THE UNIVERSITY of ADELAIDE

Annual Report
2020

ROBINSON RESEARCH INSTITUTE

Healthy children from the start

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HEALTHY CHILDREN FROM THE START

Cover & page 4 images: Artist impression of sperm and egg cell. Natural fertilisation (images not to scale)

WHO WE ARE

The foundations for lifelong health are established before birth. A child's growth, development and susceptibility to disease is programmed by a myriad of cues, including genetic, social and environmental factors, the health of parents at conception, the circumstances of conception, environmental exposures and health during pregnancy, the events of labour, and early life experiences.

The Robinson Research Institute at The University of Adelaide is comprehensively addressing how to give all children a healthy start in life. Our 45+ research teams are uncovering how events and circumstances before birth and during early life impact an individual's healthy development, their susceptibility to disease and their resistance to adversity. With these discoveries, we are developing effective interventions to protect children and improve their health prospects throughout life.

Vision and mission

Our **VISION** is life-time health for all children and families, through research excellence

Our **MISSION** is to deliver world-class advances in human reproduction, pregnancy and child health, informing clinical care, policy and practice to improve health across generations and global communities.

2020 SNAPSHOT

$22,269,135
Competitive funding

48
Research Leaders

12
Awarded NHMRC grants

416
Members

6
Awarded MRFF grants

26
Honours students

4
Fellowships from 3 funding agencies

138
PhD students

REFLECTIONS ON 2020

2020 was a disruptive and tumultuous year for us, with COVID-19 causing unavoidable impacts on the Institute's research activity. Nevertheless, despite the lockdowns and associated setbacks for both clinical and laboratory research, the Institute again had a productive and successful year.

COVID-19 provided opportunities for the RRI and medical research as a whole. In particular, it highlighted the importance of investment in health and medical research and the necessity for governments and policymakers to engage with scientists and experts.

While infectious disease is not a direct focus for the RRI, several of our members are collaborating with other researchers to respond to the world-wide research effort aimed at finding solutions to COVID-19. This has included establishing biobanks which will give insights into susceptibility and immunity (including in pregnant women and infants), trialling existing vaccines, combining our epidemiological and mechanistic understanding of the virus to identify pharmaceuticals for potential repurposing, and supporting adaption of low-cost ventilators used in animal studies for application in low-resource settings.

The Institute provided input to the SA Productivity Commission Inquiry into Health and Medical Research in South Australia. The Inquiry examined the performance of health and medical research, including trends in grant funding, research output and activity, research collaborations and commercialisation. This was an important opportunity to shape the future of health and medical research in our State and we look forward to the outcomes.

Our world-class researchers, with our key stakeholders and research partners, continued to excel in 2020, progressing research with a focus on healthy children from the start. With the significant changes to the NHMRC schemes in recent years, it was pleasing to see $11.1M awarded to RRI researchers through the relatively new NHMRC Investigator and Ideas grants programs. In particular, the award of just over $3M through three Ideas grants to RRI mid-career researchers was a great achievement. These researchers and their projects had all been supported by RRI's funding programs, indicating their instrumental value to facilitating this level of national competitiveness.

RRI researchers were also awarded $8.5M from the Medical Research Future Fund (MRFF) through five projects, demonstrating the value of specific University and RRI support to undertake research that addresses the priorities of the MRFF. The MRFF represents a significant step change in national health and medical research funding and achieving translational impact. The Commonwealth Government is to be congratulated on the introduction of the MRFF and achieving its full capitalisation.

Clockwise from top left: Professor Brandon Wainwright, Professor Sarah Robertson and Professor Anton Middelberg

Other key achievements in 2020 include The University of Adelaide again scoring Lead Institution in Australia in Reproductive Health in The Australian newspaper's Research 2020 analysis; award of $2.39M funding from the Bill and Melinda Gates Foundation for investigating ovarian targets for novel contraceptives to Professor Darryl Russell; the outcome of the $12M GSK-sponsored B Part Of It Meningococcal B herd immunity study, led by Professor Helen Marshall, being published in the February 2020 edition of the New England Journal of Medicine which has an Impact Factor of 70.67; Professor Mark Hutchinson being elected as President of Science and Technology Australia; and Professor Megan Warin being elected as a Fellow of the Australian Academy of Social Sciences.

Our researchers produced 592 publications, with many outstanding advances. Some notable outcomes were the finding that infertile women have a higher incidence of cardio-metabolic risk factors compared with fertile women; defining epigenetic mechanisms causing fetal growth restriction; uncovering that children of mothers with metabolic syndrome in pregnancy have shorter telomeres (a biomarker of accelerated aging); furthering understanding of 'screen time' and 'green time' on child mental health and wellbeing; and identifying that risk factors for periodontal disease are more pronounced in children and adolescents with type 1 diabetes.

We continue to evolve our comprehensive suite of research support programs to match the needs of our members and the changing research environment. The RRI COVID-19 Research Impact Support program was run during 2020 to provide support to research projects that had been significantly impacted by COVID-related issues. In July, we launched a new initiative to focus on career development for our early and mid-career researchers, particularly towards them achieving independent research fellowship funding. This included a Direction-setting Workshop followed by the start of a Career Development Program, which will also run throughout 2021. Additionally, we ran a Narrative Ninja Workshop in November to demonstrate why narrative counts, and to develop skills in constructing an effective narrative for grant applications.

Professor Jock Findlay retired from the Institute's Advisory Board in 2020. Jock joined the Board in 2012 and had been Chair since February 2014. He has displayed unwavering support and commitment over this almost 8-year period and we are sincerely thankful for his guidance and expertise. Professor Brandon Wainwright, who recently completed 14 years as Director at the University of Queensland's Institute of Molecular Bioscience, has stepped into the role as Chair of the RRI Advisory Board and brings great insight and experience with him.

We are continually thankful to the RRI's Advisory Board, Executive Committee, Early and Mid-Career Researchers' Council, professional services team, and our highly-valued members for their hard work and perseverance. Together we are making a difference to improve the health and wellbeing of families in Australia and around the world.

Professor Brandon Wainwright,
Chair of the Advisory Board
Professor Sarah Robertson, Director
Professor Anton Middelberg, Deputy Vice-Chancellor (Research)

RESEARCH THEMES

FERTILITY AND CONCEPTION

Conception is the foundation event for each new life. Every child's development, growth trajectory and health throughout life is set in motion at the moment the embryo is formed.

Biological and social factors influence the events that facilitate (or interfere with) healthy conception. These factors ultimately determine not only whether pregnancy can commence, but also the progression of pregnancy, the growth of the fetus in utero and the health of the infant after birth.

Achieving a healthy natural conception is a challenge for many people; infertility impacts 1 in 6 couples, and 1 in 25 children are conceived by IVF. The reasons for infertility are often not easily identifiable, but age, health conditions and lifestyle factors are major contributors in both men and women.

The Robinson Research Institute is:

- Expanding knowledge of the molecular and cellular biology of each phase of the reproductive cycle
- Understanding developmental programming in gametes and embryos
- Understanding the role of the immune system in establishing a healthy pregnancy
- Uncovering the causes of infertility, including health conditions, lifestyle choices, environmental exposures and experiences
- Identifying the factors that couples can modify to improve fertility chances
- Understanding the long-term implications of assisted reproductive technologies
- Empowering individuals to make informed decisions about their fertility, including pre-conception health, positive behavioural changes and alternative options to IVF
- Understanding the mechanisms of diseases that affect reproductive capability, including endometriosis, polycystic ovary syndrome and reproductive cancers
- Development of new non-hormonal contraceptives

Research Advances

- We are progressing research in stem cells into applications that improve IVF outcomes for patients. Prof Mark Nottle and team are developing a new method to isolate and mature embryo stem cells to ultimately create a safer, cheaper, and easier method of IVF that doesn't rely on daily hormonal injections.
- We are improving disease classification for accurate detection and identification. The weakly supervised disease classification and localisation rely on saliency or attention maps that are not specifically trained for localisation, or on region proposals that can't be refined to produce accurate detections. Prof Gustavo Carneiro and Mr Renato Hermoza introduced a new model that combines region proposal and saliency detection to overcome both limitations for weakly supervised disease classification and localisation.
- We are identifying new biomarkers for detecting ovarian cancer at an early stage allowing for treatment. Dr Carmela Ricciardelli, Prof Martin Oehler, and team described for the first time the utility of Annexin A2 as diagnostic and predictive marker in early stage serous ovarian cancer.
- We are increasing the capability of medical imaging by using machine learning to detect key features in images for interpretation. Prof Gustavo Carneiro and Mr Yu Tian propose a new few-shot anomaly detection method based on an encoder trained to maximise the mutual information between feature embeddings and normal images, followed by a few-shot score inference network, trained with a large set of inliers and a substantially smaller set of outliers.
- We are improving methods in deep learning protocols to increase accuracy of artificial intelligence applied to health systems. Prof Gustavo Carneiro is improving deep learning models by studying the roles of confidence calibration (via post-process temperature scaling) and classification uncertainty (computed either from classification entropy or the predicted variance produced by Bayesian methods). Results suggest calibration and uncertainty adjusts classification interpretation and accuracy which improves deep learning models.
- We are identifying the issues for policy translation for breast screening of women with high breast density. A/Prof Wendy Ingman, Dr Pallave Dasari, and team have classified the ethical and legal issues in Australia that are associated with breast density notification policy to assist policy-makers.
- We are improving precision medicine tests that can affect diagnosis of breast cancer in young women and subsequent decisions on best treatment. A/Prof Wendy Ingman, Dr Sarah Bernhardt, and team found the hormones in menstrual cycles in young women can affect the expression of breast cancer biomarkers measured in clinical genomic tests. These tests do not account for the menstrual cycle hormones which affects the treatment decisions for young women demonstrating the need to improve these tests.
- We partner with international societies to develop international guidelines for managing infertility. Prof Rob Norman and the European Society of Human Reproduction and Embryology commenced the guidelines addressing unexplained infertility.
- We are deepening our understanding of hormone receptors, FSHR and LHCGR, associated with ovarian cancer prognosis, metastasis, and survival rates. Dr Ricciardelli, Prof Martin Oehler, and team showed that higher expression of FSHR and LHCGR are associated with early stage, low grade ovarian cancer, and that FSHR and LHCGR expression is reduced in high grade serous ovarian cancer compared to benign ovarian tumours. High grade serous ovarian cancer patients with high FSHR and high LHCGR expression had best survival outcome, whilst patients with low FSHR and low LHCGR had poorest survival outcome. And removing FSHR or LHCGR expression increased invasion of serous ovarian cancer cells.
- We are investigating ways to overcome acquired chemotherapy resistance in ovarian cancer to improve survival rates. Dr Carmela Ricciardelli, Prof Martin Oehler, and team demonstrate the role of ABCA1 in ovarian cancer acquired carboplatin resistance and progression. They found high ABCA1 expression was associated with poor clinical outcome and increased in ovarian cancer cell lines and primary serous ovarian cancer cells following acquired chemotherapy resistance. Developing strategies to inhibit ABCA1 expression has potential to overcome chemotherapy resistance and improve ovarian cancer survival.
- We are identifying new biomarkers for ovarian cancer in the blood as potential screening markers for cancer diagnosis. Dr Carmela Ricciardelli, Prof Martin Oehler, and team identified the novel diagnostic marker junction, plakoglobin, in early ovarian cancer by blood sampling.
- We are improving the prognostic indicators of ovarian cancer to recognise potential for metastatic progression. Dr Carmela Ricciardelli, Prof Martin Oehler, and team found premalignant serous lesions of the female genital tract have metastatic potential. This correlates with the common presentation of invasive serous gynaecological malignancies at advanced stage.
- We are improving IVF outcomes by developing drugs to improve sperm health and, therefore, improve embryo development. Prof Rebecca Robker and team discovered and patented a pharmaceutical compound that can protect sperm from damage due to aging or oxidative stress, and improve embryo development. The technology was sold N-Gene Research Lab Inc. to be progressed for continued research and future clinical trials.
- We have discovered the developmental origins for polycystic ovary syndrome occurs during the fetal stage of life for this adult disease. Prof Ray Rodgers, Menghe Liu, and Dr Katja Hummitzsch showed that PCOS candidate genes are surprisingly not expressed in adult ovaries but rather in the developing fetal ovary. This suggests that PCOS arises early in development and is manifest later in life.
- We are examining the broad genetic basis of causative and accompanying genes that underpin the development of polycystic ovary syndrome. Prof Ray Rodgers, Rafiatu Azumah, and Dr Katja Hummitzsch surveyed the genes that co-regulated with candidate genes of polycystic ovary syndrome and mapped their cellular function. Some genes co-regulated with mitochondria function and others with formation of connective tissue in the ovary. The next step is to identify what disrupts expression of these genes and whether it can lead to PCOS.
- We are finding new methods for non-hormonal contraceptives in women by screening various molecules involved in ovulation. Prof Darryl Russell and team developed a unique screening method which led to the discovery of previously unknown molecular pathways essential for ovulation. These new pathways may yield unique candidate drugs as potentially new contraceptives.
- We are continuing to map the molecular and genetic profiles for various activities in the ovary including ovum maturation and ovulation. Prof Darryl Russel and team established genomics methods for complete profiling of molecular and genome structural responses to hormones that mediate folliculogenesis, oocyte maturation, and ovulation in the ovary.
- We are understanding how epilepsy on GATOR1 gene is functioning. Prof Paul Thomas and team are showing that many putative disease variants for GATOR1 epilepsy are not functionally compromised. They also developed a unique mouse model and show that "second hit" mutations derepress the mTORC pathway causing brain abnormalities.

THE PEOPLE BEHIND THE RESEARCH

DR BECK O'HARA

My main research focus is translating people's experiences of endometriosis into practical solutions to assist with diagnosis and management of the condition.

I worked for 10 years in chronic disease research, health policy and health promotion before undertaking my PhD at Monash University. When I was considering a PhD, I wanted to work in an area that focused on Women's Health, that included rural and remote populations and where I could have an impact on the day to day lives of people in the community. I was interested in endometriosis as I had volunteered with some of the endometriosis associations in Australia, found that it takes many years to be diagnosed with the condition and there remained many unanswered questions about this disease.

When investigating this topic, I saw many similarities between managing this disease and managing other chronic diseases. It built on my 10-year research career in chronic disease research, health policy and health promotion.

My PhD and postdoctoral work focus on understanding the key challenges for people affected by endometriosis and identifying areas of unmet need. As part of this PhD, I completed a policy review which established that endometriosis meets the criteria of chronic disease in Australian policy documents, investigated the role of self-management in the literature, undertook a national survey (n=620) and conducted interviews with the community.

Since completing my PhD and moving to Adelaide to join the Robinson Research Institute I have been coordinating a national platform to support people affected by endometriosis. This project is co-created with the endometriosis community including researchers, people with the condition, Australian endometriosis associations and clinicians. It aims to provide a central place for endometriosis information, strategies to help people manage the disease and opportunities to engage in research.

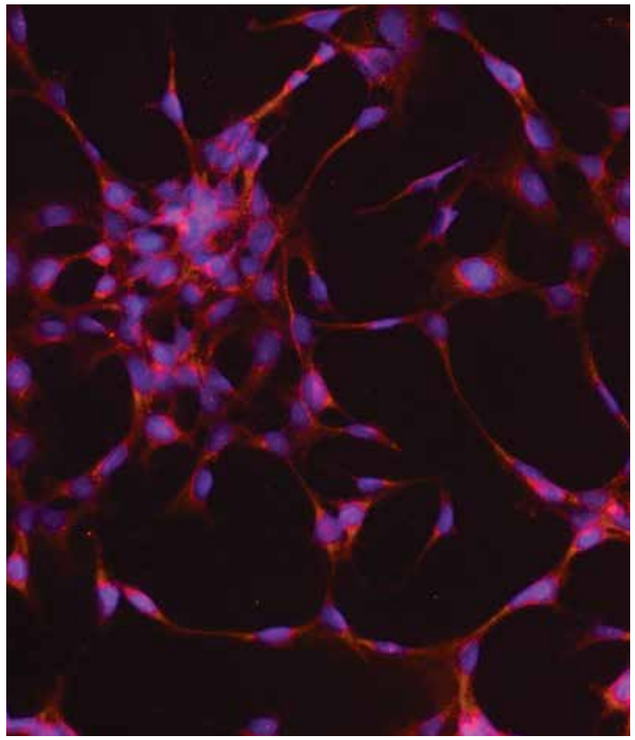
My vision is to continue to translate people's experiences with endometriosis into practical solutions to give people the tools to manage their disease and improve their quality of life. I would like to see a reduction in the time to diagnosis (currently 6.4 years in Australia). I'm also collaborating on a project which aims to develop a less invasive means to diagnose endometriosis (currently diagnosis is made through surgery). The project uses MRI and ultrasound images with AI technology which aims to reduce the delay to diagnosis.

RESEARCH THEMES

PREGNANCY AND BIRTH

Most prospective parents anticipate healthy, problem-free pregnancies. In reality, complications are common, with a quarter of Australian pregnancies affected by one or more of the following conditions: preeclampsia, preterm birth, fetal growth restriction, and gestational diabetes.

Pregnancy complications can have serious life-long health implications for both the mother and her baby; identifying at-risk individuals and administering effective interventions is vital for healthy communitities.



Lipid peroxidation in HTR8/SVneo placenta cells, image provided by Nahal Habibi

THE PEOPLE BEHIND THE RESEARCH

DR JESSICA GRIEGER

I am a nutrition research scientist with a focus on nutrition and metabolic health, both before and during pregnancy, and the impact on a range of reproductive health outcomes including infertility, pregnancy complications, and offspring health.

I have had a love for science from a very young age. I was fascinated by food, what happens in the body, and about our health. I was always intrigued as to how or why people in bigger bodies could be fitter than others in smaller bodies, and why some kids could eat anything they wanted and not gain weight. My continued interest in nutrition led me to complete a bachelor of science degree, and a brilliant honours project combining my key interests of diet and cardiovascular health.

My research journey has always included nutrition as the core component, investigating a broad range of populations, spanning from children to the elderly. My journey has not been without its own obstacles including re-inventing myself multiple times, and really identifying a niche area that I can contribute to. About 7 years ago, it was only by chance that the funding climate led to my transition into reproductive health. In this space, I have developed and led a variety of publications investigating how nutritional intake, both before and during pregnancy, plays a key role for the health of the mother and offspring.

I lead the nutrition, metabolic, and reproductive health group within the RRI. I am an NHMRC funded researcher, and lead a small, highly motivated, research group. We investigate a variety of modifiable exposures, including diet, physical activity, and metabolic health, that influence reproductive health, including infertility, gestational diabetes, and future child health.

Over my career, I hope to make significant contributions to reproductive health by placing improved nutritional intake at the forefront of pre-conception care, to support reproductive success and improve the future health of children.

The Robinson Research Institute is:

- Defining the biological pathways and processes enabling healthy pregnancy and fetal growth
- Understanding the factors and pathophysiological events that lead to pregnancy complications
- Addressing the additional challenges facing disadvantaged communities
- Understanding the maternal immune response to implantation and the immune adaptations allowing placental formation, including vascular supply and nutrient transportation
- Understanding the immune and inflammatory mechanisms controlling the timing of labour, and causing preterm labour
- Identifying the modifiable risk factors that affect pregnancy health
- Developing interventions to measure risk, and prevent or limit pregnancy complications
- Maximising maternal and infant health and well-being after birth
- Educating pregnant women on how to achieve a healthy pregnancy, including diet and lifestyle behaviours and timing of appropriate maternal vaccinations

Research Advances:

- We continue to show the importance of maternal nutrition during pregnancy for health babies. Dr Tina Bianco-Miotto and Dr Nahal Habibi were the first to confirm uptake of micronutrients in the placenta during supplementation in the first trimester. Uptake of micronutrients, like selenium and iodine, reduces oxidative stress in the placenta which increases healthy outcomes during pregnancy.
- We are investigating if interventions in clinical trials are useful for managing weight gain in pregnancy. Prof Jodie Dodd and team found current recommendations for gestational weight gain needs revision in light of evidence from their research. Target ranges defined by BMI categories don't accurately reflect risk of adverse outcomes and there is little evidence that gestational weight gain can be modified by dietary and lifestyle interventions.
- We are deepening our understanding of the immune basis of allergies at the point of birth for babies. Prof Antonio Ferrante, Khalida Perveen, Prof Simon Barry, and team found that low expression of the molecule, PKCz, in cord blood is associated with T cells that mature into cells with predisposition to allergy. However, we show that low PKCz levels are transient and can be overcome by adding omega3 fats to cells which then skews them away from the allergy predisposition.
- We are the first to show there are gastrointestinal changes during pregnancy to allow increased food consumption. Dr Kathy Gatford, Georgia Clarke, and collaborators found that down-regulation of "stretch" signals in the stomach is an important adaptation in the satiety system to permit increased food intake during pregnancy. These results also implicate the rise in maternal growth hormone during pregnancy as a driver of this system.
- We are building evidence for diagnostic guidelines for gestational diabetes, despite the challenges of COVID-19. Prof Bill Hague and team continued to recruit participants for the Treatment of Booking Gestational Diabetes Mellitus clinical trial to determine the validity of diagnostic oral glucose tolerance test in early pregnancy. This research examines if this diagnostic test is appropriate for diagnosing gestational diabetes in early pregnancy, as well as determining whether the gestational diabetes should be treated.
- We are improving our knowledge on how cells function which will improve scientific tools to treat diseases based on cellular dysfunction. Prof Stefan Hiendleder and team discovered that tissue grown from cells that had somatic cell nuclear transfer lacked mitochondrial DNA, which is critical for cell function. This knowledge will improve the technique of somatic cell nuclear transfer to improve protocols for healthy tissue development.
- We know that smoking is a well-known risk factor for poor pregnancy outcomes, but paradoxically, it been linked to lower prevalence of type 1 diabetes in childhood. Dr Mumtaz Begum, A/Prof Lisa Smithers, Dr Catherine Chittleborough, and Dr Rhiannon Pilkington investigated whether this association was causal. They used the Better Evidence Better Outcomes Linked Data platform (led by Prof John Lynch) and found that maternal smoking in pregnancy led to lower childhood type 1 diabetes. Further studies are needed to understand how smoking reduces type 1 diabetes prevalence.
- We are assessing safety and confirming benefits of influenza vaccinations for pregnant women and their infants. Prof Helen Marshall, Hassen Mohammed, and team reaffirmed the safety of influenza vaccination during pregnancy, for mothers, and infants. They also showed maternal influenza vaccination reduces the risk of pre-delivery hospitalisation, and has a protective effect in reducing the rates of low birthweight and small for gestational age births during periods of high influenza activity. The potential benefits of receiving influenza vaccine during pregnancy in improving neonatal health outcomes can be important for countries weighing up the additional benefits of incorporating maternal influenza vaccination programs.
- We continue to reassure expecting women and healthcare providers about the safety of pertussis vaccination during pregnancy. Prof Helen Marshall, Hassen Mohammed, Prof Gus Dekker, and team found the maternal pertussis vaccine for whooping cough is safe to administer at set times during pregnancy. This supports recommendations for pertussis vaccination during pregnancy to prevent morbidity and mortality associated with early-infant pertussis disease.
- We are investigating the role of immune mediators in women with pregnancy loss. Prof Sarah Robertson, Dr John Schjenken, and team investigated microRNAs that are deficient in some women with pregnancy loss, and found miR-155 is a key regulator of immune adaptation to pregnancy. The miR-155 is necessary for enough regulatory T cells, an immune cell, to achieve robust immune tolerance during pregnancy which will protect against the loss of the fetus.
- We are exploring potential new drugs to prevent triggers for early birth. Prof Sarah Robertson, Dr Loretta Chin, and team are working with US collaborators to evaluate the drug, (+)-naltrexone, which inhibits the immune molecule TLR4, for preventing preterm birth. The (+)-naltrexone suppresses the signals from sterile inflammation which are triggered by platelet-activating factor. This novel drug affords potent protection from prematurity and fetal inflammatory injury.
- We are investigating how activation of the maternal immune system contributes to brain development in the fetus. Prof Sarah Robertson, Dr Kerrilyn Diener, and team mimicked viral infection in mid-gestation pregnancy and found elevated inflammation in the fetal brain was linked to autism-like behaviours in adult offspring.
- We are demonstrating the need to effective communicate health messages in antenatal care for pregnant women. A/Prof Alice Rumbold and team found simple messages about preventing and managing diabetes in pregnancy had limited reach with Aboriginal women in the Northern Territory. This research identified the need to redesign maternity and diabetes care to incorporate the cultural and social context of Aboriginal women's lives.
- We are evaluating public health intervention programs for the re-emergence of iodine deficiency in Australia. Dr Jo Zhou and team has highlighted a safety concern related to the concurrent intervention programs demonstrating that the concurrent interventions increased the risk of iodine excess and impaired neurodevelopment of children. This work has led to the call for timely revision of the recommended iodine intake in Australia.

RESEARCH THEMES

EARLY ORIGINS OF HEALTH

The health of every child is profoundly influenced by events in early life.

THE PEOPLE BEHIND THE RESEARCH

DR ZOHRA LASSI

I am an epidemiologist in the Equity & Healthy Futures Group, and am recognised internationally for my research on identifying interventions to improve reproductive, maternal, neonatal, child, and adolescent health and nutrition in low- and middle-income countries, by advancing knowledge in public health practice and translation into global guidelines and policies.

I was born and raised in the world's sixth most populous country in the world, Pakistan - with 65% of its people living in the rural areas and an estimated 21% of the population lives below the poverty line. The country has one of the highest maternal, neonatal, and under-five mortality rates in the world; and most of these deaths occur from preventable causes. The country is facing challenges related to poor health and nutrition and currently struggling with the triple burden of malnutrition. The country is home to 40 million young adults and almost 50% of the population comprises children and adolescents. Therefore, there is a pressing need to improve the health of the younger population as investing in their health will have significant flow-on effects for longer-term outcomes such as maternal, newborn, and child health, growth, and development. The scenario is not very different in other developing countries and growing up in a country with such dire needs inspired me to work on identifying solutions to improve the health and nutrition of children and adolescents particularly in those groups bearing the highest burden of disadvantage and poor health outcomes.

My biggest success is being involved in the work that has underpinned improvements in maternal and child health in developing countries while simultaneously building the capacity to deliver them. Academically, for my first research project and systematic review, I was awarded the Kenneth Warren Prize from the Cochrane for preparing a review of high methodological quality and relevant to health problems in developing countries.

My vision is to improve the health of adolescents and youth by promoting evidence-informed and co-designed service delivery and policymaking across health care and education settings. I want to focus on adolescents and youth because they are in the foundational years of health and human development, and these individuals are the parents of the next generation.

Early life environment determines the trajectory of chronic disease later in life including metabolic and cardiovascular health, immune and reproductive health, and neurological function.

Parental health and well-being prior to conception, during pregnancy and in early postnatal life determines the quality of this crucial early environment – a concept known as developmental programming.

Understanding the mechanisms underlying early life 'programming' is essential for developing effective interventions, in identifying early prognostic markers of risk, and defining optimal parental health and lifestyle.

The Robinson Research Institute is:

- Uncovering the role of factors that affect early development, including: poor nutrition, lack of exercise, obesity, diabetes, infection, shift work and stress
- Developing interventions that can be administered during pregnancy to improve the life-long health of the infant
- Demonstrating that even late preterm babies are at increased risk of impaired neurological function in childhood, and developing effective interventions
- Understanding the early life environments that program asthma and allergy development
- Demonstrating that paternal factors such obesity and age also influence fertility and later child health
- Uncovering the impact of economic and social disadvantage on life-long health
- Utilising our knowledge to inform pregnancy and infant care guidelines and public health policy

Research Advances

- We are linking the early origins of renal disease in adults to restriction of growth in early life. Dr Tina Bianco-Miotto and Amy Doan collaborated with Prof Mary Wlodek, supported by RRI Seed Funding, showing epigenetic enzymes and imprinted genes were altered in the kidneys of growth restricted offspring in mice. These findings suggest that the offspring may be pre-disposed to kidney disease in later life by altered kidney function due to epigenetic mechanisms in kidney development affected in growth-restricted offspring.
- We are continuing our studies on obesity in early life by examining effects of health interventions during pregnancy. Prof Jodie Dodd and team followed children born to women who participated in the LIMIT randomised trial; the LIMIT trial tested antenatal dietary and lifestyle interventions in pregnant women on child outcomes at 3-5 years of age. There is no evidence that an antenatal dietary intervention altered child growth and adiposity at age 3-5 years on more than 1400 children assessed. This cohort of children remains at high risk of obesity, and warrants ongoing follow-up.
- We show early evidence that disrupted sleep patterns mimicking shift work does not adversely affect offspring. A/Prof Kathy Gatford, Prof David Kennaway, and team demonstrated that sleep disruption in experimental-simulated shiftwork in pregnant sheep, there were no adverse effects on the metabolic outcomes of offspring. While this does not raise "red flags" for women doing shift work during pregnancy, we need to confirm impacts in human populations by following up children of shift working mothers.
- We are bringing together stakeholders to inform approaches of genetic research with Indigenous Australians. Prof Megan Warin and team hosted a one-day workshop on Indigenous Epigenetics brought key researchers and stakeholders together to discuss the use of, and implications of epigenetics in Aboriginal and Torres Strait Islander contexts.

RESEARCH THEMES

CHILD AND ADOLESCENT HEALTH

The future health of society depends on the health and wellbeing of our children, as many chronic physical and mental disorders originate in childhood.

There is a clear need to develop safe and effective interventions that can be accessed in early life to prevent life-long conditions.

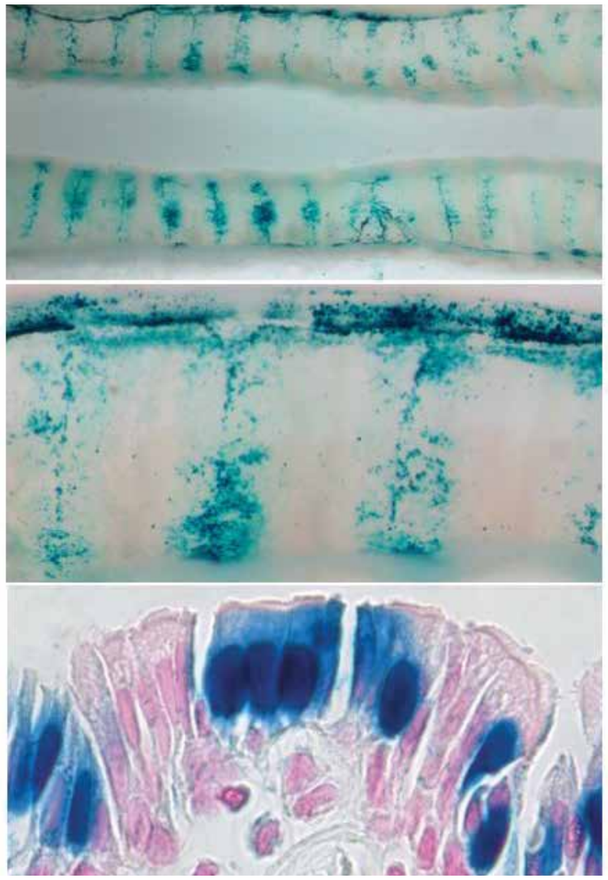
Our members comprise world-leading clinicians and researchers who are working to detect, prevent and treat serious childhood diseases. Collectively we seek to improve the health of infants, children, and adolescents in Australia and around the world.

The Robinson Research Institute is:

- Improving the reach and effectiveness of immunisation programs to prevent serious infections in children
- Advancing better treatments for paediatric conditions including diabetes, sleep and neurological disorders, allergies, joint disease and cystic fibrosis
- Identifying biomarkers to ensure early diagnosis and treatment of autoimmune disease, allergies and asthma
- Defining the genetics of intellectual disability, cerebral palsy, and epilepsy to provide targets for new treatment
- Working to prevent and alleviate childhood diabetes and obesity
- Strengthening the mental health of mothers, young children and adolescents through e-learning programs
- Understanding the serious implications of generational disadvantage and working with Government to comprehensively address these issues
- Running large clinical trials and cohort studies in the areas of obesity, gestational diabetes and type 1 diabetes

Research Advances:

- We increased the genomics capability in South Australia through the establishment of a new Functional Genomics centre. Prof Simon Barry, Dr Jason Gummow, and team, with support by Phenomics Australia and NCRIS, delivered this resource for medical researchers to use high-level genomics to investigate health and disease.
- We streamlined and increased efficiency for studying genomic factors of autoimmune disease to identify target genes for therapy. Prof Simon Barry, Dr Jimmy Breen, and team identified a novel gene as a potential therapeutic target in autoimmune disease by developing a bioinformatic pipeline to assess the impact of genetic risk.
- We are identifying genetic factors behind immune responses against viruses. Prof Simon Barry, Soon Wei Wong, and Dr Cheryl Brown are investigating how ZEB2 gene can improve fitness and responsiveness of T lymphocytes, an important immune cell that fights viruses.
- We joined research efforts against COVID-19 by recruiting South Australian patients recovering from COVID-19 to investigate its long-term effects. Prof Simon Barry, Dr Christopher Hope, and team are mapping the differences in biological samples from mild, moderate, and severe COVID-19 to understand long-term effects, and immune factors to predict the efficacy of vaccinations in patients.
- We identified a new gene that regulate the activity of cells in the human immune system. Prof Simon Barry, Dr Cheryl Brown, and team found the JAZf1 gene is important for the metabolic activity for regulatory T lymphocytes, a subset of immune cells that controls the activity of the immune response.
- We are leading research in diabetes and heart disease for children and adults. Prof Jenny Couper is leading the Australasian Diabetes Data Base across 10 centres to analyse and define how diabetes affects the risk of cardiovascular disease in children and adults with type 1 diabetes.
- We are increasing South Australian access to clinical trials for new drugs in diabetes. Prof Jenny Couper has established WCHN Diabetes Centre as the South Australian site for the Australian BANDIT trial. The BANDIT trial is examining if baricitinib, a new drug, helps type 1 diabetic patients extend their production of insulin.
- We are finding how type 1 diabetes is affected by dental health in children. Prof Jenny Couper, A/Prof Alexia Pena, and collaborators are the first to show that early periodontal disease and oral microbiota is related to glycaemic control in children with type 1 diabetes.
- We responded rapidly to the COVID-19 pandemic by changing research operations to COVID-safe practices and ensures The Environmental Determinants of Islet Autoimmunity (ENDIA) Study into type 1 diabetes continues. Prof Jenny Couper and ENDIA Project Management Team rapidly modified ENDIA protocols to ensure the study visits continued during the COVID-19 pandemic. Consequently there were no appreciable drops in the number of study visits with ongoing biospecimen collection. Therefore ENDIA has a valuable longitudinal biobank that will span the pre-, inter- and post-pandemic environment.
- We are progressing gene therapy research into cystic fibrosis to develop new therapies. Prof David Parsons, Alexandra McCarron, and Dr Martin Donnelley have developed a novel method of dramatically increasing gene expression levels in the lung, and lodged a provisional patent in late 2020.
- We are identifying new molecules as potential diagnostic targets for inflammatory diseases and cancer. Prof Antonio Ferrante, Annabelle Small, and team are investigating the Complement Receptor Immunoglobulin, a poorly understood immune molecule that clears bacteria. We have discovered that this molecule is expressed by neutrophils, an immune cell, when it's activated during inflammation. This suggests Complement Receptor Immunoglobulin has a greater role during infection, inflammatory diseases, and cancer.
- We are continuing to investigate the genetic basis for speech and language disorders in children. Prof Jozef Gecz and Dr Lachlan Jolly discovered a mutation in the UPF3B gene causes these disorders and that this mutation is part of a large networks of genes essential for controlling healthy brain development.



The CF Airway Research Group established a novel technique that substantially increases the effectiveness of airway gene therapy. ***Top and Middle:*** *The presence of numerous blue-coloured dots in rat airways indicates highly effective gene delivery.* ***Bottom:*** *The desired airway cell types have been successfully targeted with this new method*

THE PEOPLE BEHIND THE RESEARCH

DR CATHERINE CHITTLEBOROUGH

I'm an epidemiologist with the BetterStart Child Health and Development Research Group. My research focus is on how we can improve health, development, and educational outcomes for children who have not had the opportunity for the best start in life. I am very fortunate to be able to use the Better Evidence Better Outcomes Linked Data (BEBOLD) platform in my research. BEBOLD holds de-identified administrative data for all children (~500,000) born in South Australia since 1991, and their parents and carers. It contains data from health, education, welfare and social services, including child protection, youth justice and Centrelink. In public health we are always focused on a population-based view of the world, but it's rare that we ever have data on whole populations like this.

Witnessing extreme poverty while living in East Africa for two years when I was preschool age was formative for my sense of social justice.

Working with de-identified population-level data, where we are interested in observing patterns across different groups of children, it's important to remind ourselves every now and then that these patterns represent the lived experiences of real children. The recent increasing focus of my research on children in contact with the child protection system coincided with a discovery that I had a personal connection with the child protection system. My mum was investigating her ancestry and had tracked down the will of her great-grandfather, who was a successful businessman in Adelaide in the late 1800s-early 1900s. In that will mum discovered that some of her great-grandfather's estate went towards the upkeep of her father (my grandfather) who was under the care of the child protection system from age 11 to 18. Mum had some understanding that her father was looked after by a family other than his parents, but none of us had known any of the details. A Provision of Information Request gave us access to documents that revealed many details of my grandfather's life in care. In his case, it appeared that he was given a better chance at life in this system than he would have had if cared for by his mother. I know from our data that 1 in 4 children have been notified to child protection by the age of 10, but I had no idea that one of those children many years ago was my grandfather. It was a bit like an episode of "Who Do You Think You Are", but the discovery has provided renewed inspiration for my research. It confirmed for me that aiming to better understand who the children are in the child protection system, how and why they get there, what happens to them in their life, and what we can do to improve their outcomes, is worthwhile.

There are some grant successes and publications, but it is also exciting when we see the impact we have on policy and practice and the way people view the world. Analysing and interpreting data for our government partners in a way that they've not previously been able to do, and that helps them better understand how to provide services to their populations is very motivating. A large part of my academic role is teaching undergraduate students, and my experiences and expertise as an epidemiologist is fundamental to providing them with an authentic learning experience. Transforming their view of health from a biological, individual, treatment focus, to a public health, population-based, preventive perspective, or expanding their knowledge of determinants of health so that they understand that there are many influences on health that are beyond the control of the individual, is very rewarding.

- We are better understanding how genes affect childhood learning and memory which affects early child development. Prof Jozef Gecz and Dr Lachlan Jolly identified several mutations in a gene called USP9X which causes a new syndrome in childhood learning and memory affecting boys and girls in different ways. This discovery has improved the diagnosis for this rare syndrome which gives more information to families with disorders in early life development.
- We are continuing to lead and collaborate with international partners to understand the genetic basis of cerebral palsy. Prof Jozef Gecz co-leads an international team to study 250 children with cerebral palsy and their parents to understand the contribution of genetics variants to cerebral palsy.
- We continue to work with international consortia for deep studies to understand genetic causes of autism. Prof Jozef Gecz as part of the Autism Spectrum Intellectual Disability Consortium studied 16,294 patients with neurodisability and identified 48 genes with genome-wide significant burden of mutations.
- We are learning about the origins of breast cancer by understanding the factors for breast development in young girls during puberty. A/Prof Wendy Ingman, Amita Ghadge, Dr Pallave Dasari, and team identified puberty as a critical life stage where adult breast density and the associated risk of cancer is established.
- We are finding that early origins of vascular health can be traced to sleep disorders in childhood. Prof Declan Kennedy and Dr Anna Kontos showed children with sleep disordered breathing have increased clumping of platelets, a marker of vascular damage, compared to children in the control group. This suggests children with sleep disordered breathing may develop poor vascular health consistent with early vascular ageing.
- We show there are links between vascular health and poor sleeping patterns in children. Prof Declan Kennedy, Dr Anna Kontos, and Priscilla Vokolos showed that children with sleep disordered breathing and increased blood flow velocity, a marker of increased vascular resistance, have thicker arteries. This suggests sleep disordered breathing in children has negative effects on vascular development in children affecting their health as adults.
- We are finding poor lung function is affected by children suffering from sleep disordered breathing and poor vascular development. Prof Declan Kennedy, Dr Anna Kontos, and Victoria Christanthopoulos showed children with sleep disordered breathing, increased blood flow velocity, and arterial thickness have abnormal muscle fibres and increased muscular thickness in the pharynx. This abnormal muscle development in the upper airway may predispose these children to increased airway collapse during sleep.
- We are taking research out of universities and to government to prevent child abuse and neglect. Prof John Lynch, Dr Rhiannon Pilkington, and team worked with the Department for Human Services and Department for Child Protection to showcase their research to stakeholders in government, non-government, community, and academia to discuss the infrastructure needed to support a public health approach to preventing child abuse and neglect.
- We are promoting the translation of research to clinical practice. Prof John Lynch and Dr Mi Du applied machine learning algorithms to predict the survival of patients with oral and pharyngeal cancers, and developed an online calculator to estimate the survival probability for patients.
- We are improving methods in measurements and models which are essential tools for medical research. Prof John Lynch and Dr Murthy Mittinty developed a new method to improve the estimate mediation effect when the mediator is measured over time (longitudinally measure). Moreover this new natural effects models does not require any special software and existing software can be used.
- We are analysing the use of emergency services by children in all public hospitals in South Australia. Prof John Lynch, Alexandra Procter, and team are the first to quantify and characterise frequent users of paediatric emergency department of public hospitals. They found that frequent presenters were more likely, than non-frequent presenters, to present with an injury/poisoning or a chronic health condition, and were characterised by higher levels of socio-economic and health disadvantage at birth.
- We are identifying the most important time in early life to invest in educational activities for best developmental outcomes. Prof John Lynch, Dr Angela Gialamas, and team created a novel analytical approach using educational data to determine which time investment in the first five years of life mattered most for children's outcomes at school. We are the first to show that, relative to other time investments, time spent on educational activities at 2–3 years of age was the most important time investment for developmental outcomes at school entry.
- We are expanding knowledge about the genetic basis of cerebral palsy and continuing to reveal that the basis of this disease is not associated with 'incidents' at birth. Our Cerebral Palsy Research Team continues to discover increasing numbers of causative genetic variations in its large cerebral palsy patient cohort. E/Prof Alastair MacLennan, Prof Jozef Gecz, and team created a paradigm shift internationally in the understanding of the causes of cerebral palsy away from the common assumption of "birth asphyxia" to a genetic or epigenetic cause.
- We are tracking the impact of the national rotavirus vaccine program on rotavirus hospitalisations in young children. Prof Helen Marshall, Michelle Clarke, and team found the rotavirus vaccine reduces hospitalisations and severe gastroenteritis in young children.
- We are continuing our clinical trials to assess effects of influenza vaccines. Prof Helen Marshall, Michelle Clarke, and team completed recruitment of 44 adolescents into the FLUTE study to investigate any impact of obesity on influenza vaccine responses.
- We are tracking the carriage of N.meningiditis, the disease-causing bacteria, in high school students after vaccination with the 4CMenB in the B Part of it Study. Prof Helen Marshall, Dr Bing Wang, and team found from this randomised clinical trial there was no reduction in N. meningitidis carriage density in 4CMenB vaccinated students compared to unvaccinated students 12 months post vaccination. The lack of effect of 4CMenB on carriage of disease-causing meningococci emphasizes the need for direct protection of those at highest risk for meningococcal disease.
- We are tracing the effectiveness of Bexsero, the meningococcal group B vaccine, for preventing invasive meningococcal disease in over 30,500 high school students for the B Part of it Study. Prof Helen Marshall, Dr Bing Wang, and team compared the number of cases of serogroup B invasive meningococcal disease in B Part of it Study versus 4CMenB vaccination trial 14 years earlier. They found approximately 15 less serogroup B cases in the post vaccination period than the number of predicted cases for Bexsero vaccine. This study provides the first real world evidence that the Bexsero vaccine provides good protection for adolescents. In South Australia, meningococcal B immunisation programs for children and adolescents based on direct protection are continuing.
- We show how early origins of intellectual disability is when the fetal brain responds to altered gene function early in development leading to the changes that present during postnatal life. A/Prof Cheryl Shoubridge and team is trialling treatment of a genetic mouse modelling intellectual disability and seizures with neurosteroids that reduces the frequency and severity of seizures. This approach identifies the molecular pathways that contribute to overlapping phenotypes of intellectual disability, seizures and neuropsychiatric disorders.

PhD students, Nahal Habibi and Amy Garrett

TRANSLATING FINDINGS THROUGH COLLABORATION

Our members collaborate extensively with researchers and stakeholders, both locally and internationally, to translate research findings into improved care.

CLINICIANS

Many RRI Members are clinicians, and we collaborate with fertility clinics, hospitals, and other primary health organisations.

PEAK BODIES

We advocate for the importance of our research through memberships and partnerships with peak bodies including AAMRI and PSANZ.

NOT-FOR-PROFITS

We partner with not-for-profit organisations to support evidence-based impact.

HEALTH CONSUMERS

Collaborating with health consumers ensures our research is relevant and facilitates access to unique perspectives and solutions.

HOSPITALS

Members are embedded within the 5 South Australian public hospitals

INDUSTRY

Research translation is facilitated through industry and pharmaceutical collaborations.

ACADEMIC

Collaborating with researchers at hundreds of institutions across 20+ countries.

GOVERNMENT

Our Members connect with local, state and federal Government on projects to improve the health of the community.

Healthy conception tool added to Medibank Health Support resources

In collaboration with the Victorian Assisted Reproductive Treatment Authority, the Institute developed the *Healthy Conception Tool* to provide more information about fertility and the modifiable changes individuals can make to improve their chances of having a baby – available on the *Your Fertility* website.

In October 2020, Medibank added the web tool to its range of Health Support resources (medibank.com.au/health-support/pregnancy/research/healthy-conception), which is greatly assisting in spreading the message about healthy fertility to a wider audience.. The tool asks questions about people's weight, lifestyle and age as well as other factors which influence fertility, and provides a pdf printout about factors impacting their fertility potential which is a useful starting point for GP and IVF clinician consultations.

The impact of human populations on climate change and biodiversity

Professor Sarah Robertson is involved in an Australian Academy of Science initiative to develop two position statements on *Climate Change and Biodiversity* targeted to government, industry, and the public. This initiative notes the significant impact and negative implications of major fluctuations in human population on critical challenges to humanity.

Machine learning for endometriosis diagnosis

Associate Professor Louise Hull and Professor Gustavo Carneiro have brought together their two areas of expertise (endometriosis and machine learning) to facilitate less invasive and quicker diagnosis for endometriosis. Using a diagnostic dataset as a training sample, a computer program has been built that reads specialist ultrasounds and MRIs to recognise the imaging markers of endometriosis. The project is recruiting for participants for the next phase of the study during 2020 and 2021.

Reproductive Health Australia

Established by Prof Jock Findlay AO (ex Chair of the RRI Advisory Board), Reproductive Health Australia provides a unified voice for Australian researchers in reproduction, advocating directly to the community, opinion leaders, and the Government on behalf of the entire sector. This alliance seeks to make reproductive health a national priority for the economic and social benefit of the nation, leading to improved environmental, agricultural and human health outcomes. The RRI is a founding partner and continues to support this alliance for the benefit of the community.

The Illusion of Evidence-Based Medicine

Professor Jon Jureidini together with Dr Leemon McHenry from California State University, published the book *The Illusion of Evidence-Based Medicine*, which is an exposé of the corruption of medicine by the pharmaceutical industry at every level, from exploiting the vulnerable destitute for drug testing, through manipulation of research data, to disease mongering, and promoting drugs that do more harm than good.

They argue that medicine desperately needs to re-evaluate its relationship with the pharmaceutical industry.

National Guidelines for Endometriosis

Dr Beck O'Hara published the findings from her national survey investigating women's experiences of managing endometriosis in Australia. She determined that there was an average delay of 6.4 years from first symptom presentation to diagnosis. This study has been quoted in the National Clinical Guidelines for Endometriosis.

Cerebral Palsy Genome Sequencing

E/Prof Alastair MacLennan and Prof Jozef Gecz from the Cerebral Palsy Research Group's work has led to the new clinical recommendation that all children with cerebral palsy should have whole genome sequencing as early as possible in life. They have shown that some genomic pathways to cerebral palsy have clinically actionable interventions which have greater chance of success while there is still neural plasticity. Knowledge of a genomic cause also facilitates parental understanding of causation, future family planning and reduces litigation and ineffective therapies.

Novel lung diagnostics and monitoring technology

In 2019 A/Prof David Parsons and Dr Martin Donnelley from the Cystic Fibrosis Airway Research Group, together with the late Dr Tim Kuchel from SAHMRI, successfully acquired funding for new imaging infrastructure, including a 4DMedical Permetium scanner, a Siemens Artis Zee fluoroscope, and a PET-CT being installed at the Gilles Plains Preclinical Imaging and Research Laboratory facility.

The Permetium now enables X-ray Velocimetry lung imaging to be performed in rat and mouse models, giving localised information about airflow within the lungs. The fluoroscopy system has been utilised for a range of lung imaging studies, including for models of acute respiratory distress disorder (ARDS; for modelling COVID-19) and asthma. The PET-CT suite has been constructed, ready for operation in 2021.

Dr Martin Donnelley working with the 4DMedical Permetium scanner

The Discovery Pod

The *Discovery Pod* podcast series is an initiative of The University of Adelaide, where they speak to leading experts about solutions to society's most pressing challenges.

Institute members contributed to two podcasts in 2020, to educate the community on:

- Forget fad diets – what should we be eating, and does this need to change as we get older? Presented by A/Prof Leonie Heilbronn and Dr Jessica Grieger
- The gift of life – how do we build healthy habits today to give the children of tomorrow the best start in life? Presented by Prof Jodie Dodd and Dr Alison Care

Neurodevelopmental Disabilities of the Australian Genomics Health Alliance

Prof Gecz is Chief Investigator and National Lead for the Neurodevelopmental Disabilities of the Australian Genomics Health Alliance, a $25 million 2016-2020 NHMRC Grant to implement genomics into health care. As part of the NDD Flagships Prof Gecz leads, in excess of 350 patients have been investigated and clinical genomics reports issued with diagnostic rates varying between 30% in epileptic encephalopathies, 37% in brain malformations and leukodystrophies, and 47% in intellectual disabilities.

Hypoxia during labour

A/Prof Kathy Gatford and team, in collaboration with colleagues in the School of Animal and Veterinary Sciences at The University of Adelaide, have developed a new approach to improve twin lamb survival adapted from approaches being tested in human babies. Treating twin-bearing Merino ewes with melatonin implants improves survival of their twins, with evidence for neuroprotection of second-born twins who may be exposed to hypoxia during long labours. By supplementing Merino ewes with melatonin during the last half of pregnancy it has been seen to improve the tolerance of prolonged parturition and survival of second-born twin lambs.

Evaluation of Influenza Vaccine

SA Health engaged Prof Helen Marshall's Vaccines and Infectious Diseases Group to conduct an independent evaluation of the distribution of publicly-funded seasonal influenza vaccine in South Australia. The aim was to identify ways to improve timely and efficient distribution of publicly-funded seasonal influenza vaccine in South Australia. 20 recommendations were made with many of these adopted by SA Health to support the roll-out of the 2021 influenza vaccine program.

Dietary Reference Values

Prof Jo Zhou's research in evaluating the impact of iodine public health interventions with her Food, Nutrition and Health group has resulted in her appointment to the NHMRC Iodine Expert Working Group to review the current recommended iodine intake as part of the dietary reference values revision.

SA Maternal Neonatal Gynaecology Community of Practice

The SA Maternal Neonatal Gynaecology Community of Practice (MNGCOP) is representative of a multidisciplinary team of health care clinicians, from metropolitan and country health, working in maternity, neonatal, and gynaecology care who are responsible for developing a sustainable, high quality, equitable state wide perinatal and gynaecology services in South Australia, of which, Prof Sarah Robertson is a member. This sees her research contribute to working towards improved health care for mothers and babies receiving care through the SA Health Service.

Left: Prof Ray Rodgers presenting at the 2020 Symposium

COMMUNITY CONNECTION

We strive to build relationships with advocacy groups, consumers and not-for-profits, to deliver research that is higher quality, meets the needs of the community, and generates translatable outcomes.

Over the last five years we have developed a suite of funding programs, training sessions, and community events, to provide the support and resources our members require to develop new relationships, and further develop existing collaborations. We are pleased to see this resulting in collaborative events and projects.

Lloyd Cox Memorial Lecture

Professor Jonathan Carapetis AM, Director of the Telethon Kid's Institute, and Infectious Diseases Consultant Physician at the Perth Children's Hospital, presented the 6th annual Lloyd Cox Memorial Lecture on the topic: *The New Closing the Gap Agreement - Implications for research*.

This agreement provides an opportunity to address the ongoing disparities between First Nations people and the wider population in Australia in ways that we have failed to do until now, and requires a re-think of everything we do to Close the Gap. Research is no different.

Prof Carapetis laid out how researchers can make a meaningful contribution in light of the new agreement, and highlighted practical examples of successful partnerships between researchers and Indigenous communities and organisations.

RRI Research Symposium

While we had planned for an in-person Symposium, at short notice we successfully switched to an online format. As it turned out, a SA 6 day COVID-19 lockdown was announced while the Symposium was being held! For the third year, the RRI opened its Symposium to stakeholders and health consumers. This event showcased the world leading research and translation activities happening across the Institute, and included the experiences and expertise of two stakeholders in the areas of immunisation at SA Health, and infant mental health.

The program focused on protecting the population from emerging health threats, a healthy start to life, and mental health. Congratulations to Dr Kylie Dunning for receiving the 2020 RRI Director's Award which was presented at the event.

Science Week

National Science Week is an opportunity to reflect on the life-saving work undertaken on our behalf by STEM professionals around the country. In 2020, the majority of these events were held online, rather than in person, including a Q&A hosted by Professor Rachel Ankeny who convenes the *Public Engagement in Science and Technology Adelaide* cluster within The University of Adelaide.

RRI's Professor Frank Grutzner discussed the EchidnaCSI project during this event as an example of how citizen science can be a powerful approach to advance scientific research, public engagement, and education, with the primary goal to produce tangible outcomes for species conservation.

Women's Health Week

As part of *Women's Health Week* in September, the Institute partnered with *Your Fertility* to host a Facebook live event to highlight the importance of preconception health checks. Dr Jessica Grieger and Dr Pallave Dasari discussed the importance of couples thinking about their health when planning a pregnancy, which was viewed by 55,000 people. Dr Jessica Grieger emphasised the need for both women and men to consider their health for a healthy pregnancy, and how this information can be found on the *Healthy Conception tool* on the Your Fertility website - yourfertility.org.au/general-resources/interactive-tools/healthy-conception-tool.

Healthy Development Adelaide

Healthy Development Adelaide (HDA) plays a key role linking research, service delivery, and policy development in South Australia. They aim to promote, facilitate, and enable multidisciplinary research to advance understanding of healthy development, ensuring the physical, psychological, and social health of infants, children, and adolescents.

The Institute was a founding partner in 2004 and has continued to support HDA annually. In 2020 RRI member Dr Anna Kontos was appointed as a new HDA Co-Convenor, representing the Institute. HDA runs a calendar of events, engaging the community, clinicians, researchers, and government.

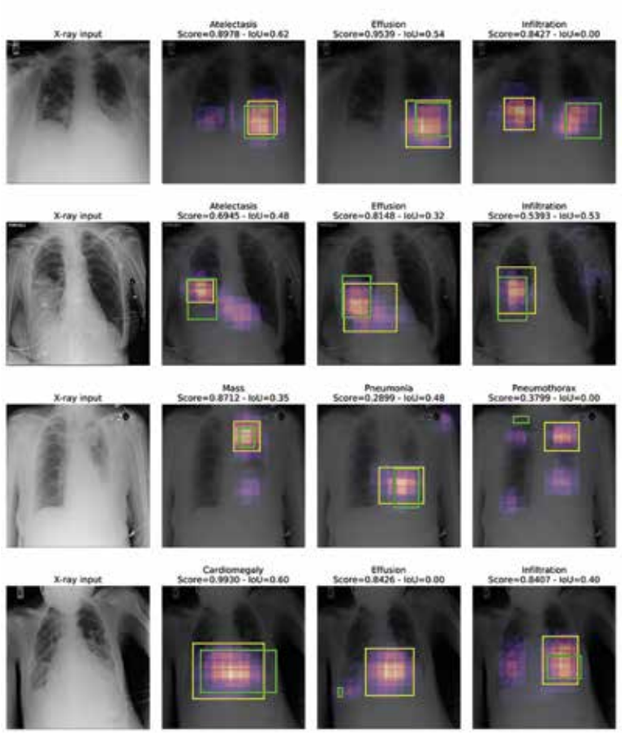
Still Aware Gala Dinner

Still Aware are committed to raising awareness of the very real statistics of stillbirth in Australia, working to end preventable stillbirth. Since 2019, the RRI has been partnering with Still Aware on new and innovative research projects, with a focus on hearing the voices of families who have experienced stillbirth.

In October, RRI hosted a table at the Still Aware Gala Dinner, providing the opportunity to support their important work and hear from those impacted by stillbirth.

ACADEMIC AND HEALTH CARE CONNECTION

Engagement with academic peers and health service delivery is necessary to advance the highest quality research and deliver tangible outcomes for the community.



Automatic multi-label classification and visual biomarker detection from chest X-ray. Each row shows a single case and the diseases shown correspond to the annotated ground truth. Predicted bounding boxes are shown in yellow and ground truth in green. Figure from [Hermoza R, Maicas G, Nascimento JC, Carneiro G. Region Proposals for Saliency Map Refinement for Weakly-Supervised Disease Localisation and Classification. In International Conference on Medical Image Computing and Computer-Assisted Intervention 2020 Oct 4 (pp. 539-549). Springer, Cham.]

Below are some of the events we hosted and supported in 2020.

SA Vaccinology Update

Together with SA Health, the Women's and Children's Hospital, and SAHMRI, the RRI hosted the sixth *SA Vaccinology Update*. This full day event for immunisation providers, doctors, and researchers educates attendees about the latest developments in immunisation research, policy, and programs and is now a highly regarded immunisation conference attracting more than 330 attendees.

For the first time, attendees joined the conference in person and online which opened it up to people from across the country and saw numbers jump significantly from previous years.

Society for the Study of Reproduction

Prof Darryl Russell is on the Board of Directors for the Society for the Study of Reproduction, and chaired the organising committee for the series of virtual symposia in 2020: *Solving Challenges in Contraceptive Discovery and Innovation*. These events were supported by the Bill and Melinda Gates Foundation and held in partnership with the International Society of Endocrinology, attracting approximately 450 registrants.

Attendees from the 2020 ENDIA Symposium

Shine SA

The RRI has an ongoing collaboration with SHINE SA to engage with young people about their support needs to help achieve happy, healthy relationships across their social networks. Sophie Kedzior facilitated several Focus Groups on 'Recipes for Healthy, Positive and Respectful Relationships' as described by adolescents.

AAMRI Membership

The Association of Australian Medical Research Institutes (AAMRI) is the peak body for medical research institutes (MRIs) across Australia; representing through advocacy, information provision, relationship building, and member services. The Institute joined AAMRI in 2016.

In 2020, Professor Sarah Robertson was a Board Member for AAMRI and sat on the panel at the annual convention, discussing *The future of the medical research funding system*.

WCH Co-hosted Grand Rounds

Continuing our collaboration with the Women's and Children's Hospital, the RRI co-hosted a Grand Rounds seminar in 2020: Dr Tom Goddard, Consultant, Paediatric Respiratory and Sleep Medicine, Women's and Children's Hospital – *A tale of two cities – London before and during COVID-19*.

These seminars highlight tangible benefits of research on clinical practice, and facilitate engagement with researchers and clinicians at the Women's and Children's Hospital.

Sponsorship of ASMR

Sponsorship of the ASMR Annual Scientific Meeting provides the opportunity to support the Institute's early career researchers and students in career development. The Institute sponsored the *Robinson Research Institute prize for the best presentation in the field of reproduction, pregnancy or child health*, awarded to RRI Member, Amita Ghadge for her talk *Deposition of adipose tissue during puberty alters mammary cancer risk in adulthood*.

ENDIA Symposium

Around 80 participants attended the 2020 ENDIA symposium in Adelaide, including international guests Prof Marian Rewers from the type 1 diabetes cohort study in the northern hemisphere, TEDDY, Prof Carla Greenbaum Chair of the International Consortia, TrialNet and Helen Murphy, Professor of Medicine (Diabetes and Antenatal Care) at the University of East Anglia and Professor of Women's Health at Kings College London, and funder representatives from JDRF Australia and the Leona M. and Harry B. Helmsley Trust.

For the first time, three families attended to share their experiences of participating in ENDIA. One mother with type 1 diabetes (two weeks away from giving birth to her second participating ENDIA baby), presented at the meeting receiving accolades from those in attendance. Evaluation of the event indicated that consumer involvement should be continued in all future meetings.

The meeting highlighted achievements, outlined the final cohort profile and shared findings to date. Another first for an ENDIA symposium was the inclusion of a "pitch session" where members of the ENDIA team proposed future directions and funding opportunities going forward.

BE INVOLVED WITH THE RRI

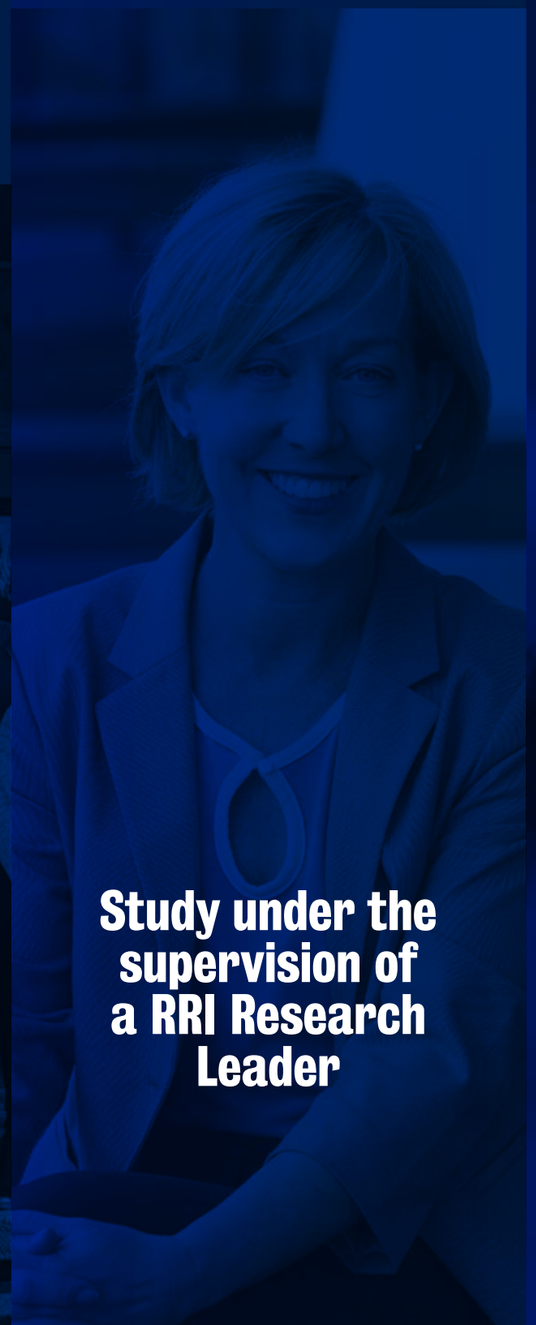
We want to collaborate, partner, and work with the community, businesses, not-for-profits, government, and other groups as much as possible. There are many ways to be involved, please contact us to explore any idea or visit https://www.adelaide.edu.au/robinson-research-institute/be-involved for more information.

robinsonresearch@adelaide.edu.au
+61 8 8313 1342

Discuss potential research collaborations

Participate in our clinical trials

Join the RRI team



Study under the supervision of a RRI Research Leader

Donate to our life-saving research

DIGITAL DEVELOPMENTS

Endometriosis Digital Health Platform

The Robinson Research Institute and Australia's endometriosis community, with the support of the Australian Government and Jean Hailes for Women's Health, are co-creating a web-based platform to empower and support people affected by endometriosis, to make informed and timely decisions regarding their health.

This platform will respond to the needs of the endometriosis community, with a particular emphasis on current unmet needs, and research into how we can better serve those living with the condition. The platform will be co-created with the endometriosis community including the Australian Coalition for Endometriosis (ACE), people with, and those who support people with endometriosis, clinicians, researchers, health informatics specialists, and IT developers.

In 2020, development focused on the consultation phase of the project, seeking to understand the experience of endometriosis from those affected by the disease.

Survival Probability Online Calculator

An online calculator (research only) was provided as part of the publication 'Du M., Haag, D. G., Lynch, J. W., Mittinty, M. N. *Comparison of the Tree-Based Machine Learning Algorithms to Cox Regression in Predicting the Survival of Oral and Pharyngeal Cancers: Analyses Based on SEER Database*. Cancers. 2020;12(10), 2802'. It was developed to estimate the 1-5 year survival probabilities for patients with oral and pharyngeal cancers. This program was written using a R package 'ShinyApp'. The statistical algorithm involved is the Cox proportional hazard regression analysis. Data used to train the model were obtained from an open-access data platform: the Surveillance, Epidemiology, and End Results (SEER). The potential users of this calculator are clinicians, patients, and researchers who are interested. This online calculator is an example of translation of the research outputs to clinical practice.

BEBOLD Platform

The BetterStart Group's BEBOLD project is a whole-of-population linkage study called the *Better Evidence, Better Outcomes, Linked Data platform*. The study uses de-identified linked data from pre-existing government databases for SA children born 1991 onwards, as well as their caring environment (e.g. parents, households).

It is an on-going sustainable platform that receives data updates on a regular basis following approvals by both the Data custodians and Human Research Ethics Committees.

The goal is to improve service delivery across health, education, and human services to support better outcomes for all children and young people, and for disadvantaged populations in particular. The 'joining' up of data across government agencies has offered new opportunities for examining a broad range of outcomes across the life-course. Utilising the BEBOLD platform to work towards this goal has only been possible with the support of government partners who have shared our vision for providing better evidence than has previously been available to inform policy, program and practice decisions.

COMPETITIVE FUNDING HIGHLIGHTS

NHMRC

Investigator Grants commencing in 2020

$2,078,030 to Prof Claire Roberts
Leadership: *Health in pregnancy and beyond*

$1,504,485 to Prof Philippa Middleton
Emerging Leadership: *Implementing nutrition and lifestyle interventions for women, young children and families*

Investigator Grants awarded in 2020

$3,560,520 to Prof Sarah Robertson
Leadership: *Critical determinants of reproductive and pregnancy health*

$1,705,260 to Prof Jodie Dodd
Leadership: *Healthy diet and weight management in pregnancy: evidence to ease a hefty clinical burden.*

Partnership Project commencing in 2020

$1,292,029 to Prof Helen Marshall
Gono B Gone: *Targeted immunisation programs for vulnerable children and young people against serious infectious diseases.*

Ideas Grants commencing in 2020

$935,080 to Prof Paul Thomas
Investigating the molecular pathology for PCDH19-Girls Clustering Epilepsy

Ideas Grants awarded in 2020

$1,629,373 to Prof Jus St John
Understanding the benefits and limitations of metaphase II spindle transfer

$1,266,777 to Dr Kylie Dunning
Novel optical approaches in diagnosing cellular and embryo health

$1,122,760 to Prof Jozef Gecz
A no-nonsense approach to genetic disease

$936,623 to Dr Alison Care
Immune cell dysregulation impairs vascular function in early-onset preeclampsia

$876,030 to Dr Jessica Grieger
Revolutionising personalised nutrition for gestational diabetes

$685,453 to Prof Laura Parry
A sweet therapeutic for vascular disease in pregnancy

Clinical Trial & Cohort Study Grants commencing in 2020

$2,071,936 to A/Prof Michael Stark
The effect of transfusion with washed versus unwashed red blood cells to modify neonatal morbidity and mortality: A randomised trial

PROF SARAH ROBERTSON

"There is a growing need for improved evidence-based therapies that prevent or mitigate immune disorders of reproduction and pregnancy.

This research program will advance knowledge of key immune events in the peri-conception environment that impact fertility, pregnancy outcomes, and offspring health. We will map critical immune mediators and processes operating at or before conception, focusing on both male and female partner contribution. Our findings will advance understanding of the origins of common and important reproductive and obstetric conditions, identify tractable targets for intervention, and progress novel treatments to reduce the incidence and better manage important infertility and pregnancy disorders.

My team and I are recognised internationally as leaders in discovery and translational pregnancy immunology. We have led international efforts to understand how immune tolerance is generated, and how this fails in some couples. Our work has built evidence to show that a lack of immune tolerance is a central deficit and/or pre-disposing factor in recurrent implantation failure and recurrent miscarriage, as well as common obstetric disorders including fetal growth restriction, preeclampsia and preterm birth.

In the long run, I hope this research program will deliver safe and effective immune therapies to assist women at high risk of common fertility and pregnancy disorders."

PROF MICHAEL DAVIES

"Congenital anomalies are, globally, a major cause of mortality in the first year of life and enduring disability. .

In this project we are focusing specifically on congenital heart defects, with the aim being to identify how these defects might be prevented. Such defects affect around 15 children in 1000 and can be life threatening. While surgery can be successful, many heart defects are accompanied by compromised brain development, so prevention is paramount.

The great majority of heart defects are not genetic. Some health problems in the mother, such as diabetes, are known to contribute - but the cause of most heart defects is not known. The combination of impact, frequency, and knowledge gaps makes it a tremendously important target for new research. We will investigate possible roles of other health problems in the mother, certain medications, and different types of treatment for infertility.

We are ideally positioned to conduct this research because we have built a large database corresponding to all births (n=557,000) that occurred in South Australia from 1986 to 2015. De-identified data from a variety of sources has been linked together, so there is information on maternal health, medications, and infertility treatment as well as birth defects reported until children turn 5 years old.

We hope to identify avoidable causes of congenital heart defects. For example, there may be alternatives to some medications that are safer, and low technology infertility treatment may be an option for some couples."

Centre for Research Excellences commencing in 2020

$2,500,000 - Prof Rob Norman AO (Lead CI Prof Teede at Monash University)
Centre for Research Excellence in Health in Preconception and Pregnancy: Prevention of maternal obesity

$2,500,000 - Profs Rob Norman AO and Ray Rodgers (Lead CI Prof Teede at Monash University)
Centre for Research Excellence- Women's Health in Reproductive life

ARC

Awarded in 2020

$812,340 to Prof Frank Grutzner
Discovery Project: *Evolution and function of mammalian sex chromosomes*

Commenced in 2020

- Future Fellowship to Dr Tanya Zivokovic
- Future Fellowship to Prof Gustavo Carneirno
- Discovery Early Career Researcher Fellowship to Dr Catia Malaso

Medical Research Future Fund

$3,235,960 to Prof Jo Zhou
RCRDUN Neurological Disorders: *Iodine supplementation in pregnancy to improve early childhood neurodevelopment: how much is enough?*

$3,041,594 to Prof Michael Davies
Congenital Heart Disease: *Maternally mediated factors and the risk of congenital heart defects in a whole of population cohort*

$2,790,917 to Prof Jodie Dodd
Preventative and Public Health: *The Begin Better randomised trial*

$1,012,420 to A/Prof Leonie Heilbronn
Preventative and Public Health: *Time-Restricted EATing to reduce the risk of developing type 2 diabetes (TREAT).*

$987,208 to A/Prof Lisa Smithers
Preventative and Public Health: *A pragmatic randomised controlled trial to test whether incentives and carbon monoxide monitoring help pregnant women quit smoking*

$675,000 to Dr Branka Grubor-Bauk
Biomedical Translation Bridge: *World-first needle-free zika virus vaccine*

Bill and Melinda Gates Foundation

Commenced in 2020

$2,395,000 to Prof Darryl Russell
Grand Challenge Research Grant: *Non-hormonal contraceptive targets that block the mechanism of ovulation*

FELLOWSHIPS AND AWARDS

Fellowships (awarded or commenced in 2020)

- Barbara Kidman Fellowship: Dr Kylie Dunning
- THRF Mid-career Fellowship: Dr Luke Grzeskowiak
- THRF Mid-career Fellowship: Dr Clare van Eyk

Awards and Prizes

2020 Tall Poppy Science Award
Dr Kylie Dunning

American Society of Criminology Early Career Researcher Award
Dr Catia Malvaso

Australia Day Council of SA and the Office for Women, Inspiring South Australian Women
Prof Helen Marshall

Australian Society for Medical Research
Ross Wishard Award: *Sarah Bernhardt*

Australian Society for Medical Research
RRI Prize: *Amita Ghadge*

Australia New Zealand Obesity Society
ECR Best Oral Presentation – Clinical Stream: *Lijun Zhao*

Healthy Development Adelaide
Women's Excellence in Research Award: *Dr Kylie Dunning*

Society for Reproductive Biology
SRB-RFD Publication of the Year Award: *Dr Vahid Atashgaran*

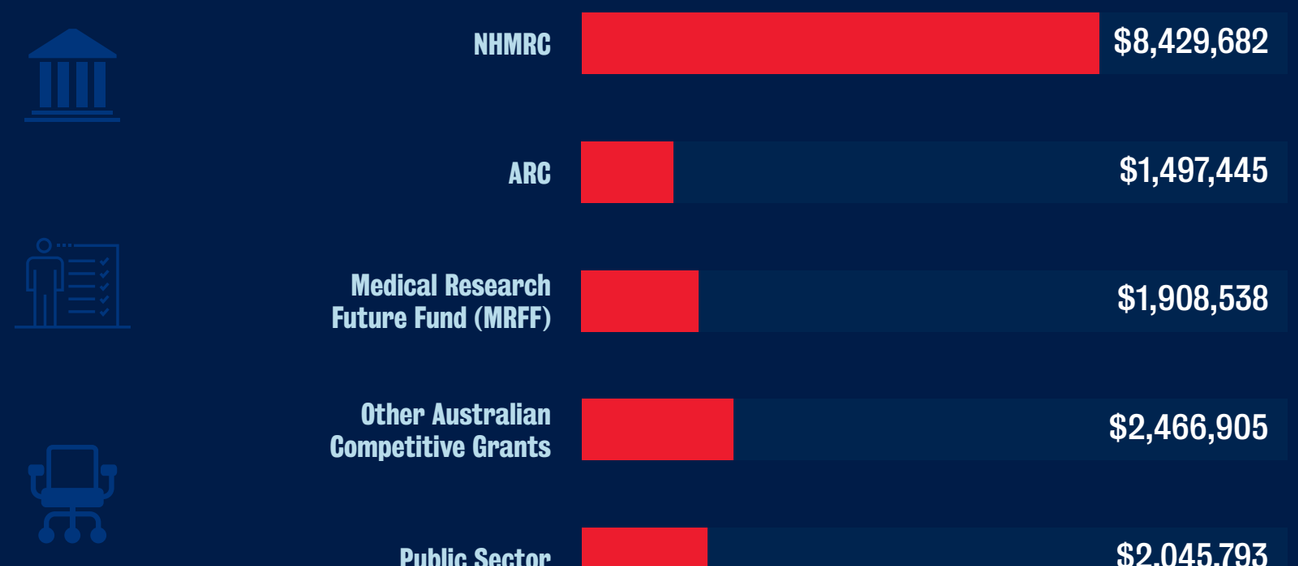
Westpac Scholars Trust
Future Leaders Scholarship: *Shanna Hosking*

Society for the Study of Reproduction
EMCR Presentation Award: *Thao Dinh*

DR ZOHRA LASSI
receives Executive Dean's Award for EMCR Research Excellence in 2020

FINANCIAL SUMMARY 2020

$22,269,135



RESEARCH GROUPS

Our Research Leaders lead a diverse range of groups across the Institute's four themes.

FERTILITY AND CONCEPTION GROUP LEADERS

Prof Gustavo Carneiro
Medical Machine Learning

Developing new machine learning methods to solve medical image analysis problems

Group Members:

PhD Students – Luke Oakden-Rayner, Renato Hermoza, Po Liu, Yu Tian, Fengbei Liu, Michael Mogford, Khan Pham, James Condon, Yuan Zhang, Wenping Du

Prof Frank Grutzner
Comparative Genome Biology

Comparing genetic and epigentic mechanisms in mammalian species to improve our understanding of how human diseases originate

Group Members:

PhD Candidates - Eunice Lee, Filip Paijpach, Tahlia Perry, David Stevens

Affiliated Research Fellow - Peggy Rismiller

Postdoctoral Researcher - Linda Shearwin

Casual Student - Isabella Wilson

Dr Luke Grzeskowiak
Reproductive and Perinatal Pharmacoepidemiology

Evaluating the use, safety, and effectiveness of medications in pregnancy and lactation

Group Members:

PhD Candidates - Anna Fragkoudi, Grace McBride

Senior Research Associate - Gabbie Zizzo

A/Prof Leonie Heilbronn
Obesity and Metabolism

Does when we eat matter in preventing chronic disease?

Group Members:

PhD Candidates - Rajesh Chaudhary, Prashant Regmi, Xiao Ting Teong, Lijun Zhao, Kai Liu, Rasha Charrouf

Posdoctoral Fellows - Amy Hutchison, Bo Liu

A/Prof Louise Hull
Endometriosis

Developing diagnostic and therapeutic tools to treat pelvic pain and infertility caused by endometriosis

Group Members:

Postdoctoral Researchers - John Schjenken, Rebecca O'Hara

PhD Candidates - Kavita Panir, Diksha Sirohi

Visiting Professor - Neil Johnson

PhD students - Faizz Fattah, Kavita Panir

PhD student. Gynaecologist, Laparoscopic Surgeon, Specialist - Susan Evans

Clinical lead and O and G registrar - Sarah Linsthwaite

Research Fellow - Jodie Avery

Prof Mark Hutchinson
Neuroimmunopharmacology Laboratory

Exploring the real time contributions of the brain immune-like cell signalling at the neuroimmune synapse that contribute to behaviour.

Group Members:

Senior ARC Research Fellow - Sanam Mustafa

ARC Research Associate and Industry Engagement Officer - Jacob Thomas

NHMRC Fellow - Alexandra Whittaker

Senior Research Fellow - Daniel Barratt

Research Fellows - Stefan Musulino, Josh Holmes, Juliana Bajic

Lab manager - Josh Woenig

Research Associate - Sam Evans

A/Prof Wendy Ingman
Breast Biology and Cancer

Exploring how the immune system in the breast affects cancer and mastitis susceptibility

Group Members:

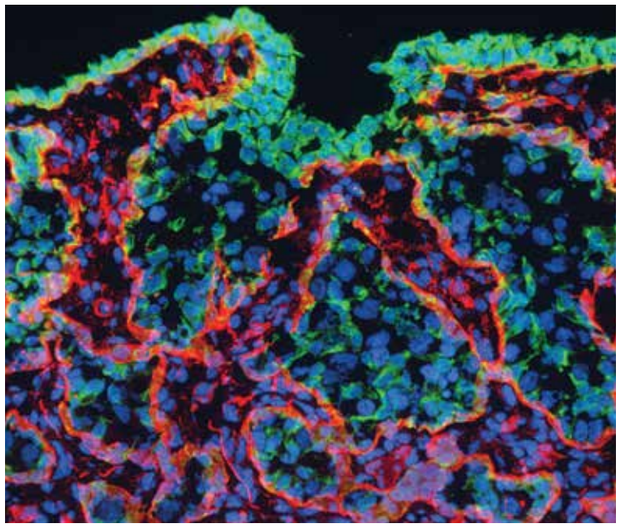
PhD candidates - Maddison Archer, Sarah Bernhardt, Amita Ghadge, Joe Wrin

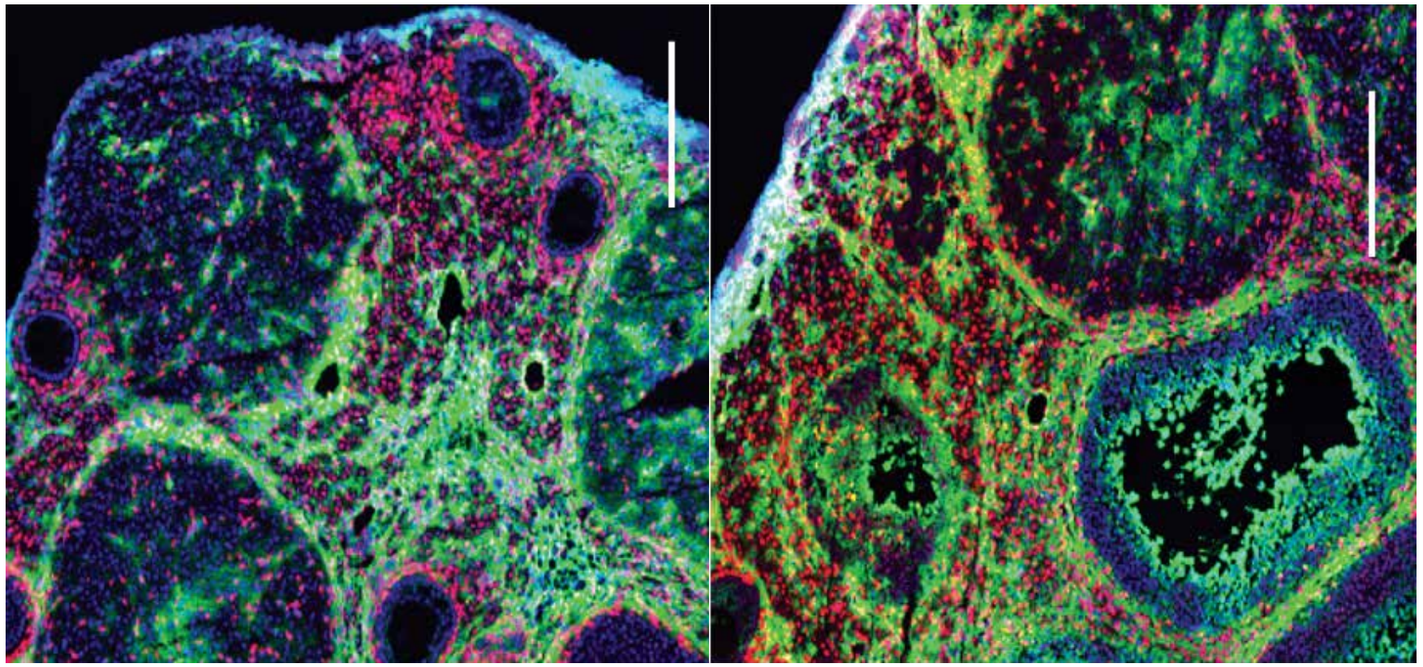
Postdoctoral Researcher - Pallave Dasari

Research Officer - Leigh Hodson

Right: Collage deposition (green) that occurs in the ovary with aging, image provided by Prof Rebecca Robker

Below: The developing fetal ovary. Stroma shown in red has penetrated from the base of the ovary towards the surface located at the top of the picture. The stroma then spreads laterally. This triggers the cells stained green to develop into epithelial cells, thus creating a protective barrier of cells on the surface (J Histochem Cytochem. 2020, 68:113-126)





Prof Rob Norman AO
Reproductive and Endocrine Medicine

Optimising outcomes in fertility treatments and preconception care

Group Members:

Collaborators - Helena Teede, Lisa Moran, Georgina Chambers, Ray Rodgers

A/Prof Mark Nottle
Reproductive Biotechnology

Innovative approaches to regenerative medicine and human IVF

Group Members:

Research Assistant - Stephen McIlfatrick

PhD candidates - Anmol Saini, Annie Whitey

Research Fellow - Ivan Vassilev

Dr Carmela Ricciardelli and Prof Martin Oehler
Reproductive Cancers

Identification of novel biomarkers and therapeutic targets for ovarian cancer

Group Members:

Postdoctoral Researcher - Noor Lokman

Senior Scientist - Anne Macpherson

PhD candidates - Tannith Noye, Zoe Price, Wanqi Wang

Research Assistants - Anita Oehler, Vasiliki June Willett, Victoria Nikitaras

Prof Sarah Robertson
Reproductive Immunology

Understanding how the immune system enables healthy conception and pregnancy and is key in infertility and inflammatory disorders of pregnancy, including preeclampsia, fetal growth restriction and preterm birth

Group Members:

Research Assistants - Bridget Arman, Camilla Dorian, Stephanie O'Hara, Jasmine Wilson, Ricky Matias

Heart Foundation Research Fellow - Alison Care

PhD Candidates - Hon Yeung (Dexter) Chan, Ella Green, Shanna Hosking, Kavita Panir

Postdoctoral Researchers - Peck (Loretta) Chin, John Schjenken, Kerrie Foyle

Senior Postdoctoral Researchers - Lachlan Moldenhauer, David Sharkey

Honours Students - Ashley Chong, Evangeline Lovelll, Hannah Lyons, Jessie Walker

Prof Rebecca Robker
Ovarian Cell Biology

Discovering the biological mechanisms that drive ovulation and early embryo development

Group Members:

Postdoctoral Researchers - Macarena Bermudez Gonzalez, Eryk Andreas

Research Assistant - Haley Connaughton

PhD Candidates - Yasmyn Gordon, David Kennedy, Kirsten Smith

Clinical Research Fellow - Atsushi Morimoto

JSPS Research Fellow - Takashi Umehara

Honours students - Matilda Nicholls, Elisha Williams

Prof Ray Rodgers
Ovarian Developmental Biology

Understanding how the ovary produces oocytes and hormones, what can go wrong, and why

Group Members:

PhD Students - Nicole Bastian, Katrina Copping, Menghe Liu, Rafiatu Azumah, Feng Tang

Research Assistant - Wendy Bonner

Postdoctoral Researcher - Katja Hummitzsch

Prof Darryl Russell
Ovarian and Reproductive Cancer Cell Biology

Defining the molecular mechanisms of hormone control of ovarian folluculogenesis

Group Members:

Research Fellow - Alaknanda Alaknanda

Research Associates - Doan Thao Dinh, Tasman Daish, Tim MvPhee

Prof Jus St. John
Mitochondrial Genetics

Focusing on how the mitochondrial genome is transmitted from the oocyte into the embryo, fetus, and offspring

Group Members:

Postdoctoral Researcher - Takashi Okada

Casual Research Assistants - Alex Penn, Vartan Vartparonian

Prof Paul Thomas
Neural Development

Generation and analysis of mouse models for epilepsy and intellectual disability

Group Members:

PhD Candidate - Chandran Pfitzner

Research Assistants - Sandra Piltz, Melissa White

Postdoctoral Research Fellows - Stefka Tasheva, Fatwa Adikusuma, Alvaro Nieto, Gelshan Godahewa

PhD Student - Luke Gierus

M.Phil Candidate - Ashleigh Geiger

PhD Student - Jayshen Arudkumar

Honours Student - Caleb Lushington

M. Biotech Student - Ya-Han Kang

Prof Jeremy Thompson and Dr Kylie Dunning
Reproductive Success

Understanding the impact of genetic and metabolic disruption to gametes, embryos, and the reproductive tract

Group Members:

Manager and Quality Coordinator - IVF Vet Solutions - Marie Ellul

PhD candidate/Postdoctoral Researchers - Megan Lim, Hanna McLennan

PhD Candidates - Cheow Yuen (Tiffany) Tan, Suliman Yagoub, Darren Chow

Research assistant/PhD Candidate - Annie Whitty

Research assistant - Carl Campugan

PREGNANCY AND BIRTH GROUP LEADERS

Dr Tina Bianco-Miotto

BM Epigenetics Lab

Understanding how all organisms develop so that we can better understand how to maximise a healthy life and reduce the chances of things going wrong.

Group Members:

PhD students - Jacqueline Barsby, Amy Doan, Nahal Habibi

Dr Jimmy Breen

Bioinformatics and Computational Biology

Identifying new analysis techniques for biological datasets

Group Members:

PhD Candidates - Ning Liu, Melanie Smith

Research Assistant - Jacqueline Rehn

Bioinformatics Officer - Alastair Ludington

Dr Alison Care

Vascular Immunology of Pregnancy

Applying a cross-disciplinary approach to better understand the immune and vascular dynamics causing preeclampsia, and to reveal new treatment targets with potential to prevent or reduce the severity of this common pregnancy complication.

Group Members:

PhD students - Shanna Hosking, Holly Groome

Honours Students - Evangeline Lovell, Ashley Chong

Prof Gus Dekker

Placental Development

Implementing screening tests for women in early pregnancy to alleviate major complications of pregnancy

Group Members:

PhD Candidates - Emily Aldridge, Konstantinos Bogias, Julia Dalton, Nahal Habibi, Catherine McCormack, Maleesa Pathirana, Michelle Plummer

Postdoctoral Researchers - Prabha Andraweera, Jessica Grieger

Senior Lecturer - Tina Bianco-Miotto

Research Fellow - Luke Grzeskowiak

Visiting Postdoctoral Researcher - Callista Mulder

Prof Jodie Dodd

Lifelong Health Research

Start early, stay healthy, stop obesity

Group Members:

Clinical Trials Manager - Andrea Deussen

Research Officers - Ashlee Jacobssen, Lavern Kannieappan, Angela Newman, Caroline Sheppard

Senior Statistician - Jennie Louise

Statistician - Jennie Louise

PhD Candidates - Casey Nottage, Cecelia O'Brien, Amanda Poprzeczny, Jago McDonald Van Dam

Research Assistants - Jordan Peters, Jacqui Aikens, Jessica Marathe

Data Manager - Mark Armstrong

Adjunct Fellow - Danielle Schoenaker

Research Midwife - Kerry Curtin

Research Coordinator - Suzette Coat

Research Leader - William Hague

Clinical collaborators - Angela Teh, Bill (William) Jeffries, Jessica Gehlert, Melissa Whalan

Trial collaborators - Michael Stark, Jodie Dodd, Yee Khong, Corey Markus, Maria Fuller, Rob (Robert) Edwards

Prof Bill Hague

Obstetric Medicine

Improving outcomes for pregnant women with medical complications

Group Members:

Research Assistants - Jacqui Aikens, Jessica Marathe

Research Coordinator - Suzette Coat

PhD Candidate - Jago McDonald Van Dam

Clinical collaborators - Angela Te, Bill (William) Jeffries, Jessica Gehlert, Melissa Whalan

Trial collaborator - Michael Stark, Jodie Dodd, Yee Khong, Corey Markus, Maria Fuller, Rob (Robert) Edwards

Statistician - Jennie Louise

Prof Stefan Hiendleder

Epigenetics and Genetics

Understanding epigenetic and genetic mechanisms and programming in prenatal development

Group Members:

PhD Candidates - Hanh Nguyen, Entesar Shuaib, Laura Latimer Marsh

E/Prof Alastair MacLennan AO and Prof Jozef Gecz

Cerebral Palsy

Uncovering the genetic causes of cerebral palsy and understanding the epigenetic interaction with genetic susceptibility

Group Members:

Data Manager - Jesia Berry

Bioinformatician - Jimmy Breen

Postdoctoral Fellow - Mark Corbett

Research Officer - Kelly Harper, Dani Webber

PhD Candidates - Sayaka Kayumi, Nandini Sandran, Urwah Nawaz

Postdoctoral Researcher - Clare Van Eyk

A/Prof Philippa Middleton

Health of Women and Babies

Improving the care of women & babies through evidence-based clinical practice and policy

Group Members:

Clinical Trials Manager - Pat Ashwood

PhD Candidate - Emily Bain

The RRI Cerebral Palsy Research Group celebrating winning The University of Adelaide Award for Best University Team in 2020.

EARLY ORIGINS OF HEALTH GROUP LEADERS

Prof Michael Davies and Prof Vivienne Moore

Life Course and Intergenerational Health

Uncovering how inequalities in the health of women and their children arise through social and biological pathways, and identifying opportunities for change

Group Members:

- Postdoctoral Researchers - Stephanie Champion, Renae Fernandez
- Teaching & Research Academic - Lynne Giles
- Project & Data Manager - Anthea Hutchison
- PhD Candidates - Ash Borqkvist, Tassia Oswald, Anna Roesler, Rachelle Warner
- Statistician - Heather McElroy

A/Prof Kathy Gatford

Early Origins of Health and Disease

Understanding how early life exposures increase risk of adult disease and developing interventions to improve long-term health

Group Members:

- PhD Candidate - Harleen Kaur
- PhD student - Georgia Clarke
- Honours student - Andrea Roff, Joshua Robinson

Prof Lyle Palmer

Machine Learning in Medicine

Discovery of novel biomarkers associated with the diagnosis and prognosis of pathology. Applying deep learning to medical images in order to generate translatable insights into clinical and public health problems.

Group Members:

- Professor of Computer Science - Gustavo Carneiro
- Statistical Analyst - Kelly Hall
- PhD Candidates - Luke Oakden-Rainer, James Condon, Dylan Mordaunt, Alice Krige, Khan Pham
- Medical Student - Kaviya Kalyanasundaram, Medhir Kumawat
- BSc Honours Student - Denghao Wu
- MBBS Honours Student - Tristan Bampton
- Postdoctoral Fellow - Gabriel Maicas
- Physician trainee - Stephen Bacchi
- Registered medical officer - Toby Zerner

A/Prof Alice Rumbold

Equity and Healthy Futures

Improving the lifelong health of women and children by reducing inequality in disadvantaged families

Group Members:

- PhD Candidates - Jessica Dawson, Sophie Kedzior, Anna Ali
- Administrative Assistant - Courtney Hammond
- Postdoctoral Research Fellow - Zohra Lassi
- Senior Research Associate - Gabbie Zizzo

A/Prof Michael Stark

Neonatal Medicine

Ensuring life-long health for newborns born preterm

Group Members:

- Clinical Researcher - Chad Anderson
- Honours Student - Anthea Hall
- PhD Students - Megan Bater, Kathryn Martinello
- PhD Candidate - Tara Crawford
- Consultant Neonatologists - Amy Keir
- Clinical Researcher - Andrew McPhee

Prof Megan Warin

Biosocial Approaches to Health

Examining the biological and social processes that are entangled in the gendered reproduction of bodies, families and environments.

Group Members:

- Researchers - Lucy Farrell, Gabbie Zizzo
- Senior Postdoctoral Researcher - Tanya Zivkovic
- PhD students - Henrietta Byrne, Pallavi Laxmikanth

Dr Jo Zhou

Food, Nutrition and Health

To optimise health through a healthy sustainable diet and lifestyle

Group Members:

- PhD student / RO - Molla Wassie
- PhD students - Jia Zhou, Shaeny Chandra
- Honours student - Angela Li
- RO - Nerrylee Watson

CHILD AND ADOLESCENT HEALTH GROUP LEADERS

Prof Simon Barry

Molecular Immunology

Understanding the molecular basis for immune tolerance

Group Members:

- Postdoctoral Researchers - Veronika Bandara, Chris Hope
- Postdoctoral Research Fellow - Cheryl Brown, Timothy Sadlon
- PhD student - Katherine Brown
- Research Assistants - Batjargal Gundsambuu, Silvana Napoli
- PhD Candidates - Ying Ying Wong, Soon Wei (Vincent) Wong
- Honours Students - Jerry Zhang, Kate Sheperdson
- Masters Students - Holly Withers, Jacqueline Stephens

Prof Jennifer Couper

Diabetes

Preventing type 1 diabetes and its complications

Group Members:

- Project Manager - Mandy Anderson
- Data manager - Pat Ashwood
- Clinical Researcher - Pyria Augustine
- Research Dietitian - Rachel Battersby
- Research Nurses - Sarah Beresford, Alison Gwiazainski, Kirsty Herewane, Meredith Kreig
- Biostatisticians - James Brown, Emma Knight, Helena Oakey
- Senior Administrator - Leanne Cavenett
- Research Officers - Roger Gent, Trung Nguyen, Ben Ramoso
- Masters Student - Myff Geyer
- PhD Candidate - Jessica Harbison
- Biospecimen manager - Dao Huynh
- Enagement Officer - Kelly McGorm
- Clinical Partner - Alexia Pena
- Project Managers - Megan Penno, Rebecca Thomson

Prof Antonio Ferrante

Developmental and Genetic Immunology

Cellular signalling pathways in childhood allergy and inflammatory disorders

Group Members:

- RMIT Master in Laboratory Medicine - Alan McGovern, Sughosh Neupane, Nirvan Ramdhian, Paul Mbevi
- Immunopathologist - Tatijana Banovic
- Senior Scientist - Nick Gorgani
- Principal Scientist - Charles Hii
- Paediatric Immunologist - Jovanka King
- PhD Candidate/postdoctoral scientist - Khalida Parveen
- Senior Scientist/molecular immunology - Alex Quach
- PhD Candidates - David Shields, Yunyu Lao
- PhD Candidate/ GFSc - Annabelle Small
- Diagnostic Scientist - Trishni Putty

Prof Jozef Gecz

Neurogenetics

Investigating the genetics and biology of human neurodevelopmental disabilities

Group Members:

- Research Assistants - Renee Carroll, Alison Gardner, Thessa Kroes, Marie Shaw, Dani Webber
- Postdoctoral Fellows - Mark Corbett, Lachlan Jolly
- PhD Candidates - Rebekah De Nys, Sayaka Kayumi, Kristy Kolc
- Research Officers - Sarah Heron, Raman Sharma
- PhD students - Urwah Nawaz, Rudrarup Bhattacharjee
- Postdoctoral Researchers - Clare Van Eyk, Danielle Mazurkiewicz
- Masters Student - Nandini Sandran

Prof Jon Jureidini

Critical and Ethical Mental Health

Promoting safe, effective and ethical research and practice in mental health

Group Members:

- Affiliate Senior Lecturers - John Walsh, Catalin Tufunaru, Tom Benjamin
- PhD Candidates - Julie Klau, Sheelah Mills
- Postdoctoral fellows - Natalie Aboustate, Melissa Raven

Prof Declan Kennedy

Sleep Disorders

Understanding the morbidity of sleep disorders and their effect on child development

Group Members:

- Medical Scientists - Anna Kontos, Jessica Carlson-Jones
- Head, School of Pschology & Social Policy - Kurt Lushington
- Respiratory Physician - James Martin
- PhD Candidate - Yunyu Lao
- Clinical trial Administrative Assistant - Anthea Hall
- Research Student - Priscilla Vokolos, Nathaneal Yap

Prof John Lynch

BetterStart

Providing children with the best start in life

Group Members:

Senior Lecturer - Catherine Chittleborough

Postdoctoral Researchers - Angela Gialamas, Dandara Haag, Catia Malvaso, Rhiannon Pilkington, Sadia Hossain, Kostas Kapellas, Pedro Henrique Ribeiro Santiago, Naomi Baum

Research Associates - Janet Grant, Alicia Montgomerie, Alexandra Procter

Research Fellow - Clare Hume

Statistician - Murthy Mittinty

Associate Professor Paediatric Public Health - Lisa Smithers

Research Assistants - Kimberly Klassman, Anna Kalamkarian

PhD Candidates - Razlyn Abdul Rahim, Mi Du, Cherise Fletcher

Honours Students - Ben Karnon, Joshua Goddard, Nooria Muradi, Alexandra Walls

PhD Student-Graduates - Mumtaz Begum, Engida Yisma Derbie

Honours Student-Graduate - Jessica Judd

Masters Students - Michaela Magann, Luke Collier, Judy Chu

Senior Research Coordinator - Jacqueline Aldis

Prof Helen Marshall

Vaccines and Infectious Diseases

Optimising protection for babies, children, adolescents, and pregnant women against serious infectious diseases through improved immunisation strategies

Group Members:

Postdoctoral researchers - Prabha Andraweer, Bing Wang

Administrative Assistant - Manasa Arani Krishna

Research Coordinators - Michelle Clarke, Mark McMillan, Kathryn Riley

Clinical Researcher - Sue Evans

Research Nurses - Louise Goodchild, Christine Heath, Mary Walker

Honours Student - Hassen Mohammed

PhD Candidate - Jane Tuckerman

A/Prof David Parsons and Dr Martin Donnelley

Cystic Fibrosis

Development of genetic therapies for treating and preventing cystic fibrosis lung disease, effective lung airway delivery and the non-invasive measurements of their effects.

Group Members:

Administration Assistant - Bernadette Boog

PhD Candidates - Chantelle Carpentieri, Thomas Goddard, Ali McCarron

Postdoctoral Researchers - Patricia Cmielewski, Juliette Delhove, Nigel Farrow, Nathan Rout-Pitt

Research Officer - Nikki Reyne

A/Prof Cheryl Shoubridge

Intellectual Disability Research

Defining molecular and cellular pathways for intellectual disability and seizures, and developing effective interventions

Group Members:

PhD Candidate - Karagh Loring

Research Assistant - Monica Thai

A/Prof Lisa Smithers

Paediatric and Perinatal Epidemiology

Understanding how early life events can influence later health and development.

Group Members:

PhD Students - Mumtaz Begum, Engida Derbie, Cherise Fletcher, Davi Macedo, Pedro Henrique Ribeiro Santiago, Molla Wassie, Briana Poirier

Mbio - Lily Chan

Honours Students - Katherine Lake, Alexandra Walls

Research Assistant - Kate Neadley

MPH Student - Hero Moller

INVESTING IN OUR MEMBERS

To support our members in delivering the highest quality research advances, we run innovative programs, support core facilities, and fund fellowships and scholarships.

Prof Jodie Dodd

INVEST FOR SUCCESS

This program increases competitiveness for external funding by developing highly competitive (but as yet unfunded) project grant applications, into more competitive applications for subsequent submission.

Professor Jodie Dodd was awarded $2.79M in 2020 from the Medical Research Future Fund after participating in Invest for Success for her project *Preventative and Public Health: The Begin Better randomised trial*.

This trial will investigate the effect of a pre-conception weight loss intervention for women with overweight or obesity, to improve pregnancy and birth outcomes. "We have previously shown that pre-pregnancy body mass index above the healthy range is the strongest predictor of child obesity. This study will be the first pre-pregnancy intervention study to follow women into pregnancy and report important pregnancy and birth outcomes.

Participating in the Invest for Success program provided funding to facilitate focus groups with women with overweight and obesity to inform important elements of the weight loss intervention for the Begin Better Randomised Controlled Trial. The participation of consumers in the co-design of clinical research studies provides unique and valuable insights ensuring research is framed, conducted and translated with relevance for end users."

Funding programs

Every year we run and develop programs which best meet the needs of our members in the ever evolving research landscape. Below are the internal programs we ran in 2020, which will be reviewed and refined for 2021 as required.

- **Building on Ideas:** provides support to advance the start-up of a recently submitted NHMRC Ideas Grant application if successful, or strengthen the grant for re-submission for the subsequent round
- **Career Development:** supports the career development of Early and Mid-Career Researchers particularly towards them achieving independent research fellowship funding
- **Co-Creation Workshops:** provides funding to support a workshop designed to identify collectively agreed priority areas of research with key stakeholders and community members, and to form research teams with these groups to facilitate strong research projects and translation
- **COVID-19 Research Impact:** provides funding to maintain critical research capacity, momentum, and outputs within RRI Research Groups that are at risk due to the impacts of the COVID-19 pandemic
- **Engaging Opportunities:** supports the development of new relationships with key stakeholders to jointly address research priorities
- **Exchange Program:** builds collaborations with international researchers to increase research capacity and facilitate access to international funding, databases and expertise
- **High Impact Paper Funding:** encourages publication in High Impact journals with funding available to support the associated costs of publication
- **Innovation Seed Funding:** supports early and mid-career researchers to collaborate across research groups and themes and to explore novel research questions
- **Investigator Grant Near-Miss Funding Program:** supports all levels of NHMRC Investigator Grant applications that were a near-miss, to be developed into more highly competitive applications for resubmission
- **Large Grants Applications:** facilitates the development and preparation of large grant applications i.e. NHMRC; ARC; MRFF; and NIH grants

- **Major Research Initiatives:** supports the planning, engagement, and grant development activities required to build major programs of research that will be led and implemented by RRI Members
- **Mentoring Program:** strengthens networks, builds relationships, develops career pathways, and enhances resumes, providing mutual benefit for both the mentee and mentor
- **Strategic Research Initiatives:** supports strategic initiatives designed to advance the Institute's strategic research agenda
- **Travel Grants:** enables researchers to present and share their research findings at national and international conferences and meetings
- **Visiting Speakers:** funds external research leaders to visit the Institute and encourages collaboration between Institutions

Core Facilities

Adelaide Research Assay Facility (ARAF)
Led by Professor David Kennaway

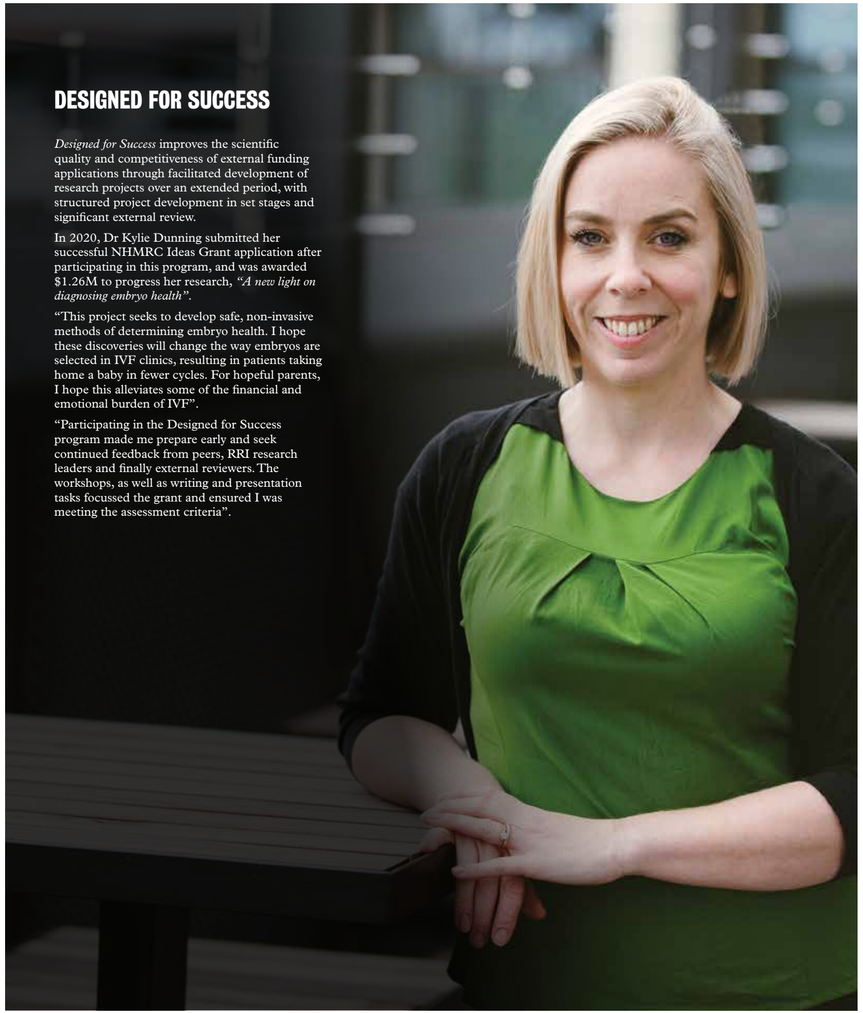
The Adelaide Research Assay Facility provides specialised, high-throughput, and high-sensitivity assays of physiologically important analytes for academic researchers and commercial customers.

Gene Silencing and Expression Facility
Led by Profs Simon Barry and Darryl Russell and managed by Jason Gummow

The Gene Silencing and Expression Facility provides gene manipulation services to Australian researchers in a fully equipped PC2 laboratory. The facility offers custom production of lentiviral, AAV, adenovirus and retroviral vectors, and stock viruses for purchase by the microlitre.

SA Genome Editing Facility (SAGE)
Led by Professor Paul Thomas

The SA Genome Editing Facility uses cutting edge genome editing technology to generate mutant mice for a wide range of applications. Utilising new genome editing technology, the facility offers a number of services including generation of custom knock out, point mutation, conditional and tagged alleles.



DESIGNED FOR SUCCESS

Designed for Success improves the scientific quality and competitiveness of external funding applications through facilitated development of research projects over an extended period, with structured project development in set stages and significant external review.

In 2020, Dr Kylie Dunning submitted her successful NHMRC Ideas Grant application after participating in this program, and was awarded $1.26M to progress her research, *"A new light on diagnosing embryo health"*.

"This project seeks to develop safe, non-invasive methods of determining embryo health. I hope these discoveries will change the way embryos are selected in IVF clinics, resulting in patients taking home a baby in fewer cycles. For hopeful parents, I hope this alleviates some of the financial and emotional burden of IVF".

"Participating in the Designed for Success program made me prepare early and seek continued feedback from peers, RRI research leaders and finally external reviewers. The workshops, as well as writing and presentation tasks focussed the grant and ensured I was meeting the assessment criteria".

2020 Fellowships and Scholarships

Career Development Fellowship

This fellowship funds the salary of 'Emerging Star' early career researchers for one year, supporting their career development to enable competitiveness for a external Fellowships. In 2020 the fellowship was jointly awarded to: Dr Lachlan Jolly for: *Maximising brain developmental potential* and Dr Jessica Grieger for: *Pre- and early pregnancy health and its impact on fertility, and pregnancy and child outcomes*.

Jeffrey Robinson Honours Scholarship

Each year the Institute awards the *Jeffrey Robinson Honours Scholarship* to a top performing student, who commences honours under the supervision of a RRI Member. This scholarship and the Institute are named after Emeritus Professor Jeffrey Robinson CBE.

In 2020, the Institute awarded the *Jeffrey Robinson Honours Scholarship* to Priscilla Vokolos to undertake the honours project *Early vascular aging in children with sleep disordered breathing*, under the supervision of Dr Anna Kontos, Prof Declan Kennedy, and Dr James Martin.

Repromed Reproductive Health Scholarship

The Institute partnered with Repromed in 2016 to establish the *Repromed Reproductive Health Scholarship*. This scholarship is awarded to a top student completing their honours year under the supervision of a RRI Member.

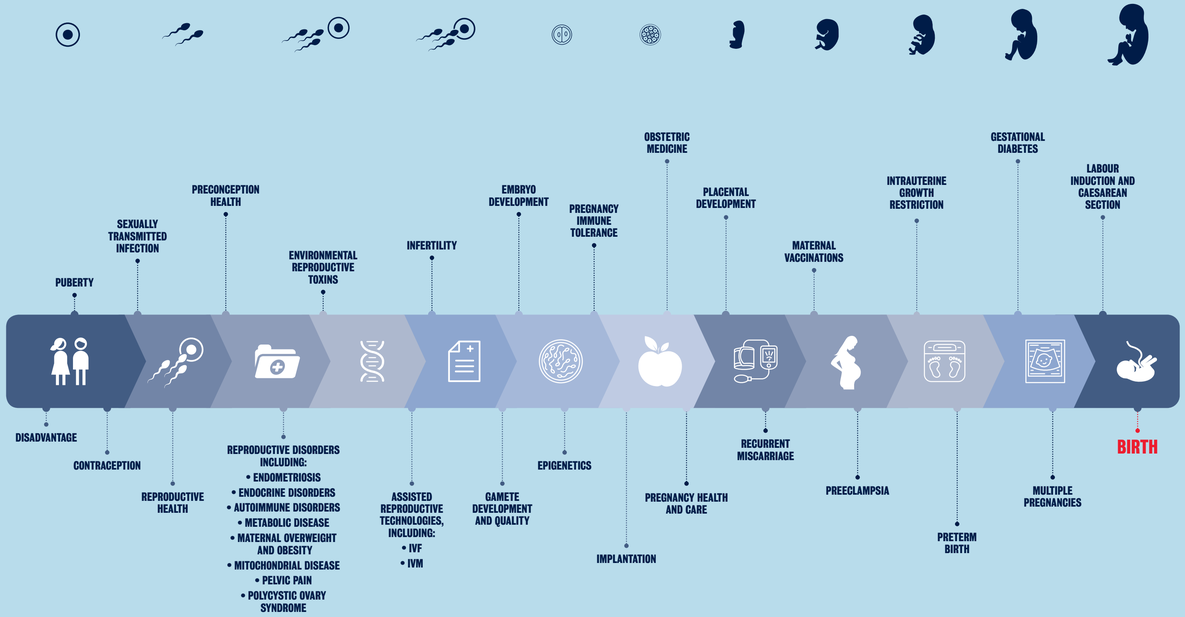
Repromed are a South Australian fertility treatment company offering a complete range of fertility treatments and options. The 2020 recipient of this scholarship was Jessie Walker who progressed her project: *Phenotypic plasticity and lineage stability of Regulatory T Cells during late stage murine pregnancies and IL-1 models of preterm birth* under the supervision of Prof Sarah Robertson.

Summer Research Scholarships

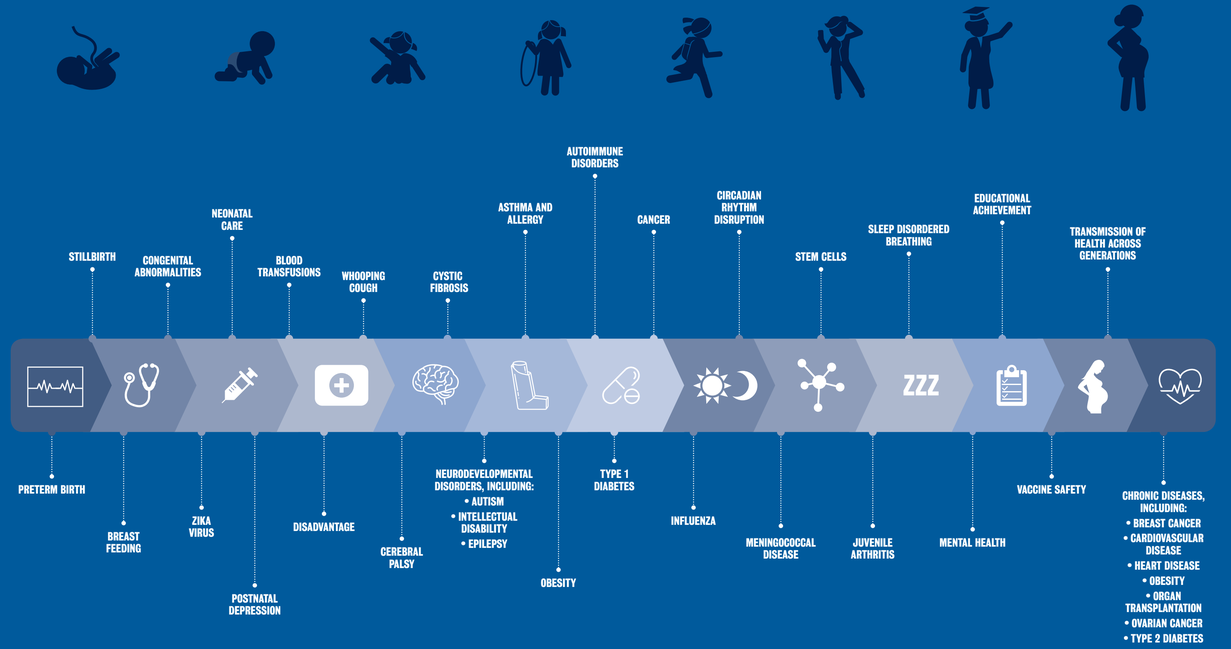
During the 2020/2021 break, the Institute funded two Summer Scholarships. These positions provide an insight into a research career and seek to encourage undergraduate students to consider postgraduate study. The recipients were:

- Lynda Sok, *Demonstrating the effectiveness of airway gene therapy for treatment of cystic fibrosis lung disease*. Supervised by Dr Martin Donnelley and Alexandra McCarron
- Christina Garnaut-Jager, *Improving outcomes for babies of asthmatic mothers*. Supervised by Dr Kathy Gatford

OUR RESEARCHERS ARE ADDRESSING HOW EVENTS BEFORE BIRTH...



SHAPE THE LIFELONG HEALTH OF OUR CHILDREN.



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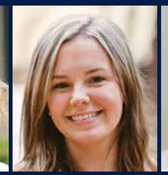
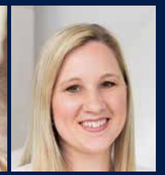
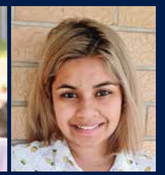

Yasmyn Winstanley


Dr Jessica Grieger


Shanna Hosking


Dr Anna Kontos


Maleesa Pathirana


Dr Nathan Rout-Pitt

REPRESENTATIVE PUBLICATIONS

The following 50 publications (of a total of 592 peer-reviewed primary papers, reviews and book chapters) illustrate the scope and impact of the RRI's research outputs in 2020.

The full list of publications can be found at adelaide.edu.au/robinson-research-institute/research/publications

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PUBLICATIONS

1. Bernhardt, S. M., Dasari, P., Wrin, J., Raymond, W., Edwards, S., Walsh, D., Townsend, A. R., Price, T. J., & Ingman, W. V. (2020). Discordance in 21-gene recurrence scores between paired breast cancer samples is inversely associated with patient age. *Breast Cancer Research, 22*(1).

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FOR FURTHER ENQUIRIES

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