

Tasmanian School of Medicine Honours Program
Honours information handbook for 2022



Honours Courses Overview

The Honours course provides students with the opportunity to undertake further training in research in biomedical sciences, clinical sciences, health services and population health. Honours is a one-year long program of advanced study that includes the development of skills in understanding scientific literature in biomedical and health fields, as well as the student's aptitude in scientific writing and presentation. The critical element of the Honours year across all programs is the focus on students undertaking a major research project, which involves learning research skills, conducting research in a relevant biomedical or health area and completing a thesis detailing and discussing the findings of the research project.

The Honours year in the Tasmanian School of Medicine, Menzies Institute for Medical Research or Wicking Centre is available to UTAS students who have completed an undergraduate degree in the BSc, BMedRes, BBiotech, (or similar) or three years of the MBBS program. Students from other institutions can also apply to do the program where they have completed similar degrees.

Course Objectives

Students will undertake a supervised research project with an emphasis on advanced disciplinary knowledge, the use of a specialised laboratory, fieldwork and/or statistical techniques relevant to their chosen research area, planning and conducting a scientific investigation and effective communication of research findings. Students will also gain experience in scientific writing and oral presentations. By the completion of the program, students should be able to write a scientific report to a standard acceptable for submission to a peer-reviewed journal and deliverable at a relevant conference or scientific meeting.

Research areas

Students can undertake projects, depending on their interest and academic background, in a broad range of areas including but not limited to:

- Anatomy
- Biochemistry
- Clinical trials
- Genetics
- Medical education
- Microbiology
- Neuroscience
- Pathological sciences
- Population and public health
- Physiology

This handbook contains an outline of available projects for 2022. If you cannot find a suitable project listed or have a desire to undertake a project in a certain area or with a certain researcher, it is worthwhile contacting that researcher to discuss your interest. Often more projects are available but have not been listed!

Scholarships

There are a number of scholarships available to students undertaking research Honours in the College of Health and Medicine. These are administered by the Scholarships Office. Further information on the availability, eligibility, closing dates and how to apply is provided at the [Scholarships and Bursaries](#) website. Students enrolling in this honours program should apply for the College of Health and Medicine Honours Scholarships – this is an umbrella option and students will be considered for any relevant scholarships depending on their institution alignment and area of research.

Many of the scholarships are made possible by generous donations from Tasmanian businesses and individuals. Scholarship recipients may be encouraged to engage with the donors throughout the period of support.

Your application to do Honours

Students should have completed a Bachelor of Medical Research (53E or M3M) from the University of Tasmania, or an equivalent qualification (AQF 7, or above) from this, or another institution. Applicants are expected to obtain at least a credit average in their third-year units of study.

Applicants should note that meeting minimum entrance requirements does not guarantee entry to the Honours program as places in the course are dependent on availability of research facilities and capacity and staff resources.

It is a good idea before you apply for entry to the Honours program that you identify a project that appeals to you and to discuss the project and its availability with the project supervisor. If you require assistance with identifying a supervisor, please contact the Honours coordinator (Dr Dino Premilovac).

All students apply online via eApplications (<https://www.utas.edu.au/admissions>) and are asked to complete the Honours Expression of Interest (EOI) form (available upon request from SOM.Honours@utas.edu.au).

MBBS students should have completed at least three years of 100% load in M3N, or similar approved course interstate; with credit average, or equivalent. Current UTAS MBBS students require approval from the Academic Lead of the MBBS program (Associate Professor Jennifer Presser) to take a leave of absence from their medical studies and enrol in an Honours course.

Student Expectations

The course extends from February to late October for students that commence in semester 1. For students that commence in semester 2, the course begins in July and runs through to April the following year.

Attendance requirements will be dictated by the nature of the research project being undertaken. However, there is an expectation that the time required to successfully complete the Honours year is a minimum of 40 hours per week, equivalent to a standard full-time working week.

Covid19 information

All project supervisors have been advised that they must have a contingency plan in place before accepting a student that will allow them to support their students' Honours study should students have restricted access to university campuses or institutes at any time during their study.

Students must also comply with all COVID-Safety Laboratory Plans and if unsure of requirements must seek advice prior to undertaking work.

Contact information

Course Coordinators

Honours course coordinator

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Project Outlines

Antibiotic resistance in *Pseudomonas aeruginosa*

Supervisor: Dr Mark Ambrose

Project description: *Pseudomonas aeruginosa* causes severe infections in people with cystic fibrosis and weakened immune systems. Treating infections caused by this organism using currently available antipseudomonal drugs is often complicated by its ability to accumulate resistance mutations during treatment. Furthermore, the mechanism(s) responsible for generating and fixing antibiotic resistance mutations in this organism are still poorly understood, thereby limiting the design of more effective targeted therapies. In this context, work in this laboratory demonstrated that stationary phase cells of *P. aeruginosa* undergoing selection accumulated antibiotic resistance mutations via a SOS-type DNA polymerase IV (DinB)-dependent mutation generation pathway. Moreover, recent studies show that the overall expression of the DinB-dependent pathway is modulated by a broad “stress response regulon” of this organism. In this project, the regulation of antibiotic resistance mutations in *P. aeruginosa* will be further characterised using specific gene-knockout strains, together with gene expression and proteomic approaches.

Key techniques: Mutation detection assays, RT-PCR, gene cloning and expression, and proteomics.

Location: Medical Sciences Precinct

Contact: Mark.Ambrose@utas.edu.au

Surgical referrals for osteoarthritis in Tasmania

Supervisor(s): Associate Professor Dawn Aitken

Project description: We are looking for an enthusiastic and highly motivated student to join our research team to work within a large program of research which aims to improve the management and outcomes for Tasmanians with osteoarthritis. Tasmania has the longest public wait times in the country for joint replacement surgery, with patients waiting 1 to 2 years (on top of the approximate 1 to 2 year wait for initial surgical assessment). The most common reason for knee and hip replacement surgery is osteoarthritis. This project will involve quantifying the volume of surgical referrals that are received each year in Tasmania in the public sector. It will require working closely with our research partners, including the THS (Tasmanian Health Service) and public hospitals around Tasmania. With supervision and support from Dawn Aitken and her team, the student will perform a THS audit to gain a better understanding of surgical referrals for hip and knee pain and identify areas in the State with high referral rates. Altogether this data will then be used to inform strategies and future research that aims to reduce the elective surgery waiting lists in Tasmania.

Key techniques used: Techniques used in this project include: research partner engagement, performing a THS (Tasmanian Health Service) data request/audit, data management, data analysis including descriptive statistics and modelling, and advanced writing. Statistical supervision and training will be provided. Students from a number of backgrounds are welcome including medical and health sciences, epidemiology, biostatistics, allied health, and public health. Strong writing and communication skills are desirable.

Location: Hobart, Medical Sciences Precinct

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Association between central and peripheral osteophytes and symptoms, cartilage and subchondral bone pathologies on knee MRI in young adults

Supervisors: Dr Benny Antony, Prof Changhai Ding

Background: Marginal osteophytes (those found at the margin of the articular cartilage) are almost always present in patients with osteoarthritis (OA) and have been shown to be associated with symptoms and other structural pathologies. However, the role of central osteophytes (those surrounded by articular cartilage on all sides) is rarely explored in OA.

MRI is ideal for the measurement of central osteophytes. MRI is more sensitive than radiographs for detection of central osteophytes because the curved articular surface obscures central osteophytes. Moreover, central osteophytes can be mistaken for free intra-articular bodies in radiographs. Central osteophytes are usually not visible on inspection of the articular surface at arthroscopy.

Objectives: To describe the prevalence of central and peripheral osteophytes in a population based sample of young adults. The relationship of central osteophytes to knee symptoms, superficial articular cartilage, compartment specific cartilage defects, marginal osteophytes, bone marrow lesions, and meniscal pathologies will be explored. We will describe the association between environmental (physical activity) and systemic (inflammatory markers) factors and central osteophytes.

Analyses: The prevalence of central osteophytes in the knee will be evaluated. Association of central osteophytes with age, sex, BMI, Knee WOMAC pain, dysfunction, and other MRI pathologies and its change over 5 years will be evaluated.

Key techniques: Data collection for the project is now completed. Participants broadly representative of the Australian young adult population were selected from the CDAH Knee Cartilage study. Central Osteophytes was assessed on T1-weighted fat saturated and proton-density fat-saturated images at tibial, femoral and patellar regions. Central osteophytes was graded using the following scale: grade 0, none; grade 1, small (<50% of cartilage thickness); grade 2, moderate (50–100% of cartilage thickness); and grade 3, large (>100% of cartilage thickness). Articular cartilage defects, marginal osteophytes, meniscal tears, and bone marrow lesions were assessed by MRI. Knee symptoms were assessed by WOMAC scale.

Location: Medical Sciences Precinct

Contact: Benny.EathakkattuAntony@utas.edu.au

Health literacy and COVID-19 vaccination uptake in Australia

Supervisor(s): Dr Bonnie Bereznicki and Dr Rosie Nash

Project description: COVID-19 has infected more than 190 million people and killed more than 4.0 million worldwide since January 2020. The global pandemic jumpstarted a race towards the development and distribution of an effective COVID-19 vaccine. The first shipment of COVID-19 vaccines arrived in Australia in February 2021, and so began the largest vaccine rollout in the nation's history. However, recent data from the Australian Bureau of Statistics suggest that many people have not been vaccinated despite being eligible. Furthermore, Australian research suggests that there are important disparities in COVID-19-related knowledge, attitudes and behaviours according to people's health literacy.

The aim of this project is to explore Australians' attitudes and beliefs surrounding the COVID-19 vaccine and to determine whether an individual's health literacy has an influence on their attitudes and the likelihood of vaccination. An online survey will be developed and administered to Australian adults, who will be recruited via social media advertising. Survey data will be analysed using appropriate statistical software. This project will suit students interested in epidemiology, public health, health literacy and quantitative research methods.

Key techniques used: Survey development, statistical analysis.

Location: Medical Sciences Precinct

Contact: Bonnie.Bereznicki@utas.edu.au

Discovering tandem repeat expansions and structural variants in families with genetic diseases.

Supervisor(s): Dr Nicholas Blackburn, Professor Kathryn Burdon

Project description: Our research works with families affected by complex diseases such as multiple sclerosis (a neurodegenerative disease), and keratoconus (a blinding eye disease). Our aim with families affected by either of these diseases is to identify the genetic causes behind disease development.

Studying families lets us focus on types of genetic variation that are rare to detect in the population but occur multiple times in families because of Mendelian inheritance. This means we can capture multiple copies of a disease-causing variant shared between affected family members.

In the past when analyzing families using genome or exome sequencing our primary focus has been on the classes of genetic variation that have traditionally been easier to detect: single nucleotide variants (SNVs), and small insertion/deletion variants (INDELs). In this project, you will work with us to move beyond these 'low hanging fruit' to study other classes of genetic variation, namely tandem repeat expansions (TRs), and structural variation (SVs).

The aim of this project is to use computational genomic methods to identify tandem repeat expansions and/or structural variation in multigenerational families with genetic diseases. We have existing whole genome sequence and whole exome sequence data from multiple families. Working with Dr Blackburn we will develop a computational pipeline to identify candidate TRs and SVs in each of these families. For the most promising candidates identified you will work with Dr Blackburn and Professor Burdon to develop laboratory assays to validate these variants using DNA samples from each family as well as to screen DNA samples from a control cohort to identify their frequency in the general population. The balance between computational analysis and laboratory analysis will be driven by the student's interest. However, this project will appeal in the first instance to students with an interest in learning computational analyses of genomic data.

Key techniques used: Computational analysis of whole genome sequence and whole exome sequence data. Laboratory methods for PCR based and Sanger sequencing-based detection of genetic variation.

Location: Hobart, Medical Sciences Precinct

Contact: Nicholas.Blackburn@utas.edu.au

Tackling a turtle tumour threat by harnessing human biology.

Supervisor(s): Dr Nicholas Blackburn

Project description: Fibropapillomatosis (FP) is a tumour promoting disease of global impact to endangered sea turtle populations. Green sea turtles (*Chelonia mydas*) are the most common species of sea turtle, and studies have shown that the prevalence of FP in green sea turtle populations can be as high as 35%. Turtles affected with FP develop large and morphologically varying cutaneous tumours on their bodies that affect their ability to swim, forage for food and avoid predation. Ocular, oral and internal tumours have also been observed in turtles affected with FP. Given the endangered species status of these turtles and the significant impact FP has on any individual turtle's survival, understanding the biology of FP is critical to the growing need to address this problem.

Previous work (Blackburn et al. 2021) has demonstrated that we can draw on the wealth of knowledge from human biology to understand the genes and pathways disrupted in sea turtle FP. By studying gene expression (transcriptomics) in FP tumour tissue and comparing it to healthy control tissue we have discovered multiple biomarkers of FP that are potential targets to understand the development of this disease. Studies to date have been based across two geographical populations of sea turtles, one in South Texas, USA, and the other in Florida, USA.

In this project you will draw upon existing, publicly available data generated by multiple researchers (including Dr Blackburn) to conduct the first cross population meta-analysis of differential gene expression in FP. This will be the largest study comparing the expression profiles of FP tumors to healthy turtle tissue samples. You will then harness what is known from human biology and human oncology to interpret the findings from this study.

In a second aspect of this study, you will also use the data to explore the microbial (bacterial, fungal and viral)

diversity of the sequenced samples. We want to computationally profile these samples (both FP and healthy tissue) to understand their microbial composition. This may reveal a common bacterial pathogen that opportunistically infects FP tumours and further complicates the FP disease course.

This project will appeal to students interested in computational bioinformatic analyses that integrates both human and wildlife biology.

Relevant reading: Blackburn NB, et al. Transcriptomic Profiling of Fibropapillomatosis in Green Sea Turtles (*Chelonia mydas*) From South Texas. *Front Immunol.* 2021;12:630988. Available at: <https://doi.org/10.3389/fimmu.2021.630988>

Key techniques used: Computational analysis of RNA sequence data, differential gene expression analysis, microbiome analysis.

Location: Hobart, Medical Sciences Precinct

Contact: Nicholas.Blackburn@utas.edu.au

[Toward tailored therapy for Amyotrophic Lateral Sclerosis \(ALS\)](#)

Supervisor(s): Dr Catherine Blizzard

Project description: ALS is a ferocious and deadly disease of the corticomotor system, once believed to be primarily neuromuscular that is now characterized by a large neurodegenerative component. Not knowing the cause of ALS or how pathology progresses through this system has been an enormous barrier to the development of effective therapeutics. One of the earliest detectable clinical markers of ALS is motor cortex hyperexcitability. We have discovered that upper motor neurons in the motor cortex and lower motor neurons in the spinal cord are vulnerable to changes in excitability, manifesting as excitotoxicity. However, our preliminary data indicates that these two types of motor neurons may be differentially vulnerable to excitotoxicity and that age and sex, two important patient variables in ALS, have the potential to influence this vulnerability of motor neurons to excitotoxicity. This indicates that a blanket treatment approach toward excitotoxicity in ALS may not be appropriate for the protection of all motor neurons, and that a more targeted intervention is necessary. An innovative and potentially more effective strategy is to specifically tailor treatment to the differential changes that are occurring in the brain and spinal cord through disease progression. To achieve this, we must first understand how and why different neurons in the brain and spinal cord are differentially vulnerable.

This honours project will draw upon our expertise and preliminary data and use leading-edge experimental design in appropriate models to test the hypothesis: Excitotoxicity differentially impacts upper and lower motor neurons in ALS in an age and sex dependent manner.

Key techniques used: This project will use established mouse models of ALS, immunohistochemistry and potentially electrophysiology to interrogate the hypothesis. Results from this project have the potential to significantly improve our understanding of motor neuron degeneration. Targeted treatment of CNS regions that are differentially affected in ALS has never been attempted before and hence this project could provide a novel and contemporary treatment approach for ALS.

Location: Hobart, Medical Sciences Precinct

Contact: Catherine.Blizzard@utas.edu.au

[Does obesity contribute to worse outcomes following traumatic brain injury?](#)

Supervisors: Nicole Bye, Sharn Perry, Vanni Caruso

Project description: Project description: Traumatic brain injury (TBI) causes immediate tissue damage, but also ongoing neurodegeneration that persists for months and contributes to motor and cognitive dysfunction. There are many pathological processes driving this continuing cell death, with neuroinflammation and impaired sensitivity to the neuroprotective actions of insulin playing dominant roles. Interestingly, obesity causes low-grade

neuroinflammation and insulin resistance within the brain, which has led us to propose that these injury mechanisms may be exacerbated following TBI in obese versus normal-weight patients, contributing to greater neurodegeneration and worse outcomes. In this project, we will begin to test this hypothesis by comparing pathological and functional outcomes between obese and normal-weight mice subjected to TBI. To do this, we induce TBI in normal-weight and obese mice using a controlled cortical impact model of unilateral focal brain injury, and compare their functional outcome using multiple motor, behavioural and cognitive tasks across a two-week time course following injury. Subsequently, the extent of inflammation and neurodegeneration in the brains of these mice will be assessed and compared using immunohistochemistry and fluorescence microscopy.

Key techniques used: Mouse motor, behavioural and cognitive testing; brain tissue slicing; immunofluorescence, microscopy and image analysis.

Location: Medical Sciences Precinct

Contact: nicole.bye@utas.edu.au

[Improving the assessment of fitness for the prevention of heart disease: the FitQ study](#)

Supervisors: Dr Niamh Chapman; Dr Martin Schultz; Dr Rachel Climie; Dr Dean Picone

Project description: Poor fitness caused by physical inactivity is a leading risk factor for heart disease. Physical inactivity is estimated to contribute to more than 3 million (6%) annual deaths globally. Despite this, fitness is not routinely assessed in health care settings, which is a lost opportunity to identify people at risk of heart disease. One reason fitness is not assessed is because it is difficult to measure, requiring specialist equipment, ample time, and technical expertise.

The broad aim of this project is to develop and test a new tool (called 'FitQ') that allows general practitioners to accurately 'estimate' fitness and provide important information about cardiovascular health. The study will be conducted in partnership with primary care health practitioners, consumers, and participants.

Our team has a range of preliminary projects that can be completed as part of this research program. Some specific opportunities are listed below, although prospective students are encouraged to contact supervisors for more details or to discuss other options for related research activities.

Potential research projects:

1. A systematic review to determine the relationship between non-exercise test methods to assess fitness and cardiovascular health
2. Determining opportunities and barriers to the assessment of fitness in primary health care settings – a qualitative study

Key techniques: Clinical (human) research; statistical analysis, systematic literature search; qualitative research, interviewing

Location: Medical Science Precinct. Elements of this project could also be conducted remotely.

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[Measuring walkability in rural communities to support active lifestyles](#)

Supervisors: Associate Professor Verity Cleland, Dr Kim Jose

Project description: In 2020, we conducted a citizen science pilot project (UPROAR) that aimed to identify environmental features that influence walkability and physical activity in rural Tasmania. Adults from three rural Tasmanian communities conducted quantitative audits of their town and participated in qualitative focus group discussions where barriers and enablers to walking were discussed in more detail. This work has led to the larger Communities for Walkability (C4W), also a citizen science project aiming to identify environmental features that influence walkability and physical activity in rural Tasmania. C4W will involve working with both young people and

adults from 10 rural Tasmanian communities and will use a novel online tool to quantitatively assess the walkability of towns and coming together to explore barriers and enablers to walkability in qualitative focus groups. There are multiple opportunities within these related projects for Honours students, including studies that aim to: a) report on quantitative walkability assessments, and examine different approaches to scoring walkability tools; b) report on qualitative focus group discussions, identifying key barriers and enablers to walkability; and c) synthesising both quantitative and qualitative data from audits and focus groups in a mixed methods project.

Key techniques used: Students may be involved in quantitative and/or qualitative analysis of the data that has been collected, depending on their preferred project. Students may develop a scoring system for the quantitative audit data using Stata software, analyse qualitative data from focus groups using NVIVO software, or a combination of both. The student will be encouraged to write a manuscript for peer-review based on the findings.

Location: Hobart, Medical Sciences Precinct

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<https://menzies.utas.edu.au/news-and-events/menzies-blog/2021/tasmanians-become-citizen-scientists-in-rural-walkability-study>

[Attitudes towards public and active transport use in Tasmanian during the 2020 COVID-19 pandemic](#)

Supervisor: Associate Professor Verity Cleland

Project description: The trips4health study was a randomized controlled trial to test the effectiveness of an incentive-based strategy to increase public and active transport use. However, it was abandoned due to the COVID-19 pandemic. Participants were asked to complete two further surveys during 2020-21 about how the COVID-19 pandemic had impacted on their public and active transport behaviours, and what strategies might encourage them to use these forms of transport again in future. This project will involve examining these behaviours and attitudes and identifying whether they changed over time as the pandemic in Tasmania was controlled and restrictions eased.

Key techniques used: Students will analyse quantitative survey data using Stata software. The student will be encouraged to write a manuscript for peer-review based on the findings.

Location: Hobart, Medical Sciences Precinct

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Website: <https://www.utas.edu.au/profiles/staff/menzies/verity-cleland>

[Assessing Cardiovascular Health of Children from a Regional Tasmanian Town](#)

Supervisors: Rachel Climie, Rosie Nash, Verity Cleland

Project description: The risk factors for cardiovascular disease (CVD) begin to develop in childhood and are associated with poor outcomes in adulthood. Importantly, CVD risk factors are more prevalent in those who are impacted by their social determinants of health. One important social determinant of our health is where we live. While health promotion activities are common in the school environment, it is increasingly recognised that children require underlying health literacy to ensure these activities are effective and sustainable.

This project will involve the baseline assessment of a CVD specific health literacy intervention with children from a regional Tasmanian town. The project will involve the collection of cardiovascular health data in primary school aged children with the specific aims to:

- 1) determine the feasibility and acceptability of cardiovascular health assessments of children
- 2) determine the cardiovascular health of children from a regional Tasmanian town

Key techniques used: Clinical (human) research, critically appraise scientific literature, data collection and management and statistical analysis.

Location: Hobart, Medical Sciences Precinct

Contact: Rachel.Climie@utas.edu.au

Remodeling myelin through learning

Supervisors: Dr Carlie Cullen, A/Prof Kaylene Young

Project description: Myelination of axons in the central nervous system (CNS) is essential for the rapid transmission of action potentials and maintaining precise spatiotemporal activity patterns within neural networks. Longstanding scientific dogma suggests that myelin internodes, once formed are static structures that remain in place as passive support for neurons. Our team recently challenged this view by demonstrating that existing myelin internodes can subtly adapt their shape during spatial learning. This structural remodeling increased action potential conduction speed along hippocampal axons and improved spatial learning outcomes. This discovery represents a paradigm shift in our understanding of myelin function in the brain, but also leaves us with many unanswered questions, such as whether this is a widespread plasticity mechanism that supports all types of learning. This project aims to determine whether myelin remodeling occurs within specific neural circuits engaged during different types of learning throughout life.

Key techniques used: Mouse behavioural testing and analysis; immunohistochemistry on brain tissue sections; confocal microscopy and image analysis; analysis of transmission electron micrographs (these will be collected for you).

Location: Hobart, Medical Sciences Precinct

Contact: Carlie.Cullen@utas.edu.au

Website: <https://www.menzies.utas.edu.au/research/diseases-and-health-issues/research-groups/glia-in-cognition-lab-cullen-group>

Characterising the molecular mechanisms that underpin myelin remodeling

Supervisors: Dr Carlie Cullen, A/Prof Kaylene Young

Project description: In the central nervous system (CNS) oligodendrocytes produce and wrap segments of fatty, insulating myelin around axons to form internodes and maintain the nodes of Ranvier. This process results in the formation of highly structured axon-glia domains referred to as internodal, juxtaparanodal, paranodal and nodal domains characterized by the spatially restricted expression of specific ion channels, and anchoring proteins. This structural configuration enables the rapid transmission of action potentials along the axon. Our lab recently discovered that during learning, myelin internodes remodel, lengthening the nodes of Ranvier and narrowing the fluid filled space that exists between the axon and myelin internode (the periaxonal space). By characterizing the expression and localization of ion channels and anchoring proteins within the axon-glia domains, this project aims to understand the molecular changes that underpin learning.

Key techniques used: Immunohistochemistry on brain tissue sections; confocal microscopy and image analysis; analysis of transmission electron micrographs (these will be collected for you).

Location: Hobart, Medical Sciences Precinct

Contact: Carlie.Cullen@utas.edu.au

Website: <https://www.menzies.utas.edu.au/research/diseases-and-health-issues/research-groups/glia-in-cognition-lab-cullen-group>

The watching eye: Identification of apnoea in preterm infants using a contactless vision-based detection system

Supervisor(s): Prof. Peter Dargaville, Dr. Tim Gale (School of Engineering)

Project description: This project will be based in the Neonatal and Paediatric Intensive Care Unit at Royal Hobart Hospital. The overarching aim of the research is to investigate the potential for contactless vision-based colour or infrared sensing systems to detect respiratory activity and hence identify respiratory pauses (apnoea) in preterm infants. Studies will be conducted in preterm infants <30 weeks gestation who are receiving respiratory support with continuous positive airway pressure or nasal high flow as part of the NHMRC-funded PANDA study.* Recordings will be made using colour and infrared imaging systems directed at the preterm infant's torso, and will be combined with physiological data already being recorded as part of the PANDA data collection. From the physiological data, periods of apnoea will be identified, and the capacity for the contactless device to detect these events will be examined. If such a device was found to be a reliable tool for signalling apnoea, this would be a significant advance in preterm care.

*Prediction and novel detection of apnoea in preterm infants (NHRMC Ideas Grant 1182515).

Key techniques used: Physiological and clinical data collection and analysis in an intensive care environment. Interaction with staff and families. Development of analytical software, with assistance from research team members.

Location: NPICU, K8E, Royal Hobart Hospital, Hobart

Contact: peter.dargaville@ths.tas.gov.au

Investigating neuron-glia interactions in a *Drosophila* model of Alzheimer's Disease

Supervisors: Dr Caroline Delandre, Dr Owen Marshall

Project description: Alzheimer's Disease (AD) is a devastating neurodegenerative disease characterised by a gradual loss of memory and cognition. Over the past decades, most AD research has been focused on the effects of amyloid plaques and tau neurofibrillary tangles on neuronal functions, even though glia, the supporting cells of the nervous system, have long been known to respond to plaque formation. Recent technological advances have revealed most glial subtypes undergo significant molecular changes in human AD patients, underscoring the need to understand the impact AD has across multiple cell types in the brain. How do neurons and glia interact as disease progresses, and more importantly, what happens during the pre-clinical AD phase before symptoms appear?

To answer this question, our lab uses the vinegar fly *Drosophila melanogaster* to model AD progression. Just as in humans, AD flies show progressive neurodegeneration, behavioural changes (locomotion and memory), and a shorter lifespan. In a recent study, we have characterised how neurons behave at different disease stages and have found dramatic changes in morphology and gene expression starting before any behavioural changes are observed. This project will seek to understand how glia surrounding these neurons respond to this dynamic environment. We will analyse cell morphology and migration via confocal microscopy, using genetic markers to independently label neurons and glia with distinct fluorescent proteins; and we will measure gene expression changes via next generation sequencing. By the end of this project, we will have obtained a new and detailed picture on the role of neuron-glia interactions during AD progression.

Key techniques used: *Drosophila* genetics, dissection, confocal microscopy, molecular biology, imaging quantification, data analysis using R

Location: Medical Sciences Precinct

Contact: caroline.delandre@utas.edu.au

Website: <https://marshall-lab.org>

Unravelling the genetics of prostate cancer

Supervisors: Dr Liesel FitzGerald and Prof Joanne Dickinson

Project description: Family history is one of the few consistently identified risk factors for prostate cancer (PrCa). It is now clear that rare inherited genetic variants are an important causal factor in PrCa development and that rare variants have a more apparent role in disease risk than common risk variants. Massively parallel sequencing in families with a dense aggregation of disease - where rare variants are enriched and there is reduced genetic complexity - has enabled significant success in the discovery of rare genetic variants contributing to disease. We have shown that a similar research approach can be applied to PrCa families to successfully identify rare variants contributing to this disease (FitzGerald *et al.* CEBP. 2013 Sep;22(9):1520-8.; Raspin *et al.* Int J Cancer. 2021 Sep 1;149(5):1089-1099).

We have generated whole-genome sequencing (WGS) data for multiple affected and unaffected relatives across several of our large Tasmanian PrCa families with the aim of identifying rare risk variants. Candidate risk variants are identified through WGS data mining, then validation and replication steps are undertaken in our larger PrCa resource for select variants. Any variants that prove to be significantly associated with PrCa risk in our Tasmanian population are then functionally characterised in the lab. The project proposed here can involve any or several of the steps described above. For example, WGS data could be mined to identify candidate risk variants, which would then be validated using Sanger Sequencing and genotyped in our larger PrCa resource using TaqMan. Alternatively, characterisation of the effect of a risk variant could be undertaken in the lab using methylation, gene and protein expression techniques.

Key techniques: A range of bioinformatics, laboratory and analysis methods will be used in this project and could include: data mining whole-genome sequencing, candidate gene literature research, primer design, PCR, Sanger sequencing, sequence analysis, TaqMan genotyping, association analysis (e.g. MqIs), qPCR (gene expression analysis of tumour samples), etc.

Location: Medical Sciences Precinct, Hobart

Contact: liesel.fitzgerald@utas.edu.au or jo.dickinson@utas.edu.au

Can a familial genetic variant in *NLRX1* cause Multiple Sclerosis?

Supervisor(s): Dr Jessica Fletcher and A/Prof Kaylene Young

Project description: Multiple Sclerosis (MS) is a complex disease, involving the immune system and brain, with no clear cause and no known cure. Numerous factors, including a person's environment, lifestyle and genetics, influence whether they will develop MS. However, many of the common genetic risk factors identified have no clear biological role in MS. Our team has studied a family with an unusually high incidence of MS within first-degree relatives, meaning that the genetic factors outweigh the environmental and lifestyle risks that contribute to developing MS. Using this approach, we have identified a variant in the *NLRX1* gene that is found in family members with MS, but not their unaffected relatives. This project aims to characterize the molecular and cellular consequences of the *NLRX1* variant to determine if it is sufficient to induce an MS-like phenotype.

Key techniques used: Transgenic mice, animal handling and monitoring, motor and behavioural testing, immunohistochemistry, confocal microscopy, image analysis.

Location: Medical Sciences Precinct

Contact: jessica.fletcher@utas.edu.au; kaylene.young@utas.edu.au

Web: <https://www.menzies.utas.edu.au/research/diseases-and-health-issues/research-groups/glia-research-team-young-group>

Identifying the phosphorylation events that drive myelin formation

Supervisor(s): Dr Jessica Fletcher

Project description: In people with Multiple Sclerosis (MS), disability worsens when the loss of insulating myelin leads to neuron damage and death. To prevent this, we need to better understand how myelin is made, so we can identify new methods to promote its repair. The goal of this project is to identify novel molecular events that allow the brain cells called oligodendrocytes to make myelin. This will be achieved by growing oligodendrocytes 'in a dish' and treating them with a naturally occurring growth factor called brain-derived neurotrophic factor (BDNF) and a synthetic, more potent version known as TDP6. We will then use mass spectrometry to discover the proteins that these signals activate within oligodendrocytes. This "phospho-proteomics" approach will allow us to identify the exact residues within the target proteins that are modified during the activation process, and the ones that are activated in response to both treatments. This will then form the basis of further studies to test which of these amino acid residues we can manipulate to drive myelin repair.

Reference: Fletcher et al. (2018) 'Targeting TrkB Targeting TrkB with a Brain-Derived Neurotrophic Factor Mimetic Promotes Myelin Repair in the Brain.' *Journal of Neuroscience*, vol. 38, pp.7088-7099. [DOI: 10.1523/JNEUROSCI.0487-18.2018](https://doi.org/10.1523/JNEUROSCI.0487-18.2018)

Key techniques used: Cell culture, biochemistry, proteomics, molecular biology, immunocytochemistry, confocal microscopy, bioinformatic data analysis.

Location: Medical Sciences Precinct

Contact: jessica.fletcher@utas.edu.au

Identification of adenovirus host cell entry receptors in marsupials

Supervisors: Dr Andrew Flies, Dr Amanda Patchett, Prof Alex Hewitt

Project description: The Tasmanian devil facial tumour (DFT1) disease has been the primary driver for an 80% decline in wild devils. Recently a second type of transmissible tumour was discovered in wild devils and this second devil facial tumour (DFT2) thus far appears to be 100% fatal. Our team is developing a viral vector that encodes DFT antigens and immunomodulatory cytokines to induce immune memory in healthy devils and induce an anti-tumour immune response in diseased devils (Flies et al., 2020). We have confirmed that a replication-deficient human adenovirus can infect DFT cells and express devil transgenes, such as interferon-gamma. In humans, several receptors are known to be exploited by adenoviruses to gain entry to the host cell. We have identified the corresponding entry receptor genes in devils but we currently lack functional evidence that these receptors are used by the virus to gain entry to devil cells. This project will use Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) to knockout potential host entry receptors encoded by CXADR, CD46, DSG2, ITGAV, and HSPG2 in DFT cells (reviewed in Puschnik et al., 2017; reviewed in Stasiak et al., 2020). These knockout cells can then be modified to re-express high levels of the missing receptor or a decoy receptor. Together this knockout/knock-in approach will allow us to quantify the relative importance of each entry receptor for infection with our vaccine vector. We will also use an existing DFT transcriptome-specific CRISPR gRNA library to perform transcriptome-wide loss-of-function and gain-of-function screening to identify additional genes associated with adenovirus infections. This will allow us to determine differential expression of genes that are associated with increased or decreased susceptibility to infection by adenoviruses. This will also open a pathway to engineering an adenovirus with increased specificity to devil receptors and decreased potential to infect via receptors in off-target species such as humans, quolls, and possums. The student will gain skills and confidence in advanced molecular biology, vaccine, and genetic engineering techniques that are broadly applicable to human and animal medicine.

Key techniques used: Cell culture, molecular cloning, flow cytometry, PCR, CRISPR, microscopy

Location: Hobart, Medical Science Precinct

Contact: andy.flies@utas.edu.au

UTAS research profile: <https://www.utas.edu.au/profiles/staff/menzies/andrew-flies>

Website: <https://wildimmunity.com/>

Muscular fitness and health-related quality of life

Supervisors: Dr Brooklyn Fraser, Dr Costan Magnussen

Project description: Muscular fitness is associated with a range of health outcomes, including mortality, cardiometabolic diseases, mental health, and bone health. However, less is known regarding the association between muscular fitness and health-related quality of life. Previous research in this area has identified the positive association between muscular fitness and health-related quality of life in children and adults separately. However, it is currently unclear if muscular fitness in childhood is an independent predictor of health-related quality of life in adulthood.

Using data from the Childhood Determinants of Adult Health Study, the aim of this project would be to explore the association between muscular fitness measured in childhood and across the life course and health-related quality of life and its individual domains in mid-adulthood.

Key techniques used: This project will provide the opportunity for the student to explore different statistical analytic techniques to explore longitudinal data. We are seeking a student with a willingness to learn new skills and problem solve. In addition to the normal Honours requirements, students will be expected to draft a manuscript with the intention to submit to a peer-reviewed journal.

Location: Medical Sciences Precinct

Contact: fraserbj@utas.edu.au , cmagnuss@utas.edu.au

Battle of the bacteria: mechanisms used by symbiotic bacteria that defend a human host against infection by pathogenic bacteria

Supervisor: Dr Dave Gell

Project description: All eukaryotes make symbiotic relationships with bacteria that confer advantages such as access to otherwise unavailable nutritional sources, or enhanced defence against pathogenic microbes. Understanding these interactions might lead to improved human health by promoting beneficial bacteria, or lead to the discovery of novel anti-microbial compounds.

We recently showed that a commensal bacterium from the human respiratory tract inhibits the growth of a pathogenic bacterium from the same ecological niche [1]. We traced the inhibitory activity to a single secreted protein, hemophilin (Hpl), that interfered with nutrient metal uptake by the pathogen. Subsequently, a group from the University of Tennessee identified Hpl-like sequences from multiple commensal bacterial species as well as some opportunistic pathogens [2], suggesting more widespread and layered mechanisms of competition between host, commensal and pathogen.

In this project, which is a collaboration with the University of Tennessee, Knoxville, we will clone, express, and purify Hpl-like proteins from different sequence families and investigate their target-binding interactions. Anticipated outcomes are: (a) to identify the type of ligand that different Hpl family proteins can bind to, (b) to generate hypotheses about the biological roles of Hpl family proteins that can be tested in model host-bacteria systems, and (c) to identify representative Hpl proteins that are suitable for future protein structure-function studies. In broader terms, we hope to gain insight into the evolution of host-bacterial interactions and find new avenues through which to address the looming challenges of widespread antibiotic resistance.

1. Latham, R.D., et al., *A heme-binding protein produced by Haemophilus haemolyticus inhibits non-typeable Haemophilus influenzae*. Mol Microbiol, 2019.
2. Grossman., A.S., et al., *Description of a widespread bacterial secretion system with chemically diverse substrates*. bioRxiv 2020.01.20.912956

Key techniques used: Recombinant DNA methods, protein expression in E. coli, protein purification, analytical methods for protein characterization

Location: Medical Sciences Precinct, Hobart

Contact: david.gell@utas.edu.au

Healthy landscapes, healthy people? Understanding the intersection of environmental microbiomes and human health in Hobart

Supervisory team: Dr Penelope Jones, Dr Emily Flies

Project description: There is increasing recognition of the importance of the ‘microbiome’ – including the microbiome of the environment around us - in shaping many aspects of human health. We are also beginning to understand that urbanisation and land use change are impacting health – potentially by altering the microbial communities to which we are exposed.

But we need a better understanding of the factors influencing environmental microbiomes, and whether exposure to biodiverse microbiomes around Hobart can contribute to community health and wellbeing. This project will investigate the environmental (e.g., soil/air) microbiome from sites around Hobart and see how the diversity of those microbiomes varies across the landscape and what that may mean for human health.

Key techniques: The project will involve the collection and/or analysis of air and/or soil samples, statistical analysis of the results, and interpretation of potential implications for the relationship between environments and human health. Statistical analysis will be conducted using R. The project will suit a student with an interest in transdisciplinary approaches to public health, environmental health and/or epidemiology.

Contact: Penelope.Jones@utas.edu.au

How can nature-based citizen science contribute to well-being?

Supervisors: Dr Penelope Jones, Dr Emily Flies

Project description: Human interaction with nature is associated with health benefits ranging from reduced obesity, cardiovascular disease and mortality and to greater overall self-reported mental health and wellbeing. Nature-based citizen science has emerged as a way to support nature experiences that can help participants feel closer to nature (‘nature connectedness’), foster pro-environmental attitudes and behaviours and, potentially, improve mental and physical wellbeing.

However, there have not been many studies exploring the connection between engagement with citizen science activities and the wellbeing benefits and there is great variety in the type and quality of nature-based citizen-science activities. In this study, we propose to examine several nature-based citizen science events (i.e. BioBlitz events), to better understand the impacts of nature-based citizen science events on knowledge, beliefs, behaviour and wellbeing. The events will be held with a shared set of core activities, but in a variety of contexts, providing an opportunity to test the transferability of results across social and geographical contexts.

Specifically, the aims of this study are to:

- 1) Determine the short-term impacts of nature-based citizen science events on aspects of participant wellbeing and nature connectedness.
- 2) Test how these impacts vary with participant demographics and event characteristics
- 3) Understand the aspects of the events that contributed to participant experience and any wellbeing impacts measured.

Key techniques used: The project will involve a mixed-methods approach. It will involve the collection and analysis of survey data (before, during and after nature-based citizen science events) using quantitative and qualitative techniques.

Location: Hobart, Medical Sciences Precinct

Contact: Penelope.Jones@utas.edu.au

Developing a new microfluidic model of neurodegeneration to test potential dementia treatment strategies.

Supervisors: Jacqueline Leung, Rachel Atkinson, Anna King

Project description: Neurodegenerative diseases such as those that cause dementia and motor neuron disease rarely involve acute cell death, rather they are thought to involve loss of the synaptic connections between neurons, which may be followed by progressive degeneration of cell. The neuron consists of cell body and dendrites (which receive incoming information) and a long axon, which can send a signal to a distant part of the nervous system and terminates at the synapse. Pathological changes in the cell body could have effects in the distant synapses and conversely, pathological changes in the axon and synapse could have downstream effects on the cell body of the connecting cells. These processes of degeneration are not well understood in neurodegenerative disease. To develop treatment strategies for neurodegenerative diseases we need to first understand how synaptic connections are lost as well as the mechanism of cell degeneration. This requires good models to mimic these processes in laboratory conditions.

In this project, you will develop a cell culture model with neurons grown in specialized microfluidic chambers, which allows the compartmentalised treatment of either the cell bodies or the axons of the cultured cells. Neurons will be transduced using virally expressed plasmids to drive the expression of either red and green fluorescent proteins, with red neurons synapsing on green neurons in the opposing chamber. The effects of a pathological insult that is related to dementia and motor neuron disease (excitotoxicity) will be examined to determine:

1. How damage to a neuron cell body affects cells synapsing onto it (die back)?
2. How damage to a neuron cell body affects its distal axon and synapse (die forward)?
3. The time course of changes to the dendrites, cell body, axon and synapses in response to the damage.
4. If we can modulate neurodegeneration pathways to prevent or slow down these changes?

Key techniques used: Primary neuron culture, viral transduction, Immunohistochemistry, live imaging fluorescence microscopy.

Location: Medical Sciences Precinct

Contacts: Jacqueline.Leung@utas.edu.au

Innovative antibody mimetic or 'insert your favourite protein here' library generation and selection in mammalian cells

Supervisors: John Y. Lin, David Gell, Agnieszka Zbela

Project description: Mutations are not always bad (despite what you have read from the other projects in this booklet) as they introduce diversities to the organisms, phenotypes and proteins. Mutations are beneficial for improving the properties of proteins or enhances the survival rates of the organisms when combined with the appropriate selection pressure. When a protein can be expressed and function in simpler organisms such as bacteria, bacteriophage and yeast, there are extensive molecular biological techniques that can be utilized to generate and introduce library of diverse mutant proteins. However, in proteins that are only functional in mammalian cells, many of these approaches are limited due to the efficiency of introducing the library into the cells and amount of diversity that can be incorporated. An alternative approach would be to instruct the cells to generate the library of diversity themselves and select the appropriate mutants in mammalian cells directly. Recently, there are some innovative approaches in other model systems that could be adapted to mammalian cells so that the recombinant DNA can be mutated by the cells directly after introducing the transgene into the cells, hence the library is generated automatically by the cells as they proliferate and expand, in a process akin to somatic hypermutation for antibody maturation. Selection can also be conducted directly in the model system most relevant to the final outcome. The aim is to develop these approaches and demonstrate the feasibility of the approach to engineer improved protein tools for biomedical and biological researches. Ideally, we would use these approaches to improve the properties of antibody mimetic proteins domains (nanobodies, affibodies) for specific targets, fluorescent proteins and optogenetic tools such as channelrhodopsins but due to the time constraints of the Honours projects, we will pick

Science should be fun, creative, exciting and innovative yet conducted with highest rigor. If you are a student with an inventor's mindset and enjoy troubleshooting problems, this would be a suitable project for you. Don't get me wrong, this won't be easy and you will have plenty of setbacks, but if you enjoy solving problems and like a good challenge, you will be an ideal person for the project.

Key techniques used: Molecular cloning, molecular biology, protein structure analysis, cell culture, high throughput screening design, fluorescent imaging, recombinant virus generation and whatever is necessary.

Protein and experimental designs => molecular cloning => recombinant virus for cell transduction => mammalian cell culture => design and implement high throughput selection of mutants => sequencing and analysis of mutants

Location: Hobart, Medical Sciences Precinct

Contact: John Y. Lin, john.lin@utas.edu.au

Website: <https://secure.utas.edu.au/health/research/groups/tasmanian-school-of-medicine/medical-sciences/lin-group>

Optical control of an intracellular phosphatase essential for learning and memory – a protein engineering project and beyond

Supervisors: John Y. Lin, Agnieszka Zbela, David Gell

Project description: When you study for the exams, you 'learned' (memorise) the information that were provided to you by your amazing lecturers, Google and Wikipedia (with the respective ratio of 1:10:10). This physiological process of learning is associated with changes of the protein composition at the synapses in the neurons of your brain. One key protein that is essential for learning is the protein phosphatase calcineurin which is a master mediator of Long Term Depression (LTD). If we are able to manipulate the activity of calcineurin artificially in the brain, we should be able to make the animal actively forget or block the learning process. Previously a PhD student in the lab had successfully developed a novel approach to inhibit calcineurin function using light so that when we deliver light to the cells, we can block the activation of calcineurin in neurons and alter animal behaviour. In this subsequent project, you will continue the development of an approach to use light to activate the activity of calcineurin so that you can achieve active 'erasing' of memories. The project aims to design and test several designs of recombinant proteins and demonstrate it is possible to artificially activate these recombinant calcineurin with light. If successful, you should be able to the 'Men in Black' thing where you can erase the memory of an animal by shining light on the organism.

Science should be fun, creative, exciting and innovative yet conducted with highest rigor. If you are a student with an inventor's mindset and enjoy troubleshooting problems, this would be a suitable project for you. Don't get me wrong, this won't be easy and you will have plenty of setbacks, but if you enjoy solving problems and like a good challenge, you will be an ideal person for the project.

Key techniques used: Molecular cloning, molecular biology, protein structure analysis, cell culture, high throughput screening design, fluorescent imaging, recombinant virus generation and whatever is necessary.

Protein and experimental designs => molecular cloning => recombinant virus for cell transduction => mammalian cell culture => design and implement high throughput selection of mutants => sequencing and analysis of mutants

Location: Hobart, Medical Sciences Precinct

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Website: <https://secure.utas.edu.au/health/research/groups/tasmanian-school-of-medicine/medical-sciences/lin-group>

Childhood physical fitness and academic performance

Supervisors: Dr Costan Magnussen and Dr Brooklyn Fraser

Project description: Emerging evidence suggests that physical activity and cardiorespiratory fitness are positively associated with academic performance and that time in the school day dedicated to recess, physical education class, and classroom-based physical activity may also benefit scholastic ability in children. However, less is known about whether there is an association between muscular fitness and academic performance.

This project is uniquely placed to address this research gap using data from the Australian Schools Health and Fitness Survey (ASHFS). As part of the ASHFS, a nationally representative sample of Australian schoolchildren had their muscular fitness measured using a wide range of different fitness tests including measures of muscular strength, power, and endurance. Data on teacher-reported academic performance and self-reported school engagement were also collected. The aim of this project is to explore if there is an association between muscular fitness and academic performance in Australian children.

Key techniques used: This project will provide the opportunity for the student to explore different statistical analytic techniques to examine data from a large national cohort. We are seeking a student with a willingness to learn new skills and problem solve. In addition to the normal Honours requirements, students will be expected to draft a manuscript with the intention to submit to a peer-reviewed journal.

Location: Medical Sciences Precinct

Contact: cmagnuss@utas.edu.au, fraserbj@utas.edu.au

[Profiling transcription factor networks in neural stem cells](#)

Supervisors: Dr Owen Marshall, Dr Caroline Delandre

Project description: Neural stem cells (NSCs) are the cells that form our brains, and through adult neurogenesis maintain them through our lifetime. Via stem cell therapy, they may represent a new and promising treatment of traumatic brain injury and neurodegeneration. Understanding how NSCs maintain their identity, or fate, is critical to both understanding healthy brain development and ultimately for treating disease.

Cells may adopt many different identities, or “fates”, determined by the genes that they express. Proteins called transcription factors (TFs) regulate the expression of these genes, binding at regulatory elements called “enhancers” and “promoters” in complex combinations to turn a gene either on or off. Understanding how TFs work within a cell is thus vital to understanding how the fate of a cell is maintained; however, we still do not understand how key NSC transcription factors regulate stem cell fate.

In this project we will use a cutting-edge molecular biology technique called Targeted DamID combined with next-generation sequencing to profile the binding of multiple transcription factors within NSCs of the model organism *Drosophila melanogaster*. We will use bioinformatics analysis to create a network graph of their binding and predict their regulatory targets. We will then genetically manipulate NSCs to perturb these networks to validate our predictions. By the end of this project, we will have uncovered new regulatory controls of neural stem cell fate.

Key techniques used: *Drosophila* culture, brain dissection, confocal microscopy, molecular biology, next-generation sequencing bioinformatics data analysis using R.

Location: Hobart, Medical Sciences Precinct

Contact: owen.marshall@utas.edu.au

Website: <https://marshall-lab.org>

[Untangling the role of natural selection in shaping geographical patterns of multiple sclerosis prevalence](#)

Supervisors: Dr Bennet McComish

Project description: Multiple sclerosis prevalence shows a heterogeneous geographical pattern, with higher prevalence in populations of European ancestry, as well as increasing with distance from the equator within those populations. This pattern has likely been shaped by both natural selection and neutral genetic drift. Identifying

genes that have undergone selection at MS risk loci will improve our understanding of the causative mechanisms behind the disease. This project will use population genomics to identify functional variation that has been subject to natural selection at loci associated with MS risk.

You will use cutting-edge bioinformatic methods to carry out genome-wide scans for natural selection in population genomic data, and localise MS-related selection by targeting loci known to be associated with MS risk. This will generate information regarding the selective forces that have driven the differences in MS risk between populations, enabling more informed targeting of the molecular mechanisms behind the disease.

Key techniques: Genome-wide scans for signatures of natural selection (bioinformatics/ population genetics).

Location: Medical Sciences Precinct

Contact: bennet.mccomish@utas.edu.au

[HealthLit4Kids: Supporting children, adolescents, and their families to make sense of health and health care \(working directly with our Paediatricians in the Child & Maternal Health Unit, THS\)](#)

Supervisors: Rosie Nash + HealthLit4Kids members

Project Description: Evidence suggests that Tasmanians face challenges accessing and interpreting health information. This indicates that further attention is required to support individuals and communities to make health promoting decisions. Health care workers such as paediatricians, nurses, teachers, social workers, etc. play a key role in promoting positive outcomes including the development of health literacy. Health literacy influences the health, educational attainment, health equity and productivity of all Tasmanians. Developing health literacy assets earlier in life can have a big impact on health behaviours and positively influence adult health outcomes. This project will increase the health literacy of children, adolescents and their families which will in turn likely reduce the burden of chronic disease and the economic impact on the Tasmanian health system. Working with key stakeholders from acute care to community services this project will improve transitions of care and self-management through capacity building and improve the health literacy responsiveness of Tasmanian health services.

Key techniques used:

Possible techniques utilised (depending on project choice): Co-Design, Interviews, Surveys, Qualitative research including thematic analysis, Quantitative analysis (basic statistics), International Review of the Literature: Scoping Review or Systematized Review. The candidate(s) would be supported by our multidisciplinary team to develop and apply skills in qualitative and/or quantitative analysis.

Location: Medical Sciences Precinct, Hobart OR OFF Campus as negotiated with Research Team

Contact: Maddie Spencer (madeline.spencer@utas.edu.au)

[Supporting the health literacy responsiveness of schools: Developing and pilot testing the HeLLOTas school companion OR OrgHLR for schools](#)

Supervisors: Rosie Nash, Claire Otten,

Project Description: The HeLLOTas tool is a toolkit for a step-by-step process for doing a self-assessment and developing a Health Literacy Action Plan for an organisation. The toolkit was used by teachers as part of the HealthLit4Kids initiative. While the toolkit was effective at highlighting the health literacy needs of the school, teachers reported the tool to be inappropriate for their setting; for example, some of the language was poorly targeted. The development of a companion could help to overcome this challenge, to support educators to use the tool. In turn, this would improve the efficiency and effectiveness of the HeLLOTas tool. The candidate will start with a compare contrast of the HeLLOTas tool and the OrHLR to determine which is most appropriate in the school environment. Existing data from our research with 5 Tasmania schools would be utilised to inform this process and will lead to the development of the HeLLOTas school companion or OrgHLR for schools. Time permitting, the tool will be tested with a group of teachers and school leaders to evaluate its acceptability and usability.

Key techniques used: Co-Design, Mixed methods, Focus Group, Interviews, Qualitative research including thematic analysis. The candidate(s) would be supported by our multidisciplinary team to develop and apply skills in qualitative and/or quantitative analysis.

Location:

Medical Sciences Precinct, Hobart OR OFF Campus as negotiated with Research Team

Contact: Maddie Spencer (madeline.spencer@utas.edu.au)

Research honours in medical education

Supervisors: Dr Kathryn Ogden, Associate Professor Tim Strong

Project description: Educating doctors for practice in modern health care systems requires the implementation of differing pedagogical strategies, clinical learning opportunities, knowledge based learning, and professional development experiences to ensure students are equipped with the graduate outcomes that have been identified by the Australian Medical Council.

At the Launceston Clinical School, we have an active interest and involvement in medical education research. There are a number of existing and potential projects that students could undertake for completion of a B Med Sci (Hons).

Areas of research interest for which research ideas are either well developed or underway include:

- Optimizing learning on clinical placements.
- Learning from reflective writing in medical education.
- Student learning from community engagement (eg HealthStop@Agfest, Teddy Bear Hospital).
- Interprofessional learning.
- Preparing students for professional aspects of practice.

Increasingly medical students are engaging in medical education research, with the benefit of having insights which contribute uniquely to the quality of the research. An honours year in medical education research provides students with a head-start to a future academic role.

Honours students will negotiate with supervisors a project that aligns with their interests prior to submitting their application.

Key techniques used: Variable, depending on the project chosen. Could include survey, interview, focus group, observation methods of data collection. It is likely that projects will be mixed methods including quantitative and qualitative methods.

Location: Launceston Clinical School

Contacts: Kathryn.ogden@utas.edu.au, Timothy.Strong@utas.edu.au

Validation of the “Health Literacy Evaluation Tool” in the healthcare student population.

Supervisors: Dr Kathryn Ogden, Dr Rosie Nash, Dr Derek Choi-Lundberg, Dr Claire Eccleston, Dr Jane O’Brien.

Project description: Health literacy is described as ‘The personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health. Health literacy includes the capacity to communicate, assert and enact these decisions.’

A health literate workforce is required to respond to the needs of people seeking health services. In order to address high rates of chronic health conditions, dangerous misinformation and the impact of socio-economic factors on the health status of people in our community, our future health workforce will require explicit training.

Embedding training for a health literate workforce within the tertiary curriculum is a priority. In order to ensure that our health care students are developing appropriate levels of responsiveness to the health literacy needs of others, we require a validated measurement instrument to monitor their progress over time.

The “Health Literacy Evaluation Tool” was developed in the context of health care providers attending capacity building workshops in order to support migrant health. This is the closest existing measurement tool available for our purposes, however it requires validation and further development in the context of healthcare education.

Aims: This study aims to validate, and where necessary adapt, the “Health Literacy Evaluation Tool” for use in health care student populations.

Validity refers to the extent to which a quantitative measurement instrument accurately measures the concept which it is intended to. The following will be evaluated:

- Face validity: Does the instrument appear suitable to measure health literacy responsiveness in health care students?
- Construct validity: Does the instrument measure health literacy responsiveness?
- Content validity: Does the instrument measure all relevant aspects of health literacy responsiveness?

Key techniques used: Expert evaluation of the instrument (face, construct and content validity), User group evaluations with healthcare students (face validity), Cognitive interviewing to determine item validity & wording (construct validity), Survey administration

Location: This is a state-wide project, the Honours student could be located in Hobart, Burnie, or Launceston. Space for the student would be provided at the relevant centre.

Contacts: You are welcome to contact any of the research team members to discuss this project further:

Rosie Nash rose.mcshane@utas.edu.au, Derek Choi-Lundberg derek.choilundberg@utas.edu.au, Claire Eccleston claire.eccleston@utas.edu.au, Jane O'Brien j.a.obrien@utas.edu.au, Kathryn Ogden kathryn.ogden@utas.edu.au

Characterisation of infiltrating host cells in devil facial tumour disease

Supervisor(s): Dr Amanda Patchett, Dr Andy Flies

Project description: Devil Facial Tumour Disease (DFTD) is a contagious cancer responsible for an 80% decline in the wild Tasmanian devil population. DFTD is unique in that the same cancer infects genetically different animals, requiring complex interactions with the host immune system to suppress immune rejection. The cellular interactions that prevent killing of DFTD cancer cells by the devil’s immune system are not fully understood. In other species, cancer cells ‘hijack’ cells of the host’s immune system such as myeloid cells, suppressing anti-cancer functions and converting them into pro-tumour effectors. Indeed, previous research suggests that DFTD cancers often contain myeloid, lymphoid and stromal host cells that could cooperate with DFTD cells to inhibit immune-mediated killing. Investigation of these tumour-infiltrating cells could inform the successful development of DFTD vaccines and therapies and will provide insight into cancer development in other species including humans. The major impediment to DFTD laboratory studies has been the lack of devil-specific reagents. However, an increasing number of reagents are being developed. This project will use these reagents, as well as additional techniques such as PCR and cell culture, to identify and characterise infiltrating host cells in DFTD.

Key techniques used: Cell culture, molecular cloning, flow cytometry, PCR, tissue dissociation, microscopy

Location: Hobart, Medical Science Precinct

Contact: amanda.patchett@utas.edu.au

Can we stop axon degeneration in amyotrophic lateral sclerosis?

Supervisor: Sharn Perry

Project Description: Amyotrophic lateral sclerosis (ALS) is an insidious, neurodegenerative disease characterised by the progressive loss of voluntary muscle control leading to muscle weakness, paralysis, and eventual death. The clinical symptoms of ALS are caused by the degeneration and death of upper (brain) and lower (spinal) motor neurons and motor neuron axons, however, the mechanisms behind selective motor neuron death, and the loss

of motor neuron axon integrity are unclear. Recently, a novel drug targeting the axon, has been identified that could potentially slow the degeneration of motor neuron axons. This drug, ACY738, promotes the acetylation of microtubules in the axon, which are important in maintaining axon integrity. Preliminary data from our lab suggests that ACY738 could be protective of axon degeneration in the spinal cord of mSOD1^{G93A} mouse model of ALS. This project will extend investigations into the role of ACY738 in axon degeneration to the brain and brainstem, using experimental ALS mouse models with and without ACY738 treatment, combined with *in vitro* tools to explore nervous system pathology in the early stages of disease progression. This study will further our understanding of the mechanism of axon degeneration in neurodegenerative disease mechanisms, particularly ALS.

Key Techniques used: Tissue dissection and preparation; immunohistochemistry; confocal microscopy, automated image analysis.

Location: Medical Sciences precinct, Hobart

Contact: sharn.perry@utas.edu.au

Understanding neurodegeneration using experimental animal models

Supervisor: Sharn Perry

Project Description: Neurodegeneration, the breakdown of neurons within our nervous system, is associated with a variety of degenerative disorders, including dementia, amyotrophic lateral sclerosis and multiple sclerosis. Declines in cognitive and motor function are common clinical symptoms of degeneration, which significantly impact quality of life for those living with these diseases. If we want to slow or prevent the onset of clinical symptoms, we need to understand which neural populations are vulnerable to degeneration. To do this, we use experimental mouse models of neurodegeneration that can target specific neural populations, and investigate whether:

- I. specific neural populations are vulnerable to degenerative mechanisms, and
- II. the onset and progression of cognitive and motor symptoms match the pathology occurring in the nervous system

This project will use a variety of experimental animal models combined with *in vitro* tools to extend our current understanding of which brain and spinal cord neural populations are vulnerable to degenerative disease mechanisms, and whether degeneration in cortical neurons, triggers changes to neural circuits in the brainstem and spinal cord.

Key Techniques used: Cell culture, electrophysiology, immunohistochemistry, confocal microscopy, automated image analysis.

Location: Medical Sciences Precinct

Contact: sharn.perry@utas.edu.au

Men are from Mars and women are from Venus? exploring sex differences in stroke care and outcomes in Tasmania

Supervisors: Dr Hoang Phan, A/Prof Seana Gall

Project description: Stroke is a leading cause of death and disability in Australia. Tasmania has substantially higher incidence and death rates attributable to stroke than the national average, but treatment and care in Tasmania lag behind the rest of Australia. We have previously found that women are more likely to die and recover less after stroke than men. However, women also receive suboptimal in-hospital stroke care than men. The reasons why women have worse outcomes and treatment than men remain unclear but may include patient-level factors like age and health before stroke, but also health system-level factors, such as organisational settings (e.g. hospital size), delays to admission from the Emergency Department.

Aim: To investigate health system- and patient-level factors contributing to sex differences in hospital care,

readmissions and 1-year survival between men and women after stroke.

Key techniques: In this project, the data from the BEATStrokeTas - first-ever Tasmanian stroke data linkage study will be used. There are more than 4,000 Tasmanians with stroke between 2007-2020 identified through a systematic linkage database between the Australian Stroke Clinical Registry and state-based datasets (e.g. Hospital Admitted Patient, Emergency Department presentations). Students with an interest in public/population health, epidemiology, and cardiovascular disease, are encouraged to apply. You will learn how to use the Stata statistical software package, gain a basic understanding of biostatistics, and gain experience working with linked data.

Location: Medical Sciences Precinct

Contact: thi.phan@utas.edu.au, Seana.gall@utas.edu.au

Do pericytes regulate capillary blood flow in skeletal muscles?

Supervisors: Dr Dino Premilovac, Dr Stephen Richards and Dr Renee Ross

Project description: Skeletal muscles make up about 40-50% of total body mass and their contraction allows for mechanical movement and exercise. This contractile function requires greater blood flow to muscle to increase nutrient (oxygen/glucose) delivery and waste removal. In muscle, resistance arteries supply muscle fibres via an intricate branching network of arterioles that give rise to terminal pre-capillary arterioles, each supplying 15–20 capillaries. Given this arrangement, it is thought that capillary blood flow, and therefore muscle contractile performance, is dictated by constriction and dilation of arterioles that supply capillaries. More recent work has shown that blood flow can be increased through individual capillaries that feed only active muscle fibres, suggesting a much finer level of flow regulation exists within the muscle microvascular network than previously thought. Although this process remains poorly understood, recent work in other organs has identified a population of cells called pericytes that reside in the capillary basement membrane and wrap themselves around capillaries. In organs like the brain, they are known to contract and relax capillaries to regulate their blood flow. Whether pericytes also contract/relax capillaries in muscle is not known and will be explored in this project.

Aim: The aim of this honours project is to determine how pericyte depletion impacts on vascular and metabolic functions in skeletal muscles.

Key techniques used: Animal handling and husbandry, surgical techniques to isolate blood flow to muscles, setup and operation of the perfusion cabinet to perform muscle perfusions, assessing metabolic changes using radioactive glucose isotopes, western blotting and Immunohistochemistry and confocal microscopy

Location: Medical Sciences Precinct

Contact: Dino.Premilovac@utas.edu.au

Could air pollution be contributing to the rise of type 2 diabetes?

Supervisors: Dr Dino Premilovac, Dr Stephen Richards and Dr Renee Ross

Project description: It is well established that a poor diet, lack of exercise and genetics contribute to the development of insulin resistance and type 2 diabetes (T2D). Worryingly, recent evidence from around the globe points to air pollution as a new and major trigger for the development of these metabolic disorders. Epidemiological studies have shown that exposure to air pollution increases the risk of T2D and diabetes-associated mortality. Studies in mice show that particulate matter less than 2.5 μm in size (PM_{2.5}) penetrates to the smallest regions of the lung, enters the blood stream, and cause a wide variety of problems in the body. More specifically, a recent study in mice reported impaired insulin signalling in blood vessels after a single exposure to ambient air PM_{2.5}. While ambient air pollution comes in several forms, in otherwise healthy rats, we have preliminary data showing that a single exposure to diesel exhaust particles (common in urban areas and in industry) causes insulin resistance. How this happens and whether similar changes are seen following exposure to particulate matter from wood combustion (bushfires/wood heaters) is not known. Based on the above, we

hypothesise that exposure to particulate matter from diesel or wood combustion triggers development of insulin resistance by interfering with vascular insulin signalling. We will test this hypothesis using the following aim:

Aim: Determine organ specific metabolic effects of diesel or wood combustion PM exposure.

Key techniques used: Animal handling and husbandry, hyperinsulinaemic euglycaemic clamps, muscle blood flow analysis, use of radioactive glucose tracers for metabolic analysis, high-performance liquid chromatography

Location: Medical Sciences Precinct

Contact: Dino.Premilovac@utas.edu.au

[Can metformin improve stroke outcomes in type 2 diabetes?](#)

Supervisors: Dr Dino Premilovac and Dr Brad Sutherland

Project description: Over the past 15-20 years, a wealth of evidence demonstrates that type 2 diabetes ravages the structure and function of the brain vasculature to promote cerebrovascular diseases such as stroke and Alzheimer's disease. In particular, type 2 diabetes increases the risk of stroke by a factor of four. Type 2 diabetics also have bigger strokes and worse neurological outcomes after a stroke. The reasons for this increased stroke severity in diabetics are not known, but likely involve changes in vascular function in the diabetic brain. Promisingly, epidemiological studies show that metformin, the front-line drug used to treat diabetes, reduces stroke incidence and severity in those with diabetes. These beneficial effects of metformin are independent of its glucose-lowering actions and the exact mechanisms behind this protective effect remain unknown. Our research group has recently shown that metformin is able to restore vascular function in skeletal muscle of pre-diabetic animals. Whether metformin also improves vascular function in the diabetic brain to reduce stroke severity is not known.

Aim: The aim of this honours project is to determine whether pre-treatment with metformin is able to reduce stroke severity in type 2 diabetic rats.

Key techniques used: Animal handling and husbandry, induction of type 2 diabetes in rodents, behavioural analysis, ultrasound based brain blood flow imaging, post-mortem dissection and processing of rat brains for histology and immunohistochemistry and confocal microscopy

Location: Medical Sciences Precinct

Contact: Dino.Premilovac@utas.edu.au

[Analysis of the nature and content of early-career GP consultations over time using ReCEnT study data \(Registrar Clinical Encounters in Training\)](#)

Supervisors: A/Prof Jennifer Presser, Dr Anthea Dallas, Prof Parker Magin (University of Newcastle). This is a joint project between UTAS and the University of Newcastle.

Project description: ReCEnT is an ongoing multi-site cohort study of early career Australian GPs (GP registrars). The data set now includes over 3580 doctors with data on over 511,000 consultations and 784,000 problems/diagnoses. Students would undertake an analysis of this data in their area of interest to answer a specific research question in the field of General Practice. Students with interests in General Practice, medical education, evidence-based medicine and epidemiology would find this a rewarding project, with experienced supervisors committed to mentoring early-career researchers.

See here for some examples of published projects using the ReCEnT study data. For further information on ReCEnT: Magin et al, 2015. The Registrars' Clinical Encounters in Training (ReCEnT) project: educational and research aspects of documenting general practice trainees' clinical experience. *Australian Family Physician* 44(9): 681-684

A wide variety of project topics are available depending upon the student's areas of interest.

Key techniques: Students would design their research question and statistical analysis plan in consultation with their supervisors. Most studies using this dataset are a cross-sectional analysis of data from the longitudinal ReCEnT study, testing associations using simple and multiple logistic regression within a generalised estimating equations framework. The analysis will be performed in consultation with the statisticians of the ReCEnT team, and students will receive training and support in interpretation of the results and their clinical implications.

Research output including peer-reviewed publication of findings is an expectation of this project.

Location: UTAS supervisors are located in Hobart (Medical Sciences Precinct and at the Hobart Clinical School), with input remotely from the ReCEnT team located in Newcastle, NSW. This project is suitable to be completed remotely, with all team and supervision meetings able to be done by video conference if required.

Contacts: jennifer.presser@utas.edu.au, anthea.dallas@utas.edu .

How does one gene dramatically increase your risk of Alzheimer's disease?

Supervisor: Jack Rivers Auty

Project description: Alzheimer's disease is a terrible condition that robs you of your memories, your personality, your language, your health and eventually your life. It effects over 26 million people worldwide, yet we only have a partial understanding of what is causing Alzheimer's disease, and because of this, we have no disease modifying treatments. The leading hypothesis of the cause of Alzheimer's disease is a disruption in the production and clearance of amyloid protein peptides. These peptides aggregate to form oligomers and fibrils which disrupt numerous processes in the brain. However, other proteins are known to be involved in Alzheimer's disease including one named apolipoprotein E (ApoE). At the age of 85 you have an estimated 14% chance of having Alzheimer's disease, unless you have the ApoE4/ApoE4 genotype, then the risk grows to 68%. How the ApoE4 protein contributes to Alzheimer's disease is unknown, but Dr. Auty and his collaborators have recently established that, like amyloid, ApoE4 forms fibrils and that these fibrils activate immune cells inducing inflammation. Inflammation in the brain is a damaging process and has been linked to Alzheimer's disease as well as many other neuropathologies. This project will research how does ApoE4 induce inflammation and is an inflamed brain the key link between ApoE4 and Alzheimer's disease.

COVID-19 plan: In the event of issues with lab access, this project will investigate a clinical dataset of Alzheimer's disease progression investigating interactions between anti-inflammatories, inflammatory disease, ApoE genotype and Alzheimer's disease progression.

Key techniques: Cell culture, iPSC stem cells, western blots, live cell microscopy, and enzyme-linked immunosorbent assay (ELISA).

Location: Medical Sciences Precinct

Contact: Jack.Auty@utas.edu.au

Are microplastics making us sick?

Supervisor: Jack Rivers Auty

Project description: Plastics are inexpensive, durable, lightweight, versatile material composed of long hydrocarbon chains. These properties have led to widespread use of plastics particularly in single use packaging. Unfortunately, this has caused a global plastic pollution problem with between 5 and 13 million tonnes of plastic entering our oceans annually. Microplastics are particles of submillimetre plastic. Microplastics have particular biological importance as they can enter and sequester in organs and can be taken up by individual cells, where they are having, as yet, unknown consequences on human health. Primary microplastics are manufactured in the micron scale such as microfiber clothing, while secondary microplastics are macroplastics that are broken down into micron scale plastics through exposure to U.V. light, erosion and digestive fragmentation. Humans are exposed to microplastics daily, they are found in water bottles, tea bags, sea salt or released into the air we breathe as we take off our synthetic clothes; however, the health consequences of this exposure are unknown.

Dr. Auty has found that microplastics are potent activators of inflammation particularly during lung exposure. Lung inflammation has been shown to leave the sufferer vulnerable to infection, therefore, this project will investigate how microplastic induce inflammation is altering our ability to fight off infection.

COVID-19 Plan: In the event of issues with lab access, this project will shift to data analysis methods. Currently, the levels of microplastics in the atmosphere and oceans is poorly quantified. Using statistical and computer modelling methods, we will combine datasets from around the world to build global estimates of microplastic levels in our environment.

Key techniques: Cell culture, iPSC stem cells, western blots, live cell microscopy, and enzyme-linked immunosorbent assay (ELISA).

Location: Medical Sciences Precinct

Contact: Jack.Auty@utas.edu.au

[Does rhPON2 therapy inhibit virulence, biofilm and infection by clinical isolates of *P. Aeruginosa*](#)

Supervisors: Dr Louise Roddam, Dr Joanne Pagnon and Dr Mark Ambrose

Project description: Cystic fibrosis (CF) is an inherited life-shortening condition that results in the build-up of thick and sticky mucus lining the airways that is particularly prone to infection by *P. aeruginosa*. Despite aggressive antimicrobial therapy this infection is associated with significant lung damage, increased treatment costs, decreased quality of life and increased mortality in people with CF. It is, therefore, clear that new therapeutic strategies are needed to treat these infections. We have developed an antimicrobial therapy that hydrolyses and inactivates a major bacterial chemical messenger (acyl homoserine lactone, AHL). Treatment of laboratory isolates of bacteria with rhPON2, decreases biofilm formation and virulence and increases their susceptibility to conventional antibiotics. However, we are yet to demonstrate the efficacy of this therapy against clinical isolates of *P. aeruginosa*.

Key techniques used: Human cell culture, RT-qPCR analyses of gene expression, apoptosis assays, UPLC-MS analysis, bacterial culture and virulence assays.

Location: Medical Sciences Precinct

Contact: lfroddam@utas.edu.au

Website: <https://secure.utas.edu.au/health/research/groups/tasmanian-school-of-medicine/medical-sciences/the-roddam-group-host-pathogen-interactions>

[Investigating the pathogenic potential of an emerging lung pathogen](#)

Supervisors: Dr Louise Roddam, Dr Joanne Pagnon and Dr Mark Ambrose

Project description: There is little doubt that the newly described *Pandoraea* is an emerging multi-drug resistant pathogen capable of establishing chronic lung infections in people with cystic fibrosis (CF) and contributing to lung damage. However, the virulence arsenal and antimicrobial mechanisms used by this organism are yet to be described. We are in a unique position to investigate the pathogenic potential and antibiotic resistance of this organism based on our recent genome and proteome analyses (the first for this human pathogen) using molecular tools available in our laboratory.

Key techniques used: Bacterial culture, human cell culture, biofilm assays, microscopy, genome analysis, PCR and RT-qPCR, apoptosis assays, human cell infection studies and ELISAs.

Location: Medical Sciences Precinct

Contact: lfroddam@utas.edu.au

Website: <https://secure.utas.edu.au/health/research/groups/tasmanian-school-of-medicine/medical-sciences/the-roddam-group-host-pathogen-interactions>

Who knew? Investigating the role and importance of blinding in trials

Supervisor: Dr Jessica Roydhouse

Project description: Patient-reported outcomes are important in health care and research. However, if patients are not able to self-report then proxies such as relatives or caregivers may be asked to report on their behalf. Relatively few measures have been developed specifically for proxy reporting. Evaluating the psychometric properties and the quality of these measures is important for advancing research and supporting the use of high-quality measurement tools. This project will undertake a critical appraisal of the psychometric properties of tools identified as part of an international task force on proxy assessment in adult health settings.

Key techniques used: systematic review, quality assessment

Location: Medical Sciences Precinct

Contact: jessica.roydhouse@utas.edu.au

Understanding the clinical value of exercise stress testing: the EXERCise stress Test collaboratiON (EXERTION) study

Supervisors: Dr Martin Schultz; Prof James Sharman

Project description: The Exercise stress Test collaboratiON (EXERTION) is a collaborative study established to enhance clinical understanding and outcomes related to clinical exercise stress testing, including abnormal exercise blood pressure. A very-large database of clinical exercise stress test data from multiple locations around Australia have been pooled and linked to administrative health datasets to enable exploration of the associations between test variables and cardiovascular outcomes. This dataset provides the means to explore a wealth of questions relating to clinical exercise stress testing, including the following examples.

1. How is the blood pressure response to clinical exercise testing influenced by functional/aerobic capacity?
2. What is the clinical value of exercise stress echocardiography by comparison to exercise stress ECG testing in the detection of coronary artery disease?
3. Does the association between exercise BP, cardiac structure and function differ by level of functional/aerobic capacity?
4. Does the association between exercise BP, cardiovascular events and mortality differ by level of functional/aerobic capacity?

Students could select one of the above questions or discuss option with the supervisors for other interests.

Key techniques: Clinical (human) research; statistical analysis, data linkage; big data; clinical physiology/epidemiology

Location: Medical Science Precinct. Elements of this project could also be conducted off-campus or from other Tasmanian campuses (i.e Launceston, northwest).

Contacts: Martin.Schultz@utas.edu.au, James.Sharman@utas.edu.au

Evaluation of a new test for the elucidation of cardiovascular adaptations to spaceflight

Supervisors: Dr Martin Schultz, Dr Brett Gooden

Background: Exposure of astronauts to weightless spaceflight results in adaptations to the cardiovascular system. These adaptations occur without any significant change in basic cardiovascular parameters such as heart rate, blood pressure and peripheral vascular resistance. However, upon return to earth's gravity, these adaptations are revealed. For example, an astronaut's arterial blood pressure may fall precipitously upon assuming the upright

posture. This phenomenon is known as orthostatic hypotension and may persist to some extent for several days after return to earth. Various provocative cardiovascular tests during and after spaceflight have been used in an attempt to elucidate similar cardiovascular adaptations with limited success.

The cardiovascular response to face immersion with breath-holding, known as the diving response, evokes a slowing of the heart rate and vasoconstriction in the limbs. Thus, it tests both parasympathetic control of the heart as well as sympathetic control of peripheral vasculature. It is unique in this regard and has not been tested in space. It could provide a valuable research tool to further assess the cardiovascular adaptations to weightlessness. Since open water cannot be used safely in space, it will be replaced by a cold stimulus to the face.

Objective of the study: To determine the effect of simultaneous cold stimulus to the face and breath-holding on cardiovascular function (including blood pressure and heart rate) and peripheral blood flow, and hence the potential value of simulated diving as a test of the cardiovascular adaptations to space flight.

Key techniques used: Human (clinical) research; electrocardiogram; blood pressure measurement; apparatus for venous occlusion plethysmography.

Location: Medical Sciences Precinct (Hobart)

Contacts: Martin.Schultz@utas.edu.au, bagooden@bigpond.net.au

Health Literacy Mediators: supporting children and their families to navigate paediatric health services in Tasmania

Supervisors: Maddie Spencer, Rosie Nash

Community Stream	Hospital Stream
other member(s) of HLE group TBC	other member(s) of HLE group TBC

Project Description: Health literacy (HL) is complex, consisting of three elements; the individual, the community and the health services/community organisations they are attempting to access.⁽¹⁾ A way to overcome the health inequities, enhance collaboration of healthcare professionals, educators, and families, and drive HL education within communities could be to introduce a Health Literacy Mediator (HLM). The emergent role of a HLM is a “a person or group of people that are dedicated to providing a combination of learning experiences and opportunities to help enable individuals and communities to overcome inequities perpetuated by their social determinants and increase their HL assets to improve their health outcomes”.⁽²⁾ The value of school based HLMs is being explored by current research as well as international colleagues. This project would seek to extend on this research of the HealthLit4Kids (an arm of the Health Literacy and Equity Group) and aim to develop the HLM role within 1) the community setting and 2) the hospital setting. The research is exploratory and seeks to work with key stakeholders to design a HLM for paediatric services in the THS. This would be achieved through two phases:

Community Stream	Hospital Stream
Consider one of the following: 1x paper: literature review (international review of children’s HL education in hospitals) 1x paper: views and opinions of key stake holders (children, families, nurses, Drs, educators) to establish role and responsibilities of a HLM in hospitals.	Consider one of the following: 1x paper: literature review (international review of children’s HL education in hospitals) 1x paper: views and opinions of key stake holders (Children, families, nurses, Drs, educators) to establish role and responsibilities of a HLM in hospitals.

Key techniques used: Co-Design, Mixed methods, Focus Group, Interviews, Surveys, Qualitative research including thematic analysis, Quantitative analysis (basic statistics), International Review of the Literature: Scoping Review or Systematized Review. The candidate(s) would be supported by our multidisciplinary team to develop and apply skills in qualitative and/or quantitative analysis.

Location: Medical Sciences Precinct, Hobart OR OFF Campus as negotiated with Research Team

Contact: Maddie Spencer (madeline.spencer@utas.edu.au)

References:

1. Batterham, R.W., et al., *Health literacy: applying current concepts to improve health services and reduce health inequalities*. Public health, 2016. **132**: p. 3-12.
2. Spencer, M; N, Kemp; V, Cruickshank; R, Nash (**Draft in Review**) An International Review to Characterise the Role, Responsibilities, and Optimal Setting for Health Literacy Mediators

[Exploring health professional’s understanding, attitudes, confidence, enablers, and barriers to supporting health literacy development](#)

Supervisors: Claire Otten, Maddie Spencer

Project Description: Most professions in Australia outline a set of competency standards. Providing health literacy education is a responsibility of many health and education professionals, for example, nurses and teachers. There is currently a paucity of knowledge on how members of these professional groups perceive their role to support health literacy development and the enablers and barriers that help or hinder this process. The following project/s aims to qualitatively explore this phenomenon. Insights gained from the project could provide critical recommendations for pre-service and in-service education of these groups:

Stream ONE	Stream TWO	Stream THREE	Stream FOUR
Teachers	Nurses	Allied Health	Medical professionals
<ul style="list-style-type: none">• Primary• Secondary• College	<ul style="list-style-type: none">• School nurses• Community nurses• Hospital nurses	<ul style="list-style-type: none">• Social workers• OT• PT• Dieticians• Pharmacists	<ul style="list-style-type: none">• Doctors• GPs• Specialists

** for an honours project one “stream” can be selected

Key techniques used: Online surveys: may use qualitative research including thematic analysis, quantitative analysis (basic statistics). Could also consider International Review of the Literature: Scoping Review or Systematized Review. The candidate(s) would be supported by our multidisciplinary team to develop and apply skills in qualitative and/or quantitative analysis.

Location: Medical Sciences Precinct, Hobart OR OFF Campus as negotiated with Research Team

Contact: Maddie Spencer (madeline.spencer@utas.edu.au)

[Contrasting the expectation to promote health literacy through education and health professional competency standards](#)

Supervisors: Claire Otten, Maddie Spencer

Project Description: The responsibility to promote health literacy development is alluded to in many health and education competency standards in Australia. While many competency standards inadvertently indicate that promoting health literacy is a role of members of those professions, the degree to which this is expected differs between professions. The following project seeks to understand how the responsibilities differ between professions. It has been proposed that health literacy is a collective rather than individual responsibility. Findings from this project could help to identify where strengths and gaps exist in health literacy responsibility. This could, in turn, support recommendations for future competencies which could improve future health literacy outcomes.

Key techniques used:

Scoping Review and Document Analysis. The candidate(s) would be supported by our multidisciplinary team to develop and apply skills in qualitative analysis.

Location: Medical Sciences Precinct, Hobart OR OFF Campus as negotiated with Research Team

Contact: Maddie Spencer (madeline.spencer@utas.edu.au)

The role of pericytes and vascular function in health and disease

Supervisors: Dr Brad Sutherland, Dr Gary Morris, Dr Jo-Maree Courtney

Project description: Pericytes are contractile cells that are found exclusively on capillaries throughout the body. In the brain, they are responsible for controlling blood flow as well as maintaining blood-brain barrier (BBB) function and aiding the growth of new blood vessels. Recent research suggests that pericytes may play a key role in outcome after stroke. During an ischaemic stroke, the most common type of stroke, a blood vessel becomes blocked, and this starves the affected brain of oxygen and nutrients. A key aim for treating stroke is restoring that blood flow.

Recent studies have shown that, after a stroke, pericytes constrict and then die. Because the pericytes die in the constricted state, the capillaries are stuck in their “clamped shut” position and this impedes the restoration of blood flow to the areas of the brain affected by stroke (Hall et al 2014 Nature 508:55-60). The mechanisms that govern these effects in pericytes are currently unknown and uncovering these could provide a novel therapeutic target for stroke. In addition, changes in pericyte function and their interaction with other cell types such as microglia within the neurovascular unit could provide insight into other neurological diseases such as Alzheimer’s disease and Multiple Sclerosis.

Our understanding of pericyte biology within the brain is limited. We offer Honours projects that will use in vivo techniques to determine how pericytes influence blood flow in the brain and maintain the blood-brain barrier. We will use disease models such as stroke or Alzheimer’s disease, or Multiple Sclerosis to uncover the importance of pericytes to the pathophysiology of these conditions. Finally, to determine direct mechanisms of pericyte biology, we will use cell culture methods where we grow pericytes or interacting cells in culture and perform functional and pharmacological studies. This research will enhance our understanding of pericytes, their interactions with other cell types and determine their roles in the progression of disease, and could potentially give rise to a novel therapeutic target.

Key techniques: In vivo models, pathology, molecular biology, blood flow, neurological disease, cell culture

Location: Medical Sciences Precinct

Contact: brad.sutherland@utas.edu.au, gary.morris@utas.edu.au, jomaree.courtney@utas.edu.au

Healthy lifestyle score from childhood to midlife and its association with the risk of carotid plaque in midlife

Supervisor(s): Dr Jing Tian, A/Prof Seana Gall

Project description: Cardiovascular disease (CVD) is the leading cause of morbidity and mortality globally and in Australia, with premature deaths largely preventable. Much of the prevention effort is focused on lifestyle modification and management of clinical risk factors in older adults but risk factors are common at young ages. Their prevalence estimates in young adults aged 18 to 44 from the 2017-18 Australian Health Survey confirm this: overweight and obesity (58.7%), physical inactivity (80.6%), less than recommended intake of fruit and vegetables (96%) and smoking (16.9%). Few longitudinal studies have examined the associations of change in healthy lifestyle score from childhood to adulthood with subclinical cardiovascular outcomes in adulthood, while all of them utilized data based on two time points, ignoring the dynamic changes over the life course which often occur. This project aims to address the research gap by expanding the healthy lifestyle score measurements to multiple life periods (from four-time points) and examining its association with the risk of carotid plaque in midlife.

Key techniques used: Students will gain proficiency in the data cleaning, analysis and interpretation, manuscript, and abstract preparation. Statistical supervision will be provided. A scientific manuscript is intended for submission to a peer-reviewed international journal.

Location: Hobart, Medical Sciences Precinct

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The epigenome of aging and age-related diseases

Supervisors: Dr Adele Woodhouse, Dr Phillippa Taberlay, Dr Beth Signal, Dr Kate Giles

Project description: Every single cell of the human body contains the same genetic sequence we inherited from our parents; yet, our skin and brain, for example, are remarkably different tissues due to the precision of epigenetic during development that is maintained throughout our lifetime. Our ability to map epigenetic marks across entire genomes occurred only relatively recently, since next-generation sequencing technologies became accessible ~7 years ago. The analysis of 'big data' from these studies has created a vast amount of new knowledge about epigenetic patterning, functions and mechanisms.

Our research focuses on epigenetic aging and the epigenetic alterations in age-related diseases, such as Alzheimer's disease (AD) and cancers. Using next-generation sequencing data from our laboratory and publicly available data this research project will investigate the similarities and differences between healthy aging, AD and cancer epigenomes. This project will include data generated in our laboratory from healthy aging, AD and cancer samples using a new technique (currently unpublished) that allows three layers of the epigenome (Nucleosome occupancy, DNA methylation and histone modifications) to be analysed simultaneously from a single DNA molecule. This new technique will produce novel insights into the epigenetic landscape in aging and age-related diseases.

Key Techniques used: Computational biology, bioinformatics.

Location: Hobart, Medical Sciences Precinct

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Establishing a human cell model of the glial dysfunction in Multiple Sclerosis

Supervisor(s): A/Prof Kaylene Young, Dr Jessica Fletcher, Dr Ashish Mehta, Dr Jack Auty, Dr Nicholas Blackburn

*** Multiple students could undertake different aspects of this project. The supervisory team will be assembled from the above researchers based on the specific cell type to be studied.*

Project description: Multiple Sclerosis (MS) is a complex disease associated with immune cell infiltration of the central nervous system (CNS), myelin loss and neurodegeneration. The exact cause of MS is not known, but knowledge of the key lifestyle, environmental and genetic risk factors has led to the development of 2 competing hypotheses – (i) the "inside-out" hypothesis where MS starts in the CNS and leads to the activation of the peripheral immune system, and (ii) the "outside-in" hypothesis where the immune system is activated peripherally and attacks the CNS. Using stem cell lines produced by reprogramming blood cells from people with MS, we will generate key brain cell types – namely, oligodendrocytes, astrocytes, microglia, and neurons. By performing RNA sequencing and cell biology assays to study CNS cells from healthy controls and people with MS, we will interrogate the "inside-out" hypothesis.

Key techniques used: Human cell culture, flow cytometry, immunocytochemistry, qPCR, biochemistry, enzyme-linked immunosorbent assays (ELISAs), confocal microscopy, image analysis.

Location: Medical Sciences Precinct

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Web: <https://www.menzies.utas.edu.au/research/diseases-and-health-issues/research-groups/glial-research-team-young-group>

Understanding Traumatic Brain Injury Massive Open Online Course (TBI MOOC)

Supervisor(s): Dr. Jenna Ziebell, Dr Claire Eccleston, Dr Kathleen Doherty, Dr Christine Padgett, Dr Peta Cook

Project description: Worldwide it is estimated that 69 million brain injuries occur each year. This number is an underestimate of the total number as many concussions are not reported. There is increasing evidence that traumatic brain injury (TBI) may be a risk factor for the development of dementia with single or multiple injuries linked to the development of Alzheimer's disease, chronic traumatic encephalopathy (CTE) and other forms of dementia. The Understanding Traumatic Brain Injury (TBI) MOOC (Massive Open Online Course) was developed by the Wicking Dementia Research and Education Centre based in the College of Health and Medicine at the University of Tasmania, with support from Connectivity. This online course is free, easily accessible and available to everyone with an interest in TBI, neuroscience or brain health.

The first iteration of the course had over 17, 500 participants. We want to understand the participant population including demographics, knowledge gain and TBI awareness. The project will use large datasets of participant response data.

Key techniques used: Generation of spreadsheets and statistical analysis of data

Location: Hobart, Medical Sciences Precinct

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Sex differences following traumatic brain injury: Is age a factor?

Supervisors: Dr Jenna Ziebell

Project description: Worldwide it is estimated that 69 million brain injuries occur each year. This number is an underestimate of the total number as many concussions are not reported. There is increasing evidence that traumatic brain injury (TBI) may be a risk factor for the development of dementia with single or multiple injuries linked to the development of Alzheimer's disease, chronic traumatic encephalopathy (CTE) and other forms of dementia. Understanding the changes in the brain that result in the progress of pathology will aid in the development of guidelines for the treatment of brain injury and concussion. We know the recovery patterns of males and females is different following TBI, but little is known about the why this is so. At the Wicking Dementia Research and Education Centre we are investigating the potential links of TBI and dementia through a variety of projects including cohort studies, as well as cell culture and animal models to examine the cellular and functional effects of brain injury on Alzheimer's disease related pathology. Of interest is the role inflammation plays in the onset and progression of disease. In the brain microglia regulate inflammatory processes and have an intimate relationship with neurons. Neurons signal together to form networks and it is when these networks begin to degenerate that disease symptoms start to appear. How microglia may be harnessed to prevent the degeneration is a key research question.

Key techniques used: Animal handling, Immunohistochemistry, Analysis of behavioural videos, Analysis of FACs data, Generation of spreadsheets and statistical analysis of data

Location: Hobart, Medical Sciences Precinct

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Cellular mechanisms of engineered stone dust induced lung injury

Supervisors: Prof Graeme Zosky, Dr Yong Song

Project description: Silicosis is a common occupational lung disease caused by inhalation of silica dust. Traditionally, miners and stonecutters are high-risk populations as they are frequently exposed to dust containing this crystalline mineral. In recent years, a surge in cases silicosis has been identified among workers involved in manufacturing and installing an engineered material known as "artificial stone". This modern version of silicosis is more severe and progressive than the traditional form of the disease and is leading to deaths and lung transplants in young Australian workers. In pilot studies, we have shown the potency of engineered stone dusts

in inducing an inflammatory response in lung cells is related to the mineral content of the stone.

In this Honours project you will examine the lung cell response in relation to the physico-chemical characteristics of engineered stone dusts. To do this you will culture a range of respiratory cell sub-types and, using a range of techniques including qPCR, ELISA and immunofluorescence assays, assess the cellular response (inflammation, oxidative stress, apoptosis).

Key techniques: Cell culture, qPCR, ELISA, Immunofluorescence assay

Location: Medical Sciences Precinct

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Role of glucocorticoid signalling in the *in utero* response to air pollution

Supervisors: Prof Graeme Zosky, Dr Yong Song

Project description: Maternal exposure to air pollution is associated with adverse fetal and post-natal effects including respiratory and cardiovascular disease, low birth weight, metabolic disorders and neurological/neurobehavioural impairments. Using a mouse model, we have recently established the effect of *in utero* exposure to “real-world” community-sampled particles on the developing lung, immune system and brain. However, the underlying mechanisms are largely unknown. Along with our pilot data, emerging evidences indicate that particulate matter (PM) component of air pollution may activate the hypothalamic-pituitary-adrenal axis, leading to elevated level of stress hormone and dysregulated glucocorticoid signalling resulting in multi-organ, multi-system effects during development.

In this project you will examine glucocorticoid signalling and glucocorticoid responsive gene expression in multiple tissues (lung, spleen, liver and brain) which we have biobanked from our previous mouse studies. These will be correlated with blood stress hormone levels, lung function, immune responses, and neuropathological changes.

Key techniques used: RNA extraction, qPCR, Western blot

Location: Medical Sciences Precinct

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Genetic and epigenetic links in the health effects of early life exposure to air pollution

Supervisors: Prof Graeme Zosky, Dr Yong Song

Project description: Early life exposure to air pollution is associated with adverse effect on the respiratory and cardiovascular system, however, the mechanisms are unclear. As part of the Latrobe Early Life Follow-up study (ELF), we have shown that prenatal and postnatal exposure to smoke from the Hazelwood coal mine fire (an unprecedented air pollution event in 2014) alters development of respiratory and cardiovascular systems.

As part of this study, we have recently collected and stored biological samples from blood (incl. plasma and DNA) from the second clinical follow-up of the ELF cohort. We have a range of projects available with different focuses which can be negotiated depending on your interest(s). These include, microRNA regulation, antioxidant gene polymorphisms and gene methylation. These projects will involve a combination of lab work (e.g. quantifying circulating microRNA, genotyping, or DNA methylation analysis), and comprehensive data analyses to link the biological outcomes with the clinical phenotypes we have established in the ELF cohort.

Key techniques: microRNA extraction, qPCR, genotyping, locus-specific DNA methylation analysis, data analysis

Location: Medical Sciences Precinct

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