



2018 Annual Report



Garvan Institute
of Medical Research

2018 Our year of big thinking, collaboration and discovery.

Our vision

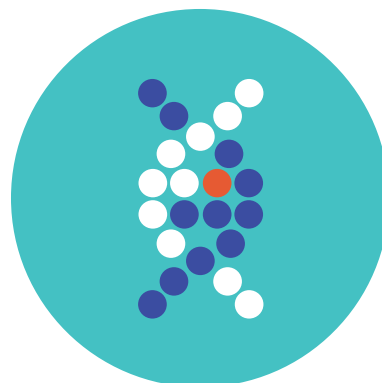
We see a future where everyone lives a longer, healthier life.

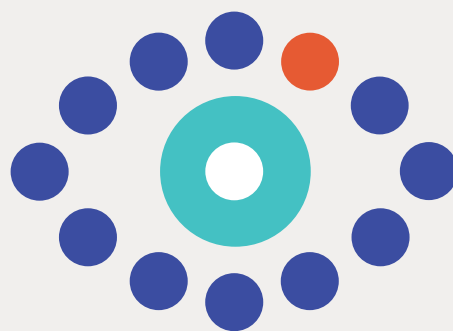
Our mission

We will harness all the information encoded in the genome to make pioneering discoveries that predict, treat and prevent diseases that have the deepest impact on society.

Our values

Excellence
Innovation
Collaboration
Community
Integrity
Respect





Who we are, what we do

Garvan is leading the nation in using genomic analysis to accelerate discovery and enable personalised, precision medicine.

Our researchers pioneer studies into some of the most difficult to solve and widespread diseases affecting the community today. Garvan is focused on understanding the molecular and cellular processes in health and disease, putting people and patients at the centre of leading-edge local and global research expertise and networks as the basis for developing future preventions and treatments.

For 56 years, Garvan scientists have been achieving significant breakthroughs in the understanding and treatment of diseases.

Aspirations

- To become the most advanced institute in the region in the adoption, application and integration of next-generation genomic and computational approaches and technologies in investigative and translational research.
- To advance knowledge in our key areas of critical mass that will lead to better understanding, reduced incidence and improved treatments for cancer, immune deficiency, inflammatory and autoimmune diseases including diabetes, osteoporosis, and diseases of ageing affecting the brain and other organs.
- To attract, develop and support exceptionally talented researchers with leading-edge programs addressing key conceptual and practical questions in human biology, and the translation of new knowledge and technologies into clinical applications.
- To embrace and uphold a culture of collegiality, collaboration, inclusivity, consideration, safety, transparency, and the highest ethical standards.
- To engage stakeholders and the community through our achievements and research vision so that we attract the significant government and donor support needed to empower our transformative agenda.

The organisation As at 31 December 2018

Garvan Institute of Medical Research			
Board of Directors		Executive	
Chair Dr John Schubert AO		Executive Director Prof Chris Goodnow FAA FRS Chief Operating Officer Kate Gunn Chief Scientific Officer Prof Marie Dziadek	
Garvan Research Foundation			
Board of Directors		Executive	
Chair Russell Scrimshaw		Director Mara-Jean Tilley Deputy Director Brad Timms	
Research Divisions			
Bone Biology	Cancer	Diabetes and Metabolism	Genomics and Epigenetics
Head Prof Peter Croucher Faculty A/Prof Paul Baldock Prof Jacqueline Center Prof John Eisman AO Prof Tuan Nguyen Prof Mike Rogers	Head Prof David Thomas Faculty Dr Christine Chaffer A/Prof Elgene Lim Prof Chris Ormandy Dr Marina Pajic A/Prof Joseph Powell A/Prof Alex Swarbrick A/Prof Paul Timpson Prof Neil Watkins The Kinghorn Cancer Centre Director Prof David Thomas	Head Prof Mark Febbraio Faculty Prof Trevor Biden Prof Lesley Campbell AM Prof Don Chisholm AO Prof Jerry Greenfield Prof Ted Kraegen A/Prof Ross Laybutt Prof Katherine Samaras A/Prof Carsten Schmitz-Peiffer	Head Prof Susan Clark FAA Faculty Dr Ozren Bogdanovic A/Prof Marcel Dinger Prof Vanessa Hayes A/Prof Tim Mercer Prof Seán O'Donoghue Prof John Shine AO FAA
Immunology	Neuroscience	Kinghorn Centre for Clinical Genomics	Garvan-Weizmann Centre for Cellular Genomics
Head Prof Stuart Tangye Faculty Prof Antony Basten AO FAA FTSE Prof Robert Brink Prof Daniel Christ Dr Tatyana Chtanova Dr Elissa Deenick Prof Chris Goodnow FAA FRS A/Prof Shane Grey A/Prof Cecile King A/Prof Tri Phan Prof Jonathan Sprent FAA FRS	Head A/Prof Antony Cooper Faculty Prof Herbert Herzog Prof John Mattick AO FAA FTSE Prof David Ryugo Dr Robert Weatheritt	Clinical Head Mary-Anne Young Scientific Head A/Prof Sarah Kummerfeld	Head A/Prof Joseph Powell
Genome.One Chief Executive Officer A/Prof Marcel Dinger			
Development and Support			
Chief Operating Officer Kate Gunn Australian BioResources: Dr Jenny Kingham Business Development & Innovation: David Barda Finance & Accounting: Samantha Malone Human Resources: Simon Hamilton Internal Audit & Business Improvement: Carolyn Loughnan Information Technology: Esteve Mayolas, Jackson Chan Legal Counsel: Christina Hardy Building Services: Lynn Croft Engineering Services: Ryan Kolster Facilities: Julie Miller Scientific Support Services: Rebecca Brown WHS and Compliance: Lisa Moncur		Chief Scientific Officer Prof Marie Dziadek Grants Administration: Sonja Bates & Grainne Mullen Human Research Governance: Therese Yim Animal Ethics: Dr Rayson Tan Animal Welfare Officer: Dr Vivian Song Student Programs: Dr Tracy Anderson	

Contents

4	Garvan Institute Chairman and Executive Director's Report	33	Division Report: Neuroscience
5	Garvan Research Foundation Chairman and Director's Report	35	Microsoft cloud computing grant to support Garvan's genomic research
6	The year at a glance	36	Centre Report: Kinghorn Centre for Clinical Genomics
7	Garvan at a glance	38	Centre Report: Garvan-Weizmann Centre for Cellular Genomics
8	Collaborations	40	Garvan Institute of Medical Research Board of Directors
9	Publications	43	Garvan Research Foundation Board of Directors
10	Awards and achievements	46	PhD completions
13	Division Report: Bone Biology	47	Post-Doctoral Development Committee
15	Ellie's story: from intensive care to the playground	48	Franklin Women's Academic Partners
16	Division Report: Cancer	49	In Memoriam
19	Taking genomic cancer medicine national	50	Leaders in Science and Society seminars
21	Division Report: Diabetes and Metabolism	51	A shared vision for a healthier future
23	A pioneering partnership	52	Partners for the Future
25	Division Report: Genomics and Epigenetics	54	Garvan community
27	A national genomics mission for Australia	60	Scientific publications
28	Division Report: Immunology	78	Peer reviewed funding
31	UNSW Cellular Genomics Futures Institute launches	84	Financial highlights

We would like to acknowledge the Gadigal people of the Eora Nation, the traditional owners and custodians of the land on which the Garvan Institute of Medical Research is located. We pay respects to the Elders, past, present and future, and recognise the continuing connection and contribution to this land.

A digital version of this report is available at
garvan.org.au/2018-annualreport.

Garvan Institute of Medical Research Report



*Dr John Schubert AO
Chairman*



*Professor Chris Goodnow FAA FRS
Executive Director*

In 2018 the Garvan Institute of Medical Research embraced change under new leadership, and celebrated numerous scientific achievements. Our talented researchers continued their pursuit of discoveries to better predict, prevent and treat a wide range of diseases with the aim of giving everyone a shot at a longer, healthier life.

Garvan continues to be a world leader in genomics-led research and translation. Genomics – the study of all the information in our DNA – is and will continue to revolutionise health care. Our strategic research centres – The Kinghorn Cancer Centre, the Kinghorn Centre for Clinical Genomics and the Garvan-Weizmann Centre for Cellular Genomics – ensure Garvan scientists, and the research community, are able to pioneer human-centred research which will be translated into clinical practice for the benefit of all.

2018 also saw us formalise a partnership between Genome.One, our wholly owned subsidiary providing clinically accredited whole genome sequencing, and pathology company Australian Clinical Labs. This new partnership is translating Garvan's genome sequencing and analysis capabilities into a critical diagnostic service, serving families and doctors across Australia. Drawing upon the very best of Garvan's cutting-edge research, this service has already changed young lives and transformed the care of many Australians. It is now set to do even more.

Following the launch of the Australian Federal Government's \$500 million genomics mission in May, Garvan's Genomic Cancer Medicine Program (page 19) was awarded a \$50 million grant from the Federal Government and a \$12.4 million grant from the NSW Government to nationalise the program, the Australian Genomic Cancer Medicine Centre, for individuals with rare and advanced cancers. The closer affiliation with UNSW, including the establishment of the Garvan-led UNSW Cellular Genomics Futures Institute (page 31), will foster even closer collaboration between Garvan and UNSW scientists in

the application of single-cell genomics and bioinformatics in a broader genomics and precision medicine framework.

With thanks to your ongoing support, the Institute is in great shape. Our Garvan family raised more than \$41 million in philanthropic funding to catalyse and accelerate research discoveries, and our scientists attracted \$24 million in critical competitive peer-reviewed funding. Our research discoveries were published in prestigious scientific journals – an important measurement of Garvan's success and crucial to ensuring our findings are disseminated globally within the medical community.

Throughout 2018, Garvan's work, at the intersection between research and clinical care has resulted in life-changing treatments for people, such as Ellie (page 15) through the Zero Childhood Cancer Program.

The executive leadership of the Institute continues to excel; we are appreciative of the passion and skill of Professor Marie Dziadek as Chief Scientific Officer, Kate Gunn (following Philip Knox) as Chief Operating Officer, Mara-Jean Tilley (following Andrew Giles) as Director of the Garvan Research Foundation, and our research leaders: Professor Susan Clark, Associate Professor Antony Cooper, Professor Peter Croucher, Professor Mark Febbraio, Professor Stuart Tangye and Professor David Thomas. Of course Garvan is nothing without its people, and we warmly acknowledge the dedication of our 47 faculty scientists, 700+ researchers and support staff.

We are immensely grateful to our Board of Directors, who offer their extensive expertise and valuable time to Garvan on a voluntary basis.

Finally, we acknowledge the generosity of the individuals, groups and organisations that form the Garvan family. At Garvan, we see a future where we can stop disease before it starts.

Garvan Research Foundation Report



Russell Scrimshaw
Chairman



Mara-Jean Tilley
Director

In 2018 the Garvan Research Foundation, the marketing and fundraising arm of the Institute, was proud to continue its purpose of supporting Garvan scientists to make discoveries that will enhance human health now and for the benefit of future generations.

Over the course of 2018, the Garvan Research Foundation was the beneficiary of more than \$41 million dollars in donations to directly support Garvan's talented scientists, strategic programs and most innovative projects. We cannot underestimate the impact of this investment, and we thank you, our Garvan family, for your generous foresight.

The Foundation team is small yet mighty; our team is passionate, dedicated and driven. We raise the profile of our scientists, promote their work and join with other like-minded organisations to create a stronger voice for medical research. Most importantly, we are privileged to work with you – our Garvan family of supporters – to enable Garvan's vital research. Thank you!

We would like to especially acknowledge Garvan's Partners for the Future, visionary individuals who have left a gift to Garvan in their Will to provide incredibly generous and critical support for Garvan's medical research.

Just some examples of our research achievements in 2018:

- We discovered an entirely new form of DNA called the 'i-motif';
- We revealed the molecule that could be the key to better tuberculosis prevention;

- We moved closer to a potential blood test for the efficacy of chemotherapy for men with advanced prostate cancer;
- We launched an e-learning module to help physicians integrate genomics into clinical care;
- We uncovered the first-ever evidence of advanced DNA regulation in invertebrates; and
- We used cellular genomic technology to reveal how to turn human stem cells into heart cells.

The continued philanthropic investment of individuals and organisations – in particular long-term members of the Garvan family, including The Kinghorn Foundation, Mrs Janice Gibson and the Ernest Heine Family Foundation, Mr Len Ainsworth AM, Mrs Jane Hemstrich, The Bill and Patricia Ritchie Foundation, Mr & Mrs Alan and Lynne Rydge, Mr John Roth and Ms Jillian Segal AO, Mr and Mrs Bob and Ruth Magid, The Paramor Family, Mr & Mrs John and Megan Wade, Ms Lysia O'Keefe and Nelune Rajapakse AM and Anna Guillan AM from The NELUNE Foundation – has been absolutely crucial to Garvan's continued success.

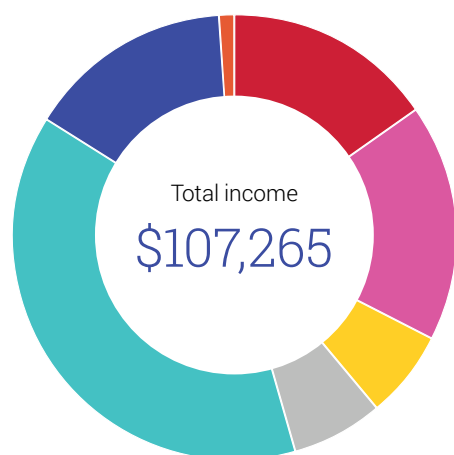
We sincerely thank our Board of Directors for their generous commitment, passion and extensive contributions.

We see a future where an individual's DNA is used to prevent, diagnose and treat disease. Thanks to your support and the dedication of our researchers, it's within reach.

The year at a glance

The Garvan Research Foundation continued to receive generous support from a wide cross section of the community during 2018 and philanthropic investment increased by \$14 million compared to 2017. The Institute continued to make significant investments in direct research support and underwriting of Garvan's scientists. In mid-2018, a restructure of Genome.One was undertaken and, as a result, the clinical diagnostics division of the business was sold to Australian Clinical Laboratories, with other divisions either wound down or their operations transferred to Garvan. During 2018, an affiliation agreement with the University of New South Wales was signed with the intention of driving closer strategic collaboration between the entities.

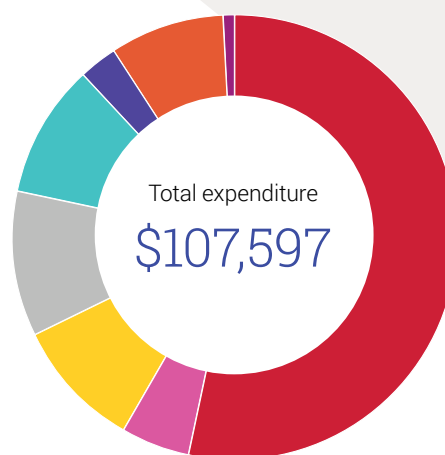
Total income



- NHMRC Grants **\$16,480**
- Other Peer Reviewed Grants **\$18,438**
- NHMRC and UNSW Infrastructure **\$7,023**
- NSW Government Support **\$7,169**
- Donations and Bequests **\$41,148**
- Sequencing and facility charges **\$15,878**
- Other Income **\$1,129**

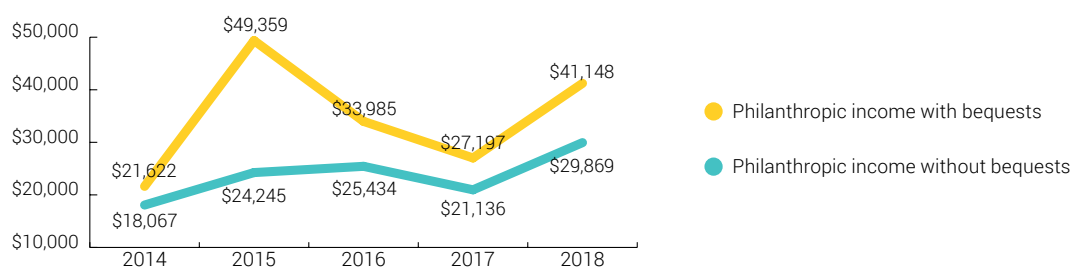
Total expenditure

As at 31 December 2018
All figures are A\$'000



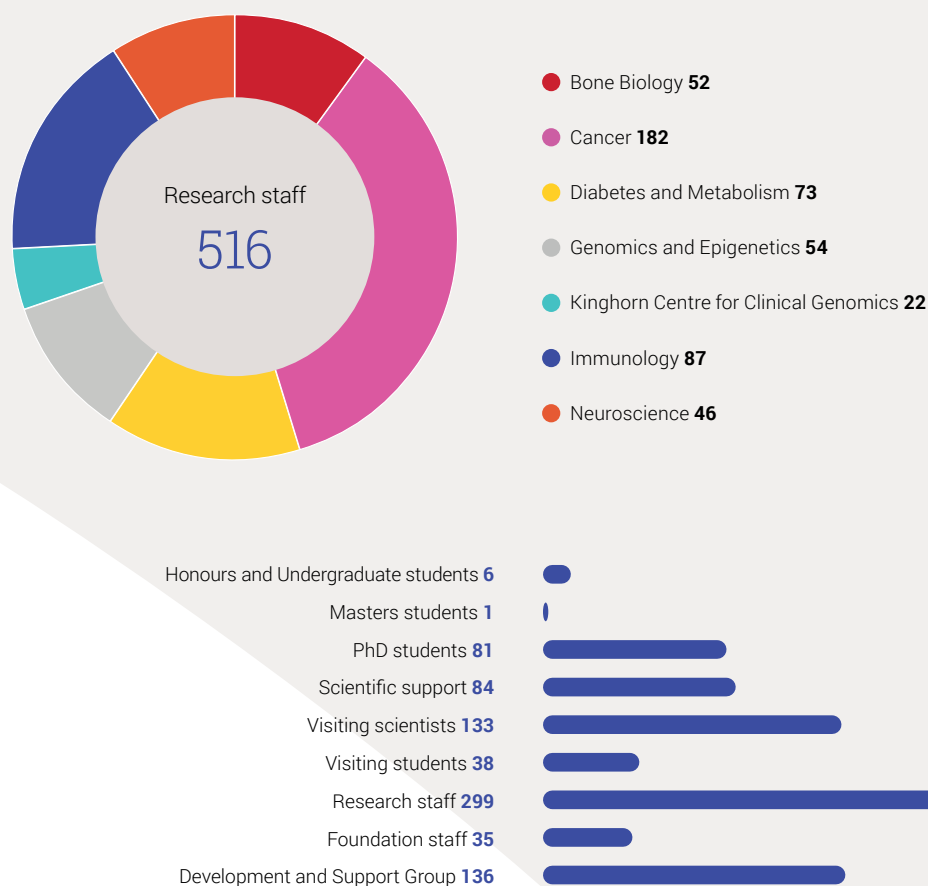
- Employment costs **\$57,386**
- Sequencing consumable expense **\$5,466**
- Research expense **\$10,278**
- Depreciation and amortisation expense **\$11,302**
- Administration expense **\$10,344**
- Fundraising and marketing investment **\$3,244**
- Building and scientific expenses **\$8,862**
- Finance costs **\$715**

Philanthropic income



Garvan at a glance

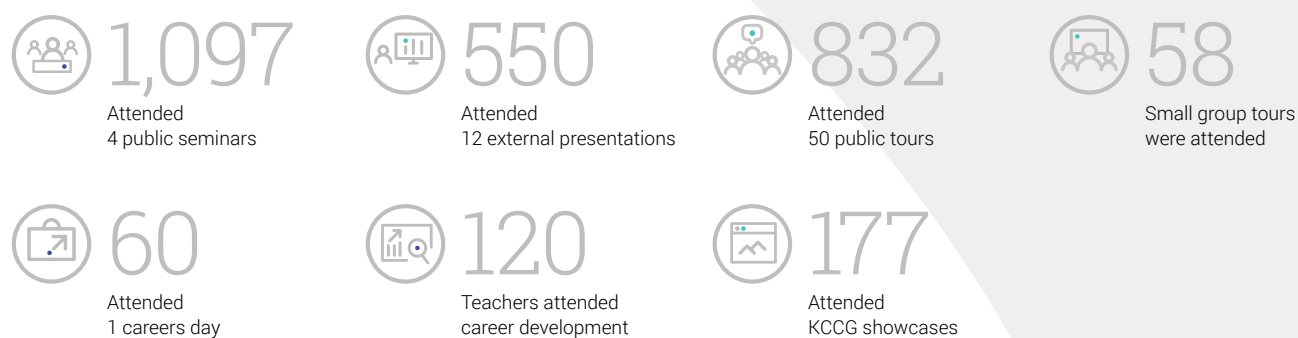
Research staff by Division As at 31 December 2018



Total staff



Public and community engagement and education

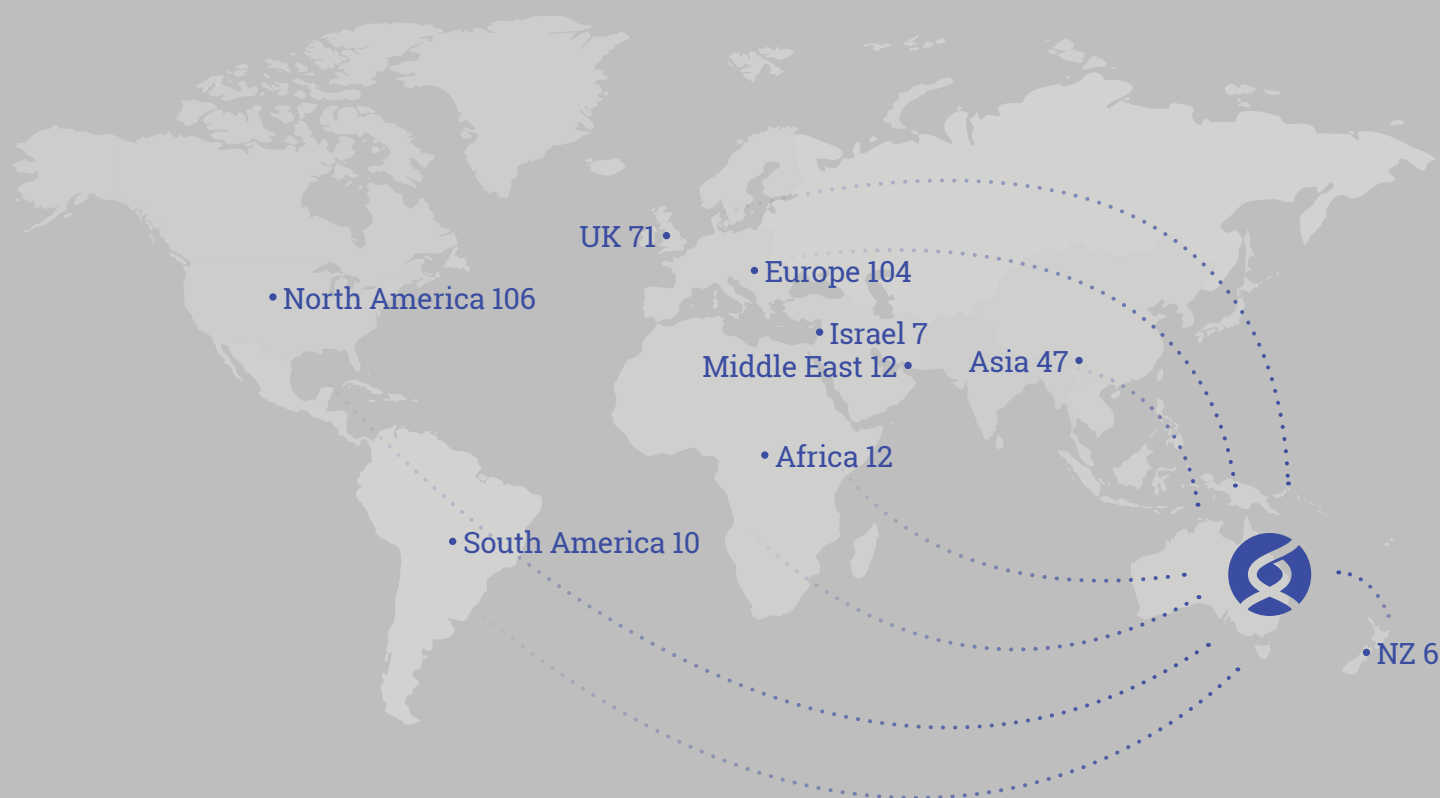


Collaborations

Collaborating around the world

Ambitious and collaborative endeavours of many kinds – both on a national and an international scale – are essential to modern medical research.

Here are the many locations that Garvan connects with to allow us to advance our ground-breaking discoveries. The numbers refer to joint publications with other institutions.



Publications



384

total publications in 2018,
including journal articles,
reports, reviews, letters
and book chapters



309

original research papers



87

publications in journals
with an impact factor
greater than 8

Top ten publications by impact factor

The impact of an academic journal is a measure reflecting the yearly average number of citations to recent articles.

Nature

Amphioxus functional genomics and the origins of vertebrate gene regulation



Science

Germinal center antibody mutation trajectories are determined by rapid self/foreign discrimination



Cell

A mild PUM1 mutation is associated with adult-onset ataxia, whereas haploinsufficiency causes developmental delay and seizures



Annual Review of Immunology

Self-reactive B cells in the germinal center reaction



Nature Reviews Genetics

Autism spectrum disorder: insights into convergent mechanisms from transcriptomics



Nature Reviews Molecular Cell Biology

Functions and mechanisms of epigenetic inheritance in animals



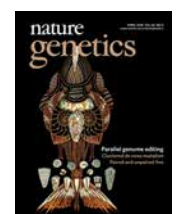
Nature Medicine

Microenvironmental control of breast cancer subtype elicited through paracrine platelet-derived growth factor-CC signaling



Nature Genetics

Plain-language medical vocabulary for precision diagnosis



Nature

Meta-analysis and the science of research synthesis



Cell

Recovering gene interactions from single-cell data using data diffusion



For a full list of
Garvan's 2018
publications,
please see page 60

Awards and achievements



Dr Dunia Alarkawi

Australia Day Award for Garvan's Dunia Alarkawi

Garvan researcher Dr Dunia Alarkawi's (Bone Biology Division) outstanding accomplishments have been acknowledged with an Australia Day Award from the National Council of Women of NSW. Dr Alarkawi's award recognises her exceptional achievements so far in her medical research career, in particular the amount she has accomplished in less than two years of PhD research.

Ridley Ken Davies Award

The 2018 Ridley Ken Davies Award was presented to Dr Liz Caldon (Cancer Division). The annual grant, which honours Mr Ken Davies, a Ridley employee who sadly passed away from cancer in 2015, supports an early to mid-career Garvan researcher to test an innovative research idea. Dr Caldon will use the award to analyse which proteins in breast cancer change as a tumour is developing resistance to a promising new class of drugs called 'CDK4/6 inhibitors'. The outcome of this project will be the identification of potential diagnostic markers of resistance and drug targets, with the aim of developing new clinical tools for advanced breast cancer.

The 2018 Champ Young Pioneer Award

This annual award from Champ Private Equity was awarded to Dr Michelle McDonald (Bone Biology Division). The award is granted to a young researcher to test an early stage idea in an innovative research project. Dr McDonald will use the award in her work understanding how to stop the growth of cancers that spread (or metastasise) to bone. She will use a specific imaging technique to study how tumour cells interact with bone cells, and the effects on this interaction of drugs that prevent bone resorption.

The Heliflite Award

This award supports two of Garvan's most outstanding early career researchers, to facilitate international travel to conferences and laboratories to foster their career development. The 2018 winners are Dr Maria Findeisen (Diabetes and Metabolism Division) and Dr Nathan Zammit (Immunology Division). Dr Findeisen is interested in the development of drugs to treat obesity-induced metabolic disease. In December she traveled to the 18th International Congress of Endocrinology in Cape Town, South Africa to present her work. Dr Zammit will spend 8-9 weeks at the University of Alberta in Edmonton, Canada in the lab of a collaborator to learn techniques using pig pancreatic islet cells in his work on islet transplantation for type 1 diabetes.

Estée Lauder Breast Cancer Awards

Estée Lauder Companies presented two awards to talented young breast cancer researchers at Garvan, Dr Simon Junankar and Dr Neil Portman, to support them in investigating a novel breast cancer research concept.

The two awards mark the 25th anniversary of The Estée Lauder Companies' Breast Cancer Campaign and were presented at Garvan's annual breast cancer community forum, From The Breast Cancer Lab To You. Each award will support the researchers to progress their projects to a stage where they have sufficient data to ensure they are competitive for peer reviewed funding. Dr Junankar, Senior Research Officer in the Tumour Progression Laboratory will use his award to investigate how breast cancer evades a patient's immune response. Dr Portman, Senior Research Officer in the Connie Johnson Breast Cancer Research Laboratory will use his award to investigate how some breast cancers develop a resistance to a class of drugs called hormone or endocrine therapies. It is hoped this will help inform strategies to prevent endocrine therapy resistance and to improve patient outcomes.

William E Paul Memorial Award

Professor Chris Goodnow was awarded the William E Paul Memorial Award by the Foundation for Primary Immunodeficiency Diseases, in Newport Beach, California.

The prestigious award recognises excellence in immunology and cell biology, and cites Chris' seminal contributions to understanding how the body functions in autoimmune diseases.



Dr Liz Caldon



Dr Michelle McDonald



Dr Simon Junankar and Dr Neil Portman

Pancreatic cancer leader honoured in Queen's Birthday list

Professor Anthony Gill FRCPA, was named a Member of the Order of Australia in the 2018 Queen's Birthday Honours list. Professor Gill was awarded an AM 'for significant service to medical research in the field of surgical pathology as an academic, author, adviser and mentor'. A leading pathologist and pancreatic cancer researcher, Professor Gill holds a research position at Garvan, where he chairs the Australian Pancreatic Cancer Genome Initiative, and at University of Sydney, where he is Professor of Surgical Pathology. In addition, he is a Senior Staff Specialist at Royal North Shore Hospital.

Eight new NHMRC fellowships

The eight Research Fellowships from the National Health and Medical Research Council to Garvan researchers were in recognition of their outstanding research into cancer and cancer epigenetics, antibody therapies, immunology, and neurodegenerative disease.

Professor Susan Clark FAA received a Senior Principal Research Fellowship. Senior Research Fellowships went to Associate Professor Daniel Christ, Associate Professor Tri Phan and Associate Professor Alex Swarbrick. Career Development Fellowships were awarded to: Dr Thomas Cox, Dr Marina Pajic and Dr Ozren Bogdanovic. Simon Hardwick received a CJ Martin Biomedical Early Career Fellowship.

The 2018 Pathfinders Award

Dr Venessa Chin will be exploring new ways to match therapies to lung cancer patients, thanks to support from Pathfinders – a Sydney-based collective group with a mission to support cancer research at Garvan. The Pathfinders Award 2018 will enable her to kickstart an innovative new project to 'fingerprint' lung cancer – which could one day help clinicians decide on the most effective treatment for each patient.

AI & Val Rosenstrauss Fellowship

Dr Andy Philp was awarded the AI & Val Rosenstrauss Fellowship, generously provided by The Rebecca L. Cooper Medical Research Foundation. Dr Philp, group leader of Garvan's Mitochondrial Metabolism and Ageing Laboratory, aims to harness the effects of exercise into therapies for diseases of ageing.

The Fellowship will provide funds for four years. With this support, Dr Philp will study the relationship between reduced mitochondrial function and the onset of sarcopenia, and test whether increasing mitochondrial function with BGP-15, a small pharmaceutical compound, can prevent the onset of sarcopenia, with the goal of finding a viable treatment strategy to combat sarcopenia and promote healthy ageing.

Millennium Award from Diabetes Australia

Professor Jerry Greenfield from Garvan's Diabetes and Metabolism Division and St Vincent's Hospital Department of Diabetes and Endocrinology received one of two Diabetes Australia Millennium Research Awards of \$150,000. The award will support Professor Greenfield's novel study of insulin resistance in people with type 1 diabetes – a group who have previously been thought only to have a defect in insulin production.

The Palmer Innovation Prize

Provided by Joseph Palmer & Sons, this annual prize encourages research innovation at Garvan and recognises the development of a product, process or technology. It was presented to Dr Nenad Bartonicek and his team: Dr Martin Smith, Mr James Ferguson and Dr Kirston Barton. The team has formed a small company, Cerebro Biosystems, to develop a diagnostic test for microbial infections using real-time DNA sequencing.

Garvan makes a splash at Lorne Genome Conference

The Lorne Genome annual meetings are a highlight in the research calendar for many at Garvan, and 2018 was no exception. Scientists from across Garvan travelled to Lorne, Victoria in February to present their work at the 39th Lorne Genome Conference, and four researchers – Dr Marina Pajic from the Cancer Division, and PhD students Qian Du, Ira Deveson and Katherine Giles from the Genomics and Epigenetics Division – received awards at the event.

We see a future where
we're able to stop
disease before it starts.

It's within reach.





Division Report

Bone Biology



From the Head

Professor Peter Croucher

In the Bone Biology Division, we examine skeletal diseases, focusing particularly on osteoporosis, on rare diseases of bone, and on cancers that grow in bone. All these diseases

share profound clinical consequences, particularly fractures, which have a stark impact on quality of life and dramatically worsen prognosis. I'm often struck by how our work on one disease informs our understanding of another, and I'm proud that we communicate these insights with one another, and with researchers around the world, to accelerate progress towards improved outcomes for skeletal disease.

The skeleton is anything but inert. Bone cells are constantly building and breaking down bone, immune cells are 'growing up' inside the bone marrow, the bone is acting on signals from elsewhere in the body and sending information back, and sometimes, cancer cells are taking up residence.

For the first time, we're in a position to explore this activity in extraordinary detail, at the level of individual cells and genes. We are examining the entire transcriptome (all the genes 'switched on' in a cell) of cells in bone, and we are using cutting-edge imaging technology to watch how individual cells in bone behave, in real time and in living animals.

We're also exploring the genome of people, in combination with rich information about their bone health, to help understand which genes are most important in controlling our skeleton. All this information will help us better predict, prevent and treat diseases of bone.

The Bone Biology Division has a strong clinical team who focus on osteoporosis and on fracture prevention. Our dual research and clinical focus is a particular strength of our Division, and helps ensure that our research is always squarely aimed at improving outcomes for individuals.

Much of our work is being made possible through the outstanding support of Mrs Janice Gibson and the Ernest Heine Family Foundation.

Research highlight

Broken bones and the risk of death

A broken bone in an older person increases their risk of death – and the risk stays high for up to 10 years, according to a study published in the *Journal of Clinical Endocrinology & Metabolism*. Hip fractures are known to increase the mortality risk, but this study confirms that breaking a different bone (which accounts for more than two-thirds of all fragility fractures) also increases the risk. It is also the first study to report how long the heightened mortality risk lasts for different fractures.

Importantly, the risk of dying is highest in the year immediately after the fracture.

"The heightened risk can last for over a decade after a hip fracture, and for most other fractures (apart from distal or minor fractures), the increased risk is for about five years," said Professor Jacqueline Center, who led the study.

"A fracture is the starting point for much wider health issues that persist long after the bone has healed and can ultimately result in earlier death. Our findings emphasise just how crucial early intervention is. We need to understand the risk of breaking a bone before the fracture happens and treat that individual accordingly."

*Tran et al., J Clin Endocrinol Metab 2018;103:3205-14.
doi: 10.1210/jc.2017-02656*

Research highlight

The atlas of 'osteoporosis genes'

A study by an international research team has compiled an 'atlas' of genetic factors associated with bone mineral density, a key risk factor for fragility fractures. Published in *Nature Genetics*, the study identifies over 500 sites across the human genome that determine bone mineral density.

Bone Biology

Professor Peter Croucher, who led Garvan's contribution to the study, says, "This is the largest ever study of its kind – and it defines the landscape of genes that are believed to control the amount of bone in our skeleton." The study looked at genetic markers and bone mineral density in almost half a million individuals from the UK Biobank.

The findings in humans were also tested in mice and showed similar changes, illustrating that these genes have a functional role.

The study identifies many potential targets for future osteoporosis drug development. The search for new drugs is crucial because existing treatments cannot rebuild bone, but only slow the rate of bone loss.

Morris et al., Nat Genet 2019;51:258-66; published online 31 Dec 2018. doi: 10.1038/s41588-018-0302-x

Research highlight

A missing link between brain, blood sugar and bone mass

When we gain or lose weight, our skeleton has to adjust accordingly: the heavier we are, the stronger our bones need to be. A study by Garvan's Bone Biology and Neuroscience Divisions has uncovered how the brain, bone and the bloodstream communicate with one another to coordinate weight changes and bone mass.

The researchers, led by A/Prof Paul Baldock (Bone Biology) and Prof Herbert Herzog (Neuroscience), zeroed in on a molecule called osteoglycin. Working with mice, the researchers found that osteoglycin is important in situations of changing energy balance (when weight is being gained or lost). In obesity, they found, osteoglycin is blocked. This has the effect of making more glucose available to form bone, which strengthens the skeleton. Conversely, in weight loss situations, osteoglycin is activated – so that the buildup of bone is limited.

Importantly, osteoglycin appears to act in a similar way in people who have undergone gastric band surgery, so it may be important for regulating energy and bone mass in humans too.

The study advances our understanding of the body's remarkable ability to deal with changes in energy availability.

Lee et al., Mol Metab 2018;13:30-44. doi: 10.1016/j.molmet.2018.05.004

News highlight

A decade of the fracture risk calculator

March 2018 marked the 10th anniversary of the Garvan Fracture Risk Calculator. Distilled from decades of research from Garvan's Dubbo Osteoporosis Epidemiology Study, the calculator is a deceptively simple tool that can uncover a person's risk of fracture due to osteoporosis. The calculator gets tens of thousands of visits every year and has helped transform the clinical management of osteoporosis worldwide.

In the 10 years since it was launched, the calculator has been further streamlined and refined. In particular, new findings make it clear that when genetic information is added, the calculator can predict individual fracture risk with even greater accuracy. And in 2016, a version of the calculator was integrated into Know Your Bones – an app that helps people to assess their own risk of fracture, and supports them to make wise health choices in discussion with their GP. Know Your Bones was developed by Osteoporosis Australia and Garvan.

Bone Biology Research Laboratories and Groups

Bone Biology Lab

Head: Prof Peter Croucher

Bone Microenvironment Group

Leader: Dr Michelle McDonald

Bone Therapeutics Lab

Head: Prof Mike Rogers

Imaging and Inflammation Group

Leader: Dr Marcia Munoz

Clinical Studies and Epidemiology Lab

Head: Prof Jacqueline Center

Genetic Epidemiology of Osteoporosis Lab

Head: Prof Tuan Nguyen

Osteoporosis and Translational Research Lab

Head: Prof John Eisman AO

Skeletal Metabolism Lab

Head: A/Prof Paul Baldock

Ellie's story:

From intensive care to the playground



Ellie, now two, with mum Mina and dad Rob. Image courtesy of the Zero Childhood Cancer personalised medicine program.

“We were told to think about saying goodbye, she was so sick we didn’t even know if she would reach her first birthday. Today she is such an active and energetic two-year-old... beyond our wildest dreams. We can’t thank the teams at Sydney Children’s Hospital and Children’s Cancer Institute enough.”
– Mina, Ellie’s Mum

If Ellie had been diagnosed two years earlier, she would have died. But the Zero Childhood Cancer trial and generous Lions support mean Ellie’s story has a happy ending.

Two years ago, Mina and Rob gave birth to a beautiful baby girl — Ellie. All seemed well, yet only 11 months later, Ellie was admitted to the Sydney Children’s Hospital, Randwick. A scan revealed a tumour in her chest so large it was pushing her tiny heart and lungs to one side. Within days, she was on life support, no longer able to breathe. The tumour was aggressive, rare and resistant to chemotherapy.

Ellie’s case was immediately referred to the Zero Childhood Cancer program, Australia’s child cancer personalised medicine program. The world-first clinical trial, led by Children’s Cancer Institute and the Kids Cancer Centre at Sydney Children’s Hospital, Randwick, uses complex genomic tests including whole genome sequencing and dedicated drug discovery research to identify personalised treatments for children with serious and aggressive cancers.

The teams jumped to find out what was pushing Ellie’s cancer to grow so large — and how it might be stopped. Through Genome Power (the Lions Kids Cancer Genome Project, funded by the Lions Clubs International Foundation and the Australian Lions childhood Cancer Research Foundation), Garvan scientists sequenced the whole genome of Ellie’s tumour. Then, at speed, they worked with the Zero Childhood Cancer team to zero in on the specific genetic change that was driving the cancer. Whole genome sequencing and other tests identified Ellie’s cancer as infantile fibrosarcoma with a rare ‘translocation’ — a reorganisation of DNA — that was likely to be driving her cancer’s growth.

The Zero Childhood Cancer team were then able to identify a drug that targeted the particular genetic change. The timing was just right. The drug had very recently been discovered, and the US company Loxo Oncology agreed to provide it on compassionate grounds, so treatment could begin.

Within four weeks of beginning treatment, Ellie’s cancer had shrunk to a point where she could breathe on her own and no longer needed life support. And six weeks later, she was home. This targeted therapy also appears to be both more effective and less toxic than standard chemotherapy.

Now, a clinical trial of larotrectinib, the drug used to treat Ellie, is open in Australia for all children whose cancer is identified by the Zero Childhood Cancer program as having the same genetic marker. This means that the work done to save Ellie will help other children as well.

One year since its launch, Zero Childhood Cancer has produced remarkable results for children like Ellie. Almost 130 children with serious and aggressive cancers have been enrolled. This state-of-the-art personalised medicine clinical trial aims to give them the best possible chance of survival and quality of life.

As Ellie’s mum Mina explains, “We were told to think about saying goodbye, she was so sick we didn’t even know if she would reach her first birthday. Today she is such an active and energetic two-year-old... beyond our wildest dreams. We can’t thank the teams at Sydney Children’s Hospital and Children’s Cancer Institute enough.”



Division Report

Cancer



From the Head

Professor David Thomas

Our cancer program is very broad and addresses almost every cancer type — from the most common to the rarest types, from cancer in children to breast and pancreatic cancer, sarcomas and many more.

Cancer is fundamentally a genetic disease — and occurs when cells lose control of their genome and begin to proliferate wildly. It's a disease that shifts and changes as it develops — irrespective of where it's located in the body. So we need to come at cancer from every angle.

We use genomic technologies including cellular genomics, complex data modeling, and devise new detection methods to treat and ultimately prevent cancer growth. And more commonly this means using precision medicine to target treatment at the particular cancer types, based on the tumour's DNA. It can also mean repurposing existing drugs to find new therapeutic targets.

We are collaborative by nature, and The Kinghorn Cancer Centre, which houses many of our labs and groups, aligns our research with cancer services at St Vincent's Hospital, to facilitate rapid translation to the clinic and develop innovative approaches in personalised medicine.

The main goal of The Kinghorn Cancer Centre is to realise the promise of innovative personalised medicine for people affected by cancer, which simply would not be possible without the generosity and foresight of The Kinghorn Foundation and our visionary donors.

A major achievement in 2018 was the establishment of the Australian Genomic Cancer Medicine Program; see our story on page 19. This program, which enrolled its thousandth patient in December, established The Kinghorn Cancer Centre as the epicentre of Australian precision oncology.

Research highlight

Understanding pancreatic cancer's moving targets

In a pioneering study, Associate Professor Paul Timpson and his team have discovered a new approach to fight treatment-resistant regions within pancreatic cancer — one of the world's deadliest cancers. For the first time, they have monitored these drug-resistant regions in pancreatic tumours as they travel, spread and grow in real time — and are finding new ways to neutralise these moving targets.

Regions of low oxygen, which move around within tumours, are a hallmark of pancreatic tumours. Importantly, these travelling pockets of low oxygen are resistant to treatment.

To tackle this problem, Associate Professor Timpson and his team developed an innovative live tracking approach, allowing them to observe the drug response of these treatment-resistant compartments in pancreatic tumours.

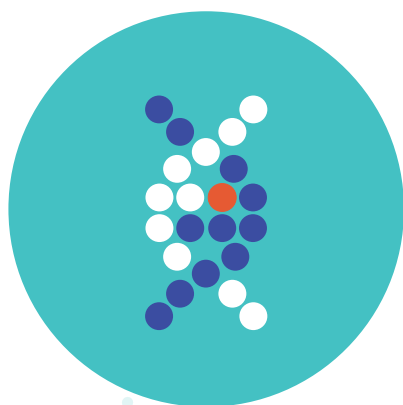
Beyond pancreatic cancer, these results have the potential to change the wider landscape of cancer treatment. Treatment resistance as a result of low oxygen is a fundamental problem across many cancers, and these findings are likely to have a broad impact in paving the way to more effective cancer therapies.

Conway et al., Cell Rep. 2018 Jun 12;23(11):3312-3326. DOI: 10.1016/j.celrep.2018.05.038

Research highlight

Turbo-charging chemotherapy for lung cancer

A naturally occurring hormone could help make chemotherapy much more effective for many Australians with lung cancer. The hormone — follistatin — also appears to prevent kidney damage, a serious side effect of chemotherapy.



Despite advances in immunotherapy for lung cancer, most patients are still treated with chemotherapy based on a drug called cisplatin. However, less than a third of these patients will see benefits, and they often develop serious side effects including kidney damage.

In an effort to improve outcomes for lung cancer patients, Professor Neil Watkins, Petre Chair in Cancer Biology, and his team discovered that a protein called activin is a culprit in both chemotherapy resistance and chemotherapy-induced kidney damage.

Professor Watkins says the use of follistatin is likely to be a safe and effective approach to making chemotherapy more effective in lung cancer. "Because follistatin is a hormone already found in the human body, there is much less potential for toxicity than with other drugs used to reduce chemoresistance."

Marini et al., Sci Transl Med. 2018 Jul 25;10(451). pii: eaat3504. DOI: 10.1126/scitranslmed.aat3504

Research highlight

We can see living cells clearly now

A new software created here at Garvan allows us to see, far more clearly than ever before, what is happening in the body.

Understanding how molecules and cells behave in living animals can give us key insights into what goes wrong in diseases such as cancer, and how well potential treatments for these diseases work. High resolution microscopy makes it possible to image events happening in single cells, or even specific parts of a cell. However, small movements like those due to the heartbeat can blur the images, making it difficult to study living animals.

Dr Sean Warren and his team have developed a new software tool called Galene. The tool can correct for small movements in images collected by a technique called fluorescence lifetime imaging microscopy. As a result, clear images can be captured in situations

that were not previously possible. For example, the researchers watched cancer cells migrating to the liver of a mouse from the spleen over 24 hours. Using a fluorescent biosensor, they showed that a repurposed drug interferes with how well the cells can attach to the liver.

Galene could help researchers study a wide range of biological processes in living animals. The software can also be applied to existing data to clarify blurred images.

Warren et al., eLife 2018;7:e35800. DOI: 10.7554/eLife.35800.001

Research highlight

Promising new breast cancer treatment

Our researchers have found a molecule that reduces the spread of cancer, slows tumour growth, increases sensitivity to chemotherapy and improves survival in mouse models.

Surprisingly, the potential treatment targets non-cancerous cells within breast tumours, instead of the cancer itself. The team found that triple negative breast tumours – which are the most aggressive and have the fewest treatment options – could be susceptible to an existing drug. It works by stopping tumour cells from 'talking' with nearby normal cells, which effectively stops tumour growth.

The collaboration between our researchers Dr Aurélie Cazet, Dr Mun Hui and Associate Professor Alex Swarbrick, the Centre for Cancer Biology (Adelaide) and GEICAM (Spain's leading breast cancer research group) was supported by funding from Love Your Sister, John and Deborah McMurtrie, the National Breast Cancer Foundation, RT Hall Trust and Novartis. The researchers will next explore whether this has potential to work on other cancer types that behave in the same way.

Cazet et al., Nat Commun. 2018 Jul 24;9(1):2897. DOI: 10.1038/s41467-018-05220-6

Division Report

Cancer

Research highlight

Some tumours have a pause button

When cancer cells break away from the primary tumour, they travel elsewhere and can grow into secondary tumours. New research from Dr Christine Chaffer and her team has uncovered a natural process in breast cancer, in which some primary tumours can signal the immune system to follow the breakaway cells and 'freeze' them. In this 'frozen' state, the cells can't grow effectively – thereby stopping secondary tumour growth in its tracks.

"We know the response is a consequence of the tumour eliciting an immune reaction. We want to understand exactly what the tumour is releasing to activate this response, and how immune cells are targeting the secondary sites," explains Dr Chaffer.

The hope is that if we can exploit this signaling process in breast cancer, we may find controls that pause other types of cancer as well. Dr Chaffer holds the Rebecca Wilson Fellowship in Cancer Research, funded by The NELUNE Foundation.

*Castaño et al., Nat Cell Biol. 2018 Sep;20(9):1084-1097.
DOI: 10.1038/s41556-018-0173-5*

Celebrating giving

Vanessa Juresic: changing the world for the better

Vanessa Juresic was 36 years old and dreamt of starting a family with her partner – instead an insidious disease ripped those dreams away.

She was diagnosed with stage four triple negative breast cancer, which is particularly aggressive and difficult to treat – with survival rates of less than 12 months if chemotherapy doesn't help.

Ms Juresic's friends set up a GoFundMe page to help her go on one last adventure, but she tragically passed away on May 11. It was her generous and visionary wish that the money raised should instead support the research of her oncologist and breast cancer researcher at Garvan, Associate Professor Elgene Lim. A total of \$34,000 has since been raised.

Her final letter to friends and family, full of life lessons and courageous advice, was read at her funeral and later shared online.

"In a world where you can be anything ... be kind. And don't let anyone make you cruel. No matter how badly you want to give the world a taste of its own bitter medicine, it is never worth losing yourself."
– Vanessa Juresic.

Cancer Research Laboratories and Groups

Clinical Cancer Research

Coordinated by Prof David Thomas and A/Prof Elgene Lim

Connie Johnson Breast Cancer Research Lab

Head: A/Prof Elgene Lim

Genomic Cancer Medicine Lab

Head: Prof David Thomas

Immunobiology of Cancer Group

Leader: Dr Maya Kansara

Genetic Cancer Risk Group

Leader: Dr Mandy Ballinger

Australian Pancreatic Genome Initiative

Head: Prof Anthony Gill

Clinical Prostate Cancer Research Group

Leader: Prof Lisa Horvath

Hormones and Cancer Group

Leader: Dr Ann McCormack

Translational Cancer Research

Coordinated by Dr Alex Swarbrick and Prof Sandra O'Toole

Tumour Progression Lab

Head: Dr Alex Swarbrick

Translational Breast Cancer Research Group

Leader: Prof Sandra O'Toole

Cancer Biology Research

Coordinated by Prof Chris Ormandy

Cancer Biology Lab

Lab Head: Prof Chris Ormandy

Cell Survival Group

Leader: Dr Samantha Oakes

Replication and Genome Stability Group

Leader: Dr Liz Caldon

Tumour Development Group

Leader: Dr David Gallego-Ortega

Cancer Cell Plasticity Lab

Head: Dr Christine Chaffer

Cancer Developmental Biology Lab

Head: Prof Neil Watkins

Network Biology Group

Leader: Dr David Croucher

Invasion and Metastasis Lab

Head: A/Prof Paul Timpson

Matrix and Metastasis Group

Leader: Dr Thomas Cox

Personalised Cancer Therapeutics Lab

Head: Dr Marina Pajic

Single Cell and Computational Genomics Lab

Head: A/Prof Joseph Powell

Taking genomic cancer medicine national



The Hon. Greg Hunt, Minister for Health



Prof David Thomas, The Hon. Greg Hunt, Kate Vines and Richard Vines

“This funding is a game changer for precision cancer medicine in Australia. The expansion of the program enables patients with rare cancers to access this critical trial closer to home, giving hope to those who have exhausted all other options.”
– Prof David Thomas

The Australian Genomic Cancer Medicine Program launched in July, with Federal Minister for Health, The Hon. Greg Hunt MP, announcing \$50 million in funding over five years — the largest ever genomics grant in Australia.

An innovative clinical trial program developed at the Garvan Institute, matches therapies to individuals with rare and uncommon cancers on the basis of their unique genetic information. The funding will enable patients based outside of New South Wales to access potentially lifesaving clinical trials in their home state.

“This funding is a game changer for precision cancer medicine in Australia. The expansion of the program enables patients with rare cancers to access this critical trial closer to home, giving hope to these individuals who have exhausted all other options. Further, their participation will see a radical shift in our understanding of rare and uncommon cancers to help the patients of tomorrow,” said Professor David Thomas, head of the Australian Genomic Cancer Medicine Program, Director of The Kinghorn Cancer Centre and Head, Cancer Division at the Garvan Institute.

The original Genomic Cancer Medicine Program was made possible by an investment of \$7 million over four years by the NSW Government. Since October 2016, over 1000 Australians with early onset, rare and less common cancers have travelled from all over Australia to The Kinghorn Cancer Centre to participate in these Garvan-led research studies and clinical trials.

“Rare and uncommon cancers account for over 50% of cancer deaths every year, and there is high demand for the Australian Genomic Cancer Medicine Program in the community. This funding will enable us to provide better access to this transformative trial, not just in Sydney but across Australia.”


Centred at the Garvan Institute, and with the support of the NHMRC-Clinical Trial Centre, this partnership will bring together clinicians, researchers, government, industry and patients. The program will be made available at:

- St Vincent’s Hospital, NSW
- Peter MacCallum Cancer Centre, VIC
- Canberra Hospital, ACT
- Royal Adelaide Hospital, SA
- Princess Alexandra Hospital, QLD
- Sir Charles Gairdner Hospital, WA
- Royal Hobart Hospital, TAS
- Royal Darwin Hospital, NT

The program is supported by Rare Cancers Australia, CanTeen, Cancer Voices, Brain Tumour Alliance Australia, Pancare Foundation, #PurpleOurWorld, Ovarian Cancer Australia, CanToo and the Unicorn Foundation. Philanthropic partners include Paul and Wendy Jeans, The NELUNE Foundation, AccorHotels, Paspaley and the Vodafone Foundation.

The program has built collaborations with the pharmaceutical, biotech and imaging industries, including Pfizer, AstraZeneca, Eisai, LOXO, Roche and Illumina, along with local business Linear. The AGCMP collaborates with the Clinical Oncology Society of Australia, Genomics England, the US National Institutes of Health and the International Rare Diseases Research Consortium.

The ability to expand this program nationwide would not have been possible without the vital contributions of the patients, whose participation has laid the foundation for the expansion of this innovative clinical trial.



We see a future where
an individual's DNA is
used to prevent, diagnose
and treat disease.

It's within reach.



Division Report

Diabetes and Metabolism



From the Head

Professor Mark Febbraio

Diabetes is now classed as a pandemic – and is fast becoming one of the biggest challenges for our health system. The incidence of type 2 diabetes is increasing in tandem with the rapid rise of

obesity. Obesity is also associated with other debilitating chronic conditions such as cardiovascular disease, cancer, Alzheimer's disease and asthma.

The Diabetes and Metabolism Division contributes to the worldwide effort to understand the relationships between genetics, the environment and the development of diabetes. With expertise in fundamental science and clinical research, one of our aims is to build an accurate picture of how obesity precipitates diabetes. We look at the molecular and genomic level as well as the interplay of diet, appetite and exercise.

Our teams are particularly interested in how fat and sugar contributes to diabetes, and how insulin fails to work properly in sufferers. This will all lead to better tools to predict, prevent and treat metabolic diseases in the near future.

It has been a privilege to work at Garvan for the last three and a half years – in early 2019 I'll be returning to Melbourne to take up a position at Monash University. I would like to thank everyone at Garvan, the many fruitful collaborations and my inspiring colleagues in the Division.

Research highlight

The mysterious interior world of exercise

When we exercise, far-flung parts of our bodies communicate with one another. This is due to tiny, particle-filled balloons that move purposefully through the bloodstream from one cell to another, carrying biochemical messages, according to an important new study undertaken by Professor Mark Febbraio and his team.

The study helps to clarify some of the body-wide health effects of working out and also underscores just how physiologically complex exercise is.

Vesicles are microscopic protein-filled packages within cells that contain tiny bits of biological material. Released into the blood, they once were thought to hold cellular garbage, as if the cells were heaving out their trash. But we now know that vesicles can also contain useful matter, including tiny amounts of genetic material and proteins that convey biological messages to other cells.

The scientists found that exercise prompts the creation of vesicles that somehow know to go to the liver and tell it to ramp up energy production.

The results also provide new insights into how exercise pervasively affects our metabolism. It has not been altogether clear before, for instance, how the liver knows that exercise is underway and that cells far removed from that organ need energy.

*Whitham et al., Cell Metab. 2018 Jan 9;27(1):237-251.e4.
DOI: 10.1016/j.cmet.2017.12.001*

Research highlight

Deciphering dangerous messages from fat

We all carry a certain amount of fat – but did you know that fat sends messages to the immune system that can affect our risk of diabetes and other diseases? Researchers from Garvan and the Baker Institute are making sense of how these messages are sent, and how they might be intercepted to halt the development of disease.

In obese individuals, fat pushes the immune system into 'inflammation mode' – but crucially, fatty tissue in leaner individuals doesn't have the same effect. Researchers think this is why such a wide range of diseases are more common in the obese.

Division Report

Diabetes and Metabolism

Now, an Australian research team including Garvan researchers has published new findings that help uncover precisely how fatty tissue in obese individuals triggers inflammation. Their research up-ends our understanding of how 'obese fat' talks to the immune system – and points to new possibilities for future therapies.

The findings open up several new approaches to halting obesity-induced inflammation. In particular, targeting the changes to membranes is a promising approach for therapeutic discovery. "This will accelerate drug discovery for type 2 diabetes and a wide range of obesity-associated diseases," says Professor Mark Febbraio.

Lancaster et al., Cell Metab. 2018 May 1;27(5):1096-1110.e5. DOI: 10.1016/j.cmet.2018.03.014

Research highlight

Does fat drive diabetes?

Our researchers have discovered that, beyond the liver and the pancreas, one of the root causes of diabetes may lie in fat tissue. This could have important implications for the development of treatments.

Associate Professor Carsten Schmitz-Peiffer and his team have examined the protein PKCε, long known to be involved in the worsening of diabetes. In mice, removing PKCε from all tissue protects them from becoming diabetic. PKCε has always been assumed to be working in the liver, but upon removal in the liver alone, they found the mice were not protected.

Remarkably, they have now found that removing PKCε from fat tissue protects the mice from becoming diabetic – indicating that fat tissue may be playing a major role in the progression of disease.

Currently, the team is collaborating with the Monash Institute of Pharmaceutical Sciences to develop an orally available peptide that can disrupt PKCε activity. Therapeutically targeting PKCε, and fat tissue, would be a brand new approach to treating diabetes.

Brandon et al., Cell Metab. 2018 Oct 8. pii: S1550-4131(18)30578-3. DOI: 10.1016/j.cmet.2018.09.013

Diabetes and Metabolism Research Laboratories and Groups

Beta Cell Regeneration Lab

Head: Dr Daniel Hesselton

Beta Cell Signalling Lab

Head: Prof Trevor Biden

Cellular and Molecular Metabolism Lab

Head: Prof Mark Febbraio

Myokine Biology Group

Leader: Dr Martin Whitham

Mitochondrial Metabolism and Ageing Group

Leader: Dr Andy Philp

Clinical Diabetes, Appetite and Metabolism Lab

Heads: Prof Lesley Campbell and Prof Jerry Greenfield

Clinical Insulin Resistance Group

Leader: Dr Dorit Samocha-Bonet

Prader-Willi Syndrome and Genetic Forms of Diabetes Group

Leader: Dr Alexander Viardot

Clinical Obesity, Nutrition and Adipose Biology Lab

Head: Prof Katherine Samaras

Insulin Signalling Lab

Head: A/Prof Carsten Schmitz-Peiffer

Islet Biology Lab

Head: A/Prof Ross Laybutt

A pioneering partnership



Chris Paspaley and Dr Mandy Ballinger

"My grandfather Nicholas Paspaley founded the company and I grew up hearing stories of his generosity and focus on community. I believe as a company we share these same values today. As a family, we have chosen to primarily focus on causes committed to supporting children and cancer," says Chris Paspaley, Director of Merchandise, Retail.

Paspaley created the Kimberley Bracelet – featuring sandalwood, onyx and hand-selected Paspaley pearls, and donates 25% of the sale to cancer research at Garvan.

Two years ago, Garvan and Paspaley formed a partnership committed to progressing Garvan's cancer research. Through donations from its Kimberley Bracelets, Paspaley provides considerable support to Garvan's pioneering Molecular Screening and Therapeutics clinical trail.



Dr Holly Holliday



"I had always wanted these bracelets to give back to the community, so it was natural to partner the Kimberley Bracelet with the charity that had inspired me the most. We have received an overwhelming response from this design. Each client has not only supported the initiative, but shared their stories with us, which is amazing!"
– Chris Paspaley



We see a future
where prevention
is the cure.

It's within reach.

Image by Dr Kate Patterson



Division Report

Genomics and Epigenetics



From the Head

Professor Susan Clark FAA

Epigenetics is an exciting and relatively new field of DNA research. The DNA structure was discovered in the 1950s, and it was fully sequenced in the 2000s, but interestingly

we still don't fully understand how it's read and interpreted differently in each cell type.

At Garvan, we use sequencing every day to study diseases — but we need to know more than just the DNA sequence — it's *how* the code is read differently in each cell that can reveal the influence and impacts on disease.

Epigenetics provides the grammar to our DNA in the form of chemical modifications that are different in each cell type and influence how genes are expressed, or read, as we develop and age. DNA methylation (which compacts the DNA) and histone modification (which can open and close DNA) are two of these modifications we study closely.

The new tools we're developing to sequence and read methyl and histone tags bring us closer to deciphering the blueprint of life, which we call the epigenome. Our big data analysis and 3D visualisation techniques help us interpret that blueprint and how it changes in space (that is, inside the cell) and time (during development and ageing).

Our three pillars of research in the Division are understanding the mechanisms that create the epigenome and how this is altered in disease; finding new biomarkers and tests for disease detection; and identifying new therapies that treat disease by targeting the genome and epigenome.

It's an exciting new frontier — and also a major new puzzle — a 3 billion piece puzzle, if you count all the basepairs in the human genome. Our challenge now is to map the genome and epigenome for each cell type and determine how this changes in disease.

Research highlight

The 'city' of cells supporting prostate tumours

A study led by Dr Ruth Pidsley and Professor Susan Clark has shed light on the cells that surround and support prostate tumours. The study investigated how cells that are adjacent to tumours differ from those that are more remote. The team found key changes in the DNA, which may explain how adjacent cells change their behaviour to help tumours grow. Dr Pidsley said, "The result of our work is a new molecular map of the cellular infrastructure that the cancer cells rely on."

The hope is to use that map to understand more clearly how cancer cells grow and spread, and to improve identification of prostate cancer in biopsies and improve patient care. The research was done in collaboration with St Vincent's Hospital and Monash University.

*Pidsley et al., Genome Res. 2018 May;28(5):625-638.
DOI: 10.1101/gr.229070.117*

Research highlight

Early marine animal reveals the ancient history of DNA control

A ground-breaking new study has revealed that our genomes have much more in common with those of ancient organisms than we ever knew. The findings were published in the world-renowned journal *Nature*.

In the study, Garvan's Dr Ozren Bogdanovic and his collaborators focused on a type of DNA regulation process called 'DNA methylation' — a chemical modification of the DNA that tells genes when to switch on or off.

The team's deep dive into the DNA of an ancient marine organism has uncovered that the tricks DNA uses to control gene expression — which genes are turned on and off, and when — may have originated much earlier than was previously thought.

Genomics and Epigenetics

The ancient, translucent fish-like organism *Amphioxus* spends the majority of its life buried in the sand, filter-feeding a variety of plankton. Although they have a similar body plan to fish, their lack of paired fins or limbs makes them quite poor swimmers.

In *Amphioxus*, the researchers found the first-ever evidence of DNA methylation as a tool to regulate gene expression in an invertebrate.

Dr Bogdanovic plans to continue investigating the link between vertebrates and invertebrates. "This will allow us to deepen our understanding of how DNA regulation works, and especially how it goes wrong in disease."

Marlétaz et al., Nature. 2018 Dec;564(7734):64-70.
DOI: 10.1038/s41586-018-0734-6

Research highlight

DNA secrets of prostate cancer in African men

A study led by Garvan's Professor Vanessa Hayes (who holds the Petre Foundation Chair of Prostate Cancer Research at Garvan and The University of Sydney) is the first to sequence the entire tumour DNA of African men with prostate cancer. It revealed significant differences compared to non-Africans. Prostate tumours in African men have more DNA changes; with, on average, a doubling of mutational burden. Along with the higher mutational burden, there was also a higher level of 'tumour driver mutations', changes in the DNA that drive cancer and make it more aggressive, and a striking absence of commonly observed non-African tumour mutational signatures.

"It's crucial that we continue to explore how our genetic ancestry might affect our response to treatments, so that the full benefits of personalised medicine reach as many people as possible," says Professor Hayes.

Prostate cancer is particularly lethal in Africa: within five years of diagnosis, five in 20 African men will lose their lives, compared to one in 20 Australian men.

The research was done in collaboration with St Vincent's Hospital, as well as the Universities of Limpopo and Pretoria in South Africa.

Jaratlertsiri et al., Cancer Res. 2018 Dec 15;78(24):6736-6746.
DOI: 10.1158/0008-5472.CAN-18-0254.

Celebrating giving

Anonymous Garvan donor

"There are many good research institutions to support; but what really struck us as being different about Garvan was the dedication of the younger students and staff. Garvan is full of passionate young researchers who devote themselves to lifesaving research and their efforts to improve the world. Hearing these inspiring scientists talk about their fields is awesome. We know our future is safe in their hands."

"So we support Garvan not only for what it is and does, but also for its commitment to support the future: for the even more amazing things those younger scientists are yet to do, and will do, but for which they need our support to get them on their way."

Genomics and Epigenetics Research Laboratories and Groups

BioVis Centre

Head: Dr Seán O'Donoghue

Epigenetics Research Lab

Head: Prof Susan Clark

Epigenetic Deregulation in Cancer Group

Leader: Dr Clare Stirzaker

Histone Variants Group

Leader: Dr Fatima Valdés Mora

DNA Methylation Biomarkers Group

Leader: Dr Ruth Pidsley

Genome Informatics Lab

Head: A/Prof Marcel Dinger

Human Comparative and Prostate Cancer Genomics Lab

Head: Prof Vanessa Hayes

Transcriptomic Research Lab

Head: Dr Timothy Mercer

Developmental Epigenomics Lab

Head: Dr Ozren Bogdanovic

Molecular Genetics of Inherited Kidney Disorders Lab

Head: Prof John Shine

A national genomics mission for Australia



“This is a vital and timely national initiative, with immense opportunity to improve Australians’ lives.”
– Prof Chris Goodnow

The May Federal Budget announced a \$500 million genomics mission for Australia. The new mission seeks to save or transform the lives of more than 200,000 Australians through research into better testing, diagnosis and treatment.

The Australian Genomics Health Futures Mission was announced as part of the 2018 Federal Budget. It forms the cornerstone of the \$1.3 billion National Health and Medical Industry Growth Plan.

The Department of Health says the \$500 million mission will involve the following:

- new and expanded clinical flagship studies to tackle rare diseases, rare cancers and complex conditions;
- new clinical trials and technology applications allowing Australian patients to benefit from the latest medical research;
- increased academic and researcher collaboration and new career pathways;
- co-investment with philanthropy and business to support new industries;
- community dialogue to better understand the value of genomics and gain appreciation of the privacy, legal, social and familial impact; and

- analytical power backed by national standards and protocols that ensure secure data holdings, access, analysis and sharing to benefit Australians.

The mission's first project will be the 'Mackenzie's Mission' – a new \$20 million trial in pre-conception screening for rare and debilitating genetic birth disorders.

Funding for the genomics mission will be sourced from the Medical Research Future Fund, and is the largest single disbursement to date from the fund.

Professor Chris Goodnow says that a national approach to genomic medicine is just what the doctor ordered for Australia.

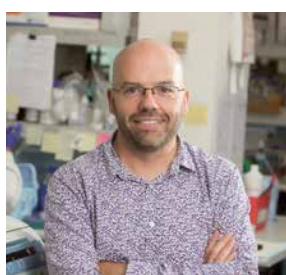
“This is a vital and timely national initiative, with immense opportunity to improve Australians’ lives.

“Some things are best handled at scale. This new initiative gives us all the opportunity to contribute to something great, and take a truly strategic approach to the development of genomic medicine.”



Division Report

Immunology



From the Head

Professor Stuart Tangye

The immune system can hold the balance between health and disease. An extremely complex and sophisticated system, it plays a role in almost every disease – from a common cold, to cancer or a rare genetic disorder.

On the one hand, an overactive immune system results in immune dysregulation, manifesting as autoimmune (rheumatoid arthritis, type 1 diabetes, lupus) or allergic diseases. On the other hand, an underactive immune system can cause immunodeficiencies and recurrent infectious disease.

In addition to studying autoimmune diseases, we're also investigating the mechanics of donor organ rejection, genetic defects and inflammatory diseases; and we're committed to developing new drugs for immune-related diseases. By leveraging the immune system's natural signaling to eradicate cancer cells, we're seeing great strides in immunotherapy as a cancer treatment. When combined with genomically targeted therapies, outcomes for patients with cancer could still be further improved.

It is an incredibly exciting time to be an immunologist, because we're at a point where immune research can rapidly impact clinical medicine, diagnosis and disease management. This is why we've developed several large-scale, human-centred research programs that interface directly with clinicians and their patients. The Clinical Immunogenomics Research Consortium Australia (CIRCA) for example is reaping significant rewards and having major impacts in the clinic.

We have a great breadth of knowledge within the Division and we're uniquely placed to undertake basic, translational and clinical research. CIRCA achieves this by collaborating with major hospitals, as well as prestigious international research institutes, to understand the immune system in the setting of health and disease, and devise better treatments for immunological diseases.

Research highlight

Your secret immunity weapon

For years, they've had a bad rap – a mysterious population of cells in the immune system once thought to cause harm. But Professor Chris Goodnow, Associate Professor Daniel Christ, Dr Deborah Burnett and others from our Immunology Division have discovered that these antibody-producing cells (B cells) could be a potent weapon against invading microbes. These 'bad apples' of the immune system are also its secret weapon, according to research published in the world-leading journal *Science*.

These B cells produce antibodies that bind to the body's own tissues, meaning they could actually cause autoimmune disease. So why would the body keep them alive in the first place? The new findings reveal these cells may be crucial to fighting threats that trick our immune system by mimicking the body's own proteins. These immune cells can be activated to attack when required. Our researchers hope these cells will one day be the basis of vaccines for viruses that hide from the immune system, such as HIV.

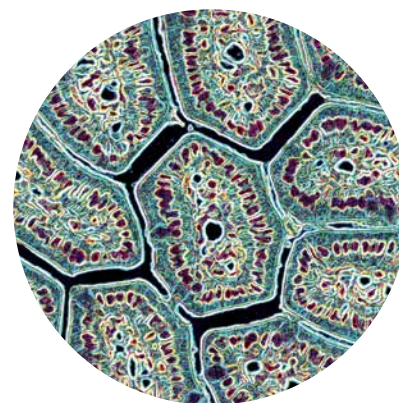
*Burnett et al., Science. 2018 Apr 13;360(6385):223-226.
DOI: 10.1126/science.aao3859*

Research highlight

Found: a new form of DNA

In a world first, our researchers Associate Professor Daniel Christ, Associate Professor Marcel Dinger and Dr Mahdi Zeraati found a new DNA structure – a twisted 'knot' they call the i-motif – inside cells.

The iconic 'double helix' shape of DNA has captured the public imagination since 1953. We know that DNA can exist in a few other shapes – in a test tube, at least. Until now, the i-motif had never before been directly seen inside living cells. In fact, scientists had debated whether i-motif 'knots' would exist at all – a mystery that is now solved.



To detect the i-motifs, the researchers developed a precise new tool – a fragment of an antibody molecule – that could specifically recognise and attach to i-motifs with a very high affinity. Until now, the lack of an antibody that is specific for i-motifs has severely hampered our understanding of their role.

The researchers showed that i-motifs mostly form at a particular point in the cell's life cycle – the late G1 phase, when DNA is being actively 'read'. They also showed that i-motifs appear in some promoter regions (areas of DNA that control whether genes are switched on or off) and in telomeres, the end sections of chromosomes that are important in the ageing process.

Zeraati et al., Nat Chem. 2018 Jun;10(6):631-637.
DOI: 10.1038/s41557-018-0046-3

News highlight

Engaging a new generation of researchers

Garvan's researchers and Sydney high school students came together to explore immunological research and to discuss rapidly evolving careers in STEM research. The 60 high school science students came to participate in Garvan's Day of Immunology event – a day of hands-on exposure to research and research careers, with a focus on all things immune system-related.

In each laboratory, students came to grips with cutting-edge biomedical research techniques that played out in real time – helping them understand how laboratory science can be translated into the treatment of real diseases.

For event organisers Dr Joanne Reed (Group Leader in Rheumatology and Autoimmunity), Dr Angelica Lau (B Cell Biology) and Julia Kiss (Public Engagement Officer), highlighting the possibility of a career in research was key to the day's activities.

Students engaged with a range of scientists at different stages of their careers, each with a different story about how they got to where they are now.

Events like the Day of Immunology help support science education by providing a unique experience that places students at the heart of biomedical research.

Research highlight

New 'micro-organ' hiding in plain sight

For the first time in decades, researchers have identified a new anatomical structure within the immune system – and an important step towards understanding how to make better vaccines.

Using sophisticated high-resolution 3D microscopy in living animals, Associate Professor Tri Phan and his team identified where immune cells gather to mount a rapid response against an infection in the body. These subcapsular proliferative foci (or SPFs) were found inside sections of lymph nodes. This is the first time these structures have ever been seen, and they were uncovered using technology developed at Garvan.

The researchers could see that several classes of immune cells gather together in the new structure – including memory B cells, which carry information, or 'memories', about how best to attack an infection. They could also see that memory B cells were changing into infection-fighting plasma cells. This is a key step in the fight against infection.

The discovery helps us understand the body's response to an infection it's been exposed to before. This could eventually help us to make better vaccines. The study was made possible by generous support from Peter and Val Duncan.

Moran et al., Nat Commun. 2018 Aug 22;9(1):3372.
DOI: 10.1038/s41467-018-05772-7

Immunology

Research highlight

Gene-hunters make sense of a new immune disease

Researchers from Garvan collaborated with Rockefeller University (New York) and the Imagine Institute (Paris) to tackle an obscure disorder, first identified in eight individuals from around the world suffering from the same unique symptoms.

"These individuals had severe weaknesses in their body's defenses," says Professor Stuart Tangye, who led the Garvan-based arm of the project. "They were incredibly susceptible to fungal and bacterial infections, they presented with severe allergies, and had a poor response to vaccination – it was clear their immune system was compromised."

At Rockefeller University and Imagine Institute, Professor Jean-Laurent Casanova and his team tracked down the faulty gene at the root of this disease – a brand new, previously unidentified gene, known as *ZNF341*.

"To understand why this mutated *ZNF341* gene was causing disease, we needed to figure out what this gene does normally, and how errors in *ZNF341* were disrupting these patients' ability to fight off infections and build their immunity."

Through functional studies, Professor Tangye and his team discovered that a faulty *ZNF341* gene leads to a 'hole' in immune defenses. Patients lack certain types of immune cells, which means they struggle to fight some infections and acquire immunity. Also, they have an abundance of a different type of immune cell – which leads to severe allergy.

"Successfully treating a disease requires more than just treating the symptoms," adds Professor Tangye. "We can only begin to treat patients effectively when we understand the cause. Finding the faulty gene raises the possibility of using tailored, gene-specific therapies to treat the disease at its core."

Béziat et al., Sci Immunol. 2018 Jun 15;3(24).
DOI: 10.1126/sciimmunol.aat4956

Celebrating giving

Mr Ken Allen AM and Mrs Jill Allen

"We've been aware of the Garvan Institute as a global centre of medical research for quite some time. Its reputation for ground-breaking research, as well as a personal interest in one particular disease that has impacted our family, compelled my wife Jill and I to help Garvan and the Hope Research team

make a difference. Since meeting Professor Chris Goodnow and the leadership team, I have found them to be humble and inspirational. We have absolute confidence that they will make a difference.

"Medical research is exploding as technology and data analysis can now identify correlations previously unseen. Our expanding knowledge of the human genome for instance has confirmed that old age is a disease and not an outcome; and that age-related diseases are treatable. Suffering in others is very painful, and so medical research is the key to extended, healthier and more satisfying lives.

"Garvan and other centres of research should be better understood by the broader public as their work can change everybody's lives. Garvan also demonstrates the importance of globalised research – and Australia's intellectual contribution to that is only constrained by support and not by talent."

Mr and Mrs Allen are generously supporting Hope Research: a research program to find the underlying cause of autoimmune disease. Find out more: www.garvan.org.au/hope-research

Immunology Research Laboratories and Groups

Antibody Therapeutics Lab

Head: A/Prof Daniel Christ

B Cell Biology Lab

Head: Prof Robert Brink

Genomic Engineering Group

Leader: Dr David Zahra

Cellular Immunity Lab

Head: Prof Jonathan Sprent

Immune Tolerance Group

Leader: Dr Kylie Webster

Immunogenomics Lab

Head: Prof Chris Goodnow

Rheumatology and Autoimmunity Group

Leader: Dr Joanne Reed

Immunology and Immunodeficiency Lab

Head: Prof Stuart Tangye

Human Immune Disorders Group

Leader: A/Prof Cindy Ma

Innate and Tumour Immunology Lab

Head: Dr Tatyana Chtanova

Intravital Microscopy Lab

Head: A/Prof Tri Phan

Lymphocyte Signalling and Activation Lab

Head: A/Prof Elissa Deenick

Mucosal Autoimmunity Lab

Head: A/Prof Cecile King

Transplantation Immunology Lab

Head: A/Prof Shane Grey

Immunopathology Group

Leader: A/Prof William Sewell

UNSW Cellular Genomics Futures Institute launches



***“I’m delighted that Garvan is playing a crucial leadership role in this new UNSW Futures Institute, which will tackle major challenges in single-cell genomics – the next great revolution in medicine.”
– Prof Chris Goodnow***

The Garvan-led UNSW Cellular Genomics Futures Institute is set to accelerate research in cellular genomics and single-cell sequencing – and to uncover new targets and treatments for disease.

The UNSW Futures Institute will focus on the new technology of cellular genomics, which seeks to characterise the genetic outputs of individual cells, thousands of cells at a time.

Professor Chris Goodnow, Garvan’s Executive Director, is the inaugural Director of the UNSW Cellular Genomics Futures Institute, and Associate Professor Joseph Powell, Head of the Garvan-Weizmann Centre for Cellular Genomics, is the Deputy Director. The Institute also brings together UNSW’s researchers from across medicine, science, and engineering, including from the Ramaciotti Centre for Genomics and the Kirby Institute.

Cellular genomics aims to overcome a major stumbling block in the study of human cells in health and disease. Many diseases, such as cancers and autoimmune diseases, arise from changes in only one or a few cells in the body. But, until recently, technological limitations have meant that we couldn’t look directly at the genetic output of those rare cells. Instead, researchers have had to look at millions of cells homogenised together, severely limiting what can be learned about the cells that initiate disease.

The sheer amount of data that will be generated from each of many thousands of cells requires data analytical tools, machine learning and data visualisation techniques that will be developed through the multi-disciplinary nature of the UNSW Cellular Genetics Futures Institute.

“I’m delighted that Garvan is playing a crucial leadership role in this new UNSW Futures Institute, which will tackle major challenges in single-cell genomics – the next great revolution in medicine,” says Professor Goodnow.

Associate Professor Powell adds, “The new UNSW Futures Institute is a fantastic recognition of Garvan’s leadership in cellular genomics through the Garvan-Weizmann Centre for Cellular Genomics, and it provides an outstanding opportunity for Garvan to work more closely with UNSW to drive the translation of our research in cellular diagnostics and therapies to health outcomes.

“Importantly, the UNSW Futures Institute is set to accelerate the work of the Garvan-Weizmann Centre, which was launched last year and whose research is exploring which individual cells contribute to the progression of diseases such as cancer, autoimmune disease and neurodegenerative disorders and how these cells develop.”

The UNSW Cellular Genomics Futures Institute is one of four UNSW Futures Institutes to launch this year. The other three UNSW Futures Institutes focus on ageing, global energy systems and materials and manufacturing.



We see a future
where health is
transformed.

It's within reach.



Division Report

Neuroscience



From the Head

Associate Professor
Antony Cooper

The brain is probably the most complex organ in the body – and diseases associated with the brain such as Parkinson's, Alzheimer's, eating disorders – have devastating symptoms and consequences.

In the Neuroscience Division we seek to understand the molecular mechanisms that drive changes in the brain. This includes the ways nerve cells communicate with each other and what goes wrong in disorders like neurodegenerative disease.

We utilise many techniques, including molecular biology, genomics, transgenic animal models, sophisticated imaging and testing. We hope to find ways to regenerate the nervous system and to better understand the brain's control of body functions, particularly the regulation of energy balance (intake and expenditure), which can affect mood, weight gain and physical fitness.

The more we think we know about the brain, the more we uncover new areas and find connections to explore. This is why we collaborate extensively internationally, and of course locally and within Garvan, to pool our expertise and make progress in these dreadful diseases.

Translating our research into the clinic is particularly urgent because people with these diseases are desperate to find treatment options that work – especially at the late stage where they're often diagnosed.

Research highlight

New method for RNA analysis

Dr Robert Weatheritt, with collaborators at the University of Toronto, published a new method for rapid and accurate reading of RNA data. RNA, or ribonucleic acid, is an important messenger linking our genome – the entire DNA code – to proteins, the machinery of the cell.

Published in the journal *Molecular Cell*, the method, called 'Whippet', has the potential to bring RNA sequencing closer to the bedside. Previous methodologies were data and time intensive, with analysis taking several days and gigabytes of data. Whippet promises to process a reading within 30 minutes and can be done on a laptop. This can lead to faster, more accurate diagnoses for a range of conditions.

Understanding the function of genetic variants (or differences in our DNA code) associated with any disease is essential for determining the cause and progression of disease and the best way to detect, treat and prevent it. Many of the genetic variants associated with disease currently have an unknown function. Whippet has the potential to read RNA quickly and accurately which is essential to understanding the mechanisms that underpin neurological, and many other, diseases. The finding also opens the field of RNA sequencing for exploration in large populations and cohort trials.

*Sterne-Weiler et al., Mol Cell. 2018 Oct 4;72(1):187-200.e6.
DOI: 10.1016/j.molcel.2018.08.018.*

Research highlight

Could a brain switch jumpstart 'brown fat' action?

A team led by Professor Herbert Herzog has uncovered a way our brain keeps us safe by helping maintain a stable bodyweight – and what it does when things go awry. The findings, uncovered in mice, reveal how we might rev up the brain's 'panic switch' for good in the face of an obesity crisis.

"If you're starving and losing weight, your brain shuts down energy-consuming processes it deems non-critical, like bone formation and reproduction. It puts all its resources to keeping every inch of fat," says Professor Herzog, whose team led the study.

"On the other hand, if you continuously over-eat, your brain recognises there's excess energy and since too much stored fat is dangerous, it has systems in place to get rid of excess calories in a different way."

Neuroscience

One of those systems is so-called 'brown fat'. Recent discoveries into brown adipose tissue are redefining the meaning of 'good fat'. It's remarkable for its ability to burn excess calories as heat – instead of storing them, leading to weight gain.

It's known to be activated by cold temperatures, but it's also activated by diet.

Diet switches on brown fat through a receptor called NPFFR2. A closer look at NPFFR2 revealed it controls the alarm bell: a protein known as NPY – which goes off when there are drastic changes in weight.

These findings suggest that fine-tuning the NPFFR2 signal – and NPY as a result – could be a way to maximise brown fat activation, and help burn excess energy before it's stored as fat.

Zhang et al., Nat Commun. 2018 Nov 9;9(1):4722.

DOI: 10.1038/s41467-018-06462-0.

News highlight

Inaugural Scrimshaw Fellow appointment

Dr Robert Weatheritt was named the inaugural Scrimshaw Fellow at the Paspaley boutique in Sydney's Martin Place in December. Paspaley have been long-time philanthropic supporters of the Garvan Institute.

Robert will head the Neurotranscriptomics Laboratory, as an EMBL Australia Group Leader within the Institute. His focus is on unravelling the complexity of human brain development and uncovering what happens when it goes wrong.

"I am delighted to be able to support a scientist as innovative and inquisitive as Dr Weatheritt as he continues his research at the Garvan Institute," said Russell Scrimshaw, who along with his wife Sue, established the Scrimshaw Fellowship and is Chairman of the Garvan Research Foundation Board of Directors. "As the complexities of the human brain begin to be more fully understood, Dr Weatheritt's research will be vital to help uncover the root of neurodevelopmental disorders."

Celebrating giving

Howard Houliston

Howard Houliston has donated to Garvan every month since 2009, and also generously contributes his time and expertise to the Foundation. He's a strong believer in the value of helping.

"I started volunteering at Garvan as a result of my then employer, who advocated employees to do volunteer work."

"I support several charities, but feel that medical research to prevent disease is better than letting a disease happen and then trying to address the problem. We should certainly help people who are suffering, but also try to prevent that suffering wherever we can."

Neuroscience Research Laboratories and Groups

Eating Disorders Lab

Head: Prof Herbert Herzog

Energy Expenditure Group

Leader: Dr Lei Zhang

Neuroendocrinology Group

Leader: Dr Yanchuan Shi

Hearing Research Lab

Head: Prof David Ryugo

Brain Circuits for Hearing Group

Leader: Dr Michael Muniak

Parkinson's Disease and Neurodegeneration Lab

Head: A/Prof Antony Cooper

Epitranscriptomics and RNA Dynamics Group

Leader: Dr Eva Maria Novoa Pardo

Neurotranscriptomics Lab

Head: Dr Robert Weatheritt

Microsoft cloud computing grant to support Garvan's genomic research



Dr Warren Kaplan and James Kavanagh, Microsoft Azure Engineering Lead

“With Microsoft’s support, Garvan will further accelerate our genome research, and help to bring closer a new and important era of healthcare.”

– Dr Warren Kaplan

Microsoft is supporting the development of Garvan’s Genetic Index, through an Azure high performance computing grant.

The Genetic Index is a resource for the international scientific community that will include summary data of 5,000 whole human genomes. Thanks to the Microsoft Azure grant, Garvan is planning to perform complex production bioinformatics for these genomes on the Azure Australia Central cloud.

“With Microsoft’s support, Garvan will further accelerate our genome research, and help to bring closer a new and important era of healthcare,” said Dr Warren Kaplan, Chief of Informatics at Garvan’s Kinghorn Centre for Clinical Genomics.

To support genomic discovery internationally, the Genetic Index will be made available to researchers around the world. Researchers will be able to get insights into the genetic basis of health and disease by looking up the frequency of genetic changes in the index. For example, if a change is rare, this could be evidence that it contributes to a disease, whereas a common change is less likely to be damaging.

“We are working with people’s sensitive health information, so it’s crucial we use best practice to secure this data and actively seek collaborators for whom this is a priority,” said Dr Kaplan.

The Genetic Index is part of an extensive suite of genomics-focused research initiatives at Garvan that seek to impact on human health, including DreamLab, the Australian Genomic Cancer Medicine Program, the Garvan-Weizmann Partnership and the Clinical Immunogenomics Research Consortium Australia (CIRCA).



Centre Report

Kinghorn Centre for Clinical Genomics

In 2018, A/Prof Sarah Kummerfeld and Mary-Anne Young were appointed as the Scientific and Clinical Heads of the Kinghorn Centre for Clinical Genomics (KCCG), respectively, to provide strategic direction and oversee the current and future activities. Sarah's expertise is in computational biology and bioinformatics, with experience spanning both academic and industry research. Mary-Anne is an eminent clinical and research genetic counselor in Australia and has contributed to genomics policy-making and strategic direction at a national level.

From the Heads

As the two new co-heads of KCCG, we're looking forward to leading the Centre to advance the use of genomic (and other -omic) information in patient care. Our combined knowledge, skills and experience extends from basic research with massive cohorts at the intersection of basic research and translation, right through to clinical implementation.

In 2016, Garvan's KCCG was proud to herald a new era in genetic diagnosis with the launch of Genome.One – Australia's first clinical whole-genome sequencing service. We're pleased that in November 2018, Australian Clinical Labs, a national pathology company, acquired the Genome.One name and business model from Garvan. Garvan's partnership with Australian Clinical Labs enables genetic pathology company Genome.One to continue and expand its clinically accredited genomic sequencing reports. This is a fantastic outcome and KCCG maintains a relationship with Genome.One, providing sequencing capabilities and translating its high-level genomic research into clinical practice, including novel tests and tools for improving quality and efficiency in genomic testing.

We are grateful to Mr and Mrs John and Jill Kinghorn and The Kinghorn Foundation for their catalytic and ongoing philanthropic investment in the Kinghorn Centre for Clinical Genomics and the next generation of omics-led research.

News highlight

New resource for clinical genomics research

The Clinical Genomics Research Resource – an online tool – aims to introduce clinicians and clinician-researchers to genomics research and familiarise them with key considerations for conducting clinical genomics research.

It walks users through key considerations for clinical genomics research, covering topics like ethics, participant interactions and the multidisciplinary team. It also addresses project and experimental design, and the challenges associated with different genomic technologies and genomic data. The content includes links to professional guidelines and case studies to allow users to apply their knowledge.

This important resource recognises the complexity of genomic research and the challenges that result from the sheer volume of data and the sensitive nature of genomic information.

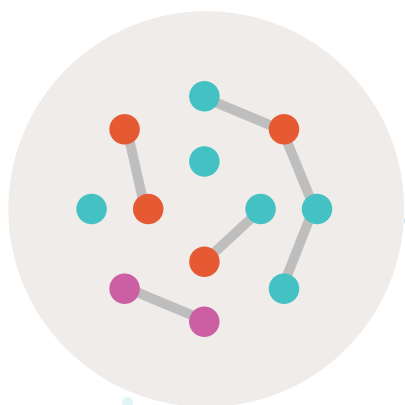
The resource was developed by Bioplatforms Australia, the NSW Health Centre for Genetics Education and KCCG with support from the NSW Ministry of Health Office of Health and Medical Research.

The Clinical Genomics Research Resource can be accessed on the Centre for Genetics Education website: www.genetics.edu.au/genomic

Research highlight

Clinical genome filtering platform now available worldwide

This year, Garvan made its web platform Seave available to researchers and clinicians around the world. Seave is an online 'genome filtering' tool that helps pinpoint which DNA changes in an individual's genome are likely to be the underlying cause of disease.



Mary-Anne Young



A/Prof Sarah Kummerfeld

Seave was built by Dr Velimir Gayevskiy and Dr Mark Cowley in KCCG. An online platform, Seave supports and streamlines genome filtering.

"When we sequence the genome of someone with undiagnosed disease, that's just the beginning of the journey," says Dr Cowley. "It's the next steps – the analysis and interpretation of the DNA sequence – that are the most complex and difficult part of the process of finding a genetic diagnosis. Because of the way Seave can sift through genomic information, it's a hugely helpful tool for speeding the path to a diagnosis."

The name 'Seave' was chosen to evoke the idea of sieving and filtering genomic information.

It is already being used widely by clinicians and researchers to help them diagnose and better understand many genetic conditions. Through the Sydney Genomics Collaborative, researchers are using Seave to investigate cardiovascular, retinal, renal, movement and mitochondrial disorders, epilepsy, and rare and genetic conditions.

*Gayevskiy et al., Bioinformatics. 2019 Jan 1;35(1):122-125.
DOI: 10.1093/bioinformatics/bty540*

Research highlight

A better test for heart disease in high-risk families

This year, researchers from Garvan and the Victor Chang Cardiac Research Institute harnessed the power of DNA to detect the deadly heart disease dilated cardiomyopathy – long before symptoms arise. In the largest patient study of its kind, a collaborative investigation put whole genome sequencing to the test, measuring its effectiveness as a first-line clinical diagnostic tool for dilated cardiomyopathy, an inherited heart disease.

The research looked at the entire genetic make-up of 42 patients with dilated cardiomyopathy. The inherited heart disease may affect up to 1 in 500 Australians and causes the heart to enlarge and weaken. It is also the most common reason for heart transplantation.

After two decades of heart disease research and three years of genetic analysis, the study found there are clear benefits of using a whole genome sequencing test to help diagnose cardiomyopathy. In particular, it is a sensitive, and more comprehensive test than is currently used clinically, and it provides rich additional information that is likely to be valuable in the future.

*Minoche et al. Genetics in Medicine, 21(3), 650-662.
DOI: 10.1038/s41436-018-0084-7*

Celebrating giving

Supporting research – Trevor Guest

"At my best friend's funeral in 2013, I gave a donation to Garvan in lieu of a floral tribute. I was subsequently invited to tour the Garvan facilities and The Kinghorn Cancer Centre. That tour was hosted by Professor John Shine – he was wearing his white lab coat and I had no idea then that the previous Executive Director of Garvan was giving of his time to explain the operations of a huge medical research organisation. I was overwhelmed by the size and the high quality of Garvan's medical research facilities. I immediately committed to being a Partner for the Future through a recognition of Garvan in my Will.

"Since my initial commitment, I decided to personally support a number of Garvan's medical research programs, the most recent being towards the Genomic Cancer Medicine Program. I'm also very interested in Garvan's research into rheumatoid arthritis, as my daughter Sharon has the disease.

"I regard the Garvan Institute as a leader in its field, with respect to ongoing communication of Garvan's discoveries to the public and to its base of loyal donors."



Centre Report

Garvan-Weizmann Centre for Cellular Genomics



From the Head
*Associate Professor
Joseph Powell*

Following its creation in 2017, the Garvan-Weizmann Centre for Cellular Genomics has evolved into one of the most sophisticated cellular genomics facilities in the world.

Cellular genomics is a revolutionary technology that's transforming biological and medical research.

Where whole genome sequencing is the study of all our DNA averaged over millions of cells, cellular genomics is the study of the genetic makeup of a single cell – from the cell's entire DNA code (its genome), to the secondary code that organises the genome (its epigenome), and the total genetic output of the cell (its transcriptome).

Garvan-Weizmann's cutting-edge cellular genomics technologies make it possible to unlock and discover how cells work individually, and how they function together. We can see answers within cells in ways that were impossible only a few years ago. Sometimes a single cell amongst thousands can drive a disease reaction.

The Centre is one of the few global sites where state-of-the-art technologies are seamlessly integrated under one roof, including the latest platforms in flow cytometry, microfluidics, genomics, high-performance computing and bioinformatics. Importantly, the Centre's expert researchers and their strong links with clinical services accelerates the capability for single cell sequencing to be at the core of translation into new diagnostic tests and precision treatment.

It is a privilege to work closely with the Weizmann Institute of Science in Israel and Weizmann Australia through our prolific Garvan-Weizmann Partnership. We are grateful for the vital support from the NSW Government, our visionary donors:

Mr John Roth and Ms Jillian Segal AO, Mr and Mrs Laurie and Di Sutton, The Johnny Kahlbetzer Family – and our many generous donors to the Garvan-Weizmann Partnership.

Research highlight

How do you mend an injured heart?

Hearts can't fix themselves. But Associate Professor Joseph Powell and collaborators from the University of Queensland have uncovered a huge amount of previously hidden information that may teach the heart to repair itself.

The in-depth study revealed how human stem cells can be turned into heart cells. The work involved measuring changes in gene activity, using cellular genomics, in tens of thousands of individual cells as they move through the stages of heart development. To explore this process, the researchers mimicked, in the lab, how a heart develops in the embryo. They started with skin-derived human stem cells (from adults), which are capable of becoming any cell type in the body. They were able to guide the cells, over time, and reprogram them to become heart cells (cardiomyocytes).

"We are now investigating at what stages during heart development, and in what cell subtypes, the genetic risks of cardiovascular disease become most dangerous," says Associate Professor Powell.

*Friedman et al., Cell Stem Cell 2018 Oct 4;23(4):586-598.e8.
DOI: 10.1016/j.stem.2018.09.009.*

Research highlight

Hope grows: finding the cause of autoimmune disease

Autoimmune diseases – such as type 1 diabetes, multiple sclerosis, lupus, rheumatoid arthritis – develop when the body's own immune system becomes overactive and begins to attack itself.



Hope Research is based on a premise first proposed by Professor Chris Goodnow, more than 10 years ago – that ‘rogue’ clones cause autoimmunity. At the time, he couldn’t prove his theory because the necessary technology didn’t exist. It now does, in the Garvan-Weizmann Centre for Cellular Genomics.

The project will tackle more than 40 different autoimmune diseases, where researchers already have a clear idea of how to identify and isolate rogue cells or ‘clones’ using cellular genomics.

This project has received funding from philanthropists and other funding bodies, including The Bill and Patricia Ritchie Foundation, Multiple Sclerosis Research Australia, Scleroderma Australia and the National Health and Medical Research Council.

Find out more: www.garvan.org.au/hope-research

Research highlight

2018 in the Garvan-Weizmann Partnership

The Garvan-Weizmann Centre for Cellular Genomics is the cornerstone of the broader Garvan-Weizmann Partnership. In addition to cellular genomics research programs, the Garvan-Weizmann Partnership includes research collaborations in other fields and education and visualisation programs, as well as staff and student exchanges.

Throughout 2018, we have:

- Sequenced 3,465,193 single cells, in 28 research projects, over 21 labs
- Hosted 6 staff and student exchanges between Australia and Israel
- Enrolled more than 1,500 patients onto clinical trials and studies within the Garvan-Weizmann Partnership
- Strengthened collaborations between 21 researchers at the Garvan and Weizmann Institutes.

Celebrating giving

Bob and Ruth Magid

In June, Bob and Ruth Magid generously donated \$1 million to the Garvan-Weizmann Partnership to establish the Magid Fellow. Bob said genomic medicine was not a field they had focused on before. “Our daughter, who lives in Israel, has become very close with the Weizmann Institute there, so we decided to visit it, and we also toured the new Garvan-Weizmann Centre in Sydney.”

“We left feeling very impressed by the researchers and the amazing work they’re doing. The fact they can look at a person’s DNA – right down to the single cell level – and the potential that has for medical science, is amazing.”

Stephen Chipkin, Chair of the Weizmann Australia Board, described the donation as ‘a gift to the world’ because of the far-ranging impact of genomic medicine advancements. “This funding of genomics research between these two great research institutes will not only help build a strong bridge between Australia and Israel – the medical research outcomes will be for the benefit of all humankind.”

The visionary donation will facilitate a new recruit under the leadership of Associate Professor Joseph Powell in the field of cellular genomics and bioinformatics. The Magid Fellow will travel between the two Institutes to accelerate collaborations and research discovery.

Garvan Institute of Medical Research

Board of Directors 2018



John Schubert AO – Chair

Dr Schubert is Chairman of the Garvan Institute of Medical Research, Chairman of the Great Barrier Reef Foundation, and a director of the Garvan Research Foundation Board. He has held

positions as Chairman of the Commonwealth Bank of Australia, non-executive director of BHP Billiton Limited, BHP Billiton Plc, and Qantas Airways Limited, Chief Executive Officer of Pioneer International Limited, Chairman of WorleyParsons Limited and G2 Therapies Ltd, Chairman and MD of Esso Australia Ltd, and non-executive director of Hanson Plc.



Chris Goodnow FAA FRS (from May)

Professor Chris Goodnow is an internationally renowned immunologist. He joined Garvan in 2015 as Deputy Director, the Bill & Patricia Ritchie Foundation Chair, and head of the Immunogenomics

Laboratory. Chris has had an extensive international research career. He has been a faculty member at Stanford University and the Australian National University, and has been closely involved in several biotechnology start-up companies. He is best known for discovering immune tolerance checkpoints by integrating molecular genetics and genomics with immunology, for which he received numerous awards and election to the Australian Academy of Science, the UK Royal Society, and the US National Academy of Science.



Annabelle Bennett AO SC

The Hon. Dr Annabelle Bennett was until recently a Judge of the Federal Court of Australia. She is presently Chancellor of Bond University, President of the Anti-Discrimination Board of NSW, Chair of Landservices SA,

Arbitrator with the Court of Arbitration for Sport, and Chair of the Australian Nuclear Science and Technology Organisation. Dr Bennett has extensive knowledge and experience in intellectual property arising from her position as a Judge, as a senior counsel specialising in Intellectual Property and as President of the Copyright Tribunal.



Stephen Johns

Mr Johns is Chairman of Brambles Limited and non-executive director of Goodman Group. He is a former chairman and non-executive director of Leighton Holdings Limited and Spark Infrastructure Group, and

former executive and non-executive director of Westfield Group. He has a Bachelor of Economics degree from the University of Sydney and is a Fellow of the Institute of Chartered Accountants in Australia and the Institute of Company Directors.



Annette Cunliffe RSC

Sister Annette was the Sisters of Charity Congregational Leader. She has been President of the Conference of Leaders of Religious Institutes, President of Catholic Religious Australia, Inaugural Chair of the Stewardship

Board of Catholic Health Australia, and a senior lecturer at the Australian Catholic University. Until the end of 2018 she was one of two executive officers of the National Committee for Professional Standards of the Catholic Church in Australia.



Anne Keating (to September)

Ms Keating is the Chairman of Houlihan Lokey, Australia, an investment bank, and a governor of the Cerebral Palsy Research Foundation. She has served on many public company boards

in various sectors over the last 24 years including two medical device companies. She was an inaugural director of the Victor Chang Cardiac Research Institute.



Anthony Kelleher (to April)

Professor Kelleher is the Senior Vice Dean Research of UNSW Medicine, UNSW and the Head of the Immunovirology and Pathogenesis Laboratory of the Kirby Institute, Head of the Infection, Immunity

and Inflammation Theme, UNSW Medicine and a Clinical Immunologist and Immunopathologist at St Vincent's Hospital, Sydney. He is a Fellow of the Australian Academy of Health and Medical Science, a member of The Australian Society of HIV Medicine, the International AIDS Society, and the Australian and American Societies of Immunology and has been Practitioner Fellow of the NHMRC since 2006.



Paul Kelly

Dr Kelly is a founding managing partner of OneVentures, a leading Australian venture capital firm, and serves as Chair of the Investment Committee of its Healthcare fund, and on the Risk Management Committee.

An Australian physician, serial entrepreneur and experienced biotechnology and life sciences executive, he currently has over 35 years experience in clinical medicine and medical science, and 25 years experience in commercialising life science related technologies in Australia, Europe and North America.



Thomas John (Jack) Martin AO FAA FRS

Emeritus Professor Martin is a John Holt Fellow, St Vincent's Institute of Medical Research and Emeritus Professor of Medicine, University of Melbourne.

He was previously the Director of St Vincent's Institute of Medical Research and the Chairman of the University of Melbourne Department of Medicine. A Fellow of the Royal Society and of the Australian Academy of Science, he was also President of the International Bone and Mineral Society.



John Mattick AO FAA FTSE FAHMS HONFRCPA (to May)

Professor Mattick was the Garvan Executive Director from 2012-2018, and now Chief Executive of Genomics England and Visiting Professor at the

University of Oxford. He has had a distinguished career in molecular biology and genomics, most recently as an NHMRC Australia Fellow and Director of the Institute for Molecular Bioscience and the Australian Genome Research Facility at the University of Queensland. He was awarded the 2011 IUBMB (International Union of Biochemistry and Molecular Biology) Medal, the 2012 HUGO (Human Genome Organisation) Chen Medal, the 2014 University of Texas MD Anderson Cancer Center Bertner Award for Distinguished Contributions to Cancer Research, the 2017 Lemberg Medal of the Australian Society for Biochemistry and Molecular Biology, and Fellowship of the Australian Academies of Science, Technology & Engineering, and Health & Medical Sciences.



Helen Nugent AO

Dr Nugent is the Chairman of the National Disability Insurance Agency and Ausgrid, and a non-executive director of Insurance Australia Group Limited. She has been the Chairman of Veda Group, Australian Rail Track Corporation,

Funds SA, Swiss Re (Australia) and Sydney Airport and a non-executive director of Macquarie Group, Origin Energy Limited, Mercantile Mutual and the State Bank of NSW, among others. She is an Officer of the Order of Australia and a recipient of the Australian Government Centenary Medal.

Garvan Institute of Medical Research

Board of Directors 2018 continued



Patricia O'Rourke

Professor O'Rourke is the CEO of St Vincent's Health Australia's Public Hospitals Division. She also serves on the board of the Aikenhead Centre for Medical Discovery. She is a graduate of the Australian Institute of

Company Directors and a member of the Harvard Business Club of Australia.



Rodney Phillips

Professor Phillips, Dean of UNSW Medicine, is an immunologist whose research impacted the world's understanding of HIV/AIDS and other infectious diseases. He described, for the first time, how HIV evades the

body's immune defences. Previously, Professor Phillips was Vice-Dean of Medical Sciences at Oxford University and Director of the Peter Medawar Building for Pathogen Research.



Anthony M. Schembri

Associate Professor Schembri, CEO of St Vincent's Health Network, holds academic appointments with the University of New South Wales and Australian Catholic University.

A/Prof Schembri is a surveyor

for the Australian Council of Healthcare Standards and Fellow of the Australasian College of Health Service Managers. He is a director of the Central and Eastern Sydney Primary Health Network, St Vincent's Curran Foundation, the National Centre for Clinical Research of Emerging Drugs of Concern and Co-Chair of the Nursing Research Institute of ACU/St Vincent's.



Russell Scrimshaw

Mr Scrimshaw is the Garvan Research Foundation Board Chair. He is also Non-Executive Chairman of Sirius Minerals Plc, Non-Executive Chairman of Tech Project Group P/L and the Executive Chairman of Torrus

Capital P/L, the Australian Philanthropic Fund, the Scrimshaw Foundation and Scrimshaw Nominees P/L. Previously, he held executive positions at Fortescue Metals Group Ltd (FMG), Commonwealth Bank, Optus and IBM. He was also a non-executive Board Director for Genome.One P/L, Commonwealth Properties Ltd, EDS Australia, Mobilesoft Ltd, Telecom New Zealand Australia P/L, and Athletics Australia. Mr Scrimshaw is a non-executive Director of the Garvan Institute.



Jillian Segal AO

Ms Segal is the Deputy Chancellor UNSW Sydney, Chairman of AICC (NSW), General Sir John Monash Foundation and the Independent Parliamentary Expenses Authority (IPEA). She is a Trustee of the Sydney Opera House and a

director of the Grattan Institute. She is a director of Rabobank Australia Limited, Rabobank New Zealand Limited and Rabo Australia Limited. She has been a senior regulator, lawyer and a director of other listed and government organisations.

Garvan Research Foundation

Board of Directors 2018



Russell Scrimshaw – Chair

Mr Scrimshaw is the Garvan Research Foundation Board Chair. He is also Non-Executive Chairman of Sirius Minerals Plc, Non-Executive Chairman of Tech Project Group P/L and

the Executive Chairman of Torrus Capital P/L, the Australian Philanthropic Fund, the Scrimshaw Foundation and Scrimshaw Nominees P/L. Previously, he held executive positions at Fortescue Metals Group Ltd (FMG), Commonwealth Bank, Optus and IBM. He was also a non-executive Board Director for Genome.One P/L, Commonwealth Properties Ltd, EDS Australia, Mobilesoft Ltd, Telecom New Zealand Australia P/L, and Athletics Australia. Mr Scrimshaw is a non-executive Director of the Garvan Institute.



Nick Abrahams (from May)

Mr Abrahams is the Global Head of Technology and Innovation at Norton Rose Fulbright and has deep commercial expertise and global networks in the technology space. He is a non-executive

director on ASX300 software company, Integrated Research. He is a director of the Institute for Economics and Peace and is on the board of the Vodafone Foundation. Mr Abrahams is past President of the Australian Communications and Media Law Association and writes regularly on technology and future trends for The Australian Financial Review. He is the author of the Kindle Business book Digital Disruption in Australia.



Jane Allen

Ms Allen runs a Governance Advisory business. Previously she was a managing partner at Egon Zehnder, where she also held a leadership role across Asia Pacific. A member of Chief Executive Women, Ms Allen has

an MBA from Harvard Business School and a Bachelor of Arts from Smith College. She has also worked for Procter & Gamble in the US and Australia.



Michael Cannon-Brookes

Mr Cannon-Brookes is a Director of Cannon-Brookes Consulting Pty Ltd, and a CEO level executive coach with Foresight Global Coaching. He established Citibank in Australia in 1985.

He retired from IBM in July 2012,

where he was IBM's Vice President, Global Strategy for Growth Markets, based in Shanghai, China. Mr Cannon-Brookes, a UK citizen, took Australian citizenship in 1994. He graduated with Honors in Law from Cambridge University. He was elected a Global Board Member of Advance in 2013, and in the same year a Fellow of the Australian Institute of Company Directors



Gabriel Farago (to April)

Mr Farago practised as a solicitor and barrister for over 30 years, specialising in commercial disputes in Australia and overseas, before becoming a full-time writer. He is the international, bestselling and multi-award-

winning Australian author of the Jack Rogan mysteries and thrillers series for the thinking reader. In 1984, Mr Farago became a member of the Knightly Order of Vitez.



Chris Goodnow FAA FRS (from May)

Professor Chris Goodnow is an internationally renowned immunologist. He joined Garvan in 2015 as Deputy Director, the Bill & Patricia Ritchie Foundation Chair, and head of

the Immunogenomics Laboratory. Chris has had an extensive international research career. He has been a faculty member at Stanford University and the Australian National University, and has been closely involved in several biotechnology start-up companies. He is best known for discovering immune tolerance checkpoints by integrating molecular genetics and genomics with immunology, for which he received numerous awards and election to the Australian Academy of Science, the UK Royal Society, and the US National Academy of Science.

Garvan Research Foundation

Board of Directors 2018 continued



**John Mattick AO FAA FTSE
FAHMS HONFRCPA
(to May)**

Professor Mattick was the Garvan Executive Director from 2012-2018, and now Chief Executive of Genomics England and Visiting Professor at the University of

Oxford. He has had a distinguished career in molecular biology and genomics, most recently as an NHMRC Australia Fellow and Director of the Institute for Molecular Bioscience and the Australian Genome Research Facility at the University of Queensland. He was awarded the 2011 IUBMB (International Union of Biochemistry and Molecular Biology) Medal, the 2012 HUGO (Human Genome Organisation) Chen Medal, the 2014 University of Texas MD Anderson Cancer Center Bertner Award for Distinguished Contributions to Cancer Research, the 2017 Lemberg Medal of the Australian Society for Biochemistry and Molecular Biology, and Fellowship of the Australian Academies of Science, Technology & Engineering, and Health & Medical Sciences.



Helen McCabe

Ms McCabe is the Head of Lifestyle for nine.com.au at Nine Entertainment Co. Prior to this she was Editor-in-Chief at the The Australian Women's Weekly, Deputy Editor of The Sunday Telegraph, Night Editor of The

Australian and held key roles on The Daily Telegraph. She is also on the board of the Australian Indigenous Education Fund and an Ambassador for Adopt Change.



**Hamish McLennan
(from May)**

Mr McLennan is a media and marketing industry executive with over 30 years of experience. He is Chairman of REA Group, Chairman of HT&E and a non-executive director of Magellan

Financial group. He was Executive Chairman and Chief Executive Officer of Ten Network Holdings until July 2015 and prior to this he was Executive Vice President, Office of the Chairman, at News Corp (formerly News Corporation). Mr McLennan has also held the role of global Chairman of Young & Rubicam, part of WPP, the world's largest communications services group. In 2017, he joined technology start-up Tiger Pistol in an advisory capacity. He has previously served on the Board of Directors for the United Negro College Fund (UNCF) and the US Ad Council.



Simon Mordant AM

Mr Mordant is Executive Co-Chairman of Luminis Partners. He is also the Chair of the Museum of Contemporary Art Australia and Lend Lease Barangaroo Public Art Committee, a board member of the Museum

of Contemporary Art in Los Angeles, MOMA PS1 in New York, Wharton Executive Board in Asia, a Trustee of the American Academy in Rome and a member of the Executive Committee of Tate International Council and a member of the International Council of the Museum of Modern Art in New York.



John Schubert AO

Dr Schubert is Chairman of the Garvan Institute of Medical Research, Chairman of the Great Barrier Reef Foundation, and a director of the Garvan Research Foundation Board. He has held positions as Chairman of the

Commonwealth Bank of Australia, non-executive director of BHP Billiton Limited, BHP Billiton Plc, and Qantas Airways Limited, Chief Executive Officer of Pioneer International Limited, Chairman of WorleyParsons Limited and G2 Therapies Ltd, Chairman and MD of Esso Australia Ltd, and non-executive director of Hanson Plc.



Jeanne-Claude Strong

Dr Strong graduated in Medicine, practicing in occupational and preventative medicine; has a postgraduate degree in Applied Finance and Investment, BA (literature), was on the Board of Blueearth, flew her Beechcraft

Baron from California to Australia via Europe, and races Etchells yachts including recent wins in the Australasian, Queensland and Victorian state championships.



Peter Young AM

Mr Young is currently a Principal for The Adelante Group, a Board member of the Barangaroo Delivery Authority Board, and a member of the Barangaroo Arts and Cultural Panel. He was previously Chairman of Standard

Life Investments Australia and subsequently Aberdeen Standard Investments Australia, Chairman of Barclays Australia, Chairman of the Queensland Investment Corporation (QIC), Chairman of the Transfield Services Infrastructure Fund, and Chairman of the Board of the Australian Federal Government-owned Export Finance and Insurance Corporation (EFIC). He is a former Non-Executive Director of Fairfax Media, the Sydney Theatre Company, PrimeAg Australia, a Trustee of NSW Art Gallery, and subsequently a Trustee of the Queensland Art Gallery, and a member of the Board of the Great Barrier Reef Foundation. He is a recipient of the Australian Federal Government's Centenary Medal and in 2008 was appointed a Member of the Order of Australia (AM) for his services to business and commerce.

PhD completions

2018

Congratulations to all the students awarded PhDs in 2018

At Garvan, we have close to 100 PhD students researching in almost every disease area across the Institute. In partnership with UNSW Sydney, through which most of our students are enrolled, Garvan is committed to supporting the important contributions our students make in the development of scientific knowledge and skills for the future.

Mahmoud Abdelatti

Supervised by Prof Daniel Christ

"Converting therapeutic monoclonal antibodies into functional VH domains"

James Conway

Supervised by A/Prof Paul Timpson, Dr David Croucher

"Intravital imaging to monitor therapeutic response in moving hypoxic regions resistant to PI3K pathway targeting in pancreatic cancer"

Louise Cottle

Supervised by A/Prof Antony Cooper

"Investigating the ATP13A2 (PARK9) and alpha-Synuclein inter-relationship in Parkinson's Disease"

Daniele Cultrone

Supervised by A/Prof Shane Grey

"A functional genomics approach to understand the role of A20 in human disease"

Simon Hardwick

Supervised by Dr Timothy Mercer, Prof John Mattick, Dr Martin Smith

"Designing synthetic spike-in controls for next-generation sequencing and beyond"

Holly Holliday

Supervised by A/Prof Alex Swarbrick, Dr Simon Junankar, Prof Chris Ormandy

"Inhibitor of Differentiation 4 (ID4) suppresses myoepithelial differentiation of mammary stem cells via E-protein regulation"

Amanda Khoury

Supervised by Prof Susan Clark, Dr Fatima Valdes Mora

"Untangling Mechanisms of the Architectural Protein CTCF"

Weng Hua Khoo

Supervised by Prof Peter Croucher, A/Prof Tri Phan, A/Prof Alex Swarbrick

"Single cell transcript profiling of dormant myeloma cells identifies therapeutic and prognostic targets"

Wing Yin (Angelica) Lau

Supervised by Prof Robert Brink, Dr Tyani Chan

"Novel function for BAFFR signalling in the regulation of Germinal Centre and B cell memory"

Ansha Luthra

Supervised by Prof Daniel Christ

"Improving bispecific antibody production by tweaking cognate heavy-light chain pairing"

Imogen Moran

Supervised by A/Prof Tri Phan, Prof Robert Brink

"Investigations into the formation and reactivation of memory B cells"

Lisa Oyston

Supervised by Dr Greg Neely, Prof Herbert Herzog

"Conserved Genetic Modifiers of Parkinson's Disease"

Thi My Hanh Pham

Supervised by Prof Tuan Nguyen, Prof John Eisman

"Osteoporotic fracture: muscular determinants and transition to consequences"

Brigitte Phillips

Supervised by A/Prof Antony Cooper

"Discovery of Molecular Mechanisms Underlying Lysosomal and Mitochondrial Defects in Parkinson's Disease"

Catherine Piggitt

Supervised by Prof Chris Ormandy

"Mechanisms of action of ELF5 in breast cancer"

Samuel Rogers

Supervised by Dr Andrew Burgess

"Exploring the origin of chromosome instability, through mitotic regulation and MASTL kinase"

Lewin Small

Supervised by Prof Greg Cooney, Prof Nigel Turner, Dr Amanda Brandon

"In vivo mechanisms of lipid-induced insulin resistance in muscle"

Post-Doctoral Development Committee



The Post-Doctoral Development Committee (PDDC) facilitates education and social events for post-docs and group leaders across the St Vincent's Precinct to come together, network, engage and collaborate.

The Committee members represent all research areas within Garvan, as well as the Victor Chang Cardiac Research Institute and St Vincent's Centre for Applied Medical Research. In 2018, the Committee organised:

- 2018 Annual Post Doc Symposium (joined with the 26th St Vincent's Campus Research Symposium), which had more than 100 attendees from across the Precinct
- 2018 Careers Forum "How mentorship can influence career progression and decision making"
- Educational seminars/workshops focusing on the development of research and soft skills
- Social and networking events



2018 PDDC members

Co-chairs: Dr Maria Findeisen (Garvan, Diabetes and Metabolism) and Dr David Herrmann (Garvan, Cancer)

Secretaries: Dr Jessica Chitty (Garvan, Cancer) and Dr Simon Junankar (Garvan, Cancer)

Treasurer: Dr Matthew Summers (Garvan, Bone)

Members: Aude Dorison (Victor Chang), Aurélie Cazet (Garvan), Benedetta Frida Baldi (Garvan), Carole Ford (St Vincent's Centre for Applied Medical Research), David Herrmann (Garvan), Jeng Yie Chan (Garvan), Jessica Chitty (Garvan), Maria Findeisen (Garvan), Marcia Munoz (Garvan), Matthew Summers (Garvan), Melissa Mangala (Victor Chang), Niall Byrne (Garvan), Niantao Deng (Garvan), Sandy Stayte (St Vincent's Centre for Applied Medical Research), Simon Junankar (Garvan), Yanchuan Shi (Garvan).



*Simon Junankar, Sandy Stayte, Aude Dorison, Aurélie Cazet, Jeng Yie Chan, Melissa Mangala, David Herrmann, Jessica Chitty, Niantao Deng.
Absent: Benedetta Frida Baldi, Carole Ford, Marcia Munoz, Matthew Summers, Niall Byrne, Yanchuan Shi.*

Franklin Women's Academic Partners



In 2018 Garvan cemented its commitment to gender equity by becoming an inaugural partner in Franklin Women's Academic Partner program, together with the Cancer Council NSW, Centenary Institute, The George Institute for Global Health, MQ Health (Macquarie University Health Sciences Centre), Kolling Institute, UNSW Sydney Medicine and Sydney Medical School.

Franklin Women is a grassroots organisation in NSW, led by women working in the health and medical research sector. They are focused on building a community of women, with the goal of empowering them to pursue rewarding scientific careers and helping them address the systemic barriers faced by women in science and achieve senior leadership positions.

With this new partnership, Franklin Women has recognised Garvan's commitment to supporting the career progression of its female staff and students, and achieving gender equity at all levels of the organisation.

Garvan's relationship with Franklin Women began in 2017, with the participation of Garvan researchers in the inaugural Franklin Women's Mentoring Program. In 2018 Prof Susan Clark and Prof Stuart Tangye were mentors, and Dr Michelle McDonald and Dr Marina Pajic were mentees. Following the success of the first Mentoring Program, Garvan looks forward to the evolution of its relationship with Franklin Women,

and working together to achieve their common goals.

Professor Marie Dziadek says the partnership is an important step for Garvan. "Generating an institute-wide culture of diversity and inclusion lies at the heart of establishing an organisation in which women, and indeed all staff, thrive and achieve their true potential.

"Garvan shares this vision with Franklin Women and all its partner organisations, and we look forward to working collectively to accelerate this cultural change."

This partnership will allow Garvan to continue being proactive in implementing policies and processes to promote gender equity. Garvan's Flexible Working Hours Policy and initiatives such as Garvan's Childcare Travel Awards, spearheaded by Professor Dziadek, have already benefitted researchers across the Institute. The Childcare Travel Awards allow primary caregivers, mostly women, to attend scientific conferences and committee meetings – critical steps in career progression – by providing funds for childcare.

The Think Tank events organised by Franklin Women look to find innovative and effective ways to support the development of a more inclusive scientific community where women thrive.

"Generating an institute-wide culture of diversity and inclusion lies at the heart of establishing an organisation in which women, and indeed all staff, thrive and achieve their true potential."
– Prof Marie Dziadek

In Memoriam



Jane Bryant

It was with great sadness that we farewelled Jane Bryant (née Wiggers de Vries).

At the age of 24, Jane, a nurse at St Vincent's Private Hospital, was diagnosed with triple negative breast cancer. She received a double mastectomy, radiotherapy and chemotherapy, and continued her work looking after patients, some of whom wouldn't have been as unwell as she was at that time.

Jane did a great deal for Garvan in the short time we knew her. She supported research by donating tumour samples, raised thousands of dollars for breast cancer research and shared her story openly, honestly and powerfully. Most importantly, she befriended and inspired our researchers and everyone who met her. Sadly, Jane's cancer returned – and in June of 2018 she passed away.

We are, and will always be, enormously grateful to Jane, her husband Cam and their family and friends for sharing part of their lives with us.



Ann Kirby

Ann Kirby (née Annemarie Plotke) came to Australia as a 10-year-old in 1939, and became the first woman to join the Council of the Law Society of NSW in 1970. Ann blazed the trail for later generations of female lawyers and was a quiet achiever who didn't let prejudice and social barriers stop her achieving her goals.

Ann was a well-known philanthropist and major benefactor of the Emanuel Synagogue, Emanuel School and the Jewish Museum. She was passionate about education, gave generously to the Department of Hebrew, Biblical and Jewish Studies at Sydney University, establishing the Special Purpose JCA Plotke fund for teacher education.

Ann was a loyal supporter of Garvan's work since 2004 and gave generously during her lifetime. In a significant act of generosity, Ann also took the important step of including Garvan as a beneficiary in her Will. We are truly grateful for Ann's farsighted gift which will provide a legacy where everyone lives longer, healthier lives.

Leaders in Science and Society seminars

We're grateful to the many speakers who presented at the Garvan Institute in 2018.



March

Prof Deborah Schofield, Professor and Chair, Health Economics. Director, GenIMPACT: Centre for Economic and Social Impacts of Genomic Medicine, Macquarie University Sydney

April

A/Prof Paul Timpson, Lab Head, Invasion and Metastasis, Garvan Institute

Prof Susan Clark, NHMRC Senior Principal Research Fellow, Head of Division, Genomics and Epigenetics, Garvan Institute

A/Prof Justin O'Sullivan, Senior Research Fellow, Liggins Institute, University of Auckland, New Zealand

Prof Paul Zimmet, Professor of Diabetes, Monash University Melbourne

May

Dr Janet Iwasa, Assistant Professor of Biochemistry, University of Utah, US

Prof Maree Teesson, Director, National Drug and Alcohol Research Centre, UNSW

Prof Ricky Johnstone, Head of Gene Regulation Laboratory, Peter MacCallum Cancer Centre Melbourne

June

Dr Lee Rubin, Harvard Department of Stem Cell and Regenerative Biology, Harvard University, US

Prof Elizabeth Hartland, Director and CEO, Hudson Institute of Medical Research

July

Dr Carlos L Arteaga, Director, Harold C. Simmons Comprehensive Cancer Center, UT Southwestern, US

Prof Jonathon Howard, Co-Director, Quantitative Biology Institute, Yale University, US

August

Dr Peter Tontonoz, Professor of Pathology and Laboratory Medicine, UCLA Los Angeles, US

Prof Jamie Rossjohn, Head, Infection and Immunity Program, Monash University

Dr Chris Armstrong, Acting NSW Chief Scientist

Prof Axel Kallies, Laboratory Head, Molecular Immunology, Walter and Eliza Hall Institute, Melbourne

September

Prof Rob Brink, Lab Head, Immunology, Garvan Institute

Prof Jonathan Baell, Larkins Fellow, Director of the Australian Translational Medicinal Chemistry Facility, Monash Institute of Pharmaceutical Sciences

Prof David James, Leonard P. Ullmann Chair of Metabolic Systems Biology, Charles Perkins Centre; Professor, School of Life & Environmental Sciences and Sydney Medical School

October

Prof John O'Sullivan, Group Leader in Cardiometabolic Disease at the Heart Research Institute and Charles Perkins Centre of the University of Sydney

Prof Kathryn North AM, Director, Murdoch Children's Research Institute; David Danks Professor of Child Health Research at the University of Melbourne

Dr Jacky Goetz, Group Lead, Tumour Biomechanics, CR1 INSERM

November

Dr Jason Vassy, Clinician-investigator, VA Boston Healthcare System and Brigham and Women's Hospital; Assistant Professor, Harvard Medical School, US

A/Prof Tara Murphy, Sydney Institute for Astronomy, University of Sydney

Prof Katherine Kedzierska, Head, Human T cell Immunity Laboratory, University of Melbourne

A shared vision for a healthier future



Miriam Douglass



Miriam Douglass and Libby were good friends and neighbours for over 12 years. Miriam became a surrogate grandmother to Libby's daughters, and she and Libby shared many adventures together. When Miriam asked if Libby would be the executor of her Will, Libby agreed because she knew that honouring Miriam's future wishes would closely align with her own values.

Miriam and Libby had a mutual experience of trying to get better care for their parents – and a mutual passion for bringing about change and improving healthcare.

For Libby, her mother suffered a brain haemorrhage which required her to live in full-time care for 17 years. And for Miriam, her mother passed away when she was very young from a suspected heart attack.

Miriam also cared for her father Alfred, who suffered with prostate cancer later in life. Miriam said she felt helpless and frustrated during this time and wanted to do more. While Alfred underwent cancer treatments, Miriam was asking "What else is available, what treatments can we try, what more can be done?"

Seeing her father suffer, Miriam believed there should be better options for cancer treatments and knew this can only be achieved by increasing our understanding of disease and through funding visionary and blue-sky medical research.

Miriam told Libby that her estate also included her father's legacy, and it meant so much to know that her future gift to medical research will have a lasting impact.

Libby describes Miriam as a generous and caring friend, full of eccentricities but always a source of joy and compassion, especially to children and animals. "I feel truly blessed for knowing Miriam and I am going to miss her friendship," said Libby.

With Miriam's farsighted bequest, Garvan has set up The Miriam Douglass Blue Sky Endowment Fund in her honour. We thank both Miriam and Libby for their shared passion and vision for a healthier future for us all.

Miriam Douglass was born in Wagga Wagga in 1934 and sadly passed away in Sydney in 2016.

With Miriam's farsighted bequest, Garvan has set up The Miriam Douglass Blue Sky Endowment Fund in her honour. We thank both Miriam and Libby for their shared passion and vision for a healthier future for us all.

Partners for the Future

We extend our gratitude to all of these wonderful supporters
who have chosen to leave a bequest to Garvan in their Wills.

Mrs Margaret Adams
Ms Ronelle Adams
Mr Ray Addison
Ms Christine Allen
Mrs Suzanne Allen
Mr Emery Angles
Mr & Mrs V & E Annuk
Ms Wilhelmina Antoniesen
Mr Ian A N Armstrong
Mr Peter Askew
Miss Margaret Atkinson
The Australian Ladies Variety
Association Inc
Dr W. Michael Baker
Ms Melissa J Ball
Mr & Mrs Joseph and
Betty Banhidi
Mr David Barclay
Mrs Ruth Barnes
Mr & Mrs David and
Robyn Barnett
Mr Wal Barrett
Mrs Esther Bartram
Mr Donald Bastin
Mrs Hazel Maude Begley
Ms James Belger
Mrs Sheila Bell
Mr Leslie B Blackshaw
Mr Ken Bloxsom
Caroline Bock
Mr Alan Barnes and
Mr Peter Bolton
Ms Linda Booth
Mr & Mrs Earle and
Marlene Boutwell
Ms Maree Bowman
Mrs Meryl Bowman
Mr & Mrs Alan & Anne Boyle
Dr William R Bradford
Mrs Judith Bradley
Ms Mary Brauer
Mr Trevor Bray
Mr Peter Brell
Mrs Meredith Briggs
Drs Ruth and Des Bright
Mrs Brenda Bristow
Mrs June Bronner
Philip & Wendy Brook
Mrs Jill Brooks
Mr Don Brown
Dr Ken Buckle
Ms Juli Buckley
Mrs Elizabeth Bunyan
Mr David Burles

Mrs Barbara E Buttery
Dr John Campbell
Ms Vicki Case
Mr Angelo Casella
Mr Tom Casella
Mrs Veronica Christie
C E Clark
Mrs Judith Clark
Ms Trish Clifford
Ms Jill Coggan
Dr & Mrs Roger and Carole Cole
Mrs Robyn Collings
Mr Peter Collis
Dr Lynne Cook
Ms Dorothy Coombs
Ms Jan Craig
Ms Loris Crisp
Mrs Philippa Croker
Mr & Mrs Alan and
Roslyn Currie
Mr Graham W Curtiss
Mr Rodney F Darke
Mr Kenneth Davies
Mr & Mrs Kevin & Sylvia Davies
Mr Don and
Mrs Christine Davison
Miss Clare Dawes
Mr Michael Day
Mr & Mrs Peter and
Susanne de Beuzeville
Ms Susanne de Ferranti
Mrs Luise de Longueville
Ms Peggy De Seriere
Ms J Del Layton
Mr & Mrs Tom and
Donna Devitt
Mr John Dickens and
Dr Ian Payne
Mrs Marlene Dixon
Mr John Dobies
Mrs Gabrielle Donovan
Mrs Phillipa Dorin
Mr John Dowd
Ms Jennifer Duncan
In loving memory of
Patrick Dunphy
Mr Alan Durham
Ms Jacqueline Dwyer
Mrs Valda Eastment
Mrs Elizabeth Efinger
Mr Philip Elder
The Evans Family
Miss Moir Evans
Mrs Wai Chiew Fairley

Ms Daile Falconer and
Mr Thomas Delisi
Mr & Mrs Gabriel and
Joan Farago
Mrs Grace Faulks
Rob Ferguson
Ms Jann Ferguson
Ms Diane Ferrier
Fred Fiegert
Mrs Frances Findley
Mr Ralph Forbes
Miss Shirley R Ford
Ms Jan Foster
Mr & Mrs Michael and
Joy Foulsham
Dr & Mrs John and
Diana Francis
Mr Donald Frazer
Mr Terry Gallagher
Mrs Lina Joan Gallo and
Mr Lauro Gallo
Mrs Gwen Gardiner
Ms Geraldine Garvan
Ms Maureen Garvey-Ross
Mr John Gea Gea
Mrs Carmel Gillett
Mrs Margrett Gilson
Girgensohn Foundation
Mr John Gissing
Miss Excelsa Glinoga
Miss Edwina Glinoga
Miss Estrella Glinoga
Pam Goldberg
Mrs Mena Valerie Good
In loving memory of
Tracey Goodley
Alan Goodwin
Mr & Mrs William and
Jacqueline Goodyear
Mrs Helen Victoria Graham
Dr Robert Gray & Mrs Jane Gray
Ms Claire Greaves
Sharon Green & Marcel Skjald
Mr Colin Green
Miss Flo Greene
Ms Patricia Griffen
In Memory of
Patricia Helen Guest
Ms Angela Guildford
In memory of Barbara Guy
Trevor Haines AO and
Paul White
Mrs Fusae Hall

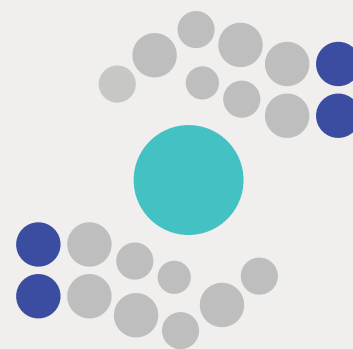
Mr Hedley Hall and
Ms Helen Gibbons
Mr John Hall
Mr Ron Hardaker
Mrs Shirley Harding-Learmont
Miss Helen Hardman
Mrs Bronwen Hargraves
Mr & Mrs Gary & Paulette Hay
Mr Brian Hayes
The Hayes Family
Mr & Mrs W & V Haynes
The Late Mr Philip Hemstritch
Ms Barbara Henderson
Mrs Frances Hession
Mr Scott Hession
Mr Brian Hewson
Miss Linda Hicks
Mr John Thomas Hill
Mr Kenneth Hillier
Ms Heather P Hindle
Mrs Dawne Hintze
Mr & Mrs Lionel & Gwen Hirning
Mr Mike Hobbs
In memory of the McDonough
& Hogan Families
Mr Hilton Hollingdale
Ms Ruth Holmes
Richard J Hudson
Mrs Eileen Hunter
Miss Marilyn Hutchison
Ms Edith Iseli
Miss V Jenkins
Mr Byram Johnston OAM and
Mrs Deborah Johnston
Lloyd Gwyn Jones and
Barbara Jones
Dr W G Grigor
Mr & Mrs Arthur and
Elizabeth Jones
Mrs Florence Jones
Mr & Mrs Terry and
Helen Jones
Ms Maryke Jonkman
Mrs Luba Kaye
Mr & Mrs Patrick and
Beryl Keane
Mr Mark Keeley
Warwick & Carole Kendall
Mrs Isabel (Rae) Kennedy
Ms Wendy Keys
Mrs Kate Khan
Mr Bob Kijurina
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 Mr & Mrs Ralph & Robyn Youie
 The Yulgilbar Foundation
 Zen Imports Pty Ltd

Community Fundraisers

Australasian Tunnelling Society
 (Sydney Chapter)
 Mr Malcolm Baker
 Mr David Blau
 Mr Sam Breed
 Ms Lisa Chikarovski
 Ms Judy Christian
 Mr William Doig
 Fundraising Townsville
 Ms Hannah Gibbon
 Mr Evan Jackson
 Emily Jones
 Mr Ryan Kolster
 Miss Janelle Love
 Mr Ian McAlpine
 Noah's Great Chop
 Mr Mark Panitz
 Pretty in Pink

Mr Michael Scott
Miss Kate Skulte
Mrs Susan Thorley
Ms Eva Wong
Yang Yang

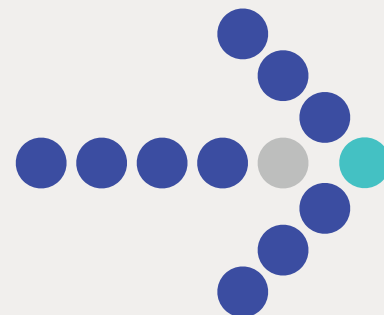
Estates received in 2018

Estate of the late Douglas Agnew
Estate of the late John Ball
Estate of the late Peter Binnie
Estate of the late Dorothy Boddy
Estate of the late Lesley Bourke
Estate of the late Ronald Brett
Estate of the late Jennifer Cowling
Estate of the late Carin Cummings
Estate of the late Alan Currie
Estate of the late Marie Dalkeith
Estate of the late Mary Dallimore
Estate of the late Dawn Daniel
Estate of the late Laksiri De Silva
Estate of the late Miriam Douglass
Estate of the late Malcolm Foley
Estate of the late Lynette Forbes
Estate of the late Pauliene Fraser
Estate of the late Dorothy French
Estate of the late Stephen Gallagher
Estate of the late Harold Garvan
Estate of the late Neville Grace
Estate of the late Beth Grainger
Estate of the late George Gray
Estate of the late Fay Harris
In memory of John and Dawn Hughes
Estate of the late Indrani Jayasinghe
Estate of the late Ann Kirby
Estate of the late Leo Mamontoff
Estate of the late Hazel McNamara
Estate of the late Mabs Melville
Estate of the late Freda Moore
Estate of the late Helen Morgan
Estate of the late Joan Murphy
Estate of the late Aveen O'Reilly
Estate of the late Eleanor Podosky
Estate of the late John Ramsbottom
Estate of the late Claire Rayne
Estate of the late Albert Reader
Estate of the late Neville Saywell
Estate of the late Robert Sharp
Estate of the late Lesly Skilton
Estate of the late Walter Spratt
Estate of the late Reginald Stubbs
Estate of the late Alexander Vuksanovic
Estate of the late Nola Wagner
Estate of the late Joyce Whitmore
Estate of the late William Wood
Estate of the late Lola Woodward

Young Garvan

Mr Will de Beaurepaire
Dr Niall Byrne
A/Prof Elissa Deenick
Mr Lindsay Leeser
Miss Lucia Robson
Ms Natasha Shah

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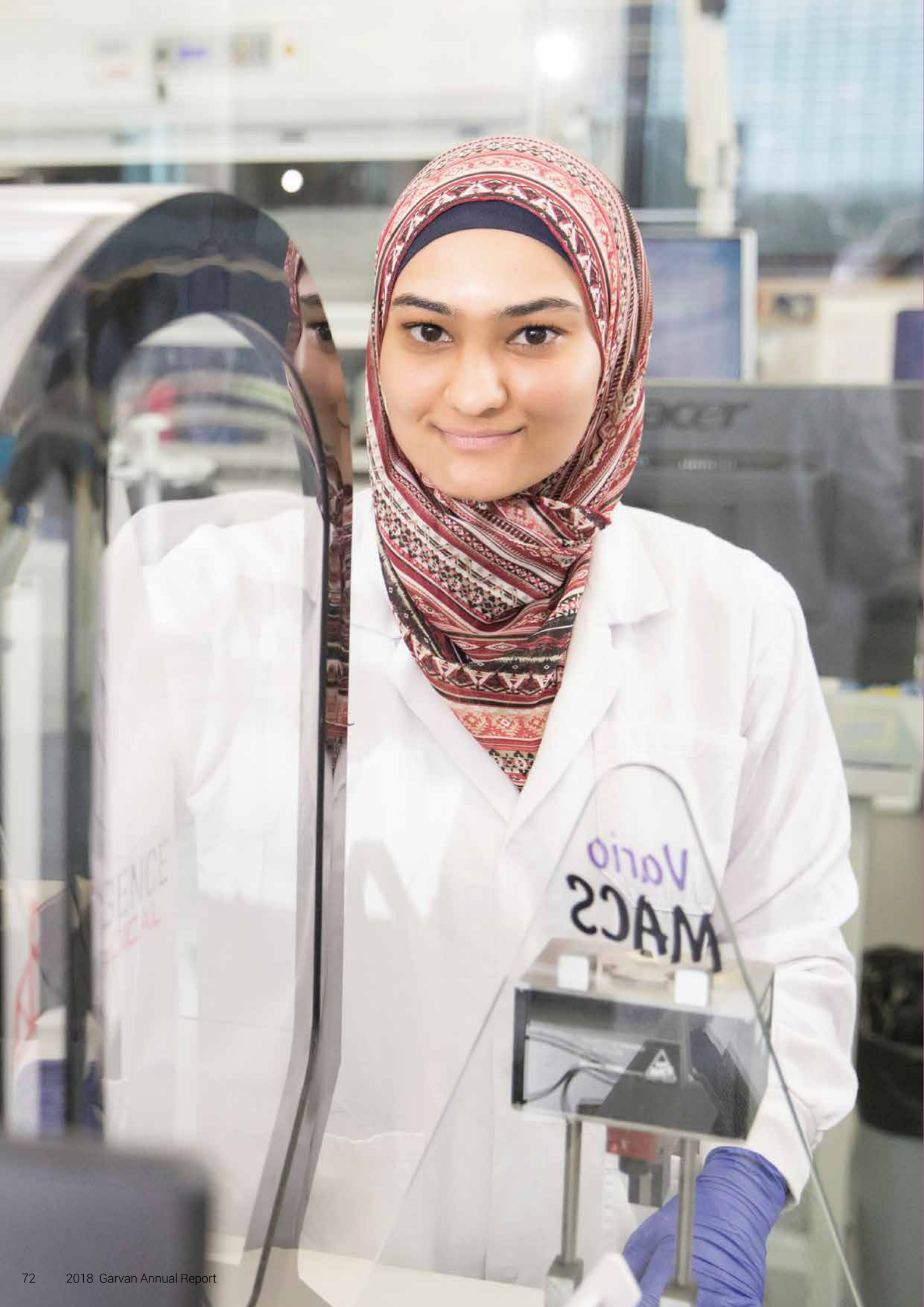
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Peer reviewed funding



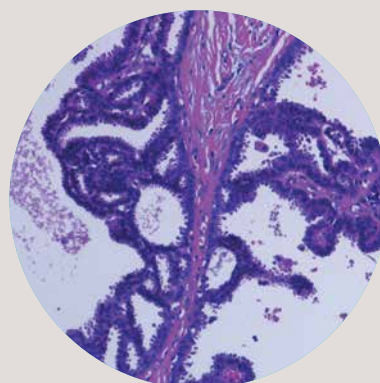
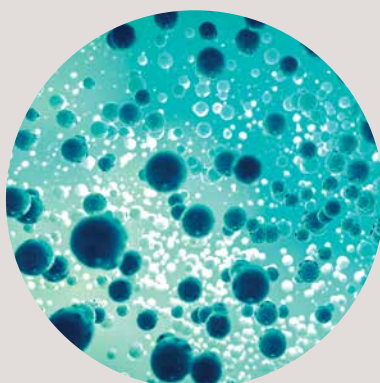
*Professor Marie Dziadek,
Chief Scientific Officer*

From the Chief Scientific Officer

Many of our researchers receive fellowship and grant funding from the National Health and Medical Research Council (NHMRC) and other funding bodies to support their own salaries and their research programs.

Peer reviewed grants are selected in a highly competitive process, with a panel of expert scientists assessing these applications. Due to funding constraints, only a small proportion of applications are funded in each round and many high quality proposals remain unfunded. Therefore, the fundraising efforts and contributions of Garvan's donors are absolutely necessary to support all our researchers' life-changing work. Private funds help our researchers continue their important projects until they're able to acquire competitive grant funding.

Garvan researchers had another excellent year in 2018 with many grant and fellowship proposals funded by NHMRC and other funding bodies, as listed on the right.



Garvan-led grants 2018

Funding Body	Type of Grant	Principal Investigator	Co-Investigators	Project Title	Amount Funded	Years of Funding
Amgen Australia Pty Ltd	Investigator Initiated Research Agreement	Jacqueline Center		The effect of antiresorptive medication on outcomes post fracture (Amgen-45 and Up)	\$372,089	2
Avner Pancreatic Cancer Foundation Ltd	Innovation Grant	David Herrmann	Herbert Herzog, Tatyana Chtanova	Dual targeting of metabolic and immunological aberrations in pancreatic cancer by combining Neuropeptide Y inhibition with immunotherapy	\$99,952	1
Bioplatforms Australia Limited (BPA)	Project Grant	Joseph Powell		Cellular Genomics Data Platform	\$1,000,000	3
Cancer Council NSW	Project Grant	Chris Ormandy	Susan Clark, Samantha Oakes, Carlo Palmieri (University of Liverpool, UK)	Overcoming endocrine resistance in breast cancer	\$448,949	3
	Project Grant	Thomas Cox	Wolfgang Jarolimek (Pharmaxis)	Targeting Lysyl Oxidases (LOX) in Pancreatic Cancer	\$450,000	3
CanTeen – the Australian organisation for young people living with cancer	Clinical Trials Initiative	David Thomas	Mandy Ballinger, Mark Cowley, John Simes (NHMRC Clinical Trials Centre, USyd), Jeremy Lewin (Peter Mac), Antoinette Anazodo (Sydney Children's Hospital)	AYA-MoST: a Molecular Screening and Therapeutics trial for Australian adolescents and young adults with advanced cancer	\$950,000	3
Diabetes Australia Research Trust	General Grant	Yanchuan Shi	Don Chisholm	Investigation of the role of adipocyte-specific Y1 receptors in controlling the browning of white adipose tissue in diet-induced obesity	\$60,000	1
	General Grant	Trevor Biden		A novel macrophage-derived mediator of beta cell dysfunction	\$60,000	1
	General Grant	Ross Laybutt		The protein folding isomerase FKBP11 protects against type 2 diabetes	\$60,000	1
	Millennium Award	Jerry Greenfield	Jen Snaith, Dorit Samocha-Bonet, Jane Holmes Walker & Christian Girgis (Westmead Hospital)	Phenotypic characterisation of adults with type 1 diabetes: towards personalised adjunctive treatment of insulin resistance	\$150,000	2
Job Research Foundation	Project Grant	Stuart Tangye		STAT3-mediated regulation of the human immune response - unravelling the complexities of disease pathogenesis of Job's syndrome	\$200,000	2
Juvenile Diabetes Research Foundation	Project Grant	Shane Grey	Greg Korbitt (University of Alberta, Canada)	Islet dependent tolerance for insulin independence without immunosuppression	\$487,931	2
MS Research Australia	Incubator Grant	Daniel Suan	Chris Goodnow, Mandeep Singh	Determining the single-cell genomic landscape of autoreactive "rogue" lymphocytes in the pathogenesis of multiple sclerosis	\$25,000	1

Garvan-led grants 2018 continued

Funding Body	Type of Grant	Principal Investigator	Co-Investigators	Project Title	Amount Funded	Years of Funding
MTP Connect-MedTech and Pharma Growth centre	Project Grant	Luke Hesson	David Thomas, Marcel Dinger, Mark Cowley, Anthony Joshua, Lisa Horvath, Michael Winlo (Linear Clinical Research company), John Simes (NHMRC Clinical Trials Centre), Charlotte Lemech (NSW Early phase Clinical Trials Alliance), Evan Dodds (Illumina)	Enabling Precision Cancer Clinical Trials: A molecular profiling platform for the Australian clinical trials industry and SMEs	\$400,000	1
MTP Connect-MedTech and Pharma Growth centre	Program Grant	Luke Hesson	David Thomas	A clinically-accredited and commercial-ready genome profiling platform to enable precision cancer medicine	\$891,500	2
National Breast Cancer Foundation	Investigator Grant	Alex Swarbrick	Joseph Powell, Sandra O'Toole, Elgene Lim	The Breast Cancer Cell Atlas	\$760,521	2
	Investigator Grant	Neil Portman	Elgene Lim, Liz Caldon, Heloisa Milioli	Targeting the p53 pathway in the age of CDK4/6 inhibitor resistant ER positive breast cancer	\$197,825	2
	Investigator Grant	Sandra O'Toole	Alex Swarbrick, Soon Lee (NSW Health Path / WSU), Niantao Deng	Improving treatment options for rare breast cancers – identifying therapeutic targets in malignant phyllodes tumours	\$247,130	2
	Investigator Grant	Tatyana Chtanova	David Gallego-Ortega	Developing novel innate-based immunotherapies in triple negative breast cancer	\$195,782	2
	Investigator Grant	Christine Chaffer		Ablating SULF1: A novel and targeted therapeutic strategy to inhibit breast cancer metastasis	\$241,247	2
	Investigator Grant	Liz Caldon	Elgene Lim	Therapeutic targeting of dual CDK4/6 inhibitor and endocrine resistant breast cancer	\$582,432	3
National Foundation for Medical Research and Innovation	Project Grant	Clare Stirzaker	Susan Clark, Matt Trau & Darren Korbie (University of Queensland)	Liquid Biopsy monitoring for Triple Negative Breast Cancer: a Novel Epigenetic Test	\$141,835	1

Funding Body	Type of Grant	Principal Investigator	Co-Investigators	Project Title	Amount Funded	Years of Funding
National Health and Medical Research Council	Project Grant	Paul Timpson	Jennifer Morton (Beatson Institute, UK), Yingxiao (Peter Mac) Wang (UCSD, USA)	Tailored priming of pancreatic cancer progression and metastatic targeting using KD025, a phase II (ROCK2) inhibitor: fine-tuning treatment via single cell intravital imaging	\$892,362	4
	Project Grant	Marina Pajic	Anthony Gill & Jas Samra (Royal North Shore Hospital), Adnan Nagrial (Westmead Hospital)	"Fine-tuned" manipulation of the c-MET oncogenic pathway in pancreatic cancer: a new paradigm of personalised medicine	\$707,521	3
	Project Grant	David Croucher	Walter Kolch (University College Dublin)	Complex epistasis between JNK and PI3K pathway mutations in breast cancer	\$686,653	3
	Project Grant	Mark Febbraio	Stefan Rose (John Christian Albrechts-Universität zu Kiel)	The designer cytokine IC7: a novel therapy for the treatment of type 2 Diabetes	\$1,081,560	4
	Project Grant	Herbert Herzog		Central control of diet induced thermogenesis	\$782,520	4
	Project Grant	Nikki Lee		Central control of energy partitioning	\$692,755	3
	Project Grant	Yanchuan Shi		Targeting NPY signaling in adipose tissue to promote thermogenesis and weight loss	\$664,920	3
Parkinson's NSW	Project Grant	Antony Cooper	Svetha Venkatesh & Sunil Gupta (Deakin Uni), Boris Guennewig (University of Sydney)	Blood RNA Biomarkers to measure Ddisease progression in Parkinson's patients	\$100,000	1
PKD Foundation (Australia/ United States)	Project Grant	John Shine	Amali Mallawaarachchi	Understanding the role of somatic variation and novel mutational mechanisms in the genetic pathogenesis of PKD	\$160,000	2
Rebecca L Cooper Medical Research Foundation	Project Grant	Joanne Reed		Targeting rogue clones in systemic autoimmune rheumatic diseases	\$100,000	2
St Vincent's Clinic Foundation	Project Grant	Elgene Lim	Neil Portman	Reactivating p53 to combat CDK4/6 inhibitor resistant ER positive breast cancer	\$40,000	1
	Project Grant	Venessa Chin	Richard Gallagher, Neil Watkins, Richard Hillman	Using genomics to understand HPV-associated squamous cell cancer of the head and neck	\$25,000	1
	Project Grant	Christine Chaffer	Elgene Lim	Blocking IL1R1 signalling to inhibit breast cancer metastasis	\$50,000	1
	Project Grant	Aurelie Cazet	Alex Swarbrick, Joseph Powell, Anthony Joshua	Single-cell analyses to tailor stratification in patients with intermediate-risk prostate cancer	\$50,000	1
	Project Grant	James Blackburn	Erin Heyer, David Thomas, Toby Trahair (Sydney Children Hospital)	Accurately diagnosing fusion genes in paediatric and adolescent and young (AYA) sarcomas	\$40,000	1
	Project Grant	Jerry Greenfield	Jennifer Snaith, Dorit Samocha-Bonet, Jane Holmes-Walker (Westmead Hospital), Christian Girgis (University of Sydney)	Phenotypic characterisation of adults with type 1 Diabetes:exploring the role of liver and muscle insulin sensitivity	\$100,000	1
Sydney Breast Cancer Foundation	Project Grant	Mun Hui		Describing the cellular landscape of recurrent / metastatic breast cancer	\$50,000	1

Fellowships and scholarships 2018

Funding Body	Type of Award	Awardee	Project Title	Amount Funded	Years of Funding
Australian Research Council	Discovery Early Career Research Award	Romain Rouet	Targeted genome editing using engineered CRISPR-Cas endonucleases	\$409,574	3
Cancer Institute NSW	Career Development Fellowship	Fatima Valdes Mora	An epigenetic approach to target akuma-myeloid-derived suppressor cells in breast cancer	\$600,000	3
	Career Development Fellowship	Michelle McDonald	Tumour-bone cell interactions: An opportunity to harness the microenvironment to overcome metastatic disease.	\$599,920	3
	Career Development Fellowship	Mark McCabe	Non-invasive monitoring of tumour burden and therapeutic response through liquid biopsy and targeted gene capture	\$600,000	3
	Career Development Fellowship	Christine Chaffer	Manipulating IL-1b/IL-1R1 signalling to inhibit breast cancer metastasis.	\$600,000	3
	Career Development Fellowship	Ozren Bogdanovic	Epigenetic regulation of germline cell fate during oncogenesis	\$410,000	3
	Early Career Fellowship	Andre Minoche	Defining the genomic and epigenetic landscape of high-risk paediatric cancer genomes using long-read sequencing	\$508,231	3
National Health and Medical Research Council	Career Development Fellowship	Ozren Bogdanovic	Epigenetic regulation of germline fate during embryonic development and oncogenesis	\$437,036	4
	Career Development Fellowship	Marina Pajic	Addressing the molecular heterogeneity of pancreatic cancer: personalised medicine in action	\$483,404	4
	Career Development Fellowship	Thomas Cox	Delving deeper into the matrix: redefining the extracellular matrix in cancer treatment	\$483,404	4
	Research Fellowship	Tri Phan	Targeting B cell dynamics in immunity, autoimmunity and cancer	\$649,175	4
	Research Fellowship	Daniel Christ	Next generation antibody therapeutics	\$717,275	4
	Research Fellowship	Alex Swarbrick	Discovering new therapeutic strategies for breast and prostate cancer at cellular resolution	\$649,175	4
	Research Fellowship	Susan Clark	The cancer epigenome	\$888,270	4
	Early Career Fellowship	Simon Hardwick	Investigating the role of long non-coding RNAs in neurological disorders using high-resolution transcriptomics	\$417,192	4
Rebecca L Cooper Medical Research Foundation	Al and Val Rosenstrauss Research Fellowship	Andrew Philp	Geriatrics – to harness the effects of exercise into therapies for diseases of ageing.	\$380,000	4

Collaborative grants led by other institutions 2018

Funding Body	Type of Grant	Admin Institution	Garvan Investigator	Co-Investigators	Project Title
Australian Research Council	Discovery Project	UNSW Sydney	Ozren Bogdanovic	Jose Luis Gomez-Skarmeta, (CSIC Spanish National Research Council)	Comprehensive characterisation of DNA demethylation pathways in vivo
National Breast Cancer Foundation	Investigator Grant	University of south australia	Sandra O'Toole	PI Philip Gregory (UniSA) Co-Is: Robin Anderson (ONJCRI), Gregory Goodall (UniSA), Sandra O'Toole	miR-342-a novel suppressor of prometastatic gene network in triple-negative breast cancer
National Health and Medical Research Council	Project Grant	University of sydney	Vanessa Hayes	Sole CI	Establishing a genomic signature for high-risk prostate cancer

Equipment grants 2018

Funding Body	Project Title	Principal Investigator	Co-Investigators	Amount Funded
Cancer Institute NSW	Accessible and affordable real-time whole genome, methylome, and transcriptome sequencing for personalized cancer research. (GridIONx5 CapEx)	Martin Smith	David Thomas, Vanessa Hayes, Marcel Dinger, Mark Cowley	\$237,000
Cancer Institute NSW	Vectra Polaris multispectral imaging platform for cancer immunology.	David Thomas	Anthony Joshua, Alex Swarbrick, Chris Ormandy, Elgene Lim, Tri Phan, Sandra O'Toole, Marina Pajic, Stuart Tangye Michelle Haber (Children's Cancer Institute)	\$465,910

Financial highlights

Statement of financial position as at 31st December 2018

Profit and loss statement

Revenue	2018 A\$'000	2017 A\$'000	Expenditure on research activities	2018 A\$'000	2017 A\$'000
Research grants			Employee benefits expense	57,386	52,597
NHMRC research grants	16,480	14,795	Sequencing consumable expense	5,466	9,728
Other peer reviewed research grants	12,200	6,839	Research expense	10,278	14,199
Other grants	5,992	4,726	Depreciation and amortisation expense	11,302	11,502
Commercial partnerships	246	533	Administration expense	10,344	11,116
	34,918	26,893	Fundraising and marketing investment	3,244	3,260
NHMRC and UNSW Infrastructure grants			Building and scientific expenses	8,862	6,827
NHMRC IRIISS grant	3,046	2,924	Finance costs	715	1,452
UNSW contribution	3,977	499		107,597	110,681
	7,023	3,423	Total comprehensive income for the year	(332)	(9,482)
NSW government support	7,169	16,256			
Donations and bequests	41,148	27,024			
Other income					
Sequencing and facility charges	15,878	20,961			
Investment/interest income	435	6,306			
Software licencing revenue	816	672			
Net gain on disposal of property, plant and equipment	0	(209)			
Net gain on foreign exchange	89	0			
Share of gain of associates accounted for using the equity method	(211)	(127)			
	17,007	27,603			
Total revenue	107,265	101,199			

Balance sheet

Assets	2018 A\$'000	2017 A\$'000	Liabilities	2018 A\$'000	2017 A\$'000
Current assets			Current liabilities		
Cash and cash equivalents	47,055	36,132	Trade and other payables	8,567	8,986
Trade and other receivables	6,848	9,468	Borrowings	159	2,224
Financial assets at fair value through profit and loss	33,018	39,962	Provisions	5,684	5,685
Financial assets at amortised cost	9,236	4,319	Deferred Revenue	1,733	70
Sequencing Consumables	1,196	3,765	Total current liabilities	16,143	16,965
Biological assets	531	518	Non-current liabilities		
Total current assets	97,884	94,164	Borrowings	12,266	12,478
Non-current assets			Provisions	1,098	1,132
Investments accounted for using the equity method	61	272	Other	906	1,043
Property, plant and equipment	82,513	86,692	Total non-current liabilities	14,270	14,653
Intangibles & others	100	968	Total liabilities	30,413	31,618
Total non-current assets	82,674	87,932	Net assets	150,145	150,478
Total assets	180,558	182,096	Funds		
			Reserves	132,593	111,020
			Retained surpluses	17,552	39,458
			Total funds	150,145	150,478

The Statement of Financial Position provided above, together with the attached Income Statement, have been extracted from the audited general purpose financial statements of Garvan Institute of Medical Research and its controlled entities. The summary financial information does not include all the information and notes normally included in a statutory financial report. The audited general purpose financial report can be obtained upon request to the Chief Operating Officer.

The statutory financial report (from which the summary financial information has been extracted) has been prepared in accordance with the requirements of the Corporations Act 2001, Australian Charities and Non-for-profits Commission Act 2012 and Regulations 2013, Australian Accounting Standards and other authoritative pronouncements of the Australian Accounting Standards Board.

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