

School of Biomedical Sciences and Pharmacy College of Health, Medicine and Wellbeing

Bachelor of Biomedical Science (Honours) Projects for Commencing Semester 1 2026

ARE YOU CONSIDERING HONOURS?

THE IMPORTANCE OF AN HONOURS YEAR

The Honours year is your opportunity to make creative use of the information you have acquired during your first 3 years of study. It should be an exciting, fulfilling experience and for those with imagination, drive and an aptitude for problem solving the Honours year will provide a logical point of entry into a research career. For many students the Honours year will lead to a higher degree. Hons 1 or 2(1) will allow access to a PhD program directly while Hons 2(2) or 3 will permit entry into a Masters program. A Masters enrolment can then be upgraded to a PhD if a sufficient level of performance is achieved.

Even if you ultimately discover that a career in research is not for you, an Honours degree will provide you with fundamental skills that are valued in the workplace and enhance your chances of finding a job; the unemployment rate amongst our Honours graduates is essentially zero.

HOW DO I FIND OUT ABOUT HONOURS AND ENTRANCE REQUIREMENTS?

Asking questions of current and past Honours students and academic staff is probably the best place to start.

There are some academic restrictions, i.e. a Credit average (GPA 5.0 overall OR for 60 units of **appropriate** 3000 level subjects) is the traditional qualification, but otherwise it is mainly a matter of finding a project and supervisor. To assist you, the Honours committee has:

- Produced these guidelines so you have a clear idea of what you are getting into and
- Posts on the Honour's website:

<https://handbook.newcastle.edu.au/program/2025/10988>

WHEN SHOULD I START LOOKING FOR A SUPERVISOR AND A PROJECT?

Although you may not know whether you have qualified for Honours until the end of the semester, before you begin Honours it is important to make enquiries and contact with potential supervisors as soon as possible.

SUPERVISORS AND PROJECTS

The School of Biomedical Sciences and Pharmacy offers a wide range of Honours training ranging from integrated human and animal projects, to bench and molecular projects. It is vitally important that you are interested in the project you undertake – so choose carefully. It is also important that you make an informed decision, and this may take some time. It is often useful to actually spend some time working as a volunteer with possible supervisors. A project that sounds great on paper or in discussion may turn out not to be your thing at all. While your supervisors and co-workers will provide a lot of support, it ultimately is your project, driven by your energy and your commitment.

A student will be co-supervised by at least two individuals. As a guide, a supervisor is any person whose contribution to the research project is such that they would, in normal practice be recognized as authors on any publications arising from the student's project. A member of the School of Biomedical Sciences and Pharmacy will be a primary supervisor to ensure good liaison between the external co-supervisor and the School.

INTRODUCTION TO THE HONOURS PROGRAM

Welcome to the Bachelor of Biomedical Science Honours program. I am sure that you will find it an interesting and stimulating program and one which will provide a very different experience from that which you have had so far in your studies.

PURPOSE

The Bachelor of Biomedical Science Honours Program is a research training degree. The primary purpose of the Honours year is for the student to develop a new testable hypothesis after reviewing the literature, design appropriate experiments, collect, and critically evaluate the generated data, and communicate the data to others. Students should note that it is an essential component of the Honours year that they critically analyse and present their **own data that was obtained throughout their honours year**.

AIMS

An Honours year in Biomedical Science will provide you with a number of generic educational skills that will be of life long value regardless of your ultimate career path. At the most basic level you should develop attitudes and fundamental skills relevant to problem solving, self-learning and team work that will be highly valued in the workplace and the broader community.

In more specific terms you should learn:

1. How to retrieve information of various kinds using electronic media.
2. How to critically evaluate the information received to develop an understanding of the background and the current status of a particular field.
3. How to use this information and your own insights to create hypotheses that can be tested experimentally.
4. How to design statistically valid experiments to test a given hypothesis.
5. How to address ethical and safety considerations in research.
6. The wide and exciting range of technologies that are currently available to address medical problems.
7. How to assimilate data and draw conclusions
8. How to present your results in written and oral form.

The development of these skills will be assessed by a number of indicators including a review in which you critically examine the literature that is relevant to your thesis work and a thesis summarizing the work you have done through the year. Your ability to present and discuss your work with others will be assessed through a presentation outlining your Honours proposal, a thesis review and an end of year seminar outlining your results and the conclusions that you drew from those results.

ADMINISTRATION OF THE COURSE

The Honours course is primarily administered by the Program Convenor with reference to the Head of the School of Biomedical Sciences and Pharmacy and the Bachelor of Biomedical Science Honours Committee (consisting of Program Convenor, Head of School, and Deputy Head of School – Research and Research Training).

Program Convenor:

Dr Sarah Valkenborghs
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ASSESSMENT SYSTEM

Students are advised that the grade of Honours obtained is dependent on the standard of performance in all aspects of a student's work, not only on a mark achieved in a particular section.

Literature Review (20%), Presentation on Honours proposal (10%), Thesis plus Thesis Defence (60%), and Final Seminar (10%).

Your final result will be an Honours grade, not a specific mark. The following is an outline of the Honours grades along with a general description of what would be expected to achieve a particular grade in a specific task.

Honours 1: 85% or higher

Work of exceptional quality and independence, showing a very high level of understanding of subject matter and appreciation of issues; well formulated; ethical and safety considerations acknowledged and addressed; arguments sustained; figures and diagrams relevant; appropriate literature referenced; strong evidence of creative ability and originality; high level of intellectual work.

Honours 2(1): 75.0 - 84.9%

Work of high quality and substantial independence, showing a strong level of understanding of subject matter and appreciation of dominant issues but not necessarily of the finer points; ethical and safety considerations partially acknowledged and addressed; arguments clearly developed; figures and diagrams relevant; relevant literature referenced; evidence of creative ability and solid intellectual work.

Honours 2(2): 65.0 - 74.9%

Work of solid quality showing competent understanding of subject matter and appreciation of main issues but with some lapses or inadequacies; ethical and safety considerations partially acknowledged; clearly identifiable deficiencies in logic or originality; some evidence of creative ability; reasonably well prepared and presented.

Honours 3: 50.0 - 64.9%

Adequate report, reasonable quality but showing a minimal understanding of the research area with major deficiencies in content or experimental rigor; little evidence of creative ability; ethical and safety considerations not acknowledged.

Fail: 49.0% or less

APPROVED PROJECTS

A list of approved available Honours projects are provided below, followed by a detailed description of each project, including contact details of supervisors.

	Project title	Primary supervisor	Co-supervisors
1	Activation state of the complement response in the presence of non-steroidal anti-inflammatory drugs.	Kristen Coupland	Jemma Mayall, Jay Horvat
2	Examining daily patterns of physical activity and sleep in relation to 24 hr glucose control	Emily Cox	Mitch Duncan, Kiranjit Kaur
3	Post-partum health in Aboriginal and Torres Strait Islander mothers	Saije Endacott	Kirsty Pringle, Rebecca Vanders
4	Digital Anatomy	Matthew Farrow	Zoe Yates, Ethan Cresswell, Ashlee Dunn
5	Soft embalming for anatomy	Matthew Farrow	Rohan Walker, Ashlee Dunn
6	Exploration of genetically informed precision medicine for schizophrenia using iPSCs & human cerebral organoids	Chantel Fitzsimmons	Murray Cairns, Steven Jackson
7	Enhancing bone health in Adolescent athletes through early risk identification: A co-designed screening and education tool for parents and coaches	Rebecca Haslam	Mitch Smith, Tracy Schumacher
8	Elucidating the Mechanism that Initiates Premature Birth	Jonathan J. Hirst	Tamas Zakar, Marina Paul, Jonathan Paul
9	Using precision medicine to understand and treat the high burden of colorectal cancer in people with cystic fibrosis	Gerard Kaiko	Gabriela Hoefel
10	Bioactivated surgical mesh to improve healing and reduce infection in intestinal anastomosis surgery for IBD and colorectal cancer.	Gerard Kaiko	Behnam Akhavan
11	Epigenetic Prioritisation of Clinically Actionable Metabolic Factors in Schizophrenia	Dylan Kiltchewskij	Alexandre Xavier, Murray Cairns
12	Discovery of novel cardioprotective agents to protect against anti-cancer therapies-induced cardiotoxicity and cardiovascular complications	Doan Ngo	Tatt Jhong Haw, Amanda Croft, Aaron Sverdlov

13	Leveraging a multi-omics approach to uncover the mechanisms of cardiotoxicity driven by anti-cancer agents	Doan Ngo	Tatt Jhong Haw, Amanda Croft, Aaron Sverdlov
14	Determining the impact of placental angiotensin-converting enzyme 2 (ACE2) deficiency for fetal growth	Kirsty Pringle	Saije Endacott, Joshua Fisher
15	Characterising placentas from women with gestational diabetes	Kirsty Pringle	Saije Endacott
16	Detrimental effects of prenatal stresses fetal neurodevelopment and childhood outcome	Julia Shaw	Hannah Palliser, Jon Hirst
17	Dissecting the influence of vaccine type and delivery site on immune responses	Alexandra Spencer	Jessica Barnes
18	Investigating the role of the Renin-Angiotensin System (RAS) in embryo development	Jessie Sutherland	Kirsty Pringle
19	The impact of dietary bisphenol exposure on endometrial health	Jessie Sutherland	Alexandra Peters, Kirsty Pringle
20	Targeting DNA repair in the treatment of glioblastoma	Paul Tooney	Kelsey Maddison
21	Does exercise during pregnancy help or hinder fetal brain development?	Sarah Valkenborghs	Oun Al-Iedani, Saadallah Ramadan
22	Reprogramming the Fetal Gut-An Innovative Intervention for Mitigating Childhood Obesity	Rebecca Vanders	Emily Hoedt, Tegan Grace
23	Obesity and Women's Health-Targeting Dietary Intake for First Nations Mums and their Babies	Rebecca Vanders	Saije Endacott, Kirsty Pringle
24	Biomechanical Validation of Synthetic Ligament Models	Rohan Walker	Matthew Farrow, Yuen Yong
25	Impact of gender inclusive language on student engagement, motivation, learning and enjoyment of undergraduate biomedical teaching and learning	Jude Weidenhofer	Melissa Tadros, Kirsty Pringle

A) **Project Title:** Activation state of the complement response in the presence of non-steroidal anti-inflammatory drugs.

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Dr. Kirsten Coupland

Location: Medical Sciences Building

Email: Kirsten.coupland@newcastle.edu.au

Phone: 4042 1611

Co-Supervisor Name (must be completed): Dr. Jemma Myall

Location: HMRI

Email: jemma.mayall@newcastle.edu.au

Phone: 40420221

Co-Supervisor Name (must be completed): Prof. Jay Horvat

Location: HMRI

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Phone: 40420220

C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Background: The complement system is a complex innate immune response that is important in recognition of invading pathogens and damaged tissue for phagocytosis. There is evidence that the complement system is activated after stroke and may worsen stroke outcomes. Counter to these reports, recent findings from Dr. Coupland's work indicate that the complement system is downregulated in serum and CSF of a sheep stroke model, and that complement component abundance in CSF and serum do not correlate. The apparent downregulation of the complement cascade in this model may be due to the use of nonsteroidal anti-inflammatory drugs (NSAIDs), but it is not known whether NSAIDs are capable of regulating the complement system. In addition, the lack of correlation between CSF and serum complement response indicates that the complement response in the central nervous system may be regulated independently to that of the periphery.

Hypothesis: the complement response of the central nervous system is differentially regulated to that of the periphery and is capable of being downregulated by NSAIDs.

Aims:

1. Validate activation state of complement system in post stroke CSF and serum samples.
2. Determine whether:
 - a. the complement system is differentially activated peripherally and in the central nervous system in disease models, and,
 - b. if NSAIDs reduce activation of the complement system.

Experimental approach: We will use a combination of immunoblots, immunohistochemistry and animal models to interrogate our aims.

D) **Laboratory Location:** HMRI and Medical Sciences Building Callaghan

A) **Project Title:** Examining daily patterns of physical activity and sleep in relation to 24 hr glucose control

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Dr Emily Cox

Location: Callaghan

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Co-Supervisor Name (must be completed): Professor Mitch Duncan

Location: Callaghan

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Phone: 4921 7805

Co-Supervisor Name (must be completed): Dr Kiranjit Kaur

Location: Callaghan

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Phone: - 02 4055 0105

C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Study Background: Physical activity and sleep are both known to impact glucose control, yet the majority of studies examine these behaviours separately. Therefore, we don't know how people's engagement in both of these behaviours are associated with glucose control. This study will use data from the *Move and Sleep* study, which tests the efficacy of a physical activity and sleep health intervention to improve glucose control in middle aged adults.

Key research question: What are the individual and joint associations between daily patterns of physical activity and sleep separate and glucose control?

Methods: Data will be used from the baseline assessment of *Move and Sleep* which is currently being completed. Eligible participants will be adults aged 45-64 years who report being physically inactive and poor sleep and who have impaired fasting glucose levels. A total of 324 participants will complete baseline assessments. At baseline, participants complete a 14 day assessment where they wear a wrist worn accelerometer and a continuous glucose monitor (CGM) on their triceps. Data from the accelerometer and the CGM will be synchronised using timestamps and the association between daily physical activity and sleep health will be examined in relation to indices of glucose control including time spent above and below recommended targets and the variability in daily glucose levels.

D) **Laboratory Location**

ATC Building, Callaghan

A) Project Title: Post-partum health in Aboriginal and Torres Strait Islander mothers

B) Supervisory Details (must be completed):

Primary Supervisor Name: Dr Saije Endacott

Location: HMRI Level 3 East

Email: Saije.morosin@newcastle.edu.au

Phone: 4042 0376

Co-Supervisor Name (must be completed): Professor Kirsty Pringle

Location: HMRI Level 3 East

Email: kirsty.pringle@newcastle.edu.au

Phone: 4042 0372

Co-Supervisor Name (must be completed): Dr Rebecca Vanders

Location: N/A (works remotely)

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Phone: 0408 656 444

C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

The Gomeri Gaaynggal study is the largest longitudinal cohort study of its kind in the world (<https://www.gomeribabies.org.au>). The Gomeri Gaaynggal Study follows women carrying Aboriginal and Torres Strait Islander (First Nations) babies throughout pregnancy and continues into early childhood. The study aims to explore the relationship between exposure to stressors to the baby and mother during pregnancy and the effect that this has on both mother and child's future health and/or growth. This project will characterise post-partum health in the cohort and will explore the effects of pregnancy complications (like preeclampsia and gestational diabetes) on the health of mothers after pregnancy.

Hypothesis: We hypothesise that pregnancy complications will be associated with an increase in markers of cardiometabolic risk post-partum.

Aim: To characterise the post-partum health of First Nations mothers in the cohort and determine if post-partum health is affected by pregnancy complications.

Experimental Approach: The Gomeri Gaaynggal Study began in 2007 and was developed by the local First Nations community in partnership with researchers from the University of Newcastle. The study has recruited over 400 First Nations mothers so far. This project will analyse existing data from the cohort using the statistics software STATA, to firstly establish the demographics and baseline health of the cohort, and then determine if pregnancy complications (including preeclampsia, gestational diabetes and preterm birth) effect the future health of mothers in the cohort. We are a proudly community led group of researchers, as a result students will also gain experience working with and reporting to our First Nations advisory committee who are based in Tamworth, NSW.

D) Laboratory Location HMRI Level 3 East and potential travel to Tamworth for community consultation.

A) **Project Title:** Digital Anatomy

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Dr Matt Farrow

Location: MSB509

Email: matthew.farrow@newcastle.edu.au

Co-Supervisor Name (must be completed): Dr Ethan Cresswell

Email: ethan.cresswell@newcastle.edu.au

Co-Supervisor Name (must be completed): Dr Zoe Yates

Location: Ourimbah

Email: Zoe.yates@newcastle.edu.au

Co-Supervisor Name (must be completed): Dr Ashlee Dunn

Location: Anatomy Lab

Email: ashlee.dunn@newcastle.edu.au

C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

The increasing demand for accessible, durable, and innovative teaching resources in anatomy education highlights the urgent need to explore digital and three-dimensional (3D) technologies as complementary tools to traditional cadaveric and plastic model-based learning. While cadaveric dissection remains the gold standard for teaching, its accessibility is often limited by ethical, logistical, and preservation challenges, and plastic models, though widely used, lack the realism and variability of human tissue. This project proposes the development of digital and 3D printed anatomy resources through the application of structured light scanning, coordinate measuring, and photogrammetry, with the dual aim of enhancing student learning and evaluating the fidelity of these resources. Using an Artec 3D scanner, Microscribe, and photogrammetry methods, both cadaveric specimens and conventional plastic models will be digitised to create high-resolution, interactive virtual models that can be curated into a comprehensive digital library accessible to students across online and blended learning environments. These models will then be processed for 3D printing, producing replicas designed to be durable, reproducible, and ethically sustainable alternatives to human material, with the added advantage of being available in large numbers to meet growing cohort sizes.

To ensure that these printed replicas are accurate and representative of the original specimens, morphometric validation will be conducted using a Microscribe digitiser, allowing precise comparative measurements to establish the degree of fidelity and anatomical reliability. In addition to technical validation, the project will incorporate a pedagogical evaluation by distributing the digital and printed models to undergraduate cohorts for integration into laboratory classes and independent study, followed by surveys designed to assess perceptions of realism, usability, accessibility, and educational value. By combining innovative scanning technology, rigorous validation, and educational research, this initiative

will deliver a scalable and reproducible model for resource development that has the potential to transform anatomy education. The anticipated outcomes include a permanent library of digital anatomy resources, a bank of durable and accurate 3D printed specimens for repeated handling, and a pedagogically informed framework for integrating such resources into curricula.

D) Laboratory Location MSW414

A) **Project Title:** Soft embalming for anatomy

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Dr Matt Farrow

Location: MSB509

Email: matthew.farrow@newcastle.edu.au

Co-Supervisor Name (must be completed): Professor Rohan Walker

Email: rohan.walker@newcastle.edu.au

Co-Supervisor Name (must be completed): Dr Ashlee Dunn

Location: Anatomy Lab

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Human Donors (Cadavers) are a cornerstone of anatomy education and surgical training, offering an unparalleled opportunity for students and clinicians to engage with the complexity of human variation, spatial relationships, and tactile properties of biological tissue. Traditional embalming methods, typically based on formaldehyde and associated fixatives, provide long-term preservation of donor bodies but alter the natural colour, flexibility, and texture of tissue. While effective for prosections and museum specimen preservation, these methods result in rigid and desiccated cadavers that do not closely resemble the properties of living tissue. This limits their applicability in surgical training, where realistic tissue handling is critical for the acquisition of fine motor skills and procedural competence.

Soft embalming techniques are a promising alternative that may enhance anatomy training. Soft embalming maintains tissue pliability, colour, and joint mobility, while still ensuring safe handling and sufficient longevity (years) for educational and research purposes. Soft embalmed Donors simulate "life-like" conditions, allowing clinicians to practise suturing, dissection, endoscopic procedures, and minimally invasive surgical techniques with higher fidelity than traditionally embalmed bodies, and without the need of freezing non-embalmed bodies which requires significant infrastructure.

Despite the benefits, soft embalming is not frequently utilised within Australia. This is often because soft embalmed bodies have a shorter longevity (years) compared to traditional embalming techniques (decades) and few institutions deliver advanced surgical courses using Donors.

This project seeks to develop and refine a soft embalming protocol tailored to the requirements of anatomy teaching and surgical skills training at the University of Newcastle. The project will evaluate chemical formulations, preservation processes, and storage conditions to identify a method that balances tissue realism with durability, safety, and cost-effectiveness.

Bodies preserved with the developed protocol will be assessed through structured observation, objective measurement, and feedback from key stakeholders including anatomy educators, medical students, and surgical trainees. Evaluation criteria will focus on the realism compared to non-embalmed tissue, authenticity of tissue handling, suitability for surgical procedures, ease of dissection for anatomical learning, and long-term stability of specimens.

The anticipated outcomes of this research are multifaceted. Firstly, it will advance anatomy education by providing students with a more realistic and engaging learning experience, improving their understanding of three-dimensional relationships and the texture of living tissue. Secondly, it will enhance surgical training opportunities by offering a sustainable resource that approximates live operating conditions, thereby bridging the gap between simulation models and live patient surgery. Finally, the project will establish a reproducible soft embalming method.

D) Laboratory Location MSW414

A) Project Title: Exploration of genetically informed precision medicine for schizophrenia using iPSCs & human cerebral organoids

B) Supervisory Details (must be completed):

Primary Supervisor Name: Dr Chantel Fitzsimmons

Location: Callaghan, MSB613

Email: chantel.fitzsimmons@newcastle.edu.au

Phone: (02) 4921 5549

Co-Supervisor Name (must be completed): Professor Murray Cairns

Location: Callaghan, MSB512

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Phone: (02) 4921 8670

Co-Supervisor Name (must be completed): Dr Steven Jackson

Location: Callaghan, LS3-40

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

Background/Hypothesis:

Despite decades of intensive research, schizophrenia remains difficult to treat, and the symptoms often persist despite the best efforts with current medications. We hypothesise that the personalised quantification of genetic risk for schizophrenia can be used to stratify individuals for precision treatment with existing and repurposed medicines. This approach uses pharmagenic enrichment scores (PES) to calculate genetic risk specifically within clinically actionable (i.e. 'druggable') systems.

Aims/Methods:

This research aims to develop sophisticated individual models of schizophrenia, in vitro, to validate the utility of PES to identify genetically informed treatments for precision medicine in schizophrenia.

Project Aims:

1. To use well-characterised patient lymphoblastoid cells (LCLs) from the Australian Schizophrenia Research Bank (ASRB) with top and bottom quantile PES for a specific drug and reprogram them into induced pluripotent stem cells (iPSCs).
2. To characterize the iPSC for pluripotency markers (flow cytometry, PCR, immunohistochemistry) & generate and characterise cerebral organoids from iPSCs (markers of ectoderm/PCR).
3. To treat iPSCs/organoids with PES -associated drugs and examine phenotypic and molecular changes associated with drug treatments to demonstrate the clinical utility of the PES tool for schizophrenia intervention. Connectivity is known to be disrupted in schizophrenia and is

an important phenotypic parameter. This can be assessed using non-invasive multi-electrode array/calcium imaging of synaptic activity.

Outcomes:

People affected by schizophrenia can be matched to treatments that are most likely to be effective.

D) Laboratory Location

Campus: Callaghan; Building/Room: Medical Science Building/MSB613

A) Project Title: Enhancing bone health in Adolescent athletes through early risk identification: A co-designed screening and education tool for parents and coaches

B) Supervisory Details (must be completed):

Primary Supervisor Name: Rebecca Haslam

Location: Vic Levi Building, Callaghan Campus

Email: Rebecca.Haslam@newcastle.edu.au

Co-Supervisor Name (must be completed): Mitch Smith

Location: Vic Levi Building, Callaghan Campus

Email: Mitch.Smith@newcastle.edu.au

Phone: (02) 4033 9235

Co-Supervisor Name (must be completed): Tracy Schumacher

Location: University Department of Rural Health, Tamworth

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

Adolescence is a period marked by rapid growth, including increases in height, bone mineralisation, and muscle mass. During this time, basal metabolic rate and nutrient demands rise significantly, yet many adolescents fail to meet energy and nutrient requirements. This issue is further exacerbated in adolescent athletes, whose energy needs are elevated due to high training demands. Together, these factors can compromise bone health and increase the risk of bone stress injury (BSI). Early identification of BSI risk is essential; however, parents and coaches often lack awareness of key risk factors.

This project aims to:

1. Identify and synthesise key indicators of growth and risk factors for BSIs in adolescents using expert consensus, clinical frameworks and stakeholder research.
2. Co-design a screening tool and suite of resources for use by parents and coaches to identify peak growth periods and BSI risk.
3. Document the intervention development process and describe the intervention for future replication and evaluation.

The project will use the GUIDED framework for systematic intervention development. A mixed-methods approach will be used, beginning with a literature review to identify and synthesise key risk factors from the sports in question. Stakeholder engagement through interviews and focus groups with parents, coaches, clinicians, and adolescents will be conducted to collaboratively develop strategies to identify key growth periods and prevent BSI and draft an associated suite of educational resources. Iterative refinement will follow, informed by usability testing and stakeholder feedback. The intervention will be described using the TIDieR checklist to ensure clarity, replicability, and transparency in future implementation and evaluation.

A) Project Title: Elucidating the Mechanism that Initiates Premature Birth

B) Supervisory Details:

Primary Supervisor Name: Jon Hirst
Location: HMRI
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Phone: 4042 0360

Co-Supervisor Name: Tamas Zakar
Location: HMRI 3404
Email: Tamas.Zakar@newcastle.edu.au
Phone: 40420543

Co-Supervisor Name: Marina Paul
Location: HMRI
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Phone: 4042 0875

Co-Supervisor Name: Jonathan Paul
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Phone: 4042 0348

C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:

Background: The mechanism that initiates parturition remains one of the greatest mysteries of human physiology. In Australia, approximately 7% of all births are preterm, and babies born prematurely are highly vulnerable to complications that can result in death, permanent disabilities, and chronic diseases later in life. The premature activation of decidual cells lining the uterine cavity is a potential mechanism that stimulates preterm birth by transforming the intrauterine tissues from a pregnancy-protecting to a labour-promoting state. Understanding this process is critical, as it may lead to the uncovering of new treatment options to prevent preterm birth, save many babies, and avoid disabilities.

The project addresses the hypothesis that premature cellular activation, triggered by oxidative stress, alters gene expression patterns and establishes a labour-inducing proinflammatory decidual cells.

Aims:

1. Isolate decidual cells from human placentae and culture them with hydrogen peroxide to cause oxidative stress that triggers cell activation.
2. Conduct genome-wide gene expression screens to identify gene activity changes associated with decidual cell activation.
3. Investigate new drugs that can reverse these changes and provide additional treatment options for women and babies at risk of preterm birth.

Methods: Decidual cells will be isolated from human placentae, purified and cultured. These cultures will be treated with H₂O₂ to cause oxidative stress and trigger activation markers.

RNA will be extracted from control and treated cultures and subjected to next-generation sequencing (RNA-seq), followed by bioinformatic analysis to determine gene expression patterns underlying activational change.

Cultures will be treated with drugs to inhibit activation and the associated labour processes change.

The research will generate essential preclinical data for developing effective new therapies to prevent preterm birth.

D) Laboratory Location: HMRI, Level 3E (Mothers and Babies Research Program).

A) **Project Title: Using precision medicine to understand and treat the high burden of colorectal cancer in people with cystic fibrosis**

B) **Supervisory Details:**

Primary Supervisor Name: Associate Professor Gerard Kaiko

Location: HMRI Level 2 East

Email: Gerard.kaiko@newcastle.edu.au

Phone: (02) 40420184

Co-Supervisor Name: Dr Gabriela Hoefel

Location: Level 2 East HMRI

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

Background: Cystic fibrosis (CF) is the most common lethal monogenic disease in Australia with an average life expectancy of ~40. CF is caused by mutations in the CFTR ion channel leading to a build-up of viscous mucous and infections in the lungs, intestinal tract, and pancreas. Although often thought of as a respiratory disease, CF manifests with intestinal pathology and inflammation as often the first sign of disease in children. As life expectancy for people with CF has increased so has the rapid rise in incidence of colorectal cancer (CRC), which is now ~1000% higher than the incidence in the general population. The recent advent of CFTR protein modulator drugs, which improve lung function and hold promise to increase average life expectancy to between ~50-60, will bring people with CF into the peak age period for CRC and further dramatically increase their risk. Due to the changing pattern of disease we need to understand the mechanism underlying CRC development in people with CF, in particular whether it is due to genetic intrinsic factors within their colonic epithelial stem cells or cell extrinsic factors like microbiota, diet, and inflammation. Furthermore, given the very high risk of CRC and the fact longitudinal epidemiological studies will take 20 years, there is an urgent clinical need to determine whether CFTR modulators can act to reverse this susceptibility to CRC. Such knowledge could fundamentally reshape national CRC patient screening programs in CF. In order to investigate this we will utilise our existing Australia-first precision medicine organoid platform for CF, which we have previously shown to predict other treatment outcomes in clinical trials.

Aim: By working with our team you will determine whether CRC development in CF patients is likely due to intrinsic factors within colon epithelial stem cells, and then whether this phenotype can be reversed using CFTR modulator therapies.

Experimental approach: Completion of the aims will involve using our CF patient 3D human colonic organoids ('mini-guts') platform to determine susceptibility to CRC. It will also use CRISPR/Cas9 to modulate known CRC-causing gene expression, such as *APC*. You will get to experience laboratory work and also have the opportunity to observe how this has been translated from the bench to the bedside with interventional clinical trials. The project will involve conducting several assays linked to CRC phenotypes with these colon organoids and determining whether CFTR modulator drugs (e.g. Trikafta Australia's most expensive medication, and Alyftrek FDA approved but not yet reached Australia) can also protect against CRC development. Other techniques involved will include assessment of gene expression by RT-qPCR, flow cytometry, immunofluorescence, live cell imaging, and mucous assays.

A) **Project Title: Bioactivated surgical mesh to improve healing and reduce infection in intestinal anastomosis surgery for IBD and colorectal cancer.**

B) **Supervisory Details:**

Primary Supervisor Name: Associate Professor Gerard Kaiko

Location: HMRI Level 2 East

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Phone: (02) 40420184

Co-Supervisor Name: Associate Professor Behnam Akhavan

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

Background: Intestinal anastomosis surgery is a life-saving but severe procedure performed on patients with colorectal cancer or inflammatory bowel disease (IBD). This surgery resects diseased intestinal tissue and joins the two healthy ends of the intestinal tract back together. Crohn's disease and ulcerative colitis constitute the inflammatory bowel diseases (IBD), and together with colorectal cancer now impact 1 in 20 people at increasingly younger ages. Unfortunately, intestinal anastomoses surgery fails in ~20% of cases due to poor healing or wound infection. These failures risk life-threatening sepsis. In order to improve these clinical outcomes our lab has developed a bioactivated nano-engineered surgical mesh to increase the rate of healing and prevent surgical site bacterial infection. This system uses a 3D printing plasma surface treatment that bioactivates the polymers in standard surgical materials. Using colonic organoid screening we then identified a key candidate molecule that drives increased intestinal healing, to now be added to the bioactivated surgical materials.

Aim: Working with a PhD student you will further develop the bioactivated surgical material by conjugating to the key candidate molecule and testing the impact on healing and infection resistance using 3D human organoids ('mini-guts').

Experimental approach: Completion of the aims will involve using 3D human gut organoids to model healing, infection, and intestinal functions. Working with nano-materials for the development of a new treatment and analysis of surface biochemistry on the surgical mesh. Other techniques involved will include assessment of gene expression, immunofluorescence, confocal microscopy, and live cell imaging.

A) **Project Title: Epigenetic Prioritisation of Clinically Actionable Metabolic Factors in Schizophrenia**

B) **Supervisory Details:**

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

Background: Individuals with schizophrenia exhibit high rates of metabolic syndrome (MetS), a cluster of risk factors for heart disease including elevated waist circumference, hypertension, hyperglycaemia and dyslipidaemia. This contributes to a staggering 80% higher risk of premature death due heart disease versus the general population. Increasing evidence suggests there is an inherent genetic link between schizophrenia and MetS that could be pivotal for improving both psychiatric and cardiometabolic outcomes. However, it is unclear if this link extends to the *epigenome*; that is, changes that modify how DNA is read without the genetic sequence. To this end, DNA methylation is one epigenetic system of key interest, as it can regulate gene expression in response to both genetic and environmental risk factors.

Hypothesis: Schizophrenia and metabolic syndrome share DNA methylation signatures that can be utilised to prioritise interventions for improved clinical management.

Aims:

1. Identify gene-specific DNA methylation signatures shared by schizophrenia and MetS.
2. Prioritise candidate genes targetable with existing pharmacological treatments.
3. Explore the utility of shared DNA methylation signatures for precision medicine.

Experimental approach: Publicly available DNA methylation data for schizophrenia and metabolic syndrome will be curated and harmonised. Epigenome-wide association studies will be conducted for each phenotype, followed by a meta-analysis to identify shared methylation signatures. These will be annotated to protein coding genes and cross-referenced with drug-gene interaction databases to prioritise compounds for further study.

A) **Project Title: Discovery of novel cardioprotective agents to protect against anti-cancer therapies-induced cardiotoxicity and cardiovascular complications**

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Professor Doan Ngo

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Cancer survival rates have significantly increased in the last two decades due to emergence of highly effective classes of anti-cancer agents, such as the Anthracyclines (Doxorubicin, Epirubicin, Daunorubicin) and Proteasome inhibitors (Carfilzomib, Bortezomib, Ixazomib). However, these anti-cancer agents have unexpectedly caused cardiovascular toxicity and led to increase incidence of cardiovascular complications (e.g., heart failure, arrhythmias, and cardiac arrest) in cancer patients. It is estimated that over a third of patients who survive more than five years after their cancer diagnosis (>50 million worldwide, ~2 million Australians by 2040) would succumb to these cardiovascular complications rather than their cancer. Moreover, >55% of Australians treated for cancer are thought to have been exposed to one or more of these cardiotoxic anti-cancer agents. Thus, Cancer therapy-related cardiovascular toxicity (CTR-CVT) is an urgent and growing challenge to cancer survivorship care.

Despite this alarming trend, no proven strategies exist to combat cardiotoxicity, especially those that applies across multiple anticancer agents/classes. To address this unmet need, our research recently uncovered evidence that Cyclin-dependent kinases (CDKs) may play an important role in cardiotoxicity induced by 2 aforementioned classes of anti-cancer agents (Anthracyclines and Proteasome inhibitors). CDKs are key regulatory enzymes involved in cell proliferation through regulating cell-cycle checkpoints and transcriptional events. Specifically, we found that inhibition of CDK9 rescued human cardiomyocyte cell line from cell death induced by 6 different chemotherapies across the 2

aforementioned classes of anti-cancer agents *in vitro*. We now propose an Honours project to follow up on these studies to unravel the underlying mechanisms and develop novel cardioprotective interventions. We **hypothesised** that selective inhibition of CDK9 will mitigate CTR-CVT induced by Anthracyclines and Proteasome inhibitors. The **aims** of this project will have candidates to:

- 1) perform a series of *in vitro* studies to examine the therapeutic effectiveness of CDK7 inhibitors in mitigating CTR-CVT in human cardiomyocyte cell line cultures
- 2) verify that these CDK7 inhibitors do not interfere with the anti-cancer properties of Anthracyclines and Proteasome inhibitors towards triple negative breast cancer cell cultures
- 3) elucidate the underlying cardioprotective mechanisms with qPCR and/or protein assays (i.e. Western blot, ELISA)

Laboratory Location

Hunter Medical Research Institute, Level 3 East
Centre of Excellence Newcastle Cardio-Oncology

A) **Project Title: Leveraging a multi-omics approach to uncover the mechanisms of cardiotoxicity driven by anti-cancer agents**

B) **Supervisory Details (must be completed):**

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Cancer survival rate has greatly improved in the last two decades due to the emergence of next-generation anti-cancer agents. For example, Carfilzomib, the second-in-class proteasome inhibitor, is a highly effective agent for the treatment of multiple myeloma, acute leukaemia amyloidosis, and other malignancies. Carfilzomib has significantly improved overall survival and progression-free survival of cancer patient. However, treatment with Carfilzomib has unexpectedly resulted in a higher incidence of cardiotoxicity and led to cardiovascular complications such as heart failure, severe hypertension, arrhythmias, and cardiac arrest. The underlying mechanism remained poorly defined and understood. This has caused a cessation of life-saving anti-cancer treatments which has detrimental impact on patients' health, quality of life, and survival. Therefore, there is an urgent need to identify novel cardioprotective therapies to mitigate cardiotoxic effects of Carfilzomib.

Our research recently completed a study using a novel animal model that recapitulate Carfilzomib-induced cardiotoxicity and cardiac dysfunction *in vivo*. We now propose an Honours project to fully characterise the cardiotoxic effects of Carfilzomib on cardiac and unravel the underlying mechanisms of Carfilzomib-induced cardiotoxicity. Candidate will perform histological analysis to identify cardiac pathologies (inflammation, fibrosis). These findings will be complemented with molecular techniques (qPCR, protein assays) and multi-omics analyses (transcriptomic and proteomic) to uncover biosignatures (gene, protein) associated with Carfilzomib-induced cardiotoxicity. We **hypothesised** that our comprehensive approach would elucidate the mechanisms, helps us gain new insights, and

identify novel therapeutic targets for future development/research into mitigating Carfilzomib-induced cardiotoxicity. The **aims** of this project will have candidates to:

- 1) perform histological analysis to identify cardiac pathologies (inflammation, fibrosis)
- 2) carry out high throughput multi-omics analyses (transcriptomic and proteomic)
- 3) validate these findings with gene expression (qPCR) and/or protein assays (i.e. Immunohistochemistry Western blot, ELISA)

Laboratory Location

Hunter Medical Research Institute, Level 3 East
Centre of Excellence Newcastle Cardio-Oncology

A) **Project Title: Determining the impact of placental angiotensin-converting enzyme 2 (ACE2) deficiency for fetal growth**

B) Supervisory Details (must be completed):

Primary Supervisor Name: Professor Kirsty Pringle

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

Fetal growth restriction (FGR) is a leading cause of infant morbidity and mortality, impacting up to 10% of all pregnancies worldwide. Growth-restricted fetuses are at greater risk of stillbirth, admission to neonatal intensive care units and, in the long-term, are at increased risk of neurodevelopmental and cardio-metabolic disorders. Currently, there are no effective preventative strategies or treatments for FGR. We have shown that the expression of angiotensin-converting enzyme 2 (ACE2) is significantly reduced in placenta from pregnancies complicated by FGR and that impaired placental oxygen delivery can decrease ACE2 levels. Moreover, treatment with recombinant human (rh)ACE2 was able to mitigate the effects of impaired placental perfusion. In the current proposal, we will, for the first time, show that reduced placental ACE2 exacerbates oxidative stress caused by impaired perfusion.

Hypothesis: Placental ACE2 deficiency exacerbates placental oxidative stress and stimulating ACE2 could offer a promising new FGR treatment.

Aim: To demonstrate that reducing placental ACE2 exacerbates the oxidative stress that is associated with impaired placental perfusion *in vitro* and show that (rh)ACE2 is a potential therapeutic strategy to mitigate these effects.

Experimental Approach: Human placental organoids will be gene-edited using CRISPR technology to either knockout ACE2 or induce an ACE2 SNP that causes a deficiency in ACE2 activity, and subsequently exposed to hypoxia/reoxygenation as an established model of impaired placental perfusion. A subset of organoids will be treated either with (rh)ACE2. Effects on ACE2 activity, Angiotensin peptide levels and oxidative stress markers will be measured.

Laboratory Location: HMRI Level 3 East

A) Project Title: Characterising placentas from women with gestational diabetes

B) Supervisory Details:

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:

In Australia, diabetes affects approximately 10% of pregnancies worldwide and 13% of pregnancies nationally. Of these, about 9% of pregnant people develop gestational diabetes mellitus (GDM), and 1% have pre-existing (type 1 or type 2) diabetes mellitus. The placenta, which separates the maternal and fetal circulations, is sensitive to hyperglycaemia. Alterations in placental structural development and subsequent vascular dysfunction are present in over 85% of pregnant people with diabetes. It is these placental morphologies that alter transport of nutrients wastes and oxygen across the placenta and hence impact fetal growth in people with GDM. The mechanisms that underpin the placental abnormalities associated with GDM are poorly understood, despite their impact on nutrient/waste transport and fetal development.

Hypothesis: Markers of glucose transport, fibrosis and inflammation are changed in the placentas of pregnant people with GDM compared with normal glucose tolerance.

Aim: To characterise changes in glucose transport and markers of fibrosis and inflammation in placentas of pregnant people with GDM or with normal glucose tolerance, so that we can better understand how the placenta adapts/changes in pregnancies complicated by GDM.

Experimental Approach:

Placentae from pregnant people with normal glucose tolerance and from people with GDM (n=40/group) have already been collected and stored. Using these stored samples, the expression/localisation of markers of glucose transport/metabolism, tissue injury and oxidative stress will be examined by qPCR and Immunohistochemistry.

D) Laboratory Location HMRI Level 3 East

A) **Project Title:** Detrimental effects of prenatal stresses fetal neurodevelopment and childhood outcome

B) **Supervisory Details:**

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

Exposure to stressful events in pregnancy adversely influences fetal development leading to increased risk of serious behavioural disorders in childhood. The mechanisms that link maternal adversity to long-term outcomes in children are unclear. We propose that actions on the placenta serve as a pathway transmitting the effects of maternal stress to the fetus and that this involves a marked suppression of neurosteroid production. Neurosteroids are elevated during pregnancy and have key protective and trophic roles in fetal neurodevelopment and are essential for fetal white matter growth. This proposal examines the idea that stress exposure suppresses enzymes in the neurosteroid production pathway, and this results in reduced levels in the fetal and maternal circulations which in turn leads to white matter deficits in the fetus. These types of deficiencies have been shown to be associated with behavioural disorders in children including ADHD. This project is based on the proposal that maternal stress acts directly on the placenta and directly lowers neurosteroids reaching the fetal circulation. This results in deficits in fetal neurodevelopment and heightened vulnerability to childhood behavioural disorders. The project will use protocols assessing behavioural outcome following stress exposed pregnancies as well as studies on neurosteroid pathways in the placenta. The studies will further utilise protocols and samples available as part of the NEW1000 family study of maternal and childhood behavioural outcomes. The work will indicate the potential of using neurosteroid based treatments for preventing white matter deficits and so improve childhood behavioural outcomes.

D) **Laboratory Location:** L3E HMRI

A) **Project Title:** Dissecting the influence of vaccine type and delivery site on immune responses

B) **Supervisory Details (must be completed):**

Primary Supervisor Name: Dr Alexandra Spencer

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Co-Supervisor Name (must be completed): Dr Jessica Barnes

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).**

Vaccines are among the most cost-effective tools for reducing the burden of infectious diseases in both animal and human health. Their primary goal is to activate the adaptive immune system and generate a highly specific memory response, capable of rapid reactivation upon exposure to the pathogen.

Achieving long-lasting protection depends on coordinated interactions between the innate and adaptive arms of the immune system. The innate immune system acts as the first line of defence, detecting pathogen, initiating inflammation and through the release of signals are able to recruit immune cells and shape the subsequent adaptive response. These signals guide the activation and differentiation of T and B cell subsets, helping to tailor the adaptive immune response to the nature of the pathogen and the site of infection.

Current licensed vaccines span a wide range of modalities each delivering antigens and stimulating immune responses in distinct ways. While certain vaccine types are known to preferentially induce specific adaptive immune profiles, the mechanisms driving this diversity remain poorly understood. By identifying the vaccine-related factors that influence early immune activation and shape adaptive immunity, it will enable tailoring the design of vaccines so that they can elicit the most appropriate immune responses for different pathogens and anatomical sites.

Key research question: How do early immune activation events shape the quality of vaccine induced immunity.

Experimental approaches: This study aims to compare immune response induced by vaccination with different types of vaccines or through alternative routes of administration, using *in vivo* animal models and a variety of *ex vivo* immunological assays (eg flow cytometry, immunohistochemistry, gene expression analysis, imaging, cell culture).

D) **Laboratory Location:** HMRI

A) Project Title: Investigating the role of the Renin-Angiotensin System (RAS) in embryo development

Supervisory Details (must be completed):

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Co-Supervisor Name: Kirsty Pringle

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B) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

The utilisation of assisted reproductive technologies (ART) is experiencing a rapid surge within the livestock and equine sectors (Fig 1). More than 1.6 million *in vitro* produced bovine embryos and 24,000 equine embryos were transferred in 2022, directly contributing to Australia's \$25 billion meat, dairy and equine industries. By facilitating the production of embryos with superior genetic quality, ART has the potential to significantly improve efficiency and sustainability of livestock breeding in Australia with significant animal welfare and economic benefits (Fig 1).

Currently however, most embryos produced *in vitro* exhibit significant differences in morphology and developmental competence profiles and often lead to pregnancy loss within the first

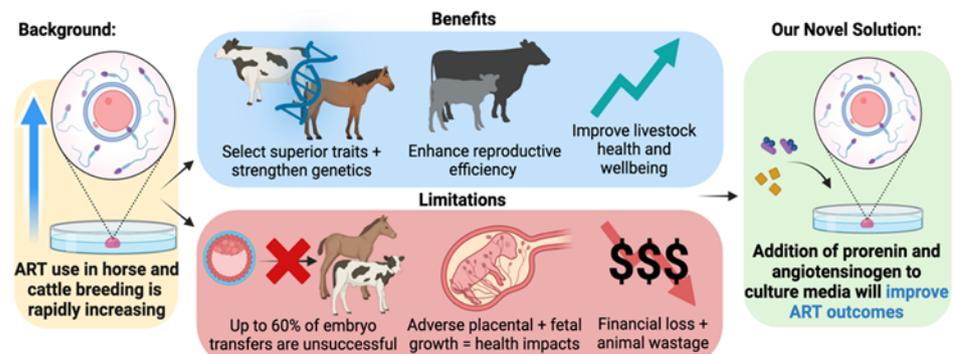


Figure 1. Overview of the background of the proposal, including current benefits and limitations to ART use in animal breeding. We propose that supplementing culture media with prorenin and angiotensinogen will improve pregnancy success and fetal growth.

6 weeks of gestation. Additionally, there is a significant difference in embryo development rates between species which has a direct impact on live birth outcomes such that 44% of equine and 73% of transferred bovine embryos fail to produce live offspring. Considering that purchasing a single high-quality livestock embryo ranges from a few hundred dollars to several thousand dollars, this represents a significant financial loss for the industry. Our team has demonstrated that key components of the renin-angiotensin system (RAS), are essential for implantation, placentation, fetal growth and pregnancy success in human/rodent pregnancies. Given the conserved nature of the RAS pathway across the mammalian order, we expect it to play a key role in livestock pregnancy.

Hypothesis: We hypothesise that the RAS plays a crucial role in embryogenesis and implantation in livestock species and is the 'missing ingredient' in current *in vitro* culture conditions.

Aim: To characterise the expression of the RAS in bovine and equine ovaries, oocytes and embryos.

Method: Here we will comprehensively characterise the gene and protein expression and localisation of all components of the RAS, including prorenin, AGT, PRR and megalin in bovine/equine oocytes (germinal vesicle (GV) stage), eggs (metaphase II; MII) and embryos (zygote to blastocyst). Cow and horse oocytes, eggs, and embryos will be collected at the GV, MII, zygote, 2-cell, 4-cell, morula and blastocyst stage and either fixed in paraformaldehyde for antibody-based exploration of or frozen for subsequent quantitative PCR (qPCR) analysis.

Expected outcomes: This study will provide significant new knowledge about the role of the RAS in pre-implantation development in these agriculturally significant species.

A) Project Title: The impact of dietary bisphenol exposure on endometrial health**B) Supervisory Details (must be completed):****Primary Supervisor Name:** Jessie Sutherland**Location:** HMRI**Email:** jessie.sutherland@newcastle.edu.au**Phone:** 49138735**Co-Supervisor Name (must be completed):** Alex Peters**Location:** HMRI**Email:** alex.peters@newcastle.edu.au**Phone:** 0401707683**Co-Supervisor Name (must be completed):** Kirsty Pringle**Location:** HMRI**Email:** Kirsty.pringle@newcastle.edu.au**Phone:** +61 2 4042 0372

** Up to 2 additional co-supervisors can be included (maximum 4 supervisors in total), please copy and paste the above information for each additional co-supervisor **

C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

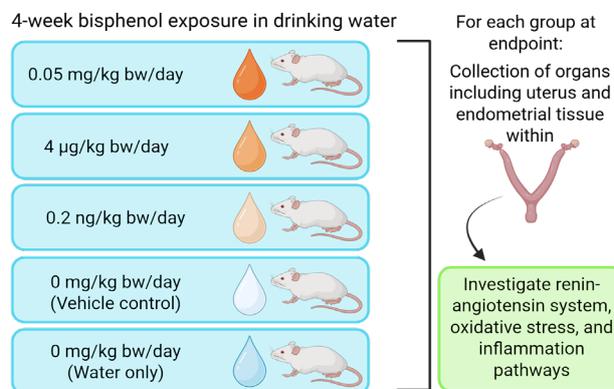
Background: This project addresses the pressing issue of plastic toxicants, bisphenols, such as BPA, and BPA alternatives, such as BPS, and their effects on reproductive health. Bisphenols are endocrine-disrupting chemicals used in the production of food and beverage packaging and migrate into our food and drinks upon contact. This unavoidable exposure in our diets poses significant health risks, particularly for reproductive health and fertility. Despite emerging evidence highlighting these dangers, bisphenol contamination in food remains largely unregulated in Australia. Furthermore, Australian regulations do not adequately consider reproductive health and fertility. We urgently need evidence demonstrating the effects of bisphenols on the development of reproductive conditions, such as endometriosis, to promote the revision of guidelines for safe bisphenol exposure in Australia.

Endometriosis is an estrogen-dependent, chronic inflammatory condition where the inner lining of the uterus, the endometrium, grows outside of the uterus, causing significant pain and infertility. Recent work from our laboratory has highlighted the importance of the renin-angiotensin system (RAS) in endometrial health, and the role of the RAS in driving oxidative stress and inflammation in other reproductive and pregnancy-related pathologies. The role that bisphenol exposure plays in the activation of these pathways and the development of endometrial disorders is not yet understood.

Hypothesis: We hypothesise that dietary bisphenol exposure at levels currently deemed 'safe' in Australia has detrimental effects on endometrial health, through activation of the pro-oxidative and pro-inflammatory components of the RAS.

Aim: To investigate how the RAS, oxidative stress, and inflammation in the endometrium is affected by realistic dietary bisphenol exposure.

Method/Experimental approach: This project will utilise our newly established mouse model of realistic low-level bisphenol exposure, delivering BPS to mice in their drinking water in 5 groups:



Endometrial tissue will either be fixed in paraformaldehyde to assess protein localisation via immunofluorescence and microscopy, or frozen at -80°C to assess gene and protein levels by qPCR, western blotting, and activity assays. These methods will be carried out for key components of pathways involved in the RAS, oxidative stress, and inflammation.

Expected Outcomes: This study will fill a significant knowledge gap in understanding the impact of repeated low-level exposure to dietary toxicants such as bisphenols in promoting the development of endometrial disorders, and the mechanisms involved.

D) **Laboratory Location** HMRI Level 3 East

A) Project Title: Targeting DNA repair in the treatment of glioblastoma**B) Supervisory Details (must be completed):****Primary Supervisor Name: Paul Tooney****Location: Level 4 East HMRI****Email: Paul.Tooney@newcastle.edu.au****Phone: 49218691****Co-Supervisor Name (must be completed): Kelsey Maddison****Location: Level 4 East HMRI****Email: Kelsey.Maddison@newcastle.edu.au****Phone:****C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

Background: Glioblastoma is the most devastating form of brain tumour in adults, with limited treatment options and average survival of just 14 months. Treatment involves surgery to remove the tumour and confirm the diagnosis, then intensive temozolomide chemotherapy and radiotherapy to kill off any remaining tumour cells by damaging their DNA. Despite this aggressive treatment approach, in most cases the tumour becomes resistant to the temozolomide treatment and grows back. We know that brain cancer cells can activate proteins that repair the DNA damage caused by chemotherapy and radiotherapy, allowing them to resist the treatment and continue to grow aggressively, spreading throughout the brain until the patient succumbs.

Our research focuses on ways to overcome this resistance to treatment by stopping the brain cancer cells from repairing the DNA damage. Three key proteins - ATR, ATM and DNA-PK - play important roles in repairing DNA when it is damaged by radiation and chemotherapy. DNA-PK is particularly important for repairing damage from radiation treatment and thus inhibitors of DNA-PK can sensitise cancer cells to radiation treatment. We have shown that inhibiting DNA-PK increases the death of brain cancer cells treated with radiation and temozolomide chemotherapy. We **hypothesise** that combination of radiation and DNA-PK inhibition will overcome resistance of brain cancer cells to temozolomide chemotherapy and cause them to die.

Aim 1 will compare the effects of DNA-PK inhibitors on treatment naïve and temozolomide resistant brain cancer cells. Experimental approach will involve testing DNA-PK inhibitors in cytotoxicity assays (MTT, Incucyte Live cell imaging), western blots to confirm inhibition of DNA-PK and assessments of DNA damage.

Aim 2 will determine whether combining DNA-PK inhibitors with radiation overcomes temozolomide resistance in brain cancer cells. Experimental approach will involve testing the best DNA-PK inhibitor from Aim 1 in combination with radiation treatment in temozolomide resistant cells put through a range of cytotoxicity assays (MTT, Incucyte Live cell imaging), synergy assays, western blots to confirm inhibition of DNA-PK and assessments of DNA damage, flow cytometry assessment of DNA damage, cell cycle and cell death mechanisms.

Aim 3 will determine if hypoxic conditions affect the ability of DNA-PK inhibitors to kill brain cancer cells alone or in combination with radiation treatment particularly in temozolomide resistant cells.

Experimental approach will involve testing the best DNA-PK inhibitor from Aim 1 in combination with radiation treatment in treatment naïve and temozolomide resistant cells grown in normoxic or hypoxic conditions then put through a range of cytotoxicity assays (MTT, Incucyte Live cell imaging), synergy assays, western blots to confirm inhibition of DNA-PK and assessments of DNA damage, flow cytometry assessment of DNA damage, cell cycle and cell death mechanisms.

D) Laboratory Location Level 3 West HMRI

A) **Project Title:** Does exercise during pregnancy help or hinder fetal brain development?

B) **Supervisory Details:**

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach.**

Accumulating pre-clinical evidence shows physical activity during pregnancy has direct beneficial intergenerational effects on baby brain development. That is, maternal physical activity during pregnancy enhances offspring brain health via enhancements in brain growth factor expression, neurogenesis and brain structure. Our lab's recent scoping review reveals that little is known about the direct intergenerational effects of maternal physical activity in humans. Therefore, the aim of this project will be to investigate the relationship between maternal physical activity levels during pregnancy and fetal brain development.

This world-first pilot study will be conducted within the pre-existing and ongoing NEW1000 longitudinal pregnancy cohort study at HMRI which aims to elucidate mechanisms responsible for the developmental origins of health and disease (DOHaD). Physical activity during pregnancy will be measured by an accelerometer and analysed using the GGIR pipeline in R-studio. Fetal brain development will be measured via in-utero MRI at 36-week's gestation and analysed using cutting-edge semi-automated fetal brain segmentation pipelines. This project will be well-suited to a student with knowledge of/interest in learning some basic coding.

Elucidating the fetal brain health benefits of physical activity during pregnancy will empower and motivate more women to remain physically active during pregnancy – in the same way that pregnant women alter their diet, as well as stop smoking and consuming alcohol.

D) **Laboratory Location:** This project will involve being located across both Callaghan (Medical Science building) and HMRI (and Imaging Centre) sites.

A) **Project Title: Reprogramming the Fetal Gut-An Innovative Intervention for Mitigating Childhood Obesity**

B) **Supervisory Details (must be completed):**

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C) **Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:**

In Australia, over 25% of all children (5-17 years) are overweight or obese. Childhood obesity is linked to many serious illnesses including cardiometabolic diseases (hypertension, dyslipidemia, insulin resistance and diabetes), atopy/asthma, obesity-related cancers, and premature death. In addition, children living with overweight or obesity have lower self-esteem, are more likely to be subject to bullying, teasing and suffer from disordered eating and body concerns as young as five years of age. Current prevention and intervention strategies for managing childhood obesity involve modifying dietary patterns, increasing physical activity, and reducing sedentary behavior. However, these current strategies alone are insufficient to mitigate the current childhood obesity pandemic. **What if we could mitigate the risk for the development of childhood obesity before the child is born?** Pregnancy offers a critical window for targeting childhood obesity before it even occurs. The use of prebiotics during pregnancy could alter fetal gut programming, thus reducing the risk of childhood obesity and its associated health risks. Our project represents a novel approach to mitigate the significant health burden of childhood obesity and ensure better health outcomes for children in Australia and worldwide.

- 1) ***Comprehensively characterise the maternal and infant microbiota composition and function of sequenced stool samples.***
- 2) ***Identify associations between microbiota and the risk of obesity onset in children.***
- 3) ***Assess association of cortisol stress levels, microbiome composition and obesity prevalence in NEW1000 cohort.***

A) **Project Title: Obesity and Women's Health-Targeting Dietary Intake for First Nations Mums and their Babies**

B) Supervisory Details (must be completed):

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach: (MAX HALF-PAGE).

In Australia, 74% of First Nations people over the age of 18 are currently living with overweight or obesity and over 50% of Australian women enter pregnancy overweight/obese, with 40% gaining excess weight during pregnancy and almost 50% occurring in obese pregnant women. This makes pregnant First Nations a priority population for addressing obesity in Australia.

Excess weight during pregnancy is considered one of the most important challenges in obstetric care, a pre-pregnancy BMI >25kg/m² and excess gestational weight gain during pregnancy is associated with an increased risk of gestational diabetes (GDM), hypertensive disorders of pregnancy (e.g. preeclampsia), pregnancy loss, post-partum haemorrhage and maternal death. In addition, babies born to mothers with obesity have an increased risk of developing obesity and associated cardiometabolic disease.

We will be working with data collected from the Gomeri Gaaynggal (GG) Study – the world's largest longitudinal cohort of First Nations mothers and babies that begins during pregnancy. More than 30% of pregnant women in this study had a pre-pregnancy BMI in the obese category (i.e. BMI >30kg/m²).

We ***hypothesise*** that increasing fruit and vegetable consumption during pregnancy will reduce the risk of maternal obesity and its related complications, both during and after pregnancy.

The ***aims*** and ***experimental approach*** of this study are:

- To analyse existing GG study data on maternal dietary intakes, maternal pre-pregnancy BMI, gestational weight gain and pregnancy outcomes (i.e. GDM and hypertensive disorders)
- To analyse serum samples collected from these mothers using ELISA to assess levels of Placental growth factor (PIGF)

We will use this data to look at the association between maternal dietary intakes during pregnancy and the association with maternal outcomes specifically related to obesity and cardiometabolic disorders.

D) Laboratory Location: HMRI Level 3 East

A) Project Title: Biomechanical Validation of Synthetic Ligament Models

B) Supervisory Details:

Primary Supervisor Name: Professor Rohan Walker

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:

This project offers an exciting opportunity to contribute to the development of next-generation synthetic models for Surgical Skills Training. At present, surgical education relies heavily on cadaveric material to provide the hands-on experience required to practice complex procedures. However, there is a desperate global shortage of cadaveric resources, leaving many students and surgeons without sufficient training opportunities. Synthetic alternatives have been introduced, but most currently available models still lack the realism required to truly replicate human anatomy and tissue response.

The knee is one of the most complex and clinically important joints, yet current training models often fail to capture the integrated behaviour of its many structures. While 3D-printed bone frameworks have advanced rapidly, synthetic representations of ligaments, tendons, muscles, skin, vasculature, and cartilage frequently lack the tensile strength, elasticity, and responsiveness of real tissue. This project aims to address that challenge by biomechanically validating synthetic knee models, comparing their properties to published human data across all major tissue types.

As a final-year biomedical sciences student, you will be part of an innovative effort to improve realism in surgical training. Your work could shape the development of cutting-edge educational tools that enhance safety, skill, and surgical outcomes worldwide.

Aims:

- Quantify the biomechanical properties (tensile strength, elasticity, compressive resistance, and shear behaviour) of synthetic knee components, including ligaments, tendons, cartilage, skin, vasculature, and bone.
- Compare these properties with published cadaveric and clinical data to assess anatomical and mechanical realism.

- Evaluate and test alternative materials and fabrication methods to improve the fidelity of synthetic knee models for surgical training.

Experimental Approach:

A series of biomechanical tests (tensile, compressive, and shear) will be performed on synthetic knee components to generate stress–strain profiles and material behaviour data. These will be benchmarked against values reported for human tissues. Advanced fabrication methods such as multi-material 3D printing, TPU and silicone blends, fibre reinforcement, and layered composites will be explored to replicate the mechanical response of different tissue types. Additional assessments will include structural integrity under simulated surgical handling and integration of multiple tissue components into a unified 3D-printed knee model. The findings will guide the optimisation of material selection and design, with the ultimate goal of developing a validated, high-fidelity synthetic knee suitable for use in surgical skills training.

Laboratory Location (MSB 317)

A) Project Title: Impact of gender inclusive language on student engagement, motivation, learning and enjoyment of undergraduate biomedical teaching and learning

B) Supervisory Details (must be completed):

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C) Background and Summary of Proposed Research, including a clear hypothesis, aims and experimental approach:

Biomedical science education requires delivery and discussion of content, particularly in the physiology, pathophysiology, anatomy and genetics disciplines, that requires reference to gender and/or sex. Traditionally, teaching, at least in lower level undergraduate courses, has simplified humans into the dichotomous genders of male and female. For these reasons a large number of scientific terms encompass aspects of gender, eg. The distinction between maternal and paternal chromosomes. With increasing awareness of human gender identity not following this dichotomous pattern, it is important to consider the impacts of the language associated with gender in biomedical teaching to ensure both inclusion within the classroom and importantly, appropriate understanding for graduates as they transition into practice. However, there is currently little research and knowledge of how best to incorporate gender inclusive language into biomedical science teaching and the impacts that this may have on students' motivation, engagement, learning and enjoyment of the content.

This study will involve a systematic review of relevant literature and analysis of existing survey data alongside development of additional survey tools and focus group prompts based on the results of the literature review and the analysis of the existing data from a first-year biomedical science course. Further survey data will be captured as part of this honours project, exploring the use of gender inclusive language in a range of biomedical science courses. Focus groups will be used to gain further insight into relevant topics as determined by initial survey data and existing literature.

This project will address the hypothesis that the use of gender inclusive language in biomedical science teaching is valued by students, through the following aims:

1. Identify the current approaches to and value proposition of gender inclusion within biomedical science teaching through the completion of a systematic review
2. Evaluate the University of Newcastle undergraduate student views on incorporation of gender inclusive language in relevant disciplines.

D) **Laboratory Location:** This work is not laboratory based. The student will utilise their own computer and/or those within the library or as provided by the supervisor when required for specific data analytic software. The student will work primarily within their own space either at the library or as agreed by the supervisors at the students home. The student will regularly discuss the project with the supervisors on site and using zoom. Parts of the project will require the student involvement in focus groups on the Callaghan and/or Gosford/Ourimbah campuses.