

Annual Report 2019

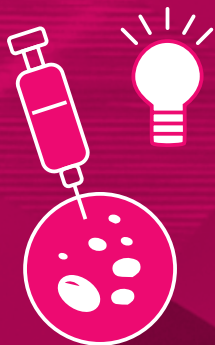
At a glance



296 staff



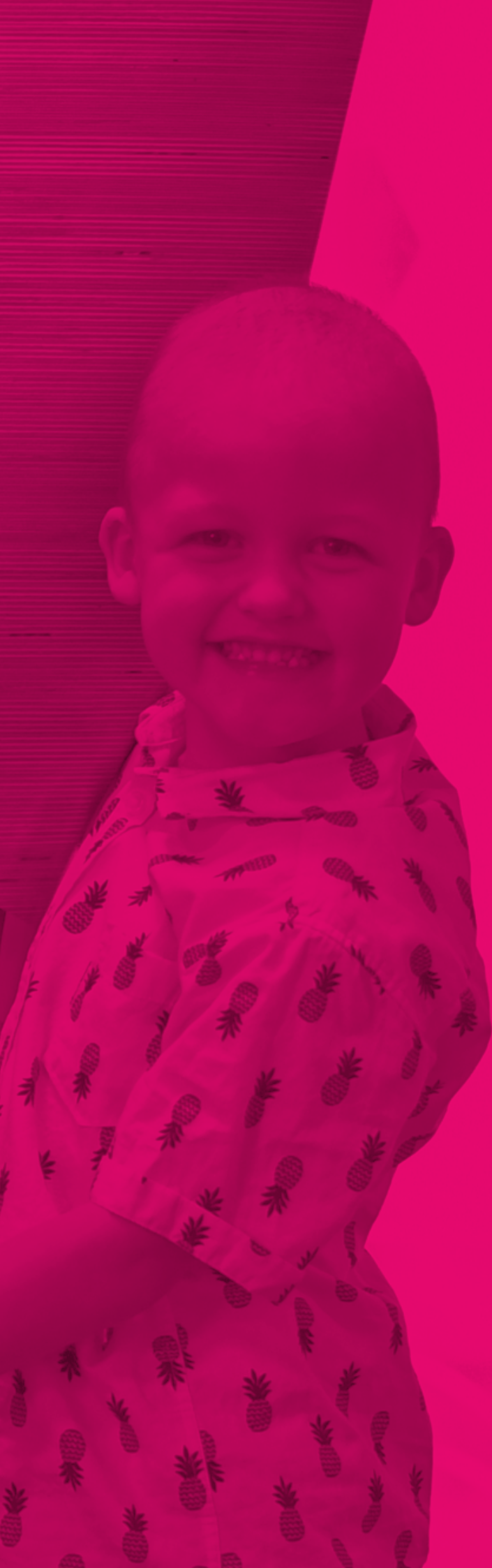
152 students



50 research groups



283 research publications



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About us

Hudson Institute is a leading Australian medical research institute recognised internationally for discovery science and translational research into reproductive health and pregnancy, infant and child health, inflammation and cancer.

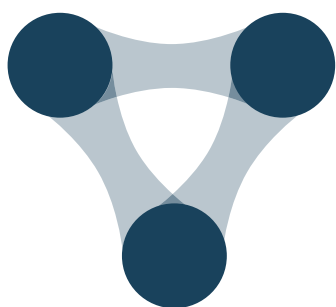
Our institute is home to more than 470 world-class scientists who strive to solve complex problems in human disease. Our close ties with clinicians and industry enable us to translate our discoveries into new preventative approaches, therapies and devices for patients.

Working alongside clinicians in Melbourne hospitals for more than 50 years, Hudson Institute scientists pioneered IVF and stem cell discoveries and are now leading developments in cell therapies, paediatric cancer and the human microbiome. Our worldwide scientific and medical collaborations provide a foundation for transformative healthcare programs across the globe.



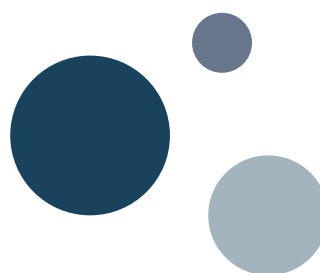
Our themes

We are leaders in four areas of medical need



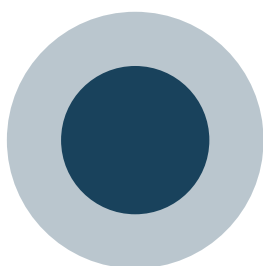
Reproductive health and pregnancy

Addressing the challenges of infertility and complications during pregnancy, and progressing women's health.



Infant and child health

Protecting vulnerable newborns from complications during birth, in the critical early weeks of life and exploring better treatments for childhood diseases.



Inflammation

Exploring how our body responds to infection and tissue damage with inflammation, and using this knowledge to fight infectious diseases, cancer and autoimmune diseases.



Cancer

Investigating the molecular and cellular mechanisms that lead to the development of cancer and how these insights may be used to better diagnose, detect and treat malignancies.



Board Chair's report

2019 was a year of unprecedented growth for Hudson Institute. Alongside significant progress in research discoveries, we continued to cement our position as a national and international leader in reproductive health and pregnancy, infant and child health, inflammation and cancer research.

We achieved outstanding funding success from the National Health and Medical Research Council, with a total of \$21.6 million in grants awarded to Hudson Institute researchers. Our success rate of 21.4 per cent in the Investigator round alone was well above the national average of 13.2 per cent.

This is a testament to the dedication of researchers and support from staff

at the Institute. Congratulations to everyone for their efforts.

We also have our philanthropic partners and donors to thank for their invaluable support of our researchers' work. In particular, the Children's Cancer Foundation for their commitment to Phase II of the Hudson Monash Paediatric Precision Medicine Program, which will expand patient recruitment over the next three years.

Our commercialisation arm provides further unique opportunities for growth and investment in life-saving research. We progressed and established significant industry partnerships across multiple research areas in 2019 and look forward to this continued expansion.

To assist our focus on funding research, the Board has overseen the review and improvement of research administration and business systems to maintain industry best practices in

transparency, probity and compliance—keeping operating costs to a minimum. In addition, our Scientific Support Group have utilised digital enhancements to improve and streamline ethics applications, staff induction and training, grants and contract management, archival management and researcher travel management.

These efforts on operational excellence underpin the research excellence at the Institute.

I thank the Board members for their vision and support, CEO Professor Elizabeth Hartland for her outstanding leadership, and our researchers, clinicians and staff for their commitment to improving health through groundbreaking research.

Dr Bob Edgar AM
Chair



Director's report

Our research is tackling some of the most complex medical challenges to improve human health. Our scientists are at the forefront of discovering new diagnostics and treatments to change the lives of patients everywhere.

Financial support for this groundbreaking research in a rapidly changing landscape is vital. I'm pleased to report we achieved significant NHMRC funding success in 2019—with six Investigator grants, nine Ideas grants and one Synergy grant awarded.

The new Hudson Institute Strategic Plan, 2019–2023, emphasises the value of providing an inspiring environment for our researchers to succeed. As part of this plan, we established the Hudson Institute Emerging Leaders program to provide

our early career researchers with comprehensive leadership training and mentoring. I'm immensely proud of this program and what it will achieve, not only for our talented young researchers, but for the Institute and future healthcare.

The generous support of all our philanthropic partners remains pivotal to our research. We are continuing our program to change the terrible statistics for childhood brain cancer, in partnership with the Children's Cancer Foundation, who committed an additional \$4.9 million for Phase II of the Hudson Monash Paediatric Precision Medicine Program. The Ovarian Cancer Research Foundation raised invaluable funds for our ovarian cancer research programs, and we witnessed the incredible generosity and power of individual fundraising from the Metafit fitness community in support of stomach cancer research.

We continue to drive innovation and ensure our discoveries reach patients, in collaboration with our clinical research partner, Monash Health. I am grateful to them, as well as our industry and philanthropic partners, and I thank our researchers, clinicians and students for their passion and dedication to improving people's lives and the health of our community.

Professor Elizabeth Hartland
Director and CEO



Clinical collaboration

Hudson Institute's medical research spans discovery, translational research and clinical trials, ensuring laboratory breakthroughs are supported every step of the way to become new drugs, devices, treatments or cures to improve patients' lives. Our scientists work in close collaboration with Monash Health and Monash University to make this possible.

As global experts in their field, Hudson Institute scientists share their specialist knowledge with clinicians and nurses by developing clinical guidelines to improve quality of care and patient outcomes.

Our precinct

Delivering cutting edge research to patients

HUDSON
INSTITUTE OF MEDICAL RESEARCH

 **MONASH**
University

 **Monash**
Health

 **Monash**
Children's
Hospital





Dr Miranda Davies-Tuck

Reducing stillbirth

Health services across Australia will have access to new clinical guidelines to prevent stillbirth. Supported by a postdoctoral fellowship from the Centre for Research Excellence in Stillbirth, Dr Miranda Davies-Tuck will lead a project to roll out, evaluate and expand guidelines she developed in 2017, providing clinicians with new parameters to monitor babies in late pregnancy.

The project aims to reduce the disproportionately high rate of stillbirth experienced by South Asian women due to differences in their placenta. The guidelines have already been implemented at Victoria's largest maternity service, Monash Health, halving the stillbirth rate at term for South Asian women to be in line with other women.

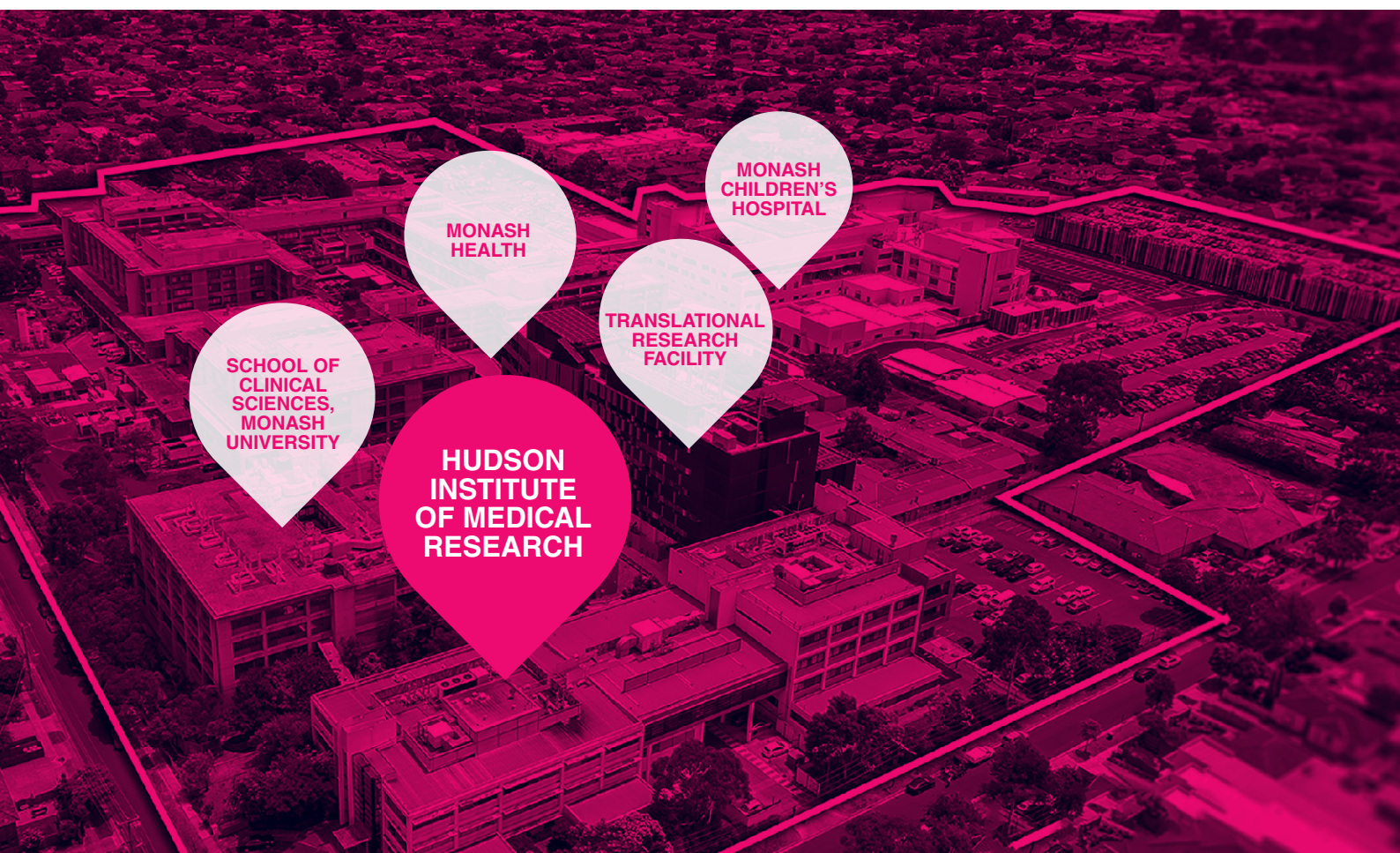


L-R: Professor Vincent Harley, Dr Nayla Leon, Dr Alejandra Reyes

Helping babies born with DSD

Differences in sex development (DSD) can sometimes make it unclear whether a newborn is a boy or girl. Some cases are mild, but others can be life-threatening. There are potentially hundreds of different causes so diagnosis is difficult and can be lengthy, placing additional pressures on stressed families.

Professor Vincent Harley, Dr Nayla Leon and Dr Alejandra Reyes have written a clinical guide, published in *The Lancet Diabetes & Endocrinology*, to assist specialists who encounter newborn babies with ambiguous genitalia. By enabling faster diagnosis, the guide will be used worldwide to improve decision-making and future quality of life for many children and their families.





Finding the cause



COLLABORATORS
University of Queensland
and Monash IVF



FUNDERS
US Department of Defense

About 176 million women worldwide have endometriosis. Professor Caroline Gargett has long known the debilitating impacts of this disease on women—and has dedicated a significant portion of her career to investigating its cause.

She has personally known women with the condition and seen first-hand how the disease interferes with all aspects of a woman's life.

In Australia and internationally, there has been a groundswell of endometriosis awareness that has led to more funding for research.

In 2019, Prof Gargett received a three-year, US\$2.07 million (AU\$3.05 million) grant from the US Department of Defense (DoD) and a

AU\$2 million NHMRC Investigator grant to further investigate the cause of endometriosis. Findings from the project will provide information to help the development of new endometriosis drugs. "This is great news for women who have suffered in silence for so long, waiting seven to 10 years for a diagnosis," Prof Gargett said.

WHAT IS ENDOMETRIOSIS?

Endometriosis occurs when cells from the endometrium grow in other areas of the body. These cells may stick to organs in the pelvic cavity, including the ovaries, fallopian tubes, peritoneal lining, bowel or bladder, forming painful lesions.

Endometriosis can cause infertility and is estimated to cost Australia around \$9.5 billion annually in lost productivity and direct healthcare costs.



Professor Caroline Gargett

of endometriosis

NEXT STEPS

Prof Gargett's team brings together molecular geneticists with expertise in endometriosis genetics at the University of Queensland, with Hudson Institute's endometrial stem cell scientists, to provide new insights into the cause of endometriosis at a molecular and cellular level. The goal is to develop non-invasive diagnostic tests and new treatments.

"Endometriosis is a complex disease and until basic research is undertaken to understand its complexities, there will not be a cure," Prof Gargett said.

AN ANSWER FOR BRIDGET

Bridget Hustwaite suffered six years of intense abdominal pain before she was diagnosed with stage four endometriosis in August 2018.

Since early adolescence, the Endometriosis Australia Ambassador and triple j broadcaster was plagued by heavy bleeding, nausea, fatigue and cramping associated with her period.



Bridget Hustwaite

When Bridget was finally diagnosed, endometriosis was found across her bladder, rectum, bowel and pelvic side walls. Despite this, she felt relieved she finally had a diagnosis.

"We need faster diagnosis, better treatments and more education and awareness about endometriosis. The fact this research is being funded is a step in the right direction," she said.

Tackling fetal growth restriction



COLLABORATORS
Department of Obstetrics
and Gynaecology, Monash
University; Monash Health



FUNDERS
Cerebral Palsy Alliance
Australia, Equity Trustees,
L.E.W. Carty Charitable
Fund, NHMRC

Fetal growth restriction (FGR) is a condition where an unborn baby does not grow well, making them susceptible to lung, cardiovascular system and brain damage.

Associate Professor Suzie Miller's close collaboration with Monash Health clinicians, who regularly see babies affected by FGR, underpinned the importance of better understanding and treating the condition.

WHAT IS FGR?

FGR is a condition where an unborn baby experiences prolonged hypoxia, a lack of oxygen usually caused by problems with the placenta. The baby stops growing and is born very small.

"The placenta doesn't work optimally in a reasonably high proportion of expectant mums—between six to eight per cent of pregnancies in Australia," A/Prof Miller said.

In 2019 A/Prof Miller and her team published new findings in the journal *Frontiers in Physiology*, showing the impact of FGR on babies' brains. A clinical trial is also underway to test a potential new treatment with a compound, melatonin.

"We found that brain injury develops *in utero* and gets worse as the pregnancy progresses," A/Prof Miller said. "The longer the growth-restricted baby stayed *in utero*, exposed to prolonged hypoxia, the worse the brain looks.

"If we want a treatment to improve brain outcomes in FGR infants, then we need to be treating the mother during pregnancy, rather than trying to repair the brain injury after the baby is born.

"If we can treat with melatonin *in utero* as we are doing in our Monash Health clinical trial, then we can prevent progression of that brain injury. The heart of this approach is treating and preventing long-term neurodevelopmental conditions, like cerebral palsy, in the womb."



Associate Professor Suzie Miller



Image, Emily King Photography

HOW WE ARE TACKLING FGR

- **Imaging:** Another study led by A/Prof Suzie Miller and Dr Atul Malhotra used advanced imaging techniques to analyse magnetic resonance imaging (MRI) scans to detect subtle brain injury associated with FGR. Dr Atul Malhotra is a consultant neonatologist at Monash Children's Hospital and a research fellow at Hudson Institute. The study also involved physicists at Monash Biomedical Imaging. The research is 'immediately transferable' to the clinic.
- **Melatonin:** Melatonin, a powerful antioxidant that can reduce oxidative stress, will be given daily to pregnant women in a clinical trial to determine whether it can protect at-risk babies' developing brains. The trial involves Monash Health and hospitals across Australia and New Zealand, and is led by Dr Kirsten Palmer and Professor Euan Wallace from Monash University and Hudson Institute.

WHY TACKLE FGR?

- More than 20,000 babies are born with FGR in Australia each year
- Up to 20 per cent of babies born globally are affected each year
- Can cause brain injury, cognitive, learning and behavioural problems, cerebral palsy and autism

Unlocking the microbiome

A game-changer for disease



COLLABORATORS

Wellcome Sanger Institute, EMBL's European Bioinformatics Institute, London School of Hygiene and Tropical Medicine, Monash University, University of Birmingham



FUNDERS

NHMRC, Wellcome Trust, BBSRC, European Molecular Biology Laboratory, UK Medical Research Council

Trillions of microbes in the gut form a vast ecosystem known as the microbiome. Understanding the complex role these bacteria play in disease has the potential to change the paradigm of human health.

Dr Sam Forster and his team, together with collaborators from the Wellcome Sanger Institute (UK), are shedding more light on the mysterious microbiome, using methods ranging from growing bacteria, to DNA sequencing and genomic analysis.

The results of their research hold significant implications for how the microbiome is studied and for improving treatment of conditions caused by imbalances in bacteria, including infections, inflammatory bowel disease, irritable bowel syndrome, and allergies—diseases of the immune system.

Dr Forster undertook a groundbreaking study that isolated more than 100 never-before-seen species from healthy people's intestines, by growing

and DNA sequencing bacterial strains. Further research in collaboration with the European Bioinformatics Institute created a 'blueprint' of the human gut by identifying almost 2000 more bacteria using computational methods to reconstruct bacterial genomes.

Dr Forster said these combined resources would help scientists worldwide investigate how our microbiome keeps us healthy and its role in disease, by enabling researchers to detect which bacteria are present in the human gut more quickly and accurately than ever before.

"Our study has led to the creation of the largest public database of genome-sequenced, intestinal bacteria, including sequences of more than 100 novel species. It is already fundamentally changing the way researchers study the microbiome," Dr Forster said.

To understand more about the development of the microbiome, in a separate study, the researchers looked to newborn babies and their type of delivery. Differences were found in the gut bacteria of babies born vaginally—who had more bacteria from their mother—and infants delivered by caesarean section, who had more hospital-acquired bacteria. While the differences evened out by the time babies turned one, the impacts on long-term health are not yet known.

Dr Forster and his team at Hudson Institute are now turning their attention to developing a new generation of microbiome-based medicine. "The microbiome field is still an emerging area. We have invested a lot of time developing methods to study it—now we are trying to understand the interactions between the bacteria and the immune system so we can develop better treatments for a diverse range of conditions."



Dr Sam Forster



2019 RESEARCH HIGHLIGHTS

- The discovery of more than 100 new gut bacteria could lead to new diagnostics and treatments for gastrointestinal disorders, infections and immune conditions (*Nature Biotechnology*, 2019).
- Almost 2000 species of bacteria are found living in the gut, using computational methods (*Nature*, 2019).
- Babies born via caesarean section have more hospital-acquired bacteria and are more likely to have antimicrobial resistance, while the microbiome of babies born vaginally is mostly from their mother (*Nature*, 2019).
- The largest-ever genomic study of the diarrhoea bacterium *Clostridium difficile*, found it is evolving to thrive on sugar-rich diets, evade common hospital disinfectants and spread easily (*Nature Genetics*, 2019).
- Our microbiome experts Dr Edward Giles, Gemma D'Adamo and Dr Sam Forster call for standardised regulation of faecal microbiota transplant (FMT) treatments, to ensure safer microbiota-based medicines (*Nature Reviews Microbiology*, 2019).

Clues to stomach cancer discovered



Hudson Institute researchers have uncovered a case of mistaken identity in the molecular drivers behind stomach cancer, which could lead to improved treatments for a range of cancers.

The study, led by Professor Brendan Jenkins and PhD student Jesse Balic, found stomach cancer is driven by a different process from that previously believed.

“It’s a welcome finding. Stomach cancer is a disease that often presents in the later stages,” said Prof Jenkins.

“Sadly, most patients are diagnosed with advanced disease, where there has been an absence of early symptoms.”

Published in *Cancer Research*, the study investigated how modifications to certain proteins in our bodies have the potential to trigger stomach and other cancers.

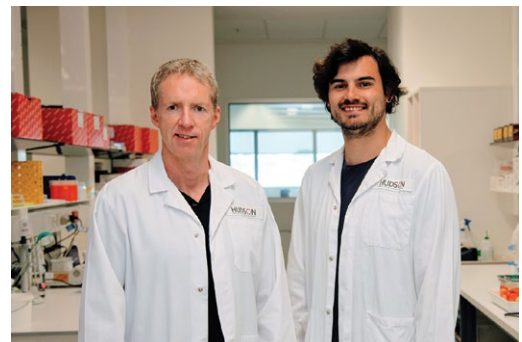
Modification of a different amino acid to the one originally believed to be important for activating the cancer signalling protein, STAT3, switched on the expression of many other genes involved in cancer cell growth and proliferation. The STAT3 protein is linked to at least half of cancers.

Prof Jenkins said the results could lead to the development of new drugs to block the newly discovered cancer pathway. He said current strategies to block STAT3 had been largely ineffective.

Chemotherapy would still be the standard of care, but targeting STAT3 with new drugs could allow

tailoring of treatments to the genetic makeup of each affected individual.

Prof Jenkins said the ability to sequence the entire genetic makeup—the genome—of tumour tissue was a major medical advancement, contributing to a better understanding of stomach cancer and more targeted treatment for patients.



Professor Brendan Jenkins, PhD student Jesse Balic

KEY FINDINGS

- Modification of an amino acid (serine) in a protein, STAT3, controls expression of other genes that promote stomach cancer
- Modification of an amino acid (tyrosine) in STAT3 was previously believed to be a main driver of cancer
- Drugs (inhibitors) need to be developed to block serine phosphorylation, rather than tyrosine phosphorylation



Daniel Wilson (centre) with two of the more than 2000 Metafit coaches Australia-wide, Lyndsay Buchanan (left) and Clarence Ho (right)

IN MEMORY OF DANIEL WILSON

Daniel Wilson was a super-fit 37-year-old when he was diagnosed with stomach cancer in March 2019.

The much-loved fitness instructor introduced Metafit, a popular High Intensity Interval Training (HIIT) program to Australia.

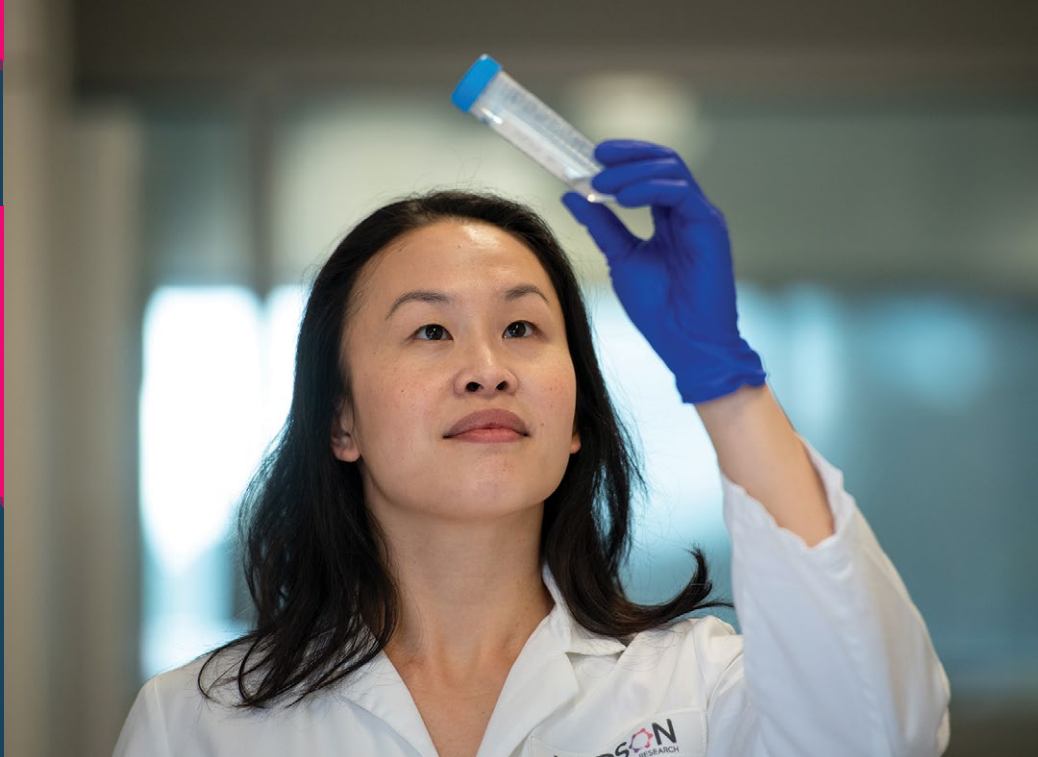
That someone so healthy and active could be struck down by this disease came as a huge shock to his friends, family and the Metafit community. They were devastated when he died just two months later.

Daniel's loved ones started a fundraising campaign to support a PhD scholarship in his memory at Hudson Institute. More than \$37,000 has been raised to support a PhD student to progress stomach cancer research.

The inaugural recipient of the Daniel Wilson PhD scholarship is Alice West, who will work with Prof Jenkins' lab to advance knowledge on the role of the innate immune system in stomach cancer.



Daniel Wilson



Associate Professor Rebecca Lim

Saving lives with cell therapies

In 2019, Associate Professor Rebecca Lim was ranked the highest applicant in the National Health and Medical Research Council (NHMRC) Career Development Fellowship (Industry) Scheme and named one of Australia's most influential Asian-Australians under 40.

Tell us about your research...

My cell therapy research focuses on understanding how cells from the amniotic sac can help reverse life-threatening conditions. I work with industry professionals and clinicians to translate the research into safe and effective technologies and treatments.

What are amniotic epithelial cells?

Amniotic epithelial cells (amnion cells) are from the amniotic sac that surrounds a baby during pregnancy. They have stem cell-like properties and can grow into many cell types. Most importantly, they have potent effects on inflammation and tissue damage.

What is exciting about this research?

Amnion cells offer a simple treatment—they don't need to be matched to the patient's blood or tissue type and can be delivered intravenously in about an hour.

Who is benefiting?

We think amniotic stem cells can help extremely premature babies with lung disease (bronchopulmonary dysplasia, BPD—which can cause cerebral palsy), as well as adults with acute stroke or chronic liver disease. We held a world-first safety trial for cell-based therapies for these diseases. The trials were to determine safety, not efficacy; however, we have begun to see some encouraging results.

Tell us more about the preterm babies...

A safety trial at the Monash Children's Hospital involved six preterm babies with BPD who were given a single, low dose of amnion cells. The cells work by attaching themselves to the damaged lungs and kick-starting the organs' own

repair process. The results showed this cell therapy can be safely used in babies with lung disease. Our current trial involves 24 extremely premature babies from Monash Children's Hospital and the Royal Women's Hospital, who are at high risk of BPD. The study's goal is to determine the optimum cell dosage and frequency for these babies.

What is the long-term goal?

We want to develop a treatment for premature babies, accessible in hospitals around the world, to increase survival rates and stop long-term complications for these vulnerable infants.



COLLABORATORS

Monash Children's Hospital, Monash University, Royal Women's Hospital



FUNDERS

Fielding Foundation, Hugh Rogers Foundation, NHMRC, Jack Brockhoff Foundation



L-R: Dr Courtney McDonald, Dr Miranda Davies-Tuck, Dr Robert Galinsky, Dr Stacey Ellery, Dr Cristina Giogha, Dr Jun Yang

Supporting our emerging leaders

Hudson Institute's Emerging Leaders program was established to propel our early career researchers to independent careers.

Six high-achieving scientists were chosen to participate in the inaugural program, which will provide comprehensive leadership training and mentoring.

AWARDEES

Dr Miranda Davies-Tuck

Dr Davies-Tuck is a perinatal epidemiologist. Her integrated research program spans laboratory-based discovery research, clinical trials, implementation science, and health policy to identify targets and develop interventions to prevent the devastating tragedy of stillbirth.

Dr Stacey Ellery

Dr Ellery investigates utero-placental and fetal energy homeostasis during pregnancy. She is particularly interested in how adjustments to maternal diet can improve outcomes in pregnancies complicated by preeclampsia, fetal growth retardation, preterm birth and intrapartum asphyxia.

Dr Robert Galinsky

Dr Galinsky's research focuses on early detection and treatment of brain injury that arises during pregnancy or around the time of birth, to reduce the incidence and severity of lifelong disability.

Dr Cristina Giogha

Dr Giogha studies several gastroenteritis-causing bacteria to understand how they cause disease and to develop more effective treatments.

Dr Courtney McDonald

Dr McDonald investigates umbilical cord blood cells to treat perinatal brain injury. Her group hopes to identify key cells that can be used to protect the developing brain.

Dr Jun Yang

Working across Hudson Institute, Monash Health and Monash University, endocrinologist Dr Yang is investigating ways to optimise the diagnosis of a potentially curable form of high blood pressure, primary aldosteronism, so as to transform clinical practice for better cardiovascular outcomes.





OUR STUDENTS



152

STUDENTS

113 PHD
4 MASTERS
35 HONOURS

28

STUDENTS
WITH MEDICAL
TRAINING

43

STUDENT
FIRST AUTHOR
PUBLICATIONS

Making an impact

Dr Nadia Bellofiore has received an award recognising world-leading research undertaken by a student for her PhD thesis.



Dr Nadia Bellofiore

In 2015, an observation by Dr Nadia Bellofiore led to the groundbreaking discovery that a desert rodent menstruates. The discovery generated significant interest from scientists worldwide, as it could potentially provide a preclinical model to study, and therefore better understand, human menstrual disorders. Previously, scientists largely believed that no rodent species menstruated.

Dr Bellofiore's PhD thesis received the 2018 Vice Chancellor's Commendation for Thesis Excellence from Monash University. The award recognises world-leading research undertaken by a student.

The team went on to discover that this particular rodent, the spiny mouse, also experiences premenstrual-type symptoms similar to humans.

"We have shown how menstrual studies in a small and readily

accessible preclinical model could be potentially translated to humans," Dr Bellofiore said. "This could significantly advance research in women's reproductive health and help us to understand menstrual disorders such as endometriosis and abnormal uterine bleeding."

Dr Bellofiore paid tribute to her supervisors, Dr Jemma Evans, Dr Fiona Cousins and Associate Professor Peter Temple-Smith (Monash University), adding that they continue to be inspirational mentors to her and other students.



COLLABORATORS
Monash University



FUNDERS
Fielding Foundation, Monash University,
Victorian Government



Sharing our knowledge

We share our research discoveries to educate and inspire the wider community about the possibilities medical science offers to prevent, treat and cure disease as well as improve health.



Professor Elizabeth Hartland with Young Women in Science candidates

YOUNG WOMEN IN SCIENCE

Gender equity is an important focus of Hudson Institute. A group of young high school women spent two weeks at the Institute being mentored by female scientists as part of the inaugural Young Women in Science program, which aims to encourage aspiring young scientists to consider a career in the field.



Public forums



A BRIGHTER FUTURE FOR CEREBRAL PALSY

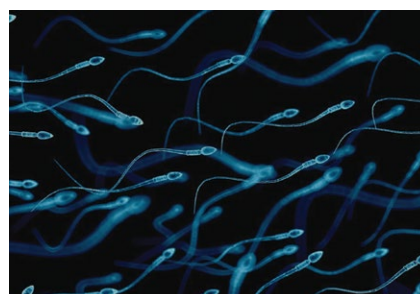
Every 15 hours, an infant in Australia is born with a brain injury that underlies cerebral palsy. Early diagnosis and intervention is critical for maximising an individual's potential.

In October, our researchers shared how their work is revealing more about the causes of cerebral palsy and leading to the development of new therapies. Attendees also heard from parents of children with cerebral palsy, carers and physical therapists.



THE SCIENCE OF REPRODUCTION: EARLY PREGNANCY AND A HEALTHY START TO LIFE

Leading reproductive health scientists and clinicians shared their latest fertility and pregnancy research at this September forum. Topics included early pregnancy, IVF, nutrition, and the critical importance of the placenta and the womb environment to developing babies. The forum also featured the artwork, *The Biggest Placenta in the World*, by Bec Vandyk.



MALE FERTILITY—A LOOK UNDER THE COVER

Infertility affects one in five Australian men and women. Reproductive scientists and clinicians outlined the causes, diagnosis and treatments for male infertility at this public forum in November. They also provided the most up-to-date information on improving fertility and how a man's health at conception affects his child's development.



Targeting childhood cancer

Sarah Russell knew something was gravely wrong with one of her twins, five-year-old Jaxon, when he became seriously ill with vomiting, nausea and unusual bruising, while his brother, Hunter, remained well.



Jaxon and Sarah

“Normally they get sick together,” Sarah said. “Jaxon was very tired, not eating and had a really nasty cough. An x-ray showed he had a mass on his chest, which is one of the symptoms of leukaemia.”

Jaxon was diagnosed in October 2019 with Acute Lymphoblastic Leukaemia (ALL). However, molecular analysis showed he had a rare mutation in his cancer that, although indicating he had a serious form of ALL, would respond best to a specific chemotherapy drug. He began an intense, nine-month regime of this drug and was considered cancer-free after one month. Despite this, Jaxon will need to continue treatment for two-and-a-half years to ensure the cancer doesn't return.

It's patients like Jaxon who could potentially benefit from the targeted molecular approach of the Hudson Monash Paediatric Precision Medicine Program. A biobank of childhood cancer samples has been established and a range of precision medicine approaches is used to trial and develop targeted treatments for individual patients, giving them the best chance of survival and quality of life.

“Many years ago, Jaxon might not have had the chance that he has today to overcome this cancer,” said Sarah, who is looking forward to the day her son can run around again and start school.



Jaxon at Monash Children's Hospital



The Hudson Monash Paediatric Precision Medicine Program hopes to significantly improve treatment, survival rates and quality of life for childhood cancer patients. With generous funding from the Children's Cancer Foundation since 2017, Hudson Institute scientists established a living biobank of paediatric cancers to trial and develop targeted treatments. The initiative includes a functional genomic program and uses individual patients' cancer cells

to identify new targeted therapies. The program is expanding patient recruitment to about 150 children over the next three years, while enabling cutting-edge molecular analyses for each child's cancer, utilising a paediatric cancer molecular tumour board to translate findings into clinical application. The Children's Cancer Foundation committed an additional \$4.968 million in 2018 for Phase II of the program.

childrenscancerfoundation.com.au

Uniting to fight ovarian cancer



Dr Amy Wilson and Ivanhoe Girls' Grammar students

IVANHOE GIRLS' GRAMMAR SCHOOL FUNDRAISER

Dr Amy Wilson was the inaugural recipient of the Ivanhoe Girls' Early Career Ovarian Cancer Research Travel Award, created to foster the career of promising early career ovarian cancer researchers.



Dr Maree Bilandzic

OCRF SUPPORTS HUDSON INSTITUTE RESEARCH

Dr Maree Bilandzic will progress research into deadly ovarian cancer 'leader cells' thanks to funding from the Ovarian Cancer Research Foundation (OCRF).

"These chemotherapy-resistant cells thrive in response to treatment," said Dr Bilandzic, whose study on leader cell research was published in the journal *Cancers*.

The \$800,000 OCRF grant will allow Dr Bilandzic to screen drugs that are already on the pharmacy shelf to unlock their hidden potential to fight ovarian cancer, which has a five-year survival rate of less than 30 per cent.

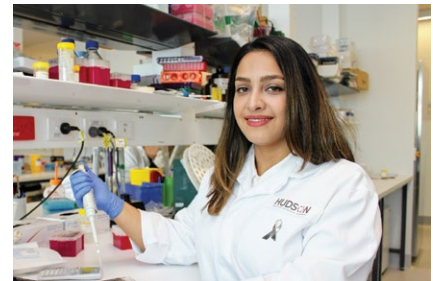


L-R: Laura Moffitt, Dr Amy Wilson, Dr Maree Bilandzic

RESEARCHERS GET BEHIND OCRF

Dr Bilandzic joined some of Australia's most influential women as an OCRF Ambassador for the Witchery White Shirt Campaign, which raised \$1.4 million for ovarian cancer research.

In October, Dr Bilandzic and Dr Wilson swapped their lab coats for frocks as part of the OCRF's Frocktober campaign, which invites the community to 'frock up, raise funds and 'frock cancer'. Frocktober raised more than \$500,000 for ovarian cancer research.



Student Nazanin Karimnia

ADDITIONAL OVARIAN CANCER SUPPORT

- Dr Bilandzic was the recipient of a \$70,000 Perpetual IMPACT Philanthropy grant focused on a new cell marker that could be used to measure treatment response.
- PhD student Nazanin Karimnia received renewed support from the Dr Sue Fowler Scholarship in Ovarian Cancer to continue her work investigating how targeting a unique marker disrupts cells that lead tumour invasion.

Thank you to our supporters

We are grateful for the gifts received from individuals, trusts, foundations and organisations during the year.

We also acknowledge the support of the Victorian State Government through the Operational Infrastructure Support Program and the Australian Government through its funding bodies including the NHMRC. These valuable contributions assist our scientists to undertake and progress life-changing research.

FUNDING BODIES

Australasian Sleep Association
 Australian Communities Foundation
 Australian Lions Childhood Cancer Research Foundation
 Australian Research Council
 Cancer Australia
 Cancer Council Victoria
 Carrie's Beanies 4 Brain Cancer Foundation
 Cell Care Australia
 Cerebral Palsy Alliance
 Children's Cancer Foundation
 Cure Brain Cancer Foundation
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 The Financial Markets Foundation for Children
 The Heart Foundation

The Ian Potter Foundation
 The Kenneth Rainin Foundation
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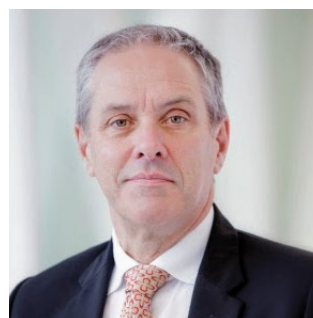
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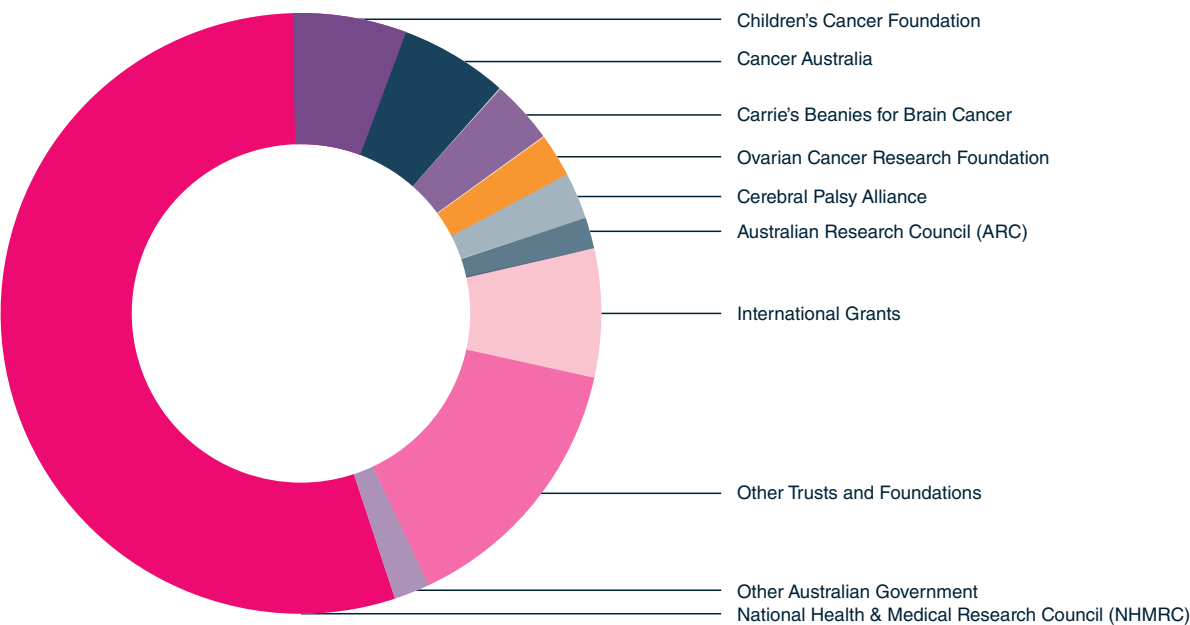
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Chair, Finance and Audit
Committee



Research outputs

Grant funding received in 2019



FUNDING BODIES (\$)

● National Health and Medical Research Council (NHMRC)	14,247,695
● Cancer Australia	1,356,872
● Children's Cancer Foundation	1,281,623
● Carrie's Beanies for Brain Cancer	799,624
● Ovarian Cancer Research Foundation	586,609
● Cerebral Palsy Alliance	552,624
● Australian Research Council (ARC)	398,018
● Other Australian Government	392,571
● Other Trusts and Foundations	
The Financial Markets for Children	286,369
Victorian Cancer Agency	225,000
Eva and Les Erdi Charitable Foundation	200,000
Science and Industry Endowment Fund	193,180
Perpetual Trustees IMPACT	152,099
Cure Brain Cancer	128,568
The Kids' Cancer Project	104,588
Cancer Council Victoria	100,000
Rebecca L Cooper Foundation	100,000
Other trusts and foundations	1,927,728
TOTAL	3,417,532
● International Grants	
Department of Defense (USA)	1,233,507
Ferring Research Institute	256,263
Other international grants	104,155
TOTAL	1,593,925
TOTAL	24,627,093

PUBLICATIONS

In 2019, Hudson Institute's researchers published extensively in international peer-reviewed journals.

Publication type	2017	2018	2019
Original research articles	273	206	203
Reviews	36	50	52
Editorials and commentaries	20	17	16
Books and book chapters	10	27	12



From research discovery to patient care

The Business Development team ensures the Institute's research discoveries reach patients. Working with academic, industry and government partners, research is protected, commercialised and pathways are built for its future use.

Partnerships are also forged with global pharmaceutical, clinical and venture capital organisations to progress research from early stages to clinical trials. Diagnostics and treatments for cancer, inflammatory disease and reproductive health are among the new discoveries now in the developmental pipeline.

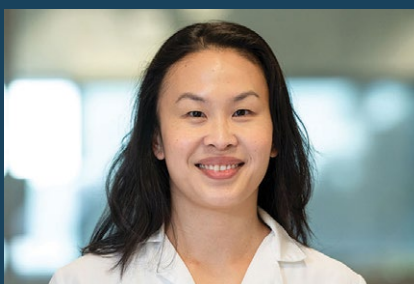
Significant venture capital funding was invested in a number of projects. The team supported development and protection of intellectual property arising from the Institute's research, with new patent filings and patents granted.



Dr Tracey Edgell

TIMING TRANSFER FOR SUCCESS

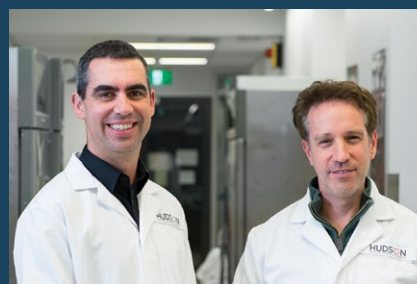
To improve IVF success rates, Dr Tracey Edgell developed a test to indicate the optimal time for embryo transfer. Following a clinical validation trial, the next step is to make the test available to IVF patients.



Associate Professor Rebecca Lim

GENERATING NEW TREATMENTS

Associate Professor Rebecca Lim is collaborating with academic and healthcare partners to develop stem cell therapies to treat a number of conditions, including lung disease in babies (bronchopulmonary dysplasia (BPD)) and adult stroke (see page 16 for more details). Following a world-first safety trial of stem cells in acute stroke patients, conducted with La Trobe University and Monash Health, the Institute is supporting A/Prof Lim to take these new regenerative medicine treatments to patients.



Dr Jason Cain, Associate Professor Ron Firestein

BUILDING PRECISION MEDICINE NETWORKS

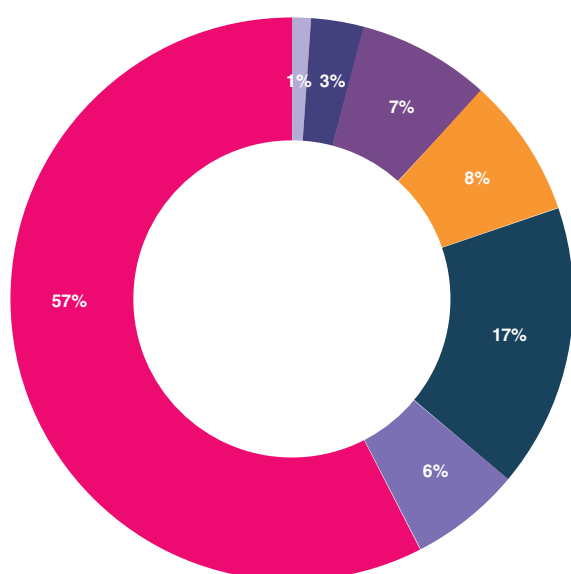
Associate Professor Ron Firestein and Dr Jason Cain are progressing precision medicine for childhood cancer patients. By building expertise and sharing resources in partnerships with other Australian and international research institutes, their findings can impact the greatest number of patients worldwide.

Organisation structure



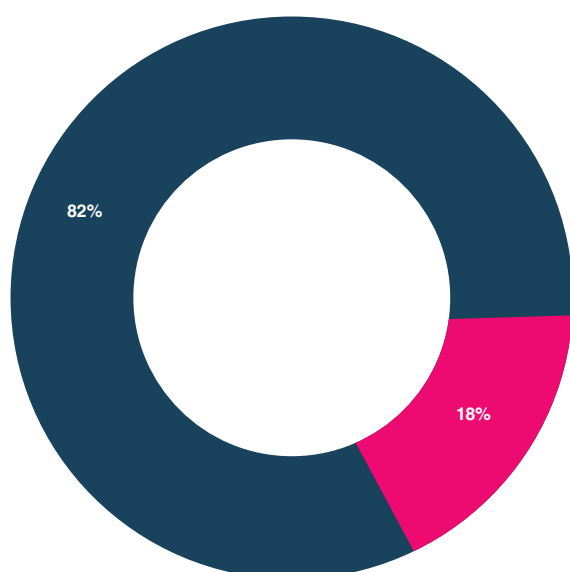
Financial snapshot

Revenue



Revenue	2019 (\$)	2018 (\$)	2017 (\$)
Australian Government	28,408,235	27,875,344	22,899,072
Victorian Government	3,172,168	3,336,283	3,089,225
Philanthropic grants	8,168,395	6,957,795	7,476,138
Commercial research	3,984,044	3,547,176	3,649,352
Infrastructure Monash University	3,616,999	3,198,626	2,474,291
Other income	1,485,615	2,122,605	2,493,126
Investment income	586,932	625,873	672,316
Total	49,432,388	47,663,699	42,753,519

Expenditure



Expenditure	2019 (\$)	2018 (\$)	2017 (\$)
Scientific and laboratory	40,238,073	38,950,957	36,222,463
Administration expenses	9,058,817	8,806,847	6,922,922
Total	49,296,890	47,757,804	43,145,385

2019 Publications

BOOK CHAPTERS

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Graduates of 2019

Congratulations to our Postgraduate and Honours students who graduated in 2019

DOCTOR OF PHILOSOPHY

Dr Aminath (Azu) Azhan

Impaired myelination in the growth restricted brain: Upregulation of Wnt and Notch signalling pathways in delayed oligodendrocyte maturation

A/Prof Mary Tolcos, A/Prof Flora Wong, Prof David Walker

Dr Atul Malhotra

Novel therapies for intrauterine growth restriction related brain injury

A/Prof Suzanne Miller, Prof Graham Jenkin, Dr Margie Zakhem

Dr Benjamin Nowotny

Using obstetric complaints and litigation as a quality improvement tool

Prof Euan Wallace AM, Dr Miranda Davies-Tuck, Prof Erwin Loh

Dr Catherine Cochrane

Investigating the role of Sonic hedgehog signalling in cerebellar development and disease

Dr Jason Cain, Prof Neil Watkins

Dr Chun Wang (Jason) Lao

Exploring a new frontier: The immune and coagulation systems of the premature infant and their relevance in major diseases of prematurity

Prof Marcel Nold, A/Prof Claudia Nold, Dr Ina Rudloff, Dr Niamh Mangan

Dr Dana Pueschl

Immune privilege and neoplasia in human testis: potential role and functional polarization of macrophages and dendritic cells

Prof Martin Bergmann, Prof Kate Loveland, Prof Mark Hedger, Prof Tina Treczek

Dr Douglas Blank

The effects of umbilical cord milking at birth

Prof Stuart Hooper AM, A/Prof Graeme Polglase

Dr James Ong

Optimising inflammasome inhibitors to treat pandemic influenza

A/Prof Ashley Mansell, Dr Michelle Tate

Dr Jasna Aleksova

The effect of androgen replacement therapy on bone and muscle health in men with chronic kidney disease

A/Prof Frances Milat, Prof Peter Ebeling AO, Prof Grahame Elder, Prof Rob McLachlan

Dr Ke Tang

STAT3-dependent regulation of inflammasomes promotes gastric tumourigenesis through regulating interleukin 1 production in glycoprotein 130 mutant mice

Prof Brendan Jenkins, Dr Daniel Croagh

Dr Maciej Szarek

Determining gonocyte migration

Prof Kate Loveland, Prof Mark Hedger, Prof Martin Bergmann

Dr Mohamed Ibrahim Ahmed Saad

Amnion cells - a potential cure for idiopathic pulmonary fibrosis. Uncovering the underlying molecular mechanism

Prof Brendan Jenkins, Dr Saleela Ruwanpura

Dr Mohammed Ibrahim A Alasseiri

Prevention of myelodysplastic syndrome progression to acute myeloid leukaemia by iron modulation

Prof Bryan Williams, Dr Afsar Ahmed

Dr Paris Papagianis

Human amnion epithelial stem cells are a treatment to chronic inflammation

A/Prof Tim Moss, A/Prof Graeme Polglase, A/Prof Jane Pillow

Dr Paulo Pinares-Garcia

The role of the male gene SRY in healthy and injured nigrostriatal dopamine neurons

Dr Joohyung Lee, Prof Vincent Harley

Dr Rashid Abdulhameed Aldahhan

The genetic causes of male infertility

Prof Mark Hedger, Prof David de Kretser AC, Prof Peter Stanton

Dr Sebastian Hobson

A pilot study of antenatal maternally administered melatonin to decrease the level of oxidative stress in human pregnancies affected by preeclampsia (PAMPR Trial)

Prof Euan Wallace AM, A/Prof Rebecca Lim

Dr Sebastian Quezada

Use of minocycline and related drugs to suppress microglial activation after hypoxia and infection

Prof Caroline Gargett, Prof David Walker

Dr Shenpeng Zhang

Effects of T helper 2-promoting agents on outcome after stroke

Prof Chris Sobey, Dr Hyun Ah Kim, Prof Marcel Nold

Dr Shreya Rana

Investigation into the mechanisms underlying cortical folding

A/Prof Tim Moss, Prof David Walker, A/Prof Mary Tolcos

Dr Stuart Emmerson

Elevation of tissue engineering construction comprising autologous endometrial mesenchymal stem cells

Prof Caroline Gargett, Prof Jerome Werkmeister

Dr Sultan Mohammed Alhayyani

The mechanistic role of glycoprotein 130 signalling in lung cancer development

Prof Brendan Jenkins, Prof Philip Bardin

Dr Yao Wang

HtrA serine peptidase 4-induced endothelial dysfunction in early-onset preeclampsia

Prof Guiying Nie, A/Prof Craig Harrison

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Ms Paige Anderson

Ms Rheannon Blucher

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Ms Lauren Hadley

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Ms Maria Petraki

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