause and chronic kidney disease

Project Description:

Peri-menopause and menopause with comorbid chronic kidney disease (CKD) may manifest earlier and symptoms may differ to women without CKD. In this study we will assess for peri-menopausal symptoms using a validated checklist in women presenting to CKD outpatient clinic. The presence of

metabolic syndrome will be determined. A questionnaire will be used to understand whether women are asked about peri-menopausal symptoms and if treatment options have been discussed and offered

Primary Supervisor: Prof Karen Dwyer

Primary Supervisor Contact: dwyerk@unimelb.edu.au

Project Site: Department of Medicine: Nephrology, Royal Melbourne Hospital - City

Honours places available: 1

Master of BioMed places available: 0

When the First Fails: Survival and Selection in Liver Retransplantation

Project Description:

One in twelve liver grafts today are offered to patients requiring retransplantation due to failure of the primary graft. This failure may occur within days of the initial transplant—such as in primary non-function—or years later due to causes like disease recurrence. Regardless of timing or cause, liver retransplantation presents a significant burden for both patients and the healthcare system. This project investigates the clinical outcomes and selection criteria for liver retransplantation following graft failure. Using retrospective data from a tertiary transplant centre, the study will analyse patient and graft survival rates, timing of retransplantation, and key factors influencing prognosis. The goal is to identify which patients derive the greatest benefit from retransplantation and to support evidence-based decision-making in this high-risk clinical setting.

Primary Supervisor: Prof Marcos Perini

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

Project Site: Department of Medicine: Austin Health

Honours places available: 1

Master of BioMed places available: 1

Population frequency of genetic diseases

Project Description:

The population frequencies of many genetic diseases are unknown and many are overlooked in the clinic. The aim of this project is to estimate the population frequencies of genetic diseases in order to improve clinician awareness, aid in health service planning and encourage pharmaceutical companies to develop treatments. This project uses simple bioinformatics tools to esimate the number of disease-causing variants in a large normal database (gnomAD). Most of our previous students have obtained at least one publication from their project.

Primary Supervisor: Prof Judy Savige

Primary Supervisor Contact: j.savige@unimelb.edu.au

Project Site: Department of Medicine: Royal Melbourne Hospital

Honours places available: 2

Master of BioMed places available: 2

Review of kidney function in patients on radioligand treatment for metastatic prostate cancer

Project Description:

Radiation nephropathy has evolved from a common complication of external beam radiation to a less frequent but still significant concern with modern targeted therapies like lutetium PSMA and PRRT, with kidney injury rates varying widely based on the type of radiation therapy. With expanding and earlier use of radiopharmaceuticals, particularly lutetium PSMA in the prostate cancer treatment paradigm, there is a growing need to recognise and understand rare and delayed toxicities (such as CKD) to allowing for early intervention to mitigate toxicity and inform clinical practice. At our centre, 650 patients have received treatment with lutetium PSMA over the past 10 years [2015-2025] as part of clinical trials, registry or standard-of-care. The aims of this study are to: 1) Review the rate of kidney disease development in the cohort, 2) Determine any associated risk factors and 3) Develop surveillance protocols for kidney function and hematologic parameter monitoring for patients receiving lutetium PSMA

Primary Supervisor: Dr Irene Ruderman

Primary Supervisor Contact: irene.ruderman@mh.org.au

Project Site: Department of Medicine: Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 0

Discovery of Mosaic Genes that Cause Brain Mosaicism and Drug-Resistant Focal Epilepsies

Project Description:

Somatic mosaicism has emerged as an important mechanism that is largely confined to the brain and difficult or impossible to detect via conventional testing of blood samples. Development of epilepsy-associated brain lesions appears to be largely driven by mutations in genes involving the mTOR or Ras-MAPK signalling pathways meaning there is the potential for the development of targeted precision therapies.

The Comprehensive Epilepsy Program at the Austin Hospital has a large cohort of patients with drug-resistant focal epilepsy and brain lesions including focal cortical dysplasias and developmental tumours as well as hippocampal sclerosis. These patients are now having prospective deep sequencing to detect mosaic gene variants in brain lesion tissue on an Austin Pathology Epilepsy Clinical Gene Panel. Discovery of mosaic gene variants may provide eligibility for trials of mTOR or Ras-MAPK inhibitors for patients who do not have successful outcomes following epilepsy surgery treatment.

Aims:

1.To perform high depth gene panel sequencing to detect somatic variants in known epilepsy or novel cancer genes in brain lesion tissue from individuals with drug-resistant epilepsy.

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, which may lead to clinical trials of targeted therapies for patients with drug-resistant epilepsy.

Methodology:

1.Prospective gene panel testing of brain lesion tissue from sporadic patients with drug-resistant epilepsy (estimate ~50 individuals).

2.Application of current genomic testing technologies including high-depth sequencing and sensitive droplet digital PCR to detect and quantify mosaic variants even at low variant allele fraction in brain lesion tissue.

3. Tissue immunostaining combined with laser capture microdissection to characterise and quantify mosaic variants in different cell populations in the brain.

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: Prof Michael Hildebrand

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

Project Site: Department of Medicine: Austin Health

Honours places available: 1

Master of BioMed places available: 1

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 The Royal Children's Hospital 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 MRFF-funded Rare Cancers Rare Diseases Unmet Needs (RCRDUN) Clinical Trial of targeted therapies for vascular anomalies commencing in 2024.

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: Prof Michael Hildebrand

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

Project Site: Department of Medicine: Austin Health

Honours places available: 1

Master of BioMed places available: 1

Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital, Royal Children's Hospital/Mercy Hopsital

Physiological and Biochemical Stress Responses in Clinicians Performing Neonatal Intubation: A Pilot Cohort Study

Project Description:

Endotracheal intubation is a life-saving intervention for neonates. It is typically performed on unstable patients in emergency and high-pressure settings, requiring complex technical skills and clinical decisions. Moreover, many infants require more than one attempt, and failure is a common phenomenon. All these challenges make neonatal intubation a highly stressful procedure where clinician performance directly affects clinical outcomes. However, the real-world stress experienced by

clinicians is poorly understood. In this pilot cohort study, we aim to describe the stress levels in clinicians performing neonatal intubation and generate preliminary data on associations between stress levels and intubation success. This study will be conducted in two tertiary hospitals in Australia, Mater Mothers' Hospital (Brisbane) and Royal Women's Hospital (Melbourne), over 12 months. The stress levels will be measured in 60 clinicians performing neonatal intubations, particularly physiological (heart rate variability, pre/during/post-extubation), psychological (State-Trait Anxiety Questionnaire), and endocrine (salivary cortisol, baseline/pre/post) responses to stress. This study will provide the first real-world, objective quantification of clinician stress during neonatal intubation and form a foundation for future interventional trials to reduce stress levels and improve intubation success and neonatal outcomes.

Primary Supervisor: Dr Kate Hodgson

Primary Supervisor Contact: kate.hodgson@thewomens.org.au

Project Site: Royal Womens Hospital

Honours places available: 1

Master of BioMed places available: 0

Elucidating the role of specific molecules in the pathogenesis of pregnancy complications

Project Description:

Placental insufficiency occurs when the placenta, the life support organ of pregnancy, fails to supply oxygen and/or nutrients to support the developing baby throughout pregnancy. It can lead to severe pregnancy complications such as preeclampsia and/or fetal growth restriction, posing significant risks to both mother and baby. However, the mechanisms that lead to placental insufficiency are still poorly understood.

Our team has identified several molecules (RNA or protein) significantly dysregulated in the placentas of patients with placental insufficiency. This honours project offers an exciting opportunity to delve into the biology of these molecules, examining their expression in disease, their regulation and function.

As a member of our research team, you will learn a wide range of wet lab techniques including cell isolation and culture, qRT-PCR and immunohistochemistry and ELISA. This project will not only advance our understanding of placental insufficiency but also aims to equip you with valuable skills and knowledge that are highly sought after in the field of biomedical research.

Primary Supervisor: Dr Lucy Bartho

Primary Supervisor Contact: lucy.bartho@unimelb.edu.au

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Mercy Hospital for Women

Honours places available: 1

Master of BioMed places available: 1

Novel therapeutics to treat the pregnancy complication preeclampsia

Project Description:

Preeclampsia is a serious pregnancy complication that affects 5-8% of all pregnancies worldwide. When it strikes, it threatens the life of both mother and baby. Although preeclampsia was first described by Hippocrates in ancient Greece, there are still no effective treatments for this disease. Delivery of the baby and diseased placenta is the only option.

Our team, based at the Mercy Hospital for Women, have been investigating different treatments for preeclampsia. This project will test the therapeutic potential of a small molecule drug. Using primary human cells and tissues, cellular assays will be conducted to examine if the therapeutic can quench known features of preeclampsia (such as anti-angiogenic molecule production).

As a member of our research team, you will learn a wide range of wet lab techniques including cell isolation and culture, qRT-PCR and ELISA.

Primary Supervisor: Prof Tu'uhevaha Kaitu'u-Lino

Primary Supervisor Contact: t.klino@unimelb.edu.au

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Mercy Hospital for Women

Honours places available: 1

Master of BioMed places available: 1

Discovering new therapies to treat ectopic pregnancy.

Project Description:

Ectopic pregnancy occurs when a fertilised egg implants outside the womb, most commonly in the fallopian tube, where it cannot develop normally. Despite its seriousness, treatment options are limited and often compromise future fertility. Therefore, most ectopic pregnancies are removed surgically. This project aims to discover and test new therapies for safe treatments for ectopic pregnancy.

Primary Supervisor: Dr Lucy Bartho

Primary Supervisor Contact: lucy.bartho@unimelb.edu.au

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Mercy Hospital for Women

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital

Honours places available: 1

Master of BioMed places available: 1

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 counselling families considering fertility preservation procedures. We have one of the largest registries of paediatric cancer patients, from which we can research risk factors, counselling and effectiveness of procedures.

Primary Supervisor: A/Prof Yasmin Jayasinghe

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

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital, Royal Children's Hospital

Honours places available: 1

Master of BioMed places available: 1

A systematic review of IVF add-ons

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

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital

Honours places available: 2

Master of BioMed places available: 2

Antioxidants for female subfertility

Project Description:

A couple may be considered to have fertility problems if they have been trying to conceive for over a year with no success. This may affect up to a quarter of all couples planning a child. It is estimated that for 40% to 50% of couples, subfertility may result from factors affecting women. Antioxidants are thought to reduce the oxidative stress brought on by these conditions. Currently, limited evidence suggests that antioxidants improve fertility, and trials have explored this area with varied results.

This project will update evidence on the effectiveness of different antioxidants in female subfertility from a previously published Cochrane review (https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD007807.pub4/full).

Primary Supervisor: Dr Sarah Lensen

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

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital

Honours places available: 1

Master of BioMed places available: 0

Effect on antibiotics on the microbiome in preterm rupture of membranes

Project Description:

Antibiotics are routinely prescribed in women with preterm ruptured membranes (broken waters) to prevent maternal and neonatal infection. The optimal antibiotic is unknown, and forms the basis of a large mutli-centre clinical trial. In this project we will be assessing the impact of different antibiotics on the vaginal, placental and neonatal microbiome.

Primary Supervisor: Dr Clare Whitehead

Primary Supervisor Contact: clarew@unimelb.edu.au

Project Site: Department of Obstetrics and Gynaecology and Newborn Health, Royal Women's Hospital

Honours places available: 1

Master of BioMed places available: 1

Efficacy of antenatal corticosteroids in women with gestational diabetes having a planned caesarean section: A retrospective cohort study

Project Description:

Despite over 50 years of research exploring the efficacy of antenatal corticosteroids for the prevention of neonatal respiratory morbidity, women with gestational diabetes have largely been excluded from randomised trials. Antenatal corticosteroids can contribute to an exacerbation of maternal hyperglycaemia which may in turn exacerbate neonatal respiratory morbidity or neonatal hypoglycaemia. This retrospective cohort study will explore the efficacy of antenatal corticosteroids when given to women with gestational diabetes prior to a planned caesarean section when the caesarean section is scheduled between 35+0 weeks' and 39+6 weeks' gestation.

Primary Supervisor: Dr Joanne Said

Primary Supervisor Contact: jsaid@unimelb.edu.au

Project Site: Department of Obstetrics, Gynaecology and Newborn Health: Joan Kirner Women's & Children's, Western Health

Honours places available: 2

Master of BioMed places available: 1

Understanding and Treating Infertility Across the Spectrum

Project Description:

Infertility is a complex medical condition affecting one in six people. Infertility is often invisible, under-recognised and under-researched, yet it places significant strain on health, wellbeing, and financial security for individuals and couples navigating treatment. The Moyna Fox Fertility Research Centre is reserching various facets of reproductive medicine from lab-based scientific work to clinical evaluations.

Primary Supervisor: A/Prof Sarah Holdsworth-Carson

Primary Supervisor Contact: sarah.holdsworth-carson@thewomens.org.au

Project Site: Royal Women's Hospital

Honours places available: 1

Master of BioMed places available: 1

Department of Psychiatry, Royal Melbourne Hospital

Ultra-high field neuroimaging of mood and anxiety disorders

Project Description:

The neurobiology of mood and anxiety disorders is increasingly understood to involve dysfunction not only within cortical brain networks, but also functional influences from subcortical neuromodulatory systems. Recent advances in ultra-high field imaging have opened new avenues to investigate the neural mechanisms underlying altered affective and cognitive processing with unparalleled detail. This includes the ability to interrogate small subcortical nuclei which have historically been difficult to characterise using standard neuroimaging approaches due to their size and proximity to surrounding structures. This project will use ultra-high field (7 Tesla) functional magnetic resonance imaging to investigate how brain networks relate to affective and cognitive processes in mood and anxiety disorders. The student will gain hands-on experience with neuroimaging data collection, advanced neuroimaging analysis techniques, and high-performance computing, working alongside a multidisciplinary team spanning psychiatry, neuroimaging, and clinical collaborators.

Primary Supervisor: Dr Alec Jamieson

Primary Supervisor Contact: alec.jamieson@unimelb.edu.au

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Qualitative experiences of antidepressant discontinuation: a co-design approach

Project Description:

While maintenance of antidepressant treatment reduces relapse risk in acutely unwell patients, up to a third of long-term antidepressant users meet current recommendations for discontinuation. For many, this can be a difficult experience, resulting in both withdrawal symptoms and an increased risk of relapse. A better understanding of individuals' experiences of coming off antidepressants would provide critical evidence to help capture and operationalise this issue for future research. This project will use qualitative methods to explore the lived experience of antidepressant discontinuation, capturing how patients understand, experience, and manage their symptoms. Data will be collected through semi-structured interviews with people with lived experience of antidepressant discontinuation. The student will learn qualitative research methods including interview design, thematic and framework analysis, and stakeholder engagement, working alongside a multidisciplinary team spanning psychiatry, neuroimaging, and lived-experience partners

Primary Supervisor: Dr Alec Jamieson

Primary Supervisor Contact: alec.jamieson@unimelb.edu.au

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Characterising brain changes during perimenopause

Project Description:

Perimenopause is a transition state experienced by women during midlife (usually between 40-58 years), resulting in reproductive senescence (menopause). While it is a reproductive transition state, the key symptoms experienced by women are neurological in nature, meaning they likely arise in the brain. However, we still have very limited understanding of the neurobiological changes that drive experienced perimenopausal symptoms. In this project, we will use advanced neuroimaging (MRI) data to probe how the brain changes during perimenopause, and how these changes may relate to cognitive or behavioural symptoms. This will provide new understanding into the neurobiology of a key transition period that almost all women will experience in their lifetime.

Primary Supervisor: Dr Remika Mito

Primary Supervisor Contact: remika.mito@unimelb.edu.au

Project Site: Department of Psychiatry, University of Melbourne

Honours places available: 1

Master of BioMed places available: 0

Mapping the connectivity of the human hypothalamus

Project Description:

The hypothalamus is a small brain region that controls several vital physiological processes, including sleep, thermoregulation, food intake, endocrine and immune responses. The organisation of this brain region is highly intricate, with many different nuclei that are connected with each other and with other distant brain regions. However, the white matter connectivity of the hypothalamus is still poorly defined in humans. This project will make use of advanced magnetic resonance imaging (MRI) data to provide novel understanding of the complex connectivity of the human hypothalamus. This project is well suited to students with a key interest in neuroanatomy and brain imaging. A willingness to learn basic coding skills is required.

Primary Supervisor: Dr Remika Mito

Primary Supervisor Contact: remika.mito@unimelb.edu.au

Project Site: Department of Psychiatry, University of Melbourne

Honours places available: 1

Master of BioMed places available: 0

Exploring the feasibility and acceptability of an adjunctive psychological intervention for individuals with Debilitating Symptom Complexes Ticks (DSCATT) - a qualitative analysis

Project Description:

DSCATT is a term conceptualised by the Australian Government Department of Health to describe individuals who experience persistent, debilitating symptoms associated with tick bites. Although research is emerging regarding the etio-pathophysiology of the illness, evidence-based treatment options are currently lacking. This leaves many DSCATT patients with profound morbidity in their physical and mental health. This project involves qualitative analysis of semi-structured interviews

completed one-to-one in a sample of DSCATT patients. The interviews explore DSCATT patients' views and experiences following participation in a 16-session psychology intervention designed to improve their quality of life. Findings from this project will contribute to the results of a mixed methods, randomised controlled trial.

Primary Supervisor: Prof Richard Kanaan

Primary Supervisor Contact: richard.kanaan@unimelb.edu.au

Project Site: Department of Psychiatry, Austin Hospital

Honours places available: 1

Master of BioMed places available: 1

Understanding cognition in bipolar disorder; a novel intra-individual approach

Project Description:

Bipolar disorder (BD) is a pervasive and complex mental health disorder, known for its characteristic mood states of depression and mania. In addition to these extreme ups and downs in mood, people with BD have been seen to experience changes in their 'thinking skills', technically known as their 'cognition'. This typically involves impairments in attention, memory, executive functioning and processing speed, all which have been shown to severely impact an individual's quality of life and overall illness experience. However, the factors and mechanisms that underpin these cognitive impairments in BD have remained unclear. Our group is currently taking a novel approach, investigating specific individual cognitive performance characteristics. We have found that people with BD have a high degree of attentional intra-individual variability; that is, BD patients fluctuate significantly in their cognitive performance over the duration of tasks measuring their sustained attention. This has been an important observation, as it correlates with their general cognitive behaviour and may reflect underlying neural pathologies such as alterations to brain structure. But, we are yet to know if BD patients also show these fluctuations and variability in tasks that measure other aspects of cognition such as memory and executive functioning. This is something we need to explore, in order to determine if intra-individual variability is a specific factor contributing to the cognitive symptoms experienced by people living with BD, and in turn learn how we can prioritise individual cognition in lifestyle and psychological treatments. In this project, the student will work to identify cognitive intra-individual variability profiles in BD, using extensive cognitive and clinical data from our ongoing BD studies. The student will become familiar with comprehensive neurocognitive assessment batteries, observe and assist with mental health study data collection and get exposure to a large multi-disciplinary network of BD researchers.

Primary Supervisor: A/Prof Tamsyn Van Rheenen

Primary Supervisor Contact: tamsyn.van@unimelb.edu.au

Project Site: Department of Psychiatry, University of Melbourne

Honours places available: 1

Master of BioMed places available: 0

Brain stimulation for mental health disorders

Project Description:

Non-invasive 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

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 2

Master of BioMed places available: 1

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

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

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

Primary Supervisor Contact: dennisv@unimelb.edu.au

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

New tools for connectomics and network neuroscience

Project Description:

The project will on focus on the development of new tools and methods to analyse brain networks, also known as connectomes. In the last 5 years, there has been an explosion in the availability of brain network data. These range from new connectomes describing the anatomy of entire nervous systems to datasets detailing activation cascades evoked by targeted brain stimulation. Current methods fall short of describing such rich data, and new analytical tools are required to generate insight about brain function. The project is fairly open ended and the student will have the opportunity to decide the precise problem they would like to work on within this space. A strong programming background is required, as well as an interest in neuroscience, network science, graph theory, complex systems or machine learning.

Primary Supervisor: Dr Caio Seguin

Primary Supervisor Contact: caio.seguin@unimelb.edu.au

Project Site: Department of Psychiatry, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

A pilot study of Tuning in to Toddlers Online parenting program

Project Description:

This project will evaluate Tuning in to Toddlers Online, an emotion socialization parenting program designed for parents and carers of children aged 12 to 47 months who have concerns about their child€™s emotional or behavioural development. Participants will be randomly assigned to either an immediate access group or a 4-month waitlist control group. Parent-reported measures will be collected at baseline and follow-up, enabling comparison between conditions. The evaluation will generate evidence on the program€™s effectiveness and support its potential for scale-up across community settings and at-risk populations.

Given the intensive demands of early parenting, families with young children often have limited access to evidence-based parenting support. Online delivery offers a flexible and accessible solution, particularly for interventions targeting emotional challenges common in toddlerhood. Rigorous evaluation of such programs is essential to ensure they meet the needs of parents and contribute to early prevention efforts.

Primary Supervisor: Professor Sophie Havighurst

Primary Supervisor Contact: sophie.h@unimelb.edu.au

Project Site: Department of Psychiatry: Mindful: Travancore site.

Honours places available: 1

Master of BioMed places available: 1

Department of Radiology

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

Project Site: Department of Radiology, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Department of Radiology, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

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: Dr Vijay Venkatraman

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

Project Site: Department of Radiology, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Mapping Brain Iron Accumulation in Adults with Binge Eating Behaviours using QSM MRI

Project Description:

Binge Eating Disorder (BED) is the most prevalent eating disorder and is associated with significant psychological distress, metabolic complications, and treatment challenges. Despite its impact, the neurobiological mechanisms underlying binge eating behaviours remain underexplored. Emerging evidence suggests that brain iron dysregulation may contribute to altered reward processing, impulse control, and emotional regulation which are the core features of BED.

Quantitative Susceptibility Mapping (QSM) is a powerful ultra-high field MRI technique that enables in vivo measurement of magnetic susceptibility, which serves as a proxy for brain iron levels in subcortical and cortical regions with high anatomical precision.

This project will leverage already acquired 7T MRI QSM data to investigate whether adults (n=~75) with binge eating behaviours and control participants (n=~100+) show altered brain iron concentrations in key regions implicated in appetite, reward, and impulse control, such as the striatum, anterior cingulate cortex, and insula. The student will learn and apply a validated processing pipeline (QSMART) for artefact correction and quantification of susceptibility values and conduct region-of-interest and exploratory whole-brain analyses.

Where appropriate, they may also explore associations between brain iron levels and eating disorder symptom severity, frequency of binge episodes, or metabolic indicators related to gut hormones and neuropeptides. This project aims to contribute to emerging research into biological biomarkers for individualized diagnosis and treatment in eating disorders.

Techniques and Skills

- Basic MRI image processing using Python and/or MATLAB
- Hands-on training in QSM data processing (QSMART pipeline)
- Statistical analysis in R or Python
- Interpretation of neuroimaging findings in the context of psychiatric research

Primary Supervisor: Dr Warda Syeda

Primary Supervisor Contact: wtsyeda@unimelb.edu.au

Project Site: Department of Radiology: Melbourne Brain Centre at Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

Patient Preference Survey for new Intraoperative Breast Cancer Detection Tool

Project Description:

This project aims to evaluate patient preferences regarding the use of a novel intraoperative breast cancer detection tool during breast-conserving surgery (BCS). The device is designed to assist surgeons in assessing tumour margins in real-time, potentially reducing the need for reoperation.

The project will involve a one-time, anonymous survey offered to patients who have undergone or are scheduled to undergo breast conserving surgery at the Royal Melbourne Hospital. The survey will explore patient values and perceived benefits.

Findings will help in the development of the tool.

Primary Supervisor: Professor Christobel Saunders

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

Project Site: Department of Surgery, Royal Melbourne Hospital

Honours places available: 2

Master of BioMed places available: 0

Evaluating real-world uptake of Brain Tumours Online, a digital supportive care platform for patients, carers and healthcare professionals

Project Description:

Our team of healthcare professionals, researchers, digital health experts, digital product developers along with people with lived experience of a brain tumour have co-designed an online supportive care platform, Brain Tumours Online (BTO). BTO offers trusted information, connection with peers and health professionals and access to self-help tools. It was evaluated by approximately 200 users in a research setting before being launched publicly in January 2025. The AIM of this study is to investigate how Brain Tumours Online is used in the â€˜real-world€™ since its launch as a public website, and to identify any new unmet needs or barriers to use that could be addressed. The methodology will be guided by process evaluation theory and comprises qualitative data analysis from interviews with users and quantitative data analysis from web analytics and standardised user surveys. Findings will contribute to quality improvement of Brain Tumours Online, a support resource for a vulnerable and under-researched group.

Primary Supervisor: Prof Kate Drummond

Primary Supervisor Contact: kjd@unimelb.edu.au

Project Site: Department of Surgery, Royal Melbourne Hospital

Honours places available: 1

Master of BioMed places available: 1

The benefit of providing patients and their health care providers with individualized real-time recovery information to optimize patient outcomes and reduce health care expenditure - A Multicentre Pilot Study

Project Description:

The aim of this study is to determine whether providing individualized real-time recovery information feedback to patients and their health care team, as opposed to no feedback, ultimately improve patient quality of overall recovery and health economic expenditure. This RCT will randomise patients and their health care team to contemporaneously be kept informed of the patient's recovery throughout their postoperative journey (or not). Recovery will be assessed at multiple postoperatively using a dedicated multidimensional recovery assessment tool, with parallel collection of clinical and health economic outcomes. The primary outcome is overall recovery at week 6 postoperatively, as measured by the PostopQRS.

Primary Supervisor: Dr Andrea Bowyer

Primary Supervisor Contact: andrea.bowyer@unimelb.edu.au

Project Site: Department of Surgery: Anaesthesia

Honours places available: 1

Master of BioMed places available: 0

PotopQRS Registry

Project Description:

Student will investigate perioperative correlates to postoperative quality of recovery (both overall, and within individual recovery domains). This will be via interrogation of the existing PostopQRS Registry, involving patients from RMH, PMCC and RWH.

Primary Supervisor: Dr Andrea Bowyer

Primary Supervisor Contact: andrea.bowyer@unimelb.edu.au

Project Site: Department of Surgery: Anaesthesia

Honours places available: 1

Master of BioMed places available: 0

Florey Institute of Neuroscience and Mental Health

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

Project Site: Florey Institute of Neuroscience and Mental Health

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Florey Institute of Neuroscience and Mental Health

Honours places available: 1

Master of BioMed places available: 1

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

Project Site: Florey Institute of Neuroscience and Mental Health

Honours places available: 1

Master of BioMed places available: 0

Understanding mechanisms and identifying new targets and treatments using various genetic mouse models of epilepsy

Project Description:

Project (1) aims to understand the biophysics of ion channels (HCN and potassium channels) using a combination of electrophysiological methods including two-electrode voltage clamp, voltage-clamp fluorometry and patch-clamp. Elucidating the biophysics of these channels that are involved in epilepsy will allow us to understand how epilepsy variants affect the properties of these channels and develop targeted treatments that correct the broken channels.

Project (2) is an umbrella project which aims to develop and characterise various genetic mouse models of epilepsy, which will be used to understand mechanisms and identify new targets and treatments. This project involves multiple techniques including behavioural studies, brain-slice electrophysiology, EEG recording, immunohistochemistry, transcriptomics and drug administration. Some of the mouse models are already up and running in the lab, including mouse models of developmental and epileptic encephalopathy (Hcn1M294L, Gabra, Cux2 etc) and Dravet syndrome (Scn1a). These mice are modelled after genetic variants of patients and mainly recapitulated patient phenotypes. The next step of this project is to understand mechanisms underlying epileptic phenotypes and identify effective therapeutics (which involves screening small molecules, currently available antiseizure medications and toxins) that can reduce symptoms.

Primary Supervisor: Professor Christopher Reid

Primary Supervisor Contact: christopher.reid@florey.edu.au

Project Site: Florey Institute of Neuroscience and Mental Health

Honours places available: 2

Master of BioMed places available: 2

Testing a new gene therapy for HCN1 developmental and epileptic encephalopathy.

Project Description:

Developmental and Epileptic Encephalopathies (DEEs) are severe neurological conditions that cause seizures and developmental delays. They are caused by genetic mutations. Unfortunately, current treatments for DEEs are rarely fully effective, highlighting a clear need to develop new treatments for DEE patients. This project will test the ability of a new potential gene therapy, called an antisense oligonucleotide (ASO), to treat a specific DEE, HCN1 DEE. Working hands-on with a mouse model of HCN1 DEE, students will learn stereotaxic surgical procedures (predominantly electrocorticography (ECoG)), mouse behavioural assays, and molecular biology techniques, and use these to study the ability of our ASO gene therapy to treat seizures and other clinical features of HCN1 DEE.

Primary Supervisor: Dr Lauren Bleakley

Primary Supervisor Contact: lauren.bleakley@florey.edu.au

Project Site: Florey Institute of Neuroscience and Mental Health

Honours places available: 1

Master of BioMed places available: 0

Orygen Youth Health (Centre for Youth Mental Health)

Childhood trauma, white matter connectivity, and self-experience in young people at ultra-high risk for psychosis

Project Description:

Childhood trauma is a well-established risk factor for psychosis. White matter — the communication highway of the brain — has been shown to be disrupted in both psychosis risk and trauma-related neurodevelopment. Childhood trauma also fundamentally shapes how individuals experience themselves and the world, potentially disrupting basic self-experience — a hallmark characteristic of individuals at ultra-high risk (UHR) for psychosis. Whether white matter integrity represents a neurobiological pathway linking these experiences in UHR individuals remains unknown, and understanding these interrelationships is an important step in uncovering the biological basis of psychosis risk.

Diffusion tensor imaging (DTI) provides a means of examining white matter pathways in vivo. This project will use existing data from a cross-sectional study in UHR individuals to analyse and explore the interrelationships between childhood trauma, different measures of white matter integrity, and self-experience. The specific outcome(s) and hypotheses will be refined with the student based on their interests and the literature, contributing to our understanding of the neurobiological pathways linking trauma and self-experience in those at risk of psychosis.

Primary Supervisor: Dr Elizabeth Haris

Primary Supervisor Contact: elizabeth.haris@unimelb.edu.au

Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1

Using AI to prevent mental illness

Project Description:

Our vision is a world where youth mental illness is preventable, care is proactive, and everyone has access to life-changing support. We are located at the largest youth mental health organisation in the world called 'Orygen' with over 200 researchers and a further 300 clinical, policy, global advocacy, lived experience, and service staff (https://www.orygen.org.au/). The 5-year mission of our lab is to improve care using artificial intelligence. We have 10-years of experience in this field and approximately $5 million dollars to achieve the mission. We need students with an interest in mental health, AI, or research translation who will help us with the mission by choosing one of two streams: a) discovery stream; b) translation stream. In the discovery stream, you will help us to research, conceptualise, and

develop new AI algorithms or uses of AI to improve care. In the translation stream, you will help us to translate existing AI algorithms into products that can be used by clinicians to improve mental healthcare. Each student project continues from existing work, but is co-developed with you and influenced by your interests and profile. Accordingly, the research project is personalised to you--just like we want treatments and care to be.

Primary Supervisor: Associate Professor Dom Dwyer

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

Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1

AMP-SCZ: Discovering biomarkers to prevent serious mental illness

Project Description:

Young people may start to show signs of serious mental illness 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 serious mental illness, 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 discover biomarkers that can help to predict the likelihood that a person will progress to serious mental illness (e.g., psychosis). We are currently focussed on clinical, cognitive, speech, brain MRI, and digital biomarkers. We work with global collaborators from the USA, Europe, South America, and East Asia 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: Associate Professor Dom Dwyer

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

Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1

Knowledge Translation and Implementation Science in Youth Mental Health

Project Description:

Orygen – the world's largest youth mental health organisation – offers exciting opportunities to design research at the intersection of youth mental health, knowledge translation (KT), and implementation science.

KT at Orygen bridges research evidence, lived experience, and practice wisdom to develop tools to improve care. Implementation science studies strategies to embed evidence-based practices and programs into real-world settings. Both KT and implementation science aim to bridge the gap between knowledge and best practice.

Potential project areas:

- Investigating barriers to implementing evidence-based programs in routine care (e.g., peer support models, migrant/refugee services)
- Designing theory-driven implementation and behaviour change strategies for trauma-informed, culturally responsive interventions.
- Exploring experiences of involvement in knowledge translation activities for young people and designing tools and resources to support best practice

Projects may use mixed methods, including:

- Surveys including implementation outcome measures
- Behaviour change technique mapping
- Qualitative interviews/focus groups with young people and practitioners

Projects will be tailored to the student's interests and skills, with mentorship from Orygen's research, KT and implementation science experts.

Primary Supervisor: Dr Isabel Zbukvic

Primary Supervisor Contact: isabel.zbukvic@orygen.org.au

Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 2

Master of BioMed places available: 2

LGBTQA+ Youth Mental Health: Advancing Equity Through Research

Project Description:

Orygen – the world's largest youth mental health organisation – offers opportunities to improve mental health care for LGBTQA+ young people, with a focus on intersectionality, cultural responsiveness, and systemic change. Despite growing awareness, LGBTQA+ young people face persistent disparities in mental health outcomes and care access. Projects will address these gaps by centring lived experience, interrogating structural barriers, and co-designing solutions with communities.

There is opportunity to focus on the mental healthcare experiences and needs of trans and gender diverse (TGD) young people, queer and trans young people of colour (QTPOC), or LGBTQA+ young people broadly. Our team is particularly interested in intersectionality and how multiple systems of privilege and power can interact to impact mental health and systems of care.

Projects may include (but are not limited to):

- Cultural humility in care: Examining how mental health professionals can work responsively with LGBTQA+ young people through an intersectional lens.
- Workforce capacity-building: Developing and testing strategies and tools for practitioners and services.
- Innovative care models: Evaluating tailored programs (e.g., gender affirming care for TGD youth delivered through primary youth mental health services).

Flexible methodologies aligned with student interests, such as:

- Qualitative: Interviews/focus groups with LGBTQA+ youth, caregivers, or clinicians.
- Mixed methods: Surveys + participatory workshops (e.g., Delphi studies, co-design).
- Implementation science and behaviour change frameworks

Primary Supervisor: Dr Isabel Zbukvic

Primary Supervisor Contact: isabel.zbukvic@orygen.org.au

Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1

The effects of sleep on cognitive and clinical measures in early psychosis

Project Description:

Sleep and circadian rhythm disturbances are common in psychotic disorders and may predict the emergence, course and severity of illness. Young people are at heightened risk of both psychosis and sleep disturbance, making this a key population for early detection and intervention. However, sleep is not routinely considered in clinical management of psychosis risk, partly because the field has limited understanding of how sleep disturbances contribute to psychosis specifically. Clarifying sleep metrics alongside symptom comorbidity and clinical heterogeneity is critical to advancing this understanding.

This project will use existing cross-sectional data from CHR individuals and healthy controls to explore associations between self-reported daily sleep diary data and (a) audiovisual perceptual sensitivity data (using the White Noise Speech Task and/or Mooney Faces Task) and (b) clinical symptoms (e.g., CAARMS, BPRS, NSI, CTQ, ReQOL). This is a secondary analysis of an ongoing study, so the student may work with an interim sample. The specific outcome(s) and hypotheses will be refined with the student based on their interests, once they've reviewed the dataset and literature.

Primary Supervisor: Dr Magdalene de Rozario

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Project Site: Centre for Youth Mental Health, Parkville

Honours places available: 0

Master of BioMed places available: 1

The Architecture of Self-Disturbance in Youth at Clinical High Risk for Psychosis: Project A Factor Analysis

Project Description:

SNAP Project A: Factor Structure of the EASE

This project will examine the factor structure of the Examination of Anomalous Self-Experience (EASE) to determine whether individual items are grouped into meaningful underlying dimensions (latent factors) that represent different aspects of self-disturbance. The findings will help improve our understanding of how self-disturbance is organised and measured. Using data from the SNAP (Self, Neuroscience, and Psychosis) study, the project will investigate the underlying structure of self-disturbance in a CHR-P cohort. Self-disturbance refers to subtle disruptions in the basic sense of self and is considered a core feature of schizophrenia-spectrum disorders. These experiences may include feeling detached from one's thoughts, body, or sense of identity, and can emerge before the onset of psychosis. The EASE is a clinician-administered interview designed to assess these experiences and is increasingly recognised as an important tool for understanding vulnerability to psychosis. Depending on student interest and the resulting factor structure, the derived dimensions can also be examined in relation to clinical, cognitive, demographic, and neuroimaging measures (subject to data availability).

This project provides an opportunity to gain experience in advanced statistical methods, psychosis research, and working with a unique longitudinal clinical dataset. Depending on its scope and the student's interests, the project can be undertaken as an Honours project or expanded into a Master's research project.

Primary Supervisor: MA/Dr Kiira Sarasjärvi

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Project Site: Centre for Youth Mental Health, Parkville

Honours places available: 1

Master of BioMed places available: 1

The Architecture of Self-Disturbance in Youth at Clinical High Risk for Psychosis: Project B Latent Class/Profile Analysis

Project Description:

SNAP Project B: Latent Class/Profile Analysis (LCA/LPA)

This project will use latent class analysis (LCA) and latent profile analysis (LPA) to identify distinct subgroups of participants who share similar patterns of self-disturbance among young people at Clinical High Risk for Psychosis (CHR-P). Self-disturbance refers to subtle disruptions in the basic sense of self and is considered a core feature of schizophrenia-spectrum disorders. These experiences may include feeling detached from one's thoughts, body, or sense of identity, and can emerge before the onset of psychosis.

Using baseline data from the SNAP (Self, Neuroscience, and Psychosis) study, the project will detect "hidden" self-disturbance profiles (e.g., low, moderate, and high) across the Examination of Anomalous

Self-Experience (EASE) dimensions. The EASE is a clinician-administered interview designed to assess self-disturbance and is increasingly recognised as an important tool for understanding vulnerability to psychosis. The identified participant subgroups can then be examined in relation to clinical and demographic characteristics, including symptom severity, social and occupational functioning, and sociodemographic variables (e.g., age, sex, and education). Depending on student interest and data availability, the project may also incorporate cognitive performance and neuroimaging measures.

This project provides an opportunity to gain experience in advanced statistical methods, psychosis research, and working with a unique longitudinal clinical dataset. Depending on its scope and the student's interests, the project can be undertaken as an Honours project or expanded into a Master's research project.

Primary Supervisor: MA/Dr Kiira Sarasjärvi

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Project Site: Centre for Youth Mental Health, Parkville

Honours places available: 1

Master of BioMed places available: 1

The Architecture of Self-Disturbance in Youth at Clinical High Risk for Psychosis: Project C Cluster Analysis

Project Description:

SNAP Project C: Cluster Analysis

This project will apply cluster analysis to identify subgroups of young people at Clinical High Risk for Psychosis (CHR-P) based on similarities in their experiences of self-disturbance. Self-disturbance refers to subtle disruptions in the basic sense of self and is considered a core feature of schizophrenia-spectrum disorders. These experiences may include feeling detached from one's thoughts, body, or sense of identity, and can emerge before the onset of psychosis.

Understanding the heterogeneity of self-disturbance within the CHR-P population may help identify clinically meaningful subgroups, providing insights into different pathways of risk, symptom profiles, and functional outcomes. The project utilises data from the SNAP (Self, Neuroscience, and Psychosis) study, with a particular focus on the Examination of Anomalous Self-Experience (EASE), a clinician-administered interview designed to assess self-disturbance. The identified participant subgroups can then be examined in relation to clinical and demographic characteristics, including symptom severity, social and occupational functioning, and sociodemographic variables (e.g., age, sex, and education). Clusters will also be compared in terms of their outcomes, including persistence of attenuated psychotic symptoms, functioning, and symptoms at follow-up timepoints.

This project provides an opportunity to gain experience in advanced statistical methods, psychosis research, and working with a unique longitudinal clinical dataset. Depending on its scope and the student's interests, the project can be undertaken as an Honours project or expanded into a Master's research project.

Primary Supervisor: Dr Cassandra Wannan

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Project Site: Centre for Youth Mental Health, Parkville

Honours places available: 1

Master of BioMed places available: 1

Temporal Stability and Transitions in Self-Disturbance Among Youth at Clinical High Risk for Psychosis: Latent Transition Analysis

Project Description:

SNAP Project: Latent Transition Analysis

This project will use Latent Transition Analysis (LTA) to identify distinct profiles of self-disturbance and examine how young people at Clinical High Risk for Psychosis (CHR-P) transition between these profiles over time. Self-disturbance refers to subtle disruptions in the basic sense of self and is considered a core feature of schizophrenia-spectrum disorders. These experiences may include feeling detached from one's thoughts, body, or sense of identity, and can emerge before the onset of psychosis.

Using longitudinal data from the SNAP (Self, Neuroscience, and Psychosis) study, the project will estimate the probability of transitions between self-disturbance profiles (e.g., low, moderate, and high) across assessment time points, as measured by the Examination of Anomalous Self-Experience (EASE). The identified transition patterns can then be examined in relation to clinical and demographic characteristics, including symptom severity, social and occupational functioning, clinical outcomes, and sociodemographic variables (e.g., age, sex, and education). Depending on student interest and data availability, the project may also incorporate cognitive performance and neuroimaging measures.

This project will improve our understanding of the longitudinal course of self-disturbance and its role in the development and progression of psychosis. It also provides an opportunity to gain experience in advanced statistical methods, psychosis research, and working with a unique longitudinal clinical dataset. Depending on its scope and the student's interests, the project can be undertaken as an Honours project or expanded into a Master's research project.

Primary Supervisor: MA/Dr Kiira Sarasjärvi

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Project Site: Centre for Youth Mental Health, Parkville

Honours places available: 1

Master of BioMed places available: 1

The efficacy of pharmacological and non-pharmacological interventions on mental health in young people with chronic pain: a systematic review and meta-analysis

Project Description:

One-in-five young people (aged 12-25 years) experience chronic pain (bodily pain that persists or recurs for more than 3 months) in Australia and globally, but the condition is underrecognized and

understudied in youth compared to adults. Young people living with chronic pain are at an elevated risk of developing mental ill-health, including depression, anxiety, and suicidal ideation, compared to their peers without chronic pain. However, there is no clear overview of which pharmacological and non-pharmacological interventions are most effective for supporting the mental health of young people with chronic pain. This project will be a systematic review and meta-analysis of randomised controlled trials exploring the efficacy of pharmacological and non-pharmacological interventions on the mental health of young people with chronic pain, including depressive symptoms, anxiety symptoms, suicidal ideation, and the safety of these approaches. This information can be used to improve the care of young people with chronic pain, who are at an increased risk of mental ill-health and a lifelong burden of chronic pain.

Primary Supervisor: Dr Scott Tagliaferri

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Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1

Social stratification of chronic pain in young people in Australia: an analysis of the Longitudinal Study of Australian Children

Project Description:

One-in-five young people (aged 12-25 years) experience chronic pain (pain that persists for more than 3 months) in Australia and globally, but the condition is underrecognized and understudied in youth compared to adults. A health equity focus prioritises addressing avoidable, unfair, and systemic factors that can lead to disparate health care outcomes for young people with chronic pain. For example, sociodemographic factors, including socioeconomic status, geographic location, sex, gender, sexual orientations, disability, neurodiversity, and cultural and linguistic backgrounds, can influence access to care and highlight the need for solutions tailored to these diverse groups. However, limited data of the social factors underpinning chronic pain in young Australians exists. Using data from a large-scale nationally representative Australian youth study (Longitudinal Study of Australian Children), this project will (1) estimate the weighted prevalences of chronic pain in young Australians, (2) estimate the weighted trajectories of chronic pain in young Australians, and (3) describe the weighted sociodemographic profiles of young Australians with chronic pain. Understanding social factors underpinning chronic pain in young Australians is critical for guiding the design and delivery of early pain solutions that aim to reduce long-term functional, psychological, and social impairments caused by the condition.

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Project Site: Orygen Youth Health (Centre for Youth Mental Health)

Honours places available: 1

Master of BioMed places available: 1