

INSTITUTE FOR GLYCOMICS

Annual Report
2021

21st
BIRTHDAY



Griffith UNIVERSITY
Institute for Glycomics

Queensland, Australia

OUR VISION

To be a world-leader in the discovery and development of drugs, vaccines and diagnostics through the application of innovative multidisciplinary science in a unique research environment.

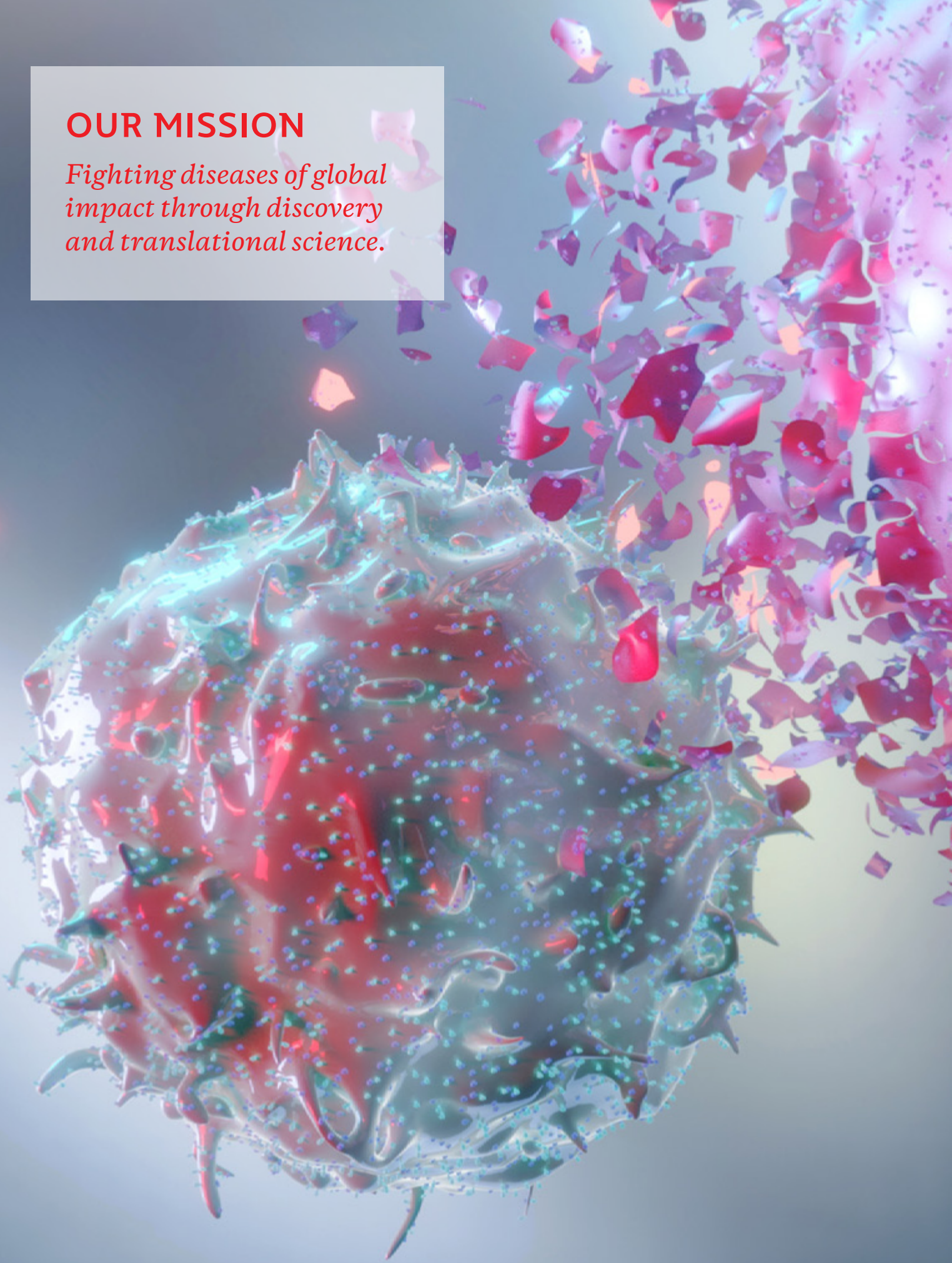


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OUR MISSION

Fighting diseases of global impact through discovery and translational science.



ABOUT THE INSTITUTE FOR GLYCOMICS

The Institute for Glycomics' research primarily targets the identification, prevention and discovery of cures for cancers and infectious diseases, with a focus on translational research to have a positive impact on human health globally.

Established in 2000, through investment by Griffith University and the Queensland Government, the Institute for Glycomics is one of Australia's flagship interdisciplinary translational biomedical research institutes, based in the heart of Griffith University's Gold Coast campus and the Gold Coast Health and Knowledge Precinct.

The Institute boasts state-of-the-art facilities combined with some of the world's most outstanding researchers focused on 'glycomics', a constantly expanding field that explores the structural and functional properties of carbohydrates (or sugars) and their roles in disease.

Our research engages worldwide partnerships, in projects that cut across multiple disciplines to apply new approaches to the identification, treatment and prevention of diseases.

Comprising over 200 staff and students, we strive to be world leaders in the discovery and development of next generation drugs, vaccines and diagnostics for diseases of global impact.

The Institute's rich and enabling research environment provides exceptional Honours, Masters and PhD education programs for the nation's future scientists. Research students are given the opportunity to study alongside some of the world's most experienced and well-known research leaders and scientists, with access to state-of-the-art research equipment and facilities.

The Institute engages with industry, other premier research institutes, philanthropic organisations and governments from across the globe, giving it significant research capacity to provide healthcare solutions to address some of the world's most intractable diseases.

With an outstanding track record in translating biomedical discoveries to the clinic, there is little doubt that our unique approach will play a major role in the discovery and development of next generation drugs, vaccines and diagnostics with the power to change our future.



What is Glycomics?

Scan the QR code for a video illustration.





DIRECTOR'S REPORT

This year we marked an incredible milestone in the life of the Institute for Glycomics – our 21st birthday! It was a year of celebration as we reflected upon 21 years of growth, development, discovery and success. We are incredibly proud of how far we have come, and our standing as experts in multidisciplinary research focussed on translational research that aspires to discover new drugs, vaccines and diagnostics. Our outstanding track record in discovery research and research translation achievements is driven by our mission to fight diseases of global impact and to deliver life-saving diagnostics, preventions and cures to those who need them most.

Throughout 2021, our Institute members continued to work tirelessly resulting in some remarkable outcomes which are highlighted in this report.

Our Institute boasts state-of-the-art facilities. In a major development, we were awarded \$2.6 million in funding from the Australian Cancer Research Foundation (ACRF) to establish the ACRF International Centre for Cancer Glycomics. The funding will allow for the acquisition of advanced mass spectrometry equipment adding to and complementing the existing resources and capabilities within our facility. The equipment will be installed in 2022.

Through generous support from the Bourne Foundation, we were also able to purchase a new Nuclear Magnetic Resonance instrument which will also be installed early 2022.

Highlights in our cancer research program for 2021 include:

- A significant \$2.6 million grant awarded by the Australian Cancer Research Foundation (ACRF) to establish the ACRF International Centre for Cancer Glycomics.
- A major funding pledge from a global private foundation and The Australian Lions Childhood Cancer Research Foundation towards a 3-year sarcoma research project.
- A number of grant successes from the US Department of Defense and the Australian Research Council.

Highlights in our infectious diseases program for 2021 include:

- National Health and Medical Research Council grant funding to develop new antibiotics for the treatment of multi-drug resistant gonorrhoea infections.
- Development of a new vaccine in pre-clinical studies to treat human babesiosis.
- A major breakthrough towards the delivery of a freeze-dried malaria vaccine.
- Major progress in the development of a new vaccine aimed at preventing Streptococcus A infection.

Our Neurological diseases research program has also seen continued success throughout 2021 through translation of Dr Thomas Ve's research supported by industry partner Disarm Therapeutics, a wholly-owned subsidiary of Eli Lilly and Company.

Our Institute's expert scientists have also had successful COVID-19 research outcomes including a successful National Health and Medical Research Council Ideas grant which will undertake proof of concept study for the development of a 2nd generation COVID-19 vaccine.

Our Business team continue to drive the translation and commercialisation of our world leading science. The Institute has engaged with over 40 industry partners, has 6 patents filed on new Institute technologies and a number of clinical trials underway.

We are incredibly grateful for the continued support from our local community, for example Community Bank Paradise Point, Warren and Sally von Bibra, Sanctuary Cove Golf and Country Club, Glycomics Circle, Women in Racing and Rotary District 9640.

We are delighted to have engaged with new philanthropic partners including Australian Lions Childhood Cancer Research Foundation, Bourne Foundation, The Snow Foundation, Gold Coast Women in Business and Earbus Foundation.

Despite the continuing threat of COVID-19 outbreaks throughout 2021, we were thrilled to once again hold our Glycomics Week events in August. The 21st Birthday Grand Ball was an incredible success with over 360 guests in attendance and \$226,000 raised through the generosity of our community partners, supporters and donors. The funds went directly towards our cancer research program to find new ways to fight the devastating disease that claims the lives of over 9 million people across the world every year.

We welcomed approximately 100 guests to our annual Glycomics Public Forum entitled *New Approaches to Tackle Cancer* who heard from an impressive panel of experts in cancer research. We also presented our 2021 Research Excellence Awards on the night. Our 9th Institute for Glycomics Student Forum saw outstanding oral and poster presentations that displayed the young scientific talent of the Institute.

It is my great pleasure to report on the continued achievements and successes of the entire Institute for Glycomics family – the research faculty, students and support teams alike over the course of 2021. Our 21st birthday year was indeed a milestone and now we look to the future with great enthusiasm and determination to progress even further in our mission to fight diseases of global impact through discovery and translational science.

PROFESSOR MARK VON ITZSTEIN AO

Founder and Director, Institute for Glycomics, Griffith University

20 | 21 YEARS

Fighting diseases of global impact

INSTITUTE HIGHLIGHTS



3 Major Research Themes

- Cancer research
- Infectious diseases research
- Neurological diseases research



200+

Institute members



100+ Publications

per year



Income Sources

for 2021

- Research grant funding **\$4,915,994**
- Industry, philanthropic and other support **\$10,399,507**

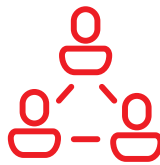


\$1 for \$1

in philanthropic funding supports our research

NEW PHILANTHROPIC ENGAGEMENT

- **Australian Lions Childhood Cancer Research Foundation** supporting our sarcoma research
- **Bourne Foundation** supporting research through infrastructure and supporting two students through their PhD
- **The Snow Foundation** supporting Streptococcus A and Strep Toxic Shock Syndrome research
- **Gold Coast Women in Business** supporting women's cancer research
- **Earbus Foundation** supporting a PhD scholarship in middle-ear infection research



Community Engagement

- **Paradise Point Community Bank** supporting our Grand Ball and Summer Student Scholarship Scheme
- **Warren and Sally von Bibra** supporting our honours and masters student scholarship scheme
- **Sanctuary Cove Golf and Country Club** joining forces with our Institute to fight breast cancer
- **Glycomics Circle** empowering women in science
- **Women in Racing** supporting our glycomics research
- **Rotary District 9640** a powerful partnership to end malaria



6 Provisional Patents

filed on new Institute technologies



Partnering

Engagement with over 40 industry partners for basic research, translation and commercialisation



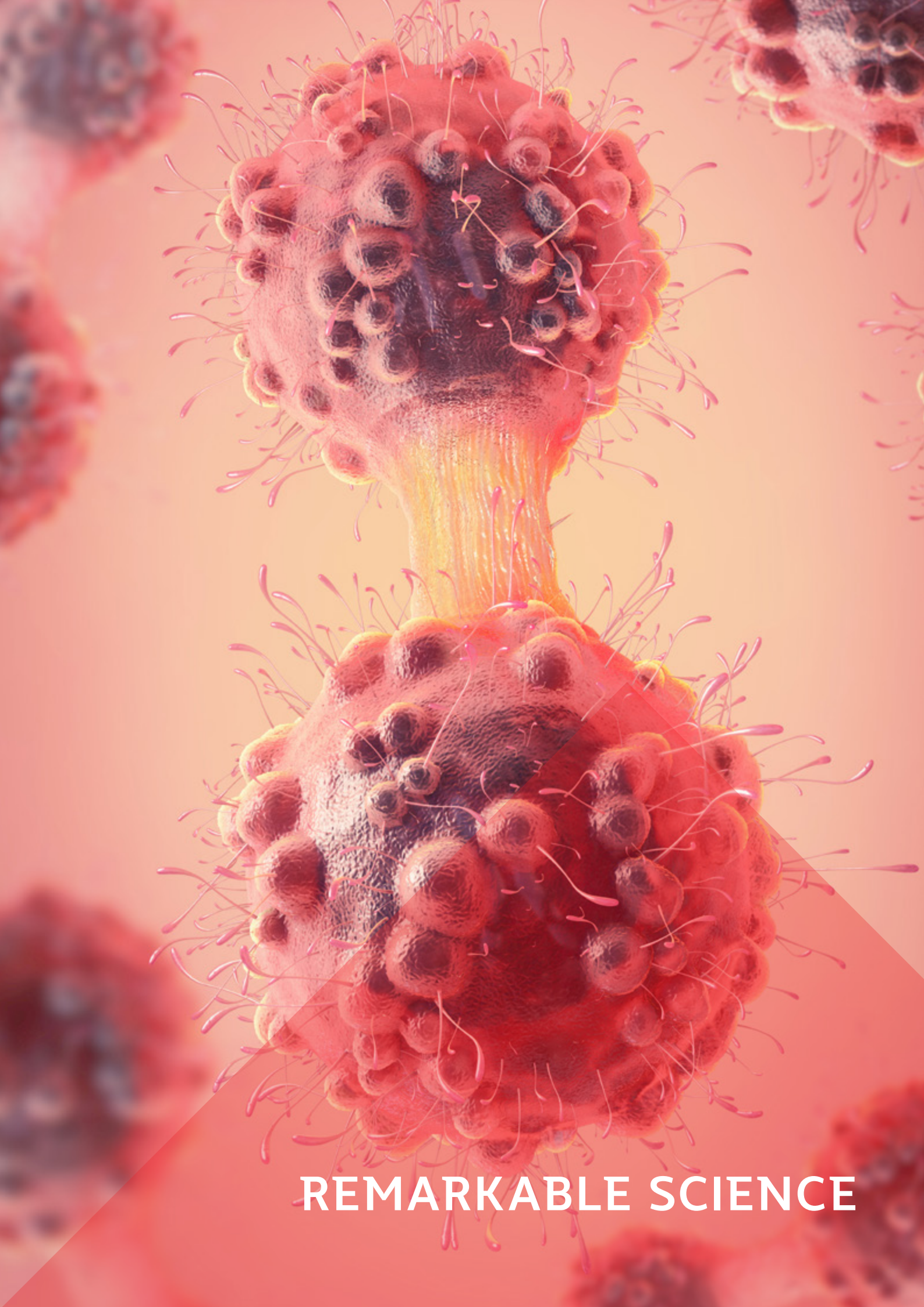
Clinical Trials

- Successful Phase 2a clinical trial results published by Paradigm Biopharma on Institute's re-purposed drug for the treatment of alphaviral induced arthritis.
- Phase 1b clinical trial in sepsis patients underway with industry partner Grand Medical Ltd.
- Health Canada CTA approval for Phase 1 clinical trial in Canada for Group A Streptococcus vaccine candidate. Trial to begin in 2022.
- Recruitment of up to 1000 patients currently underway for 2 x parallel Phase 3 clinical trials on a re-purposed vaccine for gonorrhoea.
- Preparing to enter a Phase 1b clinical trial on a field-deployable malaria vaccine with philanthropic partner Rotary.
- Preparing to enter a Phase 1b clinical trial on a Group A Streptococcus vaccine with Murdoch Children's Research Institute (supported by Heart Foundation).



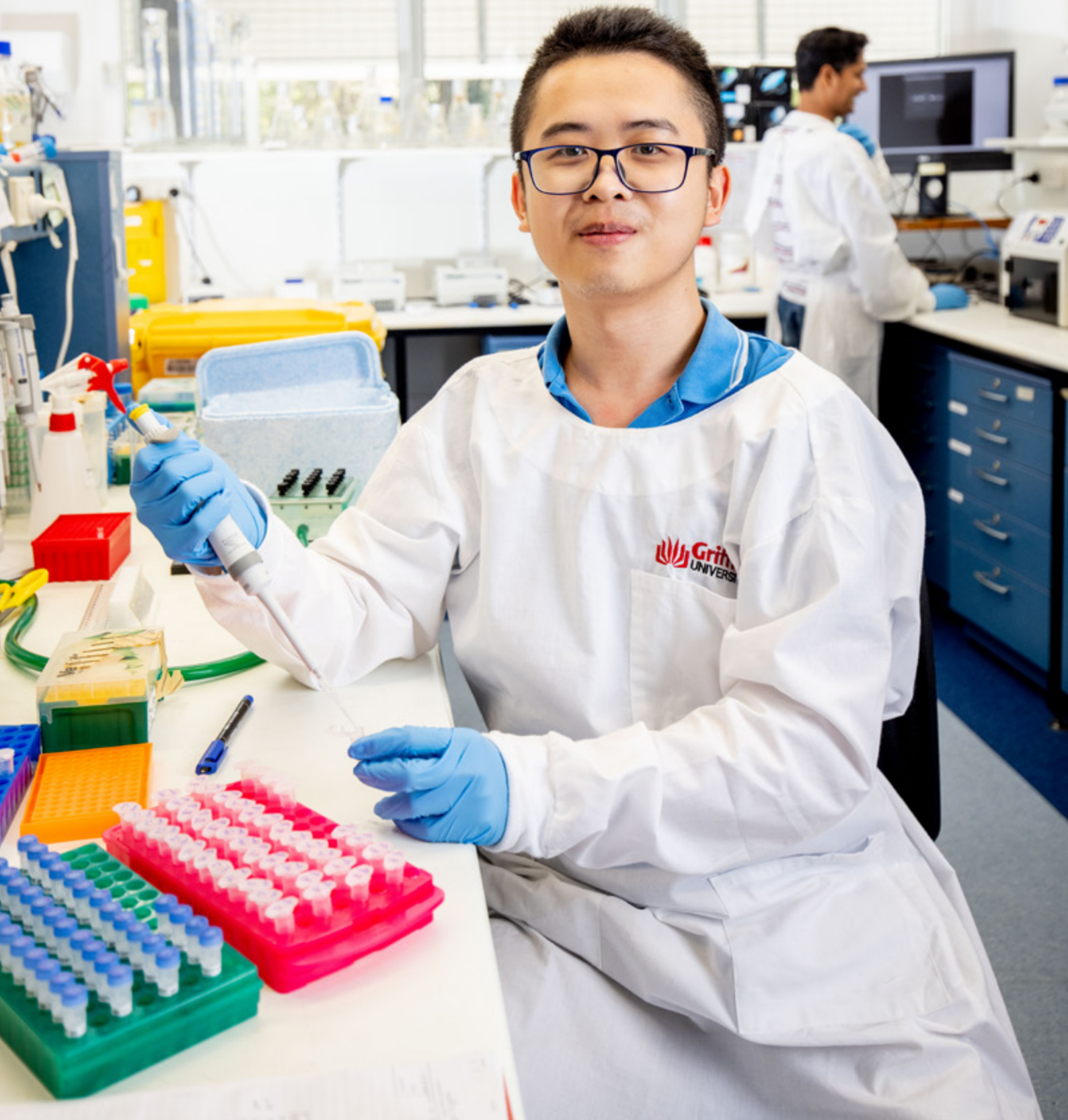
16,916 Citations

over 10 years



REMARKABLE SCIENCE

Our specialist research programs are centred around cancer, infectious diseases, and neurological diseases.



CANCER RESEARCH PROGRAM

It is estimated that cancer is the second leading cause of death globally and is responsible for over 9 million deaths every year. Globally, about 1 in 6 deaths is due to cancer. Our cancer research specialists aim to reverse these alarming statistics through the discovery and development of new scientific technologies to fight the disease.

Established in 2017, the ACRF International Centre for Cancer Glycomics (formerly A2CG Australian Centre for Cancer Glycomics) is one of our Centres of Excellence housed within the Institute for Glycomics. This unique national resource, dedicated to cancer glycomics research, is the result of significant funding from Griffith University, the Australian Cancer Research Foundation (ACRF) and the community.

Cancer glycomics research involves understanding the role that sugars/carbohydrates play in the development of cancers. Using this knowledge, our researchers can invent new drugs, vaccines and diagnostics to treat, prevent or diagnose cancer.

As the only research institute of its kind in the southern hemisphere, the Institute for Glycomics is already an epicentre of glycomics research globally, and houses many world-leading biomedical researchers. The ACRF International Centre for Cancer Glycomics brings together the Institute's experts in cancer research, while providing an ideal platform for collaboration with other leading cancer researchers and clinicians around the world.

A project with the vision and scale of the ACRF International Centre for Cancer Glycomics requires substantial human resource, technical knowledge and specialisation. By combining core expertise and infrastructure, the ACRF International Centre for Cancer Glycomics is a world-class platform for mapping cancer glycomics and glycoproteomics and translating these discoveries into novel diagnostics and therapies.

The state-of-the-art equipment and infrastructure, coupled with the brightest scientific talent in the field of cancer glycomics and glycoproteomics, makes the ACRF International Centre for Cancer Glycomics an exciting hub of truly revolutionary cancer research.

Our researchers focus on some of the world's most devastating forms of cancer, including (but not limited to) head and neck, leukaemia, lymphoma, breast, ovarian, prostate, and skin cancers.

In collaboration with other experts from around the globe, our researchers made remarkable advances in 2021. Here are some of the highlights:

ACRF International Centre for Cancer Glycomics

The Australian Cancer Research Foundation (ACRF) awarded \$2.6 million in funding to establish the ACRF International Centre for Cancer Glycomics. The funding will allow the acquisition of advanced mass spectrometry equipment (the Orbitrap Eclipse Tribrid MS and the Hyperion Imaging Mass CyTOF). These state-of-the-art instruments will add to and complement the existing resources and capabilities within our facility, enabling researchers to deep mine the cancer glyco-code down to a single cell level.

Our team of glycomics experts based at the ACRF International Centre for Cancer Glycomics will work with surgeons, radiologists, scientists, and high-risk cancer clinics to develop early markers in high-risk cohorts and therapeutics based on inhibition of the pertinent glycoconjugates. Our research will provide major advances in the early diagnosis of significant cancers, including skin, ovarian and breast cancer as well as the discovery and development of new drugs to treat these cancers. [\[E\]](#)

Sarcoma research

A global private foundation and The Australian Lions Childhood Cancer Research Foundation (ALCCRF) have pledged \$783,000 to a 3-year research project which aims to deliver novel diagnostic technologies and precision treatment options to close current gaps in sarcoma diagnoses and improve patient outcomes. Having established a robust, highly sensitive pipeline for molecular profiling of cancer tissues and cells, our Institute is now in the optimal position to address urgent needs in sarcoma diagnosis and therapy. [\[E\]](#)

Drug target pathway

Institute for Glycomics scientists have visualised and investigated a key molecular pathway that could one day help treat inflammation, diabetes, cancer, infectious diseases and potentially even COVID-19. The international collaboration led by Dr Thomas Ve, isolated and studied the MyD88 protein molecule and found the missing link between immune cell receptors and the body's inflammation response. [\[E\]](#)

Research lead: Dr T. Ve

Publication: Nature Communications

Grant successes

- US Department of Defense: US\$486,037 for research into the development of a novel diagnostic test for the early detection of breast cancer.
Prof M. Jennings, Dr L. Shewell, Dr C. Day in collaboration with the University of Adelaide and UQ.
- ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF): \$630,880 for the project titled: *A cyclic ion-mobility mass spectrometer for resolving molecular isomers.*
A/Prof D. Kolarich with Griffith Uni GRIDD, Sciences and QUT
- ARC (LIEF) \$727,596 for the project titled: *An integrated analytical network for protein characterisation.*
A/Prof D. Kolarich, Prof M. von Itzstein, Prof M. Jennings, Dr L. Dirr and Dr A. Everest-Dass with QUT led team

INFECTIOUS DISEASES RESEARCH PROGRAM

Infectious diseases pose some of the world's most significant health challenges, claiming over 17 million lives globally every year. There is an overwhelming need to find new ways to combat diseases caused by bacterial, viral, parasitic and fungal pathogens.

The increasing emergence of antibiotic-resistance is a global concern. There's an urgent need to discover new approaches to address antibiotic-resistance, antiviral drugs and effective vaccines for some of the world's most serious viral and bacterial pathogens.

Our infectious diseases research program tackles these issues, combining our cutting-edge research equipment and facilities with our world-leading scientific expertise. Our unique, multi-disciplinary approach to infectious diseases research provides us with a solid platform to discover and develop next generation drugs, vaccines and diagnostics to address some of the world's most debilitating diseases.

Bacterial infections

The Institute's research into the role of sugars/carbohydrates in diseases caused by bacteria represents new and exciting opportunities for the discovery of next generation antibiotics and vaccines. Many of the bacteria that cause some of the world's most devastating diseases are rapidly developing resistance to antibiotics, and to this end, we are also developing drugs that break anti-bacterial resistance. Types of bacterial infections included within our infectious diseases research program include Strep A/rheumatic heart disease, tuberculosis, middle ear infections, gonorrhoea, meningitis and gastroenteritis/food poisoning.

Viral infections

Diseases caused by viruses have plagued humanity for time immemorial. Unfortunately, drugs that combat viruses are extremely limited in number and are not broad spectrum. The Institute's research into viral infections such as hand, foot and mouth disease (HFMD), human immunodeficiency virus (HIV), influenza virus, human parainfluenza virus (hPIV), human metapneumovirus (hMPV), respiratory syncytial virus (RSV), Dengue virus, Ross River virus, Chikungunya virus (CHIKV) and other emerging alphaviruses, seeks to understand how sugars/carbohydrates are utilised in viral infections so that scientists can identify targets for the development of new drugs that will treat and cure these diseases.

Parasitic infections

Parasitic infections such as malaria still present as important public health challenges in tropical environments, with devastating socio-economic consequences in developing countries. It is now becoming clear that some of these parasites rely on carbohydrate-binding proteins for attachment and invasion of human host cells. Our research in this area will yield useful information for the design of diagnostic tools, vaccines and drugs to fight these diseases.

Fungal infections

Fungal infections constitute a broad range of common medical illness from a common superficial or mucosal infection to the more severe systemic invasive fungal infections that affect millions of people worldwide. Fungal infections can occur regardless of the immune status of the host. However, individuals with a compromised immune system are targets for invasive fungal infections. The Institute is fighting invasive fungal infections through novel therapeutic approaches.

Some of our infectious diseases research highlights in 2021 include:

Treatment of multi-drug resistant gonorrhoea infections

Institute for Glycomics researchers were awarded more than \$1.1 million in National Health and Medical Research Council (NHMRC) grant funding to develop new antibiotics for the treatment of multi-drug resistant gonorrhoea infections. Gonorrhoea is caused by the bacterium *Neisseria gonorrhoeae* (Ng), which is now classified as an immediate public-health threat due to recent emergence of multi-drug resistant superbugs. Researchers will now be able to delve further into the chemistry and potential application of new "zinc-binder" drugs under development to target a range of significant drug resistant bacterial infections. [\[E\]](#)

*Research leads: Prof/s M. von Itzstein and M. Jennings
Publication: Cell Reports and mBio*

Metal-based compounds pave the way for new antiviral treatments

Institute for Glycomics researchers identified that a class of metal-based anti-viral compounds can shield human cells from viruses causing hand, foot and mouth disease (enterovirus 71) and metapneumovirus respiratory infection (human metapneumovirus, hMPV) and may also trap them to prevent viral spread.

Using a variety of methods including NMR spectroscopy, virology and computational modelling, they discovered that the platinum-based complex (PPC) TriplatinNC binds in a specific manner to the large sugar biomolecule Heparan Sulfate (HS), found on the surface of cells and acts as a shield from viruses. [\[E\]](#)

*Research leads: Prof M. von Itzstein and Dr B. Bailly
Publication: ChemComm*


Human babesiosis vaccine

In a world-first, researchers have developed a new vaccine in pre-clinical studies to treat human babesiosis, a tick-transmitted disease closely related to malaria. The whole parasite Babesia vaccine acts as a universal vaccine, inducing immunity against different human Babesia species. Pre-clinical studies have shown the vaccine can kill the parasite and induce a protective immune response. The immune response is tied to two crucial aspects of the immune system – T Cells and macrophages (which clear bacteria and other germs). [\[E\]](#)

*Research leads: Prof M. Good and Dr D. Stanicic with UQ and the US Food and Drug Administration.
Publication: Cell Host and Microbe*

Broad-spectrum malaria vaccine


In a major breakthrough towards the delivery of an efficient malaria vaccine, Institute for Glycomics researchers have discovered their whole parasite malaria vaccine can be freeze-dried into a powder without losing its efficacy and making it suitable for deployment into malaria-endemic countries.

The researchers plan to hold human clinical trials to evaluate this vaccine in 2022. It will then be ready to evaluate overseas in malaria endemic areas. 

Research leads: Prof M. Good and Dr D. Stanisc
Publications: mBio

Potential vaccine to prevent deadly Strep A infection

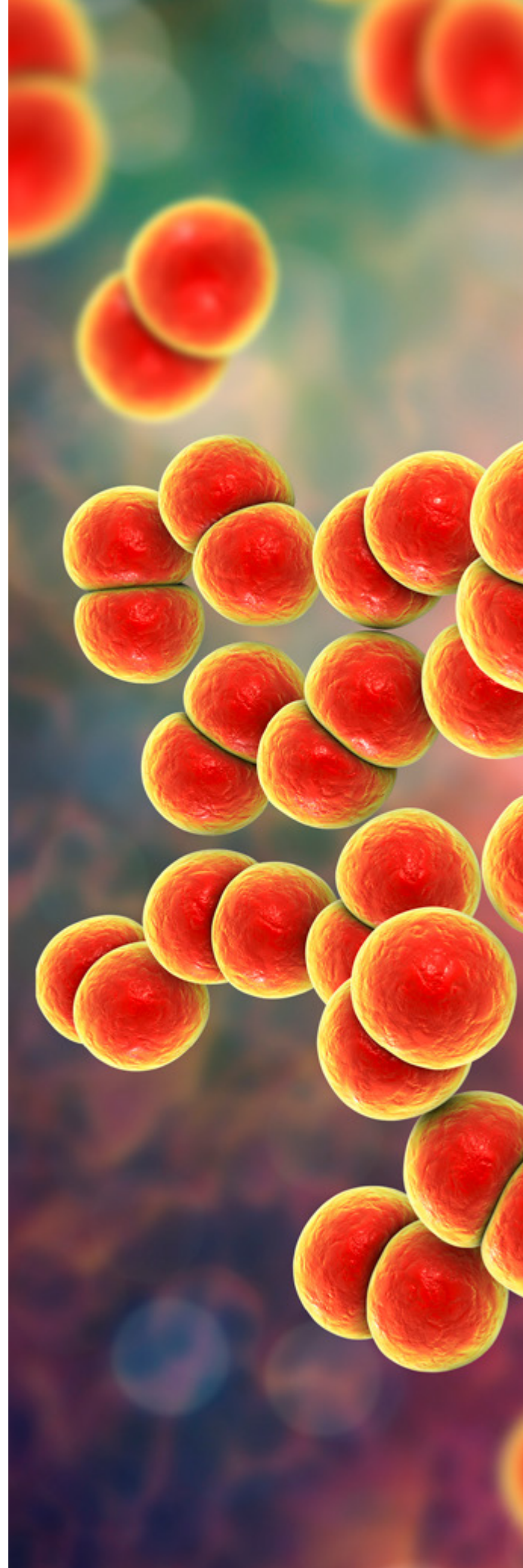
Using a novel technology, researchers are closer to the development of a new vaccine aimed at preventing deadly Streptococcus A (Strep A) infection. Researchers identified two small proteins from Strep A and combined them with a potent adjuvant (immunological agent) to enhance the body's immune response. Immune responses generated against these proteins induce enduring immunity and protect the host in the respiratory tract as well as elsewhere in the body for long periods of time.

In pre-clinical studies, the researchers found two standard intramuscular vaccinations followed by an intranasal vaccine boost induces vaccine-specific antibodies that protects the throat and skin from Strep A. Researchers hope to proceed to clinical trials in early to mid-2022. 

Research leads: Prof M. Good and Dr M. Pandey
Publications: mBio

Grant successes

- NHMRC Synergy Grant: \$5,000,000 for the project titled: *Mining the host-pathogen interface to deliver a drug pipeline for treating intractable and emerging infections.*
Prof M. von Itzstein and A/Prof L. Herrero with UQ-led team
- ARC Discovery Project: \$523,000 for the project titled: *Glycan-based prebiotic approaches to increase food safety in Australia.*
A/Prof T. Haselhorst and Dr C. Day
- \$585,000 for the project titled: *Nano optoelectronic coupling: towards an ultrasensitive sensing technology.*
A/Prof E. Streed and team



NEUROLOGICAL DISEASES RESEARCH PROGRAM

Neurological disease is the umbrella term used to describe a group of disorders that are characterised by the progressive degeneration of the structure and function of the central and peripheral nervous systems.

Neurological diseases are incurable and debilitating conditions that result in progressive degeneration and/or death of nerve cells. This causes problems with movement or mental function.

Neurological disorders have been predicted by the World Health Organisation to overtake cancer and become the second-most prevalent cause of death in the next 20 years.

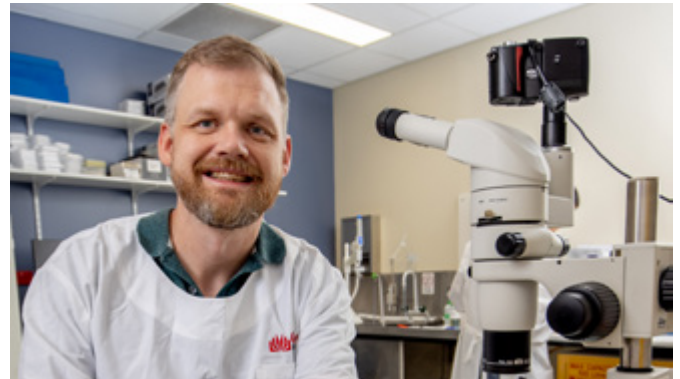
The science behind neurological diseases

Axons (nerve fibres) are the portion of the nerve cells that communicates with other cells by transmitting electrical and chemical signals. These signals underlie essential processes, such as thinking and memory, movement, language and sense of touch.

When axons are damaged, whether by injury, disease or as a side effect of certain drugs, a program is triggered to make axons self-destruct. This destruction likely plays an important role in multiple neurological conditions, including peripheral neuropathy, Parkinson's disease, amyotrophic lateral sclerosis (ALS), traumatic brain injury and glaucoma. There are no current treatments that effectively target axonal breakdown.

“As a trigger for nerve fibre degeneration, understanding how the enzyme SARM1 works may help us treat several neurodegenerative conditions,”

DR THOMAS VE



Our unique research approach – Dr Thomas Ve

An Institute for Glycomics team led by Dr Thomas Ve in collaboration with researchers from the University of Queensland and Washington University, USA, discovered how a therapeutic target common among debilitating neurodegenerative disorders is activated.

The researchers analysed the structure and function of a protein called SARM1, which is involved in the destruction of nerve fibres. They found that the protein is a sensor that responds to the levels of specific molecules derived from metabolism.

When nerve fibres are damaged, whether by injury, disease or as a side effect of certain drugs, SARM1 is called into action which sets off a series of events in the cell that trigger them to self-destruct.

This destruction likely plays an important role in multiple neurodegenerative conditions, including peripheral neuropathy, Parkinson's disease, amyotrophic lateral sclerosis (ALS), traumatic brain injury and glaucoma.

Dr Ve and collaborators used NMR spectroscopy, a biophysical tool to analyse interactions between proteins and small molecules, to demonstrate that two important metabolites in nerve cells compete for binding to the SARM1 protein, and the ratio of these two metabolites determines whether SARM1 becomes activated. They also used structural biology tools – Cryo-electron Microscopy and X-ray Crystallography – to determine three-dimensional structures of the SARM1 protein which enabled them to pinpoint exactly where these two metabolites bind to SARM1 and how they regulate SARM1 activation.

Translation of this research is supported by a long-term research collaboration with Dr Ve's industry partner Disarm Therapeutics, a wholly-owned subsidiary of Eli Lilly and Company, whose mission is to create breakthrough disease-modifying therapeutics to treat patients affected by axonal degeneration. 



Our unique research approach – Professor Carolyn Mountford


Professor Carolyn Mountford is a world leader in the development of magnetic resonance (MR) technology to address unmet clinical needs.

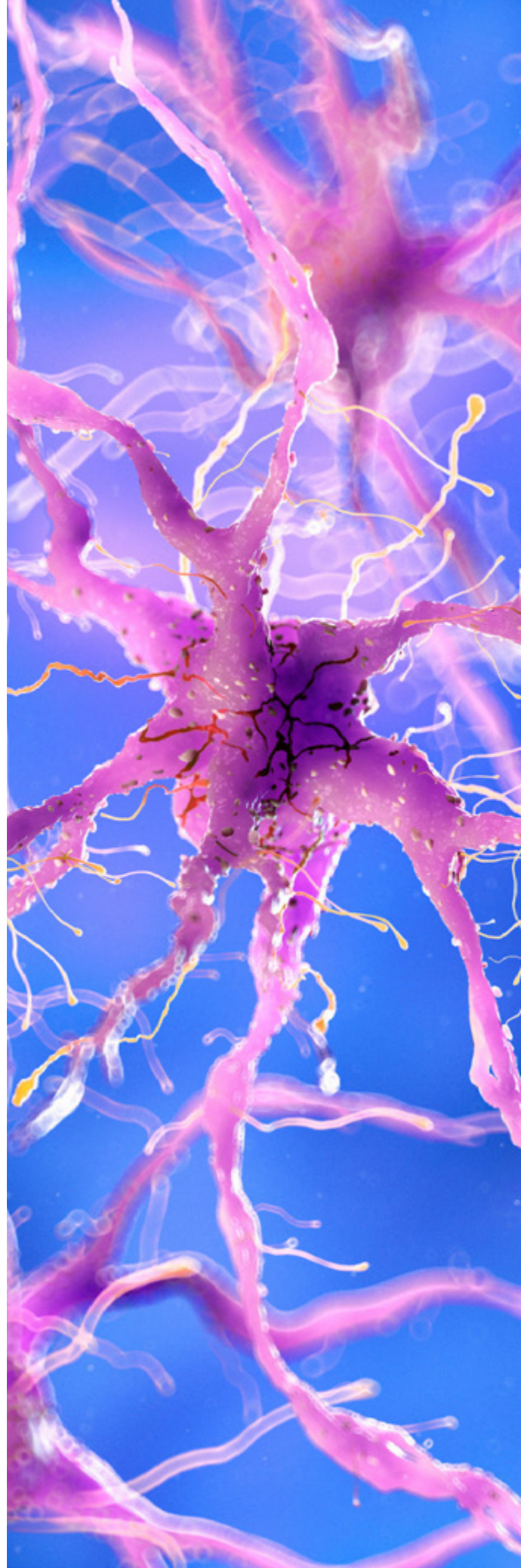
Her translational research in the neuro field centres on MR technology to identify changes to the brain associated with Post-Traumatic Stress Disorder (PTSD), injury from blast and impact, and pain. Her team is under contract to the USA and Australian military to develop this approach to improve the health of soldiers.

Professor Mountford's research team uses clinical 3T scanners to monitor the effect of disease and pain on the human glycome.

They have assigned seven fucosylated glycans in the human brain, which are affected differently by chronic pain, PTSD, and blast exposure.

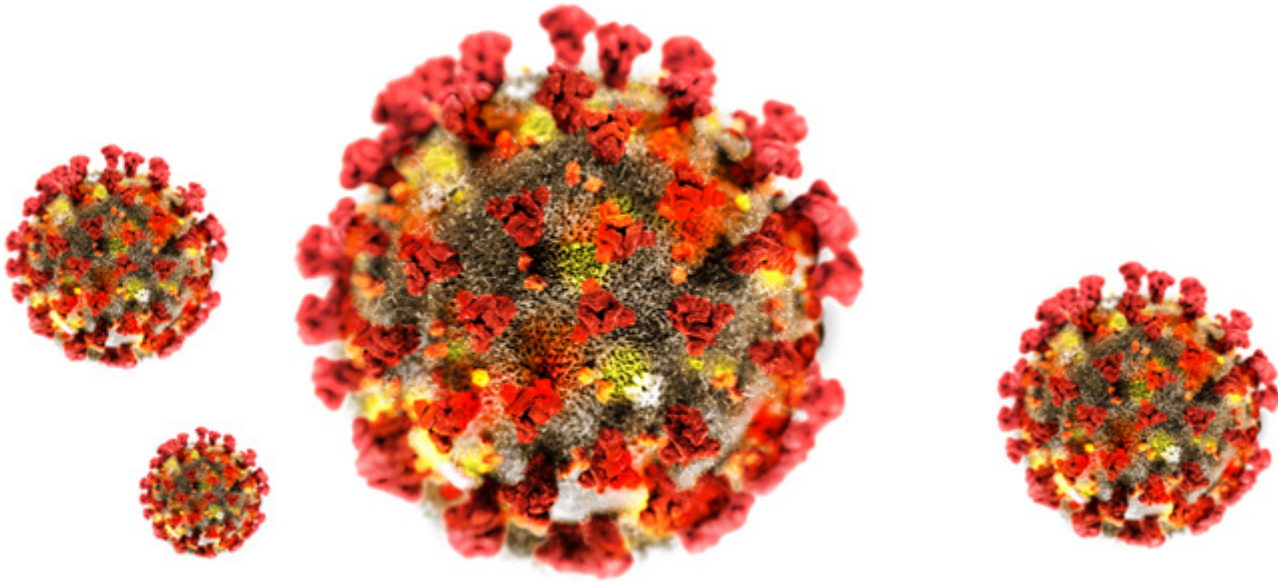
These Fuc- α (1-2) glycans have been shown in animal models by a Caltech team to be implicated in the mechanisms underlying neuronal development, learning and memory and regulation of the nervous system development and neuronal processes. In collaboration with Professor Mark von Itzstein, Associate Professor Thomas Haselhorst and others, the team is elucidating the precise carbohydrate chemistry that is underlying these conditions, which is integral to future clinical management.

In May 2021, Professor Mountford, presented at the International Society for Magnetic Resonance in Medicine (ISMRM) 2021 and Society for MR Radiographers and Technologists (SMRT) virtual annual meeting. In her talk, Professor Mountford outlined the steps for moving MRI research from the lab to the clinic using experience from her own projects as examples – particularly work on identifying biomarkers for neurophysiological and mental health conditions (such as post-traumatic stress disorder or blast impacts to soldiers), developing an objective test for chronic pain, and evaluating cancer risk associated with breast density and methylmalonic acid (MMA) in healthy women. 



World-renowned research scientists, highly skilled infectious diseases experts and state-of-the-art research facilities and equipment.





OUR COVID-19 RESEARCH SUCCESS

Multiple teams of expert scientists from the Institute for Glycomics are targeting the virus SARS-CoV-2 to discover new vaccines and drugs to prevent or cure COVID-19.

The teams are led by the Institute's group leaders Professor Mark von Itzstein, Professor Michael Good, Professor Michael Jennings and Professor Johnson Mak, all world-renowned research scientists in their various fields of infectious diseases research.

Although each team possesses a specific focus and strategy, they work closely with one another, sharing information, ideas and results, to find innovative ways to tackle the disease.

“This multi-pronged approach between highly skilled infectious diseases experts in the Institute and Queensland Health Departments, including Gold Coast University Hospital and Forensic Scientific Services, coupled with our Institute’s state-of-the-art research facilities and equipment, provides much hope in the fight against COVID-19.”

PROFESSOR MARK VON ITZSTEIN AO

COVID-19 research successes in 2021 include:

2nd generation COVID-19 vaccine

A team effort, led by Dr Manisha Pandey and Dr Penny Rudd, involving researchers from the Institute for Glycomics and Monash University lead to a successful \$1.2 million National Health and Medical Research Council (NHMRC) Ideas grant which will undertake proof of concept study for the development of a 2nd generation COVID-19 vaccine. [\[E\]](#)

Future-proofing COVID-19 vaccine

The group led by Professor Michael Good is developing a vaccine for COVID-19 utilising a peptide-based vaccine approach encompassing minimal B cell epitopes from the RBD region of SARS-CoV2. Exciting research findings were published in the Journal of Clinical and Translational Immunology.

The Mak group, led by Professor Johnson Mak contributed to the study on immune responses in COVID-19 patients using a viral vector system. [\[E\]](#)

Research leads: Prof M. Good and Dr M. Pandey
Publication: *Clinical and Translational Immunology*

COVID-19 treatments

In collaboration with Professor Michael Jennings and Dr Chris Day, a study revealing novel COVID-19 drugs was published in mBio in March 2021, with Associate Professor Haselhorst as joint-senior author. The joint groups were able to identify several new compounds that block SARS-CoV-2 from interacting with Angiotensin-Converting-Enzyme 2 (ACE2) by using a combination of in-silico screening (Haselhorst group) and an SPR re-purposing drug screening (Jennings/Day group). The efficacy of the compounds was validated using a SARS-CoV-2 viral assays in collaboration with Professor Mark von Itzstein's laboratory.

The Mak group, using a viral vector system also contributed to this study by identifying antiviral candidates against SARS-CoV-2. [\[E\]](#)

Research leads: Prof M. Jennings, Dr C. Day, A/Prof T. Haselhorst
Publication: *mBio*



Our world-renowned research group leaders and their dedicated research teams work around the clock, seeking new opportunities that can lead to novel drugs, vaccines and diagnostics, translating our research into tangible benefits for the global community.



THE INTERNATIONAL CONSORTIUM FOR ANTI-INFECTIVE RESEARCH

In 2017, the International Consortium for Anti-Infective Research (iCAIR®) was established. This is a major international partnership between Australia's Institute for Glycomics and Germany's Fraunhofer Institute for Toxicology and Experimental Medicine, the Institute for Clinical Biochemistry at the Hannover Medical School (MHH) and Helmholtz Centre for Infection Research.

The Consortium aims to discover new treatments to combat respiratory viruses including SARS-CoV-2, influenza virus and respiratory infection-causing bacteria and fungi.

Infectious diseases and antibiotic resistance are a global, and potentially deadly threat. Previously effective antibiotics are becoming less and less effective against multi-resistant bacteria, and there is an urgent need to develop new drugs and treatments to combat infection.

The biggest hurdle in developing new medications is getting them from the laboratory into clinical trials, bridging the gap from the discovery of new agents to their development by the pharmaceutical industry into potential medications.

iCAIR® is working on the development of anti-infective therapies that take new treatment options all the way from the identification of potentially beneficial substances to the pre-clinical proof of concept. The alliance establishes a development platform that covers all the steps of a targeted drug development process, from identifying potential points of attack, right through to drug design and efficacy testing.

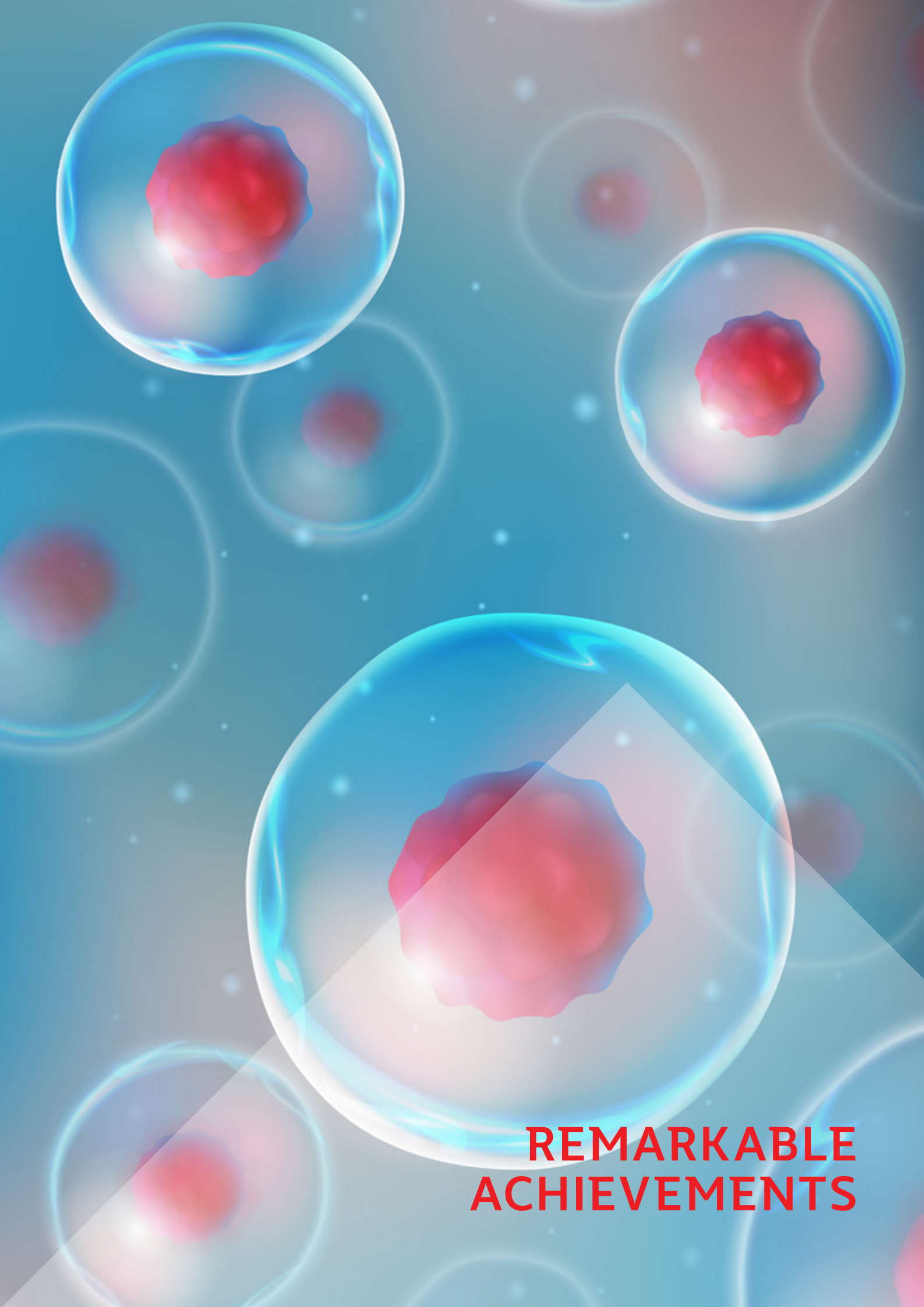
In 2020, iCAIR® commenced a joint project to develop treatments against SARS-CoV-2, the virus that causes COVID-19. The joint project aims to find cures for COVID-19 through drug-repurposing screens using advanced ex vivo human models, develop new drugs based on these findings, and discover new vaccines to prevent the disease. [\[E\]](#)

Ms Danielle Lee, PhD candidate, has further progressed the identification of novel antifungal treatment options to combat invasive Aspergillosis in A/Prof T. Haselhorst's group in collaboration with A/Prof J. Tiralongo's research group. This project is part of the international research alliance iCAIR® with a focus on bringing early-stage compounds into regulatory development for market approval.



Our unique research expertise makes us the only institute of its kind in Australia and one of only a handful in the world.





**REMARKABLE
ACHIEVEMENTS**



Professor Mark von Itzstein awarded International Society for Antiviral Research (ISAR) Antonín Holý Memorial Award

Director Professor Mark von Itzstein has won the International Society for Antiviral Research (ISAR) Antonín Holý Memorial Award for innovative contributions that have had a major impact on antiviral drug discovery and/or development.

The Antonín Holý Memorial Award, instituted in 2013, recognises a senior scientist of international stature who has made innovative contributions, has had a major impact on antiviral drug discovery and/or development and has demonstrated career-long scientific prominence in medicinal chemistry, as demonstrated by participation in study sections, membership in editorial boards, leadership in professional societies and similar activities.

Professor Mark von Itzstein has international standing in glycoscience, medicinal chemistry and drug discovery, particularly in the area of anti-infective drug discovery. He has established an internationally-recognised research program that is investigating the discovery of novel anti-microbial drugs, including novel anti-influenza drugs, anti-parainfluenza and anti-cancer drugs based on carbohydrate-related pathways.

Professor Mark von Itzstein's research led to the discovery of the anti-influenza drug, Relenza®. This drug was designed, synthesised and biologically evaluated (*in vitro*) in Professor von Itzstein's laboratory. This discovery is considered to be the most significant outcome and flagship in glycotherapeutic drug development in the last century and has consolidated the world platform of using carbohydrates and carbohydrate-recognising proteins as drugs and drug discovery targets, respectively. Relenza® is the first 'designer' anti-viral drug in the world.

Professor Mark von Itzstein will accept the award at the 2022 International Conference on Antiviral Research in Seattle.

“I am thrilled and very humbled to accept the International Society for Antiviral Research (ISAR) Antonín Holý Memorial Award. The award also recognises my research group members, past and present, and their outstanding contributions to antiviral drug discovery.”

PROFESSOR MARK VON ITZSTEIN



Professor Kate Seib awarded the Innovation, Technology and Research Award at the 2021 Gold Coast Women in Business Award

Professor Kate Seib was announced the 2021 winner of the 'Innovation, Technology and Research Award' at the Gold Coast Women in Business Awards.

This Innovation, Technology and Research Award recognises outstanding new technology, design or research in a chosen field or organisation.

Professor Kate Seib, Research Leader and Associate Director (Research) at the Institute for Glycomics, is an international leader in vaccine development and is changing the course of gonorrhoea prevention and treatment. Through her ground-breaking research and innovative contributions to science, she has, and will, provide new vaccines that will change clinical practices and improve public health. As a research leader and via her community outreach activities and volunteer work in her field, Professor Kate Seib is encouraging, mentoring and developing the next generation of future female research scientists. She is passionate about her responsibility as a role model for women in science.

Professor Kate Seib's ground-breaking research uses cutting-edge technology, and via the active collaboration of researchers and clinicians, her work has and will continue to improve public health in Australia and worldwide.

The highly prestigious Women in Business Awards recognises and honours exceptional businesswomen and industry achievers who are making a difference across Queensland. The awards encourage ambition, empower confidence and inspire new female leaders now and into the future. This award has provided a platform for Professor Kate Seib to connect further with other women in business and the wider community.

“Women are being associated with leadership, innovation, technology and research more than ever before proving that with confidence, we can succeed wherever we set our sights. I am truly honoured to receive this award in recognition of my research and I hope to inspire the next generation of female scientists to make exceptional contributions to their field.”

PROFESSOR KATE SEIB



Dr John Atack, 2021 Frank Fenner Award winner

Dr John Atack, Associate Research Leader at the Institute for Glycomics, was awarded the 2021 Australian Society for Microbiology (ASM) Frank Fenner Award.

The annual award recognises distinguished and major contributions to Australian research in microbiology. Consequently, John presented the Fenner Lecture at the ASM annual meeting in Melbourne.



Dr Ailin Lepletier, 2021 Postgraduate Career Advancement Award – Tier 2

Dr Ailin Lepletier was presented with the 2021 Postgraduate Career Advancement Award – Tier 2 from the Australian and New Zealand Society for Immunology, Australia.

The purpose of this award is to recognise and further advance the research of student and postdoctoral researcher members of ASI at a critical point in their career. The prize money will directly support Dr Lepletier's research, with a focus on career benefit.



Professor Sue Berners-Price conferred as Professor Emeritus

The University Council conferred the title of Professor Emeritus on Professor Sue Berners-Price. To be eligible for this prestigious appointment Professor Berners-Price had to have held an appointment at the level of Professor for a substantial period and have made a distinguished contribution in her discipline or research area and in provision of service to the University community at a level considered worthy of the title of Professor Emeritus.

Professor Berners-Price rejoined Griffith in 2009 as Pro Vice Chancellor (Science, Environment, Engineering and Technology), then commenced in the role of Dean, Griffith Graduate Research School in 2012.

Professor Berners-Price's most significant contributions to Griffith has been as Dean of the Graduate Research School (over a nine-year period from 2012 to 2021) and as a researcher and Principal Research Leader in the Institute for Glycomics.

As a result of strategies put in place under her leadership as Dean, Griffith's Higher Degree by Research (HDR) completions rose from a national ranking of 18th in 2013 to 10th in 2019 and Griffith's performance in overall satisfaction in the Postgraduate Research Experience Questionnaire (PREQ) has been steadily improving, exceeding the 75th percentile (8th nationally) in 2020 for the first time. Her contributions as a researcher were recognised as the recipient of the 2020 Griffith University Vice Chancellor's Research Excellence Award – Research Leadership.

Professor Berners-Price will continue to contribute to Griffith's research agenda by developing projects in the Institute for Glycomics under the new interdisciplinary research area Metalloglycomics, which links glycoscience and bioinorganic chemistry, and has revealed new avenues for targeting glycans for therapeutic benefit. Already Professor Berners-Price has published substantial contributions from her research in Metalloglycomics, during her time in the Institute for Glycomics, that informs new approaches in tackling both cancer and infectious diseases.



2021 RESEARCH EXCELLENCE AWARDS

Every year the Institute for Glycomics conducts the Glycomics Research Excellence Awards scheme to acknowledge and reward outstanding researchers in a number of categories. Winners from these categories go on to compete in the Vice Chancellor's Research Excellence Awards scheme, alongside other researchers from various institutions across Griffith University.

The 2021 Research Excellence Awards winners were:

Early Career Researcher: Dr Sharareh Eskandari

In recognition of excellent performance in pre-clinical vaccine development, working on vaccine candidates for group A streptococcus and COVID-19.

Mid-Career Researcher: Dr Thomas Ve

In recognition of research excellence using structural biology approaches to advance diverse fields including immunology, neurobiology and plant sciences.

Research Engagement: Dr Danielle Stanisic

In recognition of exceptional engagement with community groups for the development of a malaria vaccine.

Research Supervision: Professor Joe Tiralongo

In recognition of an excellent track record of higher degree research student supervision and contributions to developing a successful research culture.

Research Leadership: Professor Kate Seib

In recognition of significant contributions as a world leader in the fields of bacterial pathogenesis and vaccine development.

Research Team/Group: Dr Chris Day, Dr Lucy Shewell, Associate Professor Daniel Kolarich, Professor Michael Jennings

In recognition of significant contributions to developing Neu5Gc cancer biomarkers.

Excellence in Promoting Industry Engagement in Graduate Research: Professor Mark von Itzstein

In recognition of significant success in engagement between higher degree research candidates and industry in translational research projects.

Director's Medal: Dr Luke Blakeway

For excellence in Higher Degree Research, and significant research in the characterisation of bacterial epigenetic regulation.

Peter Gallagher Memorial Glycomics Award: Professor Carolyn Mountford

In recognition of her world leading research in Magnetic Resonance Imaging and Cancer.



2021 STUDENT SCHOLARSHIP AWARDS

2020/2021 Summer Scholarships

The 2020/2021 Summer Scholarships scheme is proudly supported by Community Bank of Paradise Point, Bendigo Bank annually and awards 10 undergraduate students a 4-week research project over December to February, giving them practical experience in the laboratory under the direction of the Institute's inspirational research leaders.

This scholarship is an important component that connects science and research, to create enthusiasm, expand basic knowledge and challenge thinking.

The 2020/2021 Summer Scholarships awardees:

- **d'Artagnan Barnard**, supervised by Dr Darren Grice
- **Pauline Dizon**, supervised by Associate Professor Daniel Kolarich
- **Jake Esposito-Leftwich**, supervised by Professor Mark von Itzstein
- **Alex Fulton**, supervised by Professor Mark von Itzstein
- **Yasin Mojtahedin**, supervised by Associate Professor Daniel Kolarich
- **Jenny Quiatchon**, supervised by Professor Yaoqi Zhou
- **Forrester Savell**, supervised by Dr Darren Grice
- **Saran Takemura**, supervised by Professor Mark von Itzstein and Dr Arun Everest-Dass
- **Peter Tennekoon**, supervised by Professor Mark von Itzstein
- **Josh Ting**, supervised by Professor Kate Seib

2021 Glycomics Student Scholarships

Sally and Warren von Bibra Student Scholarship

Sally and Warren von Bibra are loyal supporters of the Institute's research and have generously supported this prestigious Student Scholarship scheme since 2003.

The 2021 Sally and Warren von Bibra Student Scholarship was awarded to **Alex Johnston** for her research project, supervised by Dr Milton Kiefel.

Glycomics Circle Student Scholarships

The 2021 Glycomics Circle Student Scholarship awards were presented by Patron of the Glycomics Circle, The Honourable Leneen Forde AC. Every year, members of the Glycomics Circle make a financial contribution to empower the Institute's women in science through scholarships, grants and research support.

The 2021 Glycomics Circle Student Scholarship awardees:

- **Allysha Bishop**, supervised by Professor Michael Jennings and Dr Lucy Shewell
- **Emily Smith**, supervised by Professor Kate Seib
- **Mercedes Lazarou**, supervised by Professor Joe Tiralongo and Dr Darren Grice

Institute for Glycomics Student Scholarship

The Institute for Glycomics Student Scholarship provides support to an outstanding student who is undertaking their honours or master's program within the Institute for Glycomics.

This prestigious scholarship was awarded to **Arjuna Abitbol**, for his research project, supervised by Professor Joe Tiralongo.



2021 GRIFFITH UNIVERSITY POSTDOCTORAL FELLOWSHIPS

Three of our past PhD students were awarded prestigious Griffith University Postdoctoral Fellowships in 2021. These two-year fellowships are available to early career researchers with the objective of strengthening our research profile and capacity, giving the researchers the opportunity to become leaders in their field.

Dr Victoria Ozberk

Victoria's project titled *"Developing an Immunotherapy for Streptococcal Toxic Shock Syndrome"* builds on her recent work within the Institute that focused on vaccine development for *Streptococcus pyogenes*. This project will have a significant impact on invasive Streptococcal diseases and directly aligns with the Institutes' goal of developing therapeutics to improve public health.

Dr Jessica Poole

Jessica's project is titled *"Screening for Xeno-Autoantigen Expression in Important Food Species"*. She will work on the genetic basis of variable expression of glycan xeno-autoantigens by cattle, following the observation that there are food animals that naturally lack these important carbohydrate food allergens. This project exemplifies the capacity of the Institute to apply glycomics technologies and is one of several projects in which the Institute is leading research in intensive agriculture for the benefit of Australian primary producers and consumers.

Dr Greg Tram

Greg's project titled *"Designing Novel Toxoid Vaccines for a Major Class of Bacterial Toxin"* is a perfect match for the Institutes focus on infectious diseases and glycoscience. The project follows several landmark studies published by the Institute on toxin biology reporting carbohydrate cellular receptors for key bacterial toxins.

"As Director, it is a pleasure to see so many of our up and coming talented young researchers win prestigious Griffith University Postdoctoral scholarships"

PROFESSOR MARK VON ITZSTEIN AO

*Empowering future scientists -
connecting science and research
to create enthusiasm, expand basic
knowledge and challenge thinking.*



STAFF PROMOTIONS

Over the course of 2021, the Institute for Glycomics celebrated the promotion of six of its researchers in recognition of their outstanding contributions to research. We were also thrilled to have nine students awarded the degree of Doctor of Philosophy. 🎓

Principal Research Leader **Sue Berners-Price** FRACI FRSC conferred Emeritus Professor

Research Leader Associate Professor **Kate Seib** promoted to Professor

Research Leader Associate Professor **Joe Tiralongo** promoted to Professor

Research Leader Dr **Lara Herrero** promoted to Associate Professor/Principal Research Fellow

Research Leader Dr **Milton Kiefel** promoted to Associate Professor

Associate Research Leader Dr **John Atack** promoted to Senior Research Fellow

Associate Research Leader Dr **Christopher Day** promoted to Senior Research Fellow

Research Scientist Dr **Freda Jen** promoted to Senior Research Fellow

Research Scientist Dr **Evgeny Semchenko** promoted to Research Fellow, Grade 2

Research Scientist Dr **Lucy Shewell** promoted to Senior Research Fellow

“On behalf of everyone at the Institute for Glycomics, I would like to congratulate each of our researchers on this significant career milestone. It’s a testament to their outstanding research and commitment to the Institute’s mission to fight diseases of global impact through discovery and translational science.”

PROFESSOR MARK VON ITZSTEIN AO

STUDENT COMPLETIONS

Date	Student name	Thesis title	Supervisor(s)
05 February	Zhe Zhang	<i>Probing Secondary Structures of Self-cleaving Ribozymes by Deep Mutational Scanning</i>	Prof Yaoqi Zhou and Dr Jian Zhan
13 April	Tongchuan Zhang	<i>RNA Structural Modelling</i>	Prof Yaoqi Zhou
13 April	Barbara Hadley	<i>Exploring Nucleotide Sugar Transporter Structure and Function</i>	Prof Joe Tiralongo, Dr Chris Day and A/Prof Thomas Haselhorst
20 April	Luke Blakeway	<i>Moraxella Catarrhalis Phasevarions</i>	Prof Kate Seib and Dr Ian Peak
02 July	Rob-Marc Go	<i>Design and Development of Galectin-specific Inhibitors</i>	Prof Helen Blanchard and Dr Chandan Kishor, Dr Brendan Wilkinson (external)
19 July	Hadieh Eslampanah Seyedi	<i>Structural and Functional Investigation of Galectin-8 and Galectin-9: A Pathway to Develop Novel Cancer Drugs</i>	A/Prof Thomas Haselhorst, Prof Helen Blanchard and Dr Lauren Hartley-Tassell
11 August	Dylan Farr	<i>Design and Synthesis of Novel Therapeutics and Drug Delivery Systems Targeting Severe Respiratory Pathogens</i>	A/Prof Todd Houston and Dr Darren Grice
21 October	Adeana Scott	<i>Phase Variable Methyltransferases Associated with Phasevarions</i>	Prof Michael Jennings and Dr Freda Jen
26 October	Elisa Lim	<i>Host-Pathogen Interactions During Alphavirus Infection</i>	A/Prof Lara Herrero and Dr Penny Rudd

PLENARY, KEYNOTE AND INVITED LECTURES

Date	Conference	Location	Researcher
21-22 January	Fraunhofer ITEM, Models of Lung Disease special "Corona" edition	virtual	Dr Ben Bailly
31 May – 03 June	Australian Society for Microbiology – Annual Scientific Meeting	Melbourne	A/Prof Lara Herrero
31 May – 03 June	Australian Society for Microbiology 2021	online	Dr John Attack
23-25 June	Beilstein and Warren Workshop joint meeting 2021	online	A/Prof Daniel Kolarich
06-08 September	Joint Australasian Sexual Health and HIV and AIDS Conferences	online	Prof Kate Seib
24-25 November	Queensland Immunology Networking Symposium	Brisbane	Dr Thomas Ve



Associate Professor John Gerrard appointed QLD Chief Health Officer

In November, we extended our heartiest congratulations to Institute for Glycomics Adjunct Senior Clinical Research Fellow Associate Professor John Gerrard who was appointed Queensland's new Chief Health Officer.

While Director of Infectious Diseases and Immunology at the Gold Coast University Hospital, Dr Gerrard played a critical collaborative role in several Institute for Glycomics projects. In 2013, as a Clinical Investigator, he helped to establish at Griffith University, the controlled human infection model for malaria which can be used to evaluate novel malaria vaccine candidates and anti-malarial drug.

He continued as a Principal Clinical Investigator in a further five malaria-focused clinical studies, which have enabled progression of Griffith University's Malaria Vaccine Development Program and evaluation of their novel whole parasite blood-stage malaria vaccine in human volunteers. More recently, he collaborated on several COVID-19 projects, which included evaluating immune responses in samples from recovered patients to inform vaccine development and to identify immune cell populations that drive this disease.



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TRANSLATION AND COMMERCIALISATION

TRANSLATION AND COMMERCIALISATION OF WORLD LEADING SCIENCE

Translation and commercialisation of our outstanding research remains a driving principle at the Institute for Glycomics. All of our members, from undergraduate students to Principal Research Leaders and administrative support staff are committed to delivering our life-saving diagnostics, drugs and vaccines to market, where they support those who need them most.

The Institute's Business Team, led by General Manager, Dr Chris Davis, has developed a robust platform for commercialisation of Institute technologies, with a particular focus on establishing deep partnerships with Industry through licensing and co-development programs. In late 2021, we broadened our commercialisation capability within this platform to include Institute spin off and start up companies. A commitment to this new modality has been cemented through membership with Brandon Biocatalyst (formerly Medical Research Commercialisation Fund, MRCF), alongside the majority of leading Australian and New Zealand biomedical research organisations.

This approach provides multi-faceted benefit to internal research programs, including capability building, attracting and retaining a highly-skilled workforce, strong technical and commercial guidance from a product development and demand perspective from industry partners, as well as ensuring smooth technology transfer to give each technology the best chance of success *en route* to market. Additionally, the Institute's business personnel support the research cohort with their expertise in intellectual property, technology packaging, negotiation and deal making, pre-clinical and clinical technology development and post-deal project management.

This commitment is yielding results, as we support four Institute technologies into the clinic, maintain commercial co-development programs on an additional three pre-clinical technologies and continue to replenish our pipeline with a further six provisional patent filings:

“The Institute for Glycomics has successfully co-developed several of its drug and vaccine assets from pre-clinical development to human clinical trials through industry partnerships.”

DR CHRIS DAVIS, GENERAL MANAGER

Clinical development

- Phase 2a clinical trial for alpha-viral induced arthritis drug – Results of successful trial, run by commercialisation partner Paradigm Biopharma were published in BMC Musculoskeletal Disorders.
- Phase 1b clinical trial for sepsis drug – run by commercialisation partner Grand Medical is underway in Australia.
- Phase 1 clinical trial for Strep A vaccine – achieved Health Canada CTA approval with clinical trial scheduled to start Q2 2022.
- Phase 1 clinical trial for field-deployable malaria vaccine – preparing to enter Phase 1 clinical trial in 2022.

Partnered programs

- Cancer diagnostic partnered with INOVIQ Ltd (ASX:IIQ) in 2020 – the first co-development program has been completed, second co-development program ongoing.
- Parainfluenza drug candidate partnered with Grand Medical Pty Ltd in 2019 – lead candidate identified; with pre-clinical development to begin in 2022.
- Neurodegenerative disorder drug candidates partnered with Disarm Therapeutics, a wholly owned subsidiary of Eli Lilly & Co. in 2019 – co-development program ongoing.

Most significantly, 2021 saw the first Institute for Glycomics drug made available to patients, by Industry partner Paradigm Biopharma. This outstanding achievement is profiled in the Commercialisation Case Study on page 32.

With COVID-19 remaining an ever-present threat around the globe, Institute for Glycomics researchers march forward with their research into new drugs and vaccines to treat and prevent the disease. This has been supported by continued efforts to establish new research tools to support this development, such as *in vivo* and *ex vivo* assays, as well as key animal models to understand product efficacy. Our established expertise in respiratory viral infection, along with dedicated SARS-CoV-2 capability, has positioned the Institute as a key partner for companies wanting to evaluate the efficacy of their products against SARS-CoV-2, leading to a number of new commercial partnerships.

In 2022 we will continue our efforts to fight diseases of global impact by partnering with local and international biotech and pharma companies, progressing our discoveries from the bench into the clinic and beyond.



INTERNATIONALISATION

Global collaboration is an integral part of research and commercialisation at the Institute for Glycomics. We continue to establish new, and strengthen existing collaborations to deliver drugs, vaccines and diagnostics to fight diseases of global impact.

Global collaborations enable us to explore new ideas, test and validate our products, access and learn new techniques and progress our technologies along the development pipeline.

Our unique research expertise makes us the only institute of its kind in Australia and one of only a handful in the world. This is backed by a professional and flexible approach to collaboration that makes us an ideal partner for research and commercialisation.

Some examples of our international collaborative efforts include:

- **Norway** – diagnostics for breast cancer with University of Stavanger
- **Germany** – developing new solutions to respiratory diseases through iCAIR®, the International Consortium for Anti-Infective Research, with partners Fraunhofer ITEM and the Hannover Medical School
- **USA** – evaluating new drugs to treat gonorrhoea with collaborators at The Abigail Wexner Institute at Nationwide Children’s Hospital
- **Canada** – conducting a Phase 1 clinical trial on Strep A vaccine candidate with clinical development partner the Li Ka Shing Institute
- **Switzerland** – discovering new biomarkers for cancers with collaborators at the University of Basel through a unique approach with the view to develop new cancer diagnostics
- **Mainland China** – developing a world-first therapeutic for human parainfluenza with industry partner China Grand Pharma, based in Wuhan, through their Australian entity Grand Medical Ltd
- **Hong Kong** – developing new therapeutics for respiratory diseases with Hong Kong Polytechnic University
- **Denmark** – developing new vaccines for infectious diseases in humans and animals with Statens Serum Institute
- **Singapore** – developing new drugs against dengue virus infection with collaborative partner National University Singapore
- **New Zealand** – developing new vaccines for infectious diseases in humans with our NZ Immunotherapies company partner
- **United Kingdom** – developing diagnostics for bacterial infection with a UK-based diagnostics company



COMMERCIALISATION CASE STUDY

First Institute for Glycomics drug now available to patients

The Institute for Glycomics is proud to announce that the Institute invented drug, Zilosul® for viral-induced arthritis, is now being made available to patients by industry partner Paradigm Biopharma (ASX: PAR).

Announced in May, Paradigm achieved its first revenue via the provision of Zilosul® under a pay-for-use Special Access Scheme (SAS) offered by Australia's Therapeutic Goods Administration (TGA). Zilosul® has been made available to physicians with SAS approval to treat patients experiencing chronic arthralgia from Ross River Virus infection.

Institute for Glycomics lead researcher and co-inventor, Associate Professor Lara Herrero, conducts research on the pathobiology of emerging mosquito-borne viruses such as Chikungunya, Dengue, Ross River and Barmah Forest viruses. Infections from these viruses have serious health consequences in humans and can cause joint inflammation, chronic pain and loss of function due to arthralgia. Previously Ross River and Chikungunya virus sufferers were only offered symptomatic management in the form of either nonsteroidal anti-inflammatories or corticosteroids, which in some cases actually exacerbated their condition.

Typically, a new drug takes decades to develop from bench to bedside and costs in excess of US\$1.5 billion. However, A/Prof Herrero was able to expedite this process using a drug-repurposing approach; taking a drug already approved and on the market for the treatment of bladder inflammation and applying it to viral-induced arthritis. Pre-clinical experiments demonstrated world-first results showing that the historic drug, pentosan polysulfate sodium (PPS) could successfully treat both the acute and chronic disease symptoms of alphaviral infections.

Following this break-through, the new use of this existing compound was patent protected and Griffith University and Paradigm Biopharmaceuticals entered into a commercialisation agreement in 2016. Under this agreement, Paradigm received exclusive global rights to commercialise this technology and were responsible for

funding and coordinating the necessary clinical trials to progress the product to market. A/Prof Herrero and her team continue to provide their technical expertise to support technology transfer over the transitional period. The team recently published the results of the Phase 2a clinical trial, completed in 2020. The trial was a resounding success, suggesting the drug candidate is safe and efficacious as a disease-modifying therapy for alphaviral-induced arthritis.

Paradigm Biopharmaceuticals is a global, Australian-based pharmaceutical company focused on re-purposing existing molecules to meet high unmet medical needs. Paradigm's purpose is to develop and commercialise pentosan polysulfate sodium (PPS) for the treatment of arthralgia driven by injury, inflammation, aging, degenerative disease, infection, or genetics. The immediate commercial focus is the re-purposing of the historic drug pentosan polysulfate sodium (PPS or brand name Zilosul®) for the treatment of pain associated with osteoarthritis (OA). Paradigm has advanced towards phase 3 clinical trials for this indication. There is strong scientific evidence that the drug PPS addresses all aspects of the disease: inflammation, pain, and cartilage preservation, suggesting PPS has OA disease modifying potential. Other indications include the treatment of pain and arthropathy and other disease complications in patients with the rare genetic disorder mucopolysaccharidoses; treating alphavirus induced arthralgia (in patients with Ross River virus and Chikungunya); chronic heart failure and potentially acute respiratory distress syndrome.

Zilosul's®, alphaviral induced arthralgia use is Paradigm's first revenue-generating product and an outstanding demonstration of the Institute for Glycomics' continued vision to deliver drugs, vaccines and diagnostics to the patients who need them most.

OUR DEVELOPMENT PARTNER AND LICENSEE:

PARADIGM
BIOPHARMA



**COMMUNITY
ENGAGEMENT**



INSTITUTE FOR GLYCOMICS 21ST BIRTHDAY GRAND BALL

Our 21st Birthday Grand Ball, presented by Meriton Group, was indeed a night to remember. The event was held in the RACV Royal Pines Resort grand ballroom, elegantly decorated to our 21st birthday theme.

Hundreds of high-profile, influential guests from Gold Coast, Sydney, Melbourne, Brisbane and surrounding areas enjoyed a premium three-course meal and beverage package and live entertainment including comedian Lindsay Webb, the McKenzie Band, Griffith University Queensland Conservatorium harpist, Cindy (Hsin-Yi) Shih and an impressive fireworks display. Exciting raffle prizes were on offer as well as a live and silent auction. Griffith alumnus Tracey Smith from Channel 9 News Gold Coast was this year's Master of Ceremonies.

The Institute's special event has welcomed the community's support, attracting high profile event partners including Platinum Partner: Meriton Group; Gold Partners: Eco Tan and Community Bank Paradise Point and Ormeau – Bendigo Bank; Silver Partner: Lucy Cole Prestige Properties; Bronze Partners: Triple M, FB Rice, The Layt Clinic, and BARD1 Life Sciences Ltd; Fireworks sponsor: Spruson & Ferguson; and Media/Support Partners: Channel 9 News Gold Coast, Gold Coast Bulletin, Fast Proof Press, The Edit Suite and Luke Marsden Photo.

In a magnificent effort, we were able to raise \$226,000 which will go directly towards our research into finding new ways to fight cancer, a devastating disease that claims the lives of over 9 million people across the world every year.

We would like to thank our event partners, community partners, supporters, donors, colleagues and guests who all helped make our night a great success as we highlighted 21 years of truly remarkable research.

The Institute for Glycomics is an evening of glitz and glamour with many high-profile attendees and our wonderful community of supporters coming together to celebrate Institute successes and research advancements.



GLYCOMICS WEEK PUBLIC AND STUDENT FORUMS

Institute for Glycomics Public Forum

We were delighted to revert to face-to-face forums once again during Glycomics Week this year. We welcomed 80 guests to our annual Glycomics Public Forum. The Panel of Experts consisted of our internal talent Professor Carolyn Mountford, Associate Professor Daniel Kolarich, Dr Lucy Shewell and an external expert Dr Michael Slancar MD FRACP, consultant Medical Oncologist ICON Cancer Care and Associate Professor at Bond University.

The Forum titled *New Approaches to Tackle Cancer* was moderated by Carla Tooma from the Hot Tomato Broadcasting Company.

Professor Mark von Itzstein also presented the 2021 Research Excellence Awards on the night. Professor Mountford was presented with the Peter Gallagher Memorial Glycomics Scholar Award and Peter's daughter Susan presented the plaque. Carolyn was awarded for her world leading research in Magnetic Resonance Imaging and Cancer.

Institute for Glycomics Student Forum

The 9th Institute for Glycomics Student Forum celebrated our students achievements in the Institute's 21st Birthday year. We had 10 students give oral presentations and 11 students presented posters. We were supported by 12 sponsors, with 11 of them exhibiting. The forum opened with a guest lecture from Professor David Crompton OAM who presented about achieving an objective diagnosis of post-traumatic stress disorder. Professor Carolyn Mountford gave the Peter Gallagher Memorial lecture titled *Fucosylated glycans in the human brain, monitored in vivo in a clinical scanner, are affected by pain, PTSD and blast*.



Ms Lesley Woodford-Carr inducted as an Honorary Fellow

Mrs Lesley Woodford-Carr was acknowledged for her wonderful support of the Institute for Glycomics, receiving the highest accolade of Honorary Fellow in an intimate celebration held on 25th February 2021.

Lesley is Principal of prominent law practice Woodford-Carr and Associates and a long-standing influential member of the Paradise Point community.

This Honorary Fellowship award recognises Lesley’s unwavering commitment throughout her eight-year support of the Institute, specifically, the Institute’s melanoma research, Glycomics Circle – women empowering women in research and as an integral part of the Community Bank Paradise Point board who have supported the Institute across scholarships and grants for new instruments and research support.

As an influential woman who deeply cares about the community, we are incredibly grateful for her dedicated support which has assisted the vital research being conducted at the Institute for Glycomics. We thank Lesley and warmly welcome her as the newest member of our prestigious Honorary Fellow cohort.



‘Mum’s The Word’ Florist Partnership Supporting Women’s Cancer Research

For the entire month of May, and highlighting Mother’s Day, the Institute for Glycomics partnered with local Gold Coast florists to raise funds and awareness to support vital research into cancers that affect women.

“The Mum’s the Word Mother’s Day campaign invited the local community to ‘thank her a bunch’ by gifting the wonderful mothers in our lives with a beautiful floral bouquet from one of the campaign’s participating florists during the month of May,” said Professor Mark von Itzstein.

Flower Studio Gold Coast, Flowers on Sorrento, and Botanical Whisperers Florist enthusiastically jumped on board to support the Mum’s the Word campaign, to shine a light on a cause close to the hearts of so many people.

“For every bunch of flowers sold during the month of May, a donation was made towards our research into those cancers that predominantly affect women, such as breast and ovarian cancers,” added Professor von Itzstein.

“It’s likely that we have all been impacted by this insidious disease, either directly or indirectly. This campaign was created to acknowledge those women who are currently fighting cancer, to celebrate those who have survived it, and to honour and remember those who have lost their battle with the disease.

“This was a wonderful way to make our mums feel special and appreciated, while helping support the fight against cancer, a debilitating disease we so urgently need a cure for.”



Prostate Cancer Awareness Month Partnership

In September, for Prostate Cancer Awareness Month, the Institute for Glycomics partnered with barbers from across the Gold Coast to highlight the urgent need for the development of a more accurate early detection test for prostate cancer.

A special thank you to the Gold Coast barbers who partnered with us to support this very worthy cause: Nine Lives Barbershop (Paradise Point), Harry & Boo Barber (Helensvale), Young Flame Barbershop and Boutique (Parkwood), Goodfellaz Barbershop (Benowa), Park Ave Barbers (Burleigh Heads), Helensvale Hair International (Helensvale) and Luigi & Sons Barbershop (Chirn Park, Ashmore and Southport Park).

Anyone who visited one of these barbers during the month of September for their haircut, beard trim or related service, could support the Institute's pursuit of a cancer free future. While in the barber's chair, they were invited to simply scan the QR code on the mirror in front of them to make a direct donation to our cancer research and join our fight against prostate cancer.



Sanctuary Cove Golf and Country Club Breast Cancer Awareness Month Partnership

The Institute for Glycomics partnered with Sanctuary Cove Golf and Country Club for Breast Cancer Awareness Month for the second year in a row to raise funds for our vital breast cancer research.

Plenty of major and minor events were glittered throughout the month to raise money for breast cancer research at the Institute. We were ecstatic to learn that the fundraising total came in at \$22,090.25 which went straight to the laboratory bench! A fantastic effort by the amazing team at Sanctuary Cove Golf and Country Club and a community engagement partnership for which we are proud and truly grateful.



Longtime supporter of the Institute, Warren von Bibra receives an Honorary Doctorate from Griffith University

TRIBUTE BY PROFESSOR MARK VON ITZSTEIN AO

Warren von Bibra, one of our Honorary Fellows and long-standing supporters, was awarded the honorary degree, Doctor of the University.

Warren von Bibra and his wife Sally have a long history with the Institute for Glycomics, which began back in 2003 when I first gave him a tour of our facilities and introduced him to our research scientists, students and their various areas of research. Remarkably, Warren single-handedly convinced every Honda dealer in Australia, and subsequently the Honda Foundation, to establish the Honda Foundation Pandemic Research Laboratory in the Institute through a donation of \$0.5 million.

The von Bibras have been loyal, long-standing advocates of the Institute, with a special interest in supporting our research students through scholarship opportunities. As a consequence of their significant and on-going support, we established the Sally & Warren von Bibra Honours Scholarship Scheme in 2003, which they generously sponsor every year. If you do the math, that equates to eighteen years of supporting the nation's future scientists – truly remarkable!

This award is extremely well deserved, and we humbly thank Warren, Sally and the extended von Bibra family for their very welcomed support of the Institute for Glycomics' research, research scientists and research students.

On a more personal note, I also am most thankful to Warren and Sally von Bibra in welcoming me to the Gold Coast in those very early days of the Institute. 🇺🇸



GET it Magazine June issue featured the Institute for Glycomics and Women in Research: Dr Lucy Shewell and Associate Professor Lara Herrero.

GET IT | PROFILE



Dr Lucy Shewell

Balancing research, mentoring, grant applications and more, Research Scientist Dr Lucy Shewell talks to Get It Magazine about memorable career moments, exciting scientific discoveries and working on the Gold Coast at Griffith University.

1. Tell us about your work, and how did you get started in your career?

I'm a research scientist at Griffith University's Institute for Glycomics. My

Life & Learning In the Lab

areas of research are bacterial pathogenesis (which means trying to understand why bacteria make us sick) and glycobiology (which means the study of sugars, in particular those on the surface of our cells). I have been at the Institute for over 10 years.

2. Take us through a day in your life.

Typically, I will be planning and carrying out experiments in the lab, mentoring students, analysing data, writing up data for publication, or preparing grant applications - sometimes trying to balance these things all in the same day. It's not always easy, and there are many late finishes and work to be done at home.

3. What is something that surprised you about your field of work?

It surprises me in research where your projects can end up. For example, we were working on a bacterial toxin that binds to a particular sugar, called Neu5Gc. It has been known for many years that cancer cells make this sugar while healthy cells do not. We modified this bacterial toxin to make it

recognise the Neu5Gc sugar better, and now are developing this into a cancer diagnostic test!

4. What are the perks of studying with Griffith University?

Well for starters, you can't beat living on the Gold Coast; the lifestyle is great and the weather is beautiful. Add to that the many study opportunities that Griffith University offers. At the Institute for Glycomics in particular, students get the unique opportunity to study alongside some of the world's most outstanding research leaders and research scientists in the fields of cancer and infectious diseases, with access to state of the art facilities and equipment. It's a winning combination.

5. What's your best piece of career advice?

Say yes to opportunities that come your way, even if you don't necessarily want to, as you never know where these opportunities may lead you.

Science, Study & Giving Back

A National Health and Medical Research Council Research Fellow, Dr Lara Herrero talks to Get It Magazine about her work at Griffith University, career highlights and her world of science and medicine.

1. Tell us about what you do, and how did you get started?

I think of myself as a virologist researcher by day and a medical doctor by night. Some of my past roles have ranged from being a high school teacher, to science communicator, to medical doctor. The central theme that applies to everything I've done comes down to my love for science, and giving back to the community.

2. What are some career highlights?

Teaching science to remote communities in Australia, establishing viral diagnostics to labs throughout the Asia Pacific, advising on

flu surveillance in Africa for the WHO, and of course, the days where patients tell me "thank you, you don't know how much you've helped me."

3. What does a typical day look like?

I start with an early exercise routine and make sure my dogs are walked and happy. That's followed by meetings with my students, collaborative meetings to discuss new projects, the occasional media interview, and then an emergency department shift if the hospital is understaffed.

4. Congratulations on winning the Creating Change category in the 2020 Gold Coast Women in Business Awards - tell us a bit about what this win meant to you?

It was so nice to be acknowledged for the work that my team and I have been doing to develop a world-first treatment for viral

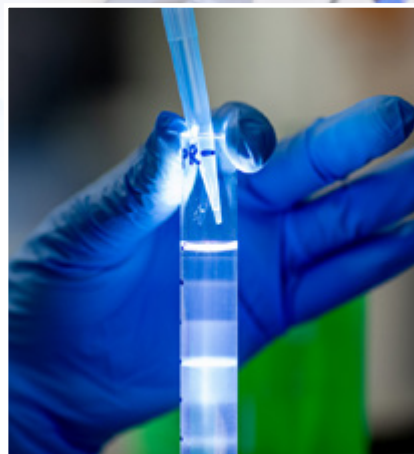


Dr Lara Herrero

arthritis. Our research in this area provides hope to millions of people worldwide who are currently suffering with viral arthritis.

6. How do you recharge and stay motivated?

I run and get outdoors as much as I can. Immersing myself in nature resets me and keeps me grounded. If that fails, I drink a glass of wine or have a whiskey - no one likes a saint!



Discover the Institute for Glycomics

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While you might not recognise the name at first, the Institute for Glycomics works to research and combat some of the world's most serious diseases, and it's all happening right here on the GC.



Calling the Gold Coast home, Griffith University's Institute for Glycomics has been leading and facilitating essential biomedical research since 2000, boasting state-of-the-art facilities combined with some of the world's top researchers.

The term 'glycomics' refers to the field that explores the structural and functional properties of carbohydrates (or sugars) and their roles in disease, and the Institute's work is focused on identification, prevention and cures for cancers, infectious diseases and neurodegenerative disorders. With such unique research expertise, the Institute for Glycomics is the only one of its kind in Australia, and one of just a handful that exist around the world.

Within the Institute, there are more than 200 working research scientists, research students and support staff, all striving to make the facility a world leader in the discovery and development of next generation drugs, vaccines and diagnostics for diseases that impact us globally.

Founder and Director, Professor Mark von Itzstein AO, has international standing in glycoscience, medicinal chemistry and drug discovery, and he was awarded one of Australia's highest honours in 2019, officially being named as an Officer (AO) of the Order of Australia in the General Division. In early 2020, he was also honoured with the Gold Coast Citizen of the Year award at the city's Australia Day awards, a fitting way to mark the celebration of the Institute's 20th Anniversary.

Successes of the Institute to date include human clinical trials for a repurposed drug

that successfully eliminates mosquito-borne arthritis, current clinical testing for their malaria vaccine candidate (with malaria deaths topping 500,000 annually worldwide), vaccine development for the prevention of gonorrhoea, and pre-clinical development for early detection of both breast and ovarian cancer, just to name a few.

The arrival of the COVID-19 pandemic has reminded us all of the ongoing battle against global diseases, and for the Institute for Glycomics it presented a unique set of challenges.

But with careful planning, their equipment and facilities were able to be maintained at a high level of operational capability with little downtime during 2020.

The Institute wasted no time in acting against COVID-19, and its researchers are working around the clock to fight this disease. Four teams of expert scientists from the Institute are using a multi-pronged approach to target the virus SARS-CoV-2 to discover new vaccines and drugs to prevent or cure COVID-19.

Across the Institute, there's clear recognition of the value of women in life sciences, with 49 per cent of its researchers being female, and active encouragement of employment and career progression for women in science.

In addition, the Institute has established the Glycomics Circle, an impressive group of powerful women from the local community coming together with the sole purpose of supporting female scientists at the Institute for Glycomics.

The women of the Glycomics Circle use their collective wisdom, connections and resources to raise funds and awareness for the Institute's female researchers, students and facilities, and recognise their significant contributions to the Institute's daily fight against diseases of global impact.

Collectively, the members have raised over \$115,000, with these funds going towards supporting female early career researchers through scholarships, honours student scholarships, travel opportunities, and to aid the purchase of new equipment.

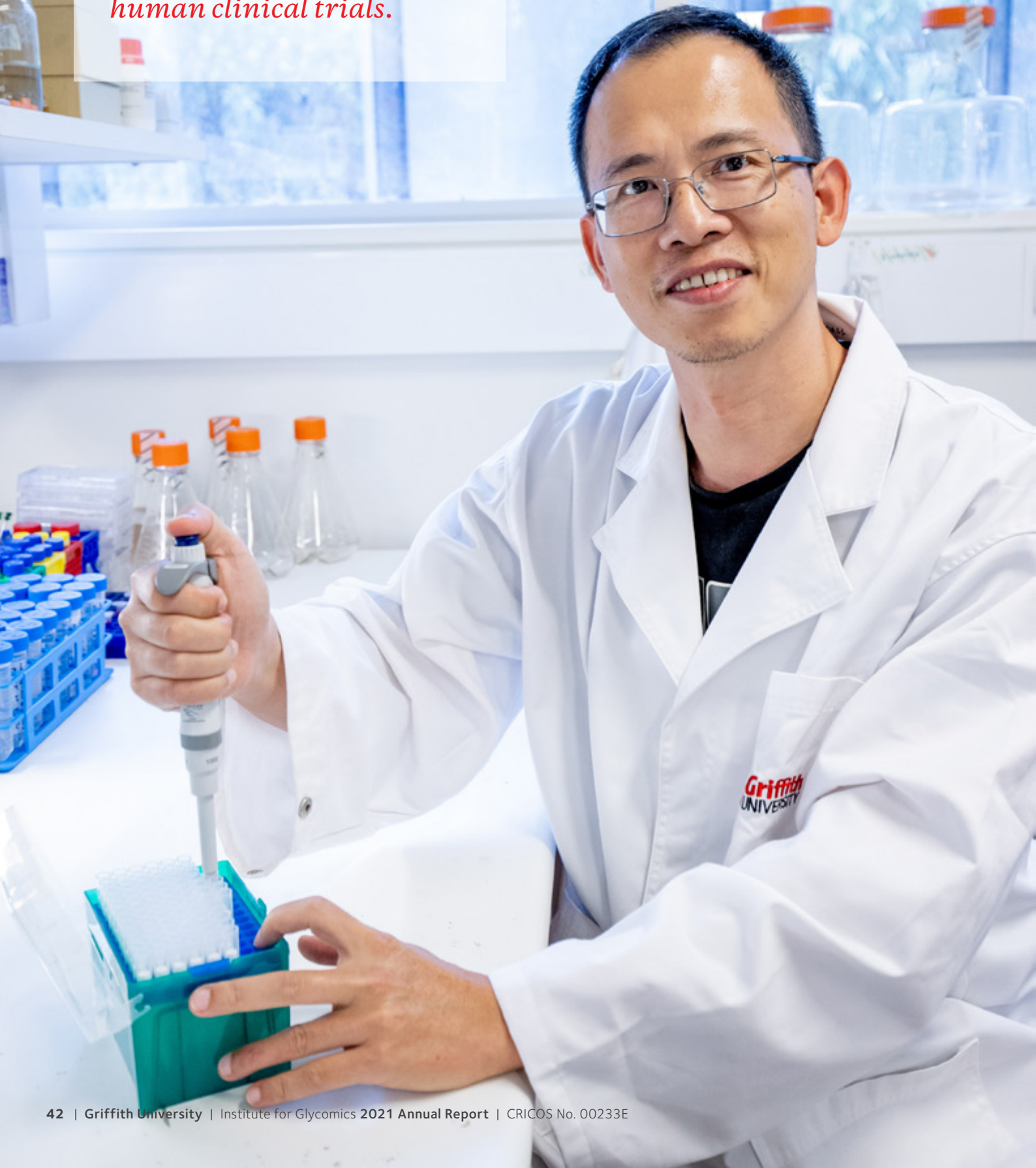
Philanthropy plays an important role in progressing the Institute's early-stage research, and 100 per cent of every donation goes straight to the laboratories.

For the Gold Coast community, there are several ways we can contribute and engage with the Institute for Glycomics, either as an individual or as a corporate partnership.

As 2021 unfolds, there's no doubt that the Institute for Glycomics will continue to play a crucial role in our community and the world alike.



Our community partners, supporters and donors play a crucial role in helping to support our groundbreaking research and human clinical trials.





REMARKABLE SUPPORT



The Institute for Glycomics joins forces with the Australian Lions Childhood Cancer Research Foundation in the fight against Sarcoma.

The Australian Lions Childhood Cancer Research Foundation (ALCCRF) has pledged \$800,000 to a 3-year major research project led by Institute for Glycomics Director Professor Mark von Itzstein. This vital research aims to deliver novel diagnostic technologies and precision treatment options to close current gaps in sarcoma diagnoses and improve patient outcomes.

The term sarcoma summarises a large number of different cancers that arise in the bones and connective tissues such as fat and muscle. It is the most diverse and heterogenous type of cancer, consisting of 14 different types of bone and approximately 39 different types of soft tissue sarcomas.

While it is considered a rare cancer in adults, sarcoma is a prevalent cancer in children representing about 20% of all childhood cancer diagnoses. Last year, over 2,000 new cases of soft tissue and bone sarcomas were diagnosed in Australia.

Sarcoma diagnosis is often delayed due to the current lack of reliable early-stage markers and the fact that many benign conditions exhibit similar symptoms. This delay in diagnosis impacts successful treatment and outcome.

Close collaboration between clinical and translational research scientists is the key to success for any patient-oriented research. As part of this unique research effort, scientists from the Institute for Glycomics will team with clinical colleagues at Fundacion Perez Scremini pediatric hospital, Montevideo, who have extensive expertise in sarcoma treatment and clinical care, particularly in children and young adults and can provide valuable clinical specimens.

Having established a robust, highly sensitive pipeline for molecular profiling of cancer tissues and cells, the Institute for Glycomics is now in the optimal position to address the needs in sarcoma diagnosis and therapy.

“Our partnership with the Australian Lions Childhood Cancer Research Foundation plays a crucial role in propelling the progress of our sarcoma research to deliver solutions to this disease. We are deeply grateful to the Australian Lions Childhood Cancer Research Foundation in supporting this vital research”.

PROFESSOR MARK VON ITZSTEIN AO





Bourne Foundation boosts Institute’s research through new hero NMR Instrument

One of the cutting-edge facilities housed at the Institute for Glycomics is our Nuclear Magnetic Resonance (NMR) Spectroscopy.

NMR can provide extensive information about the structure, dynamics, and chemical environment of atoms. Additionally, NMR spectroscopy is ideally suited to distinguish different or identical functional groups in different molecular environments. This core facility has been critical to the Institute’s drug and vaccine success.

The 600 MHz NMR has been in operation for over 10 years. In that time, maintenance, partial part replacements and upgrades had been conducted. The existing 600 MHz had been utilised at capacity and was urgently requiring full replacement.

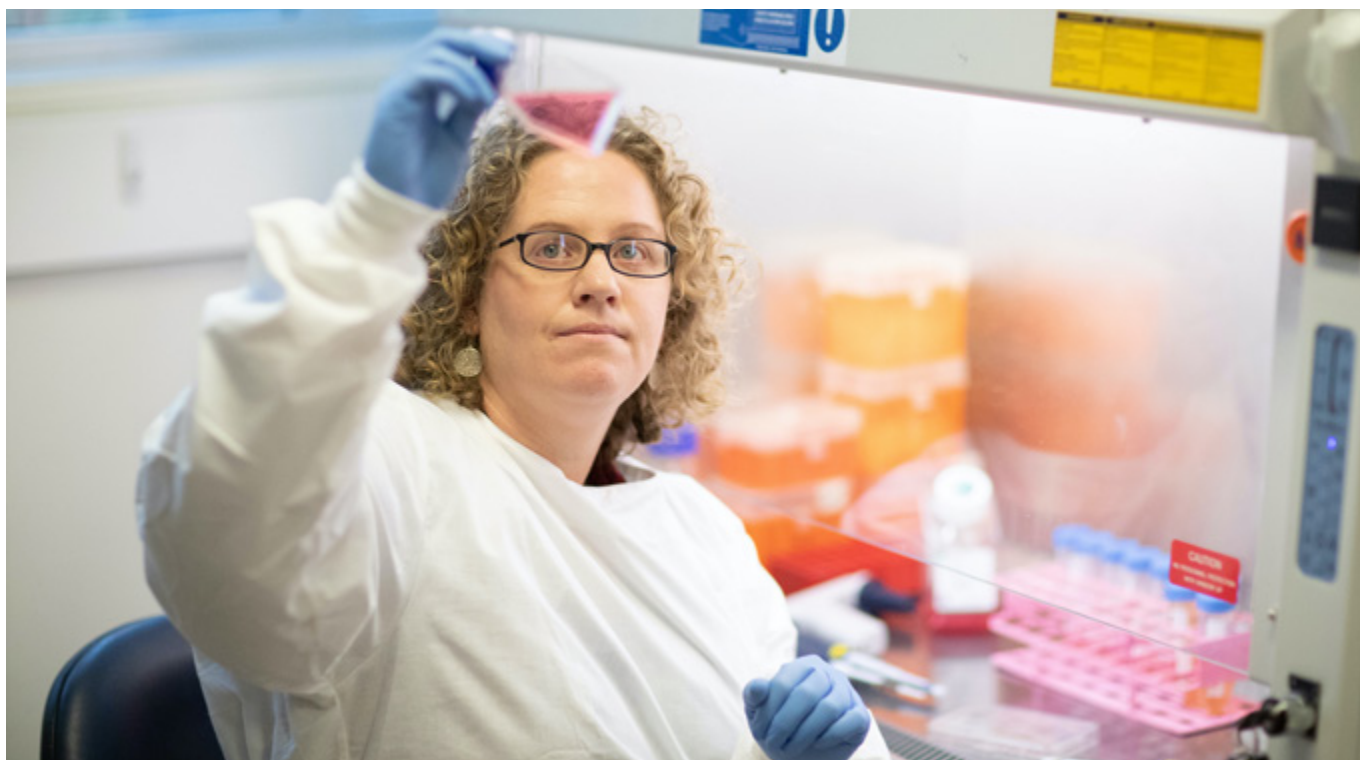
The Foundation funded the purchase of the new NMR instrument in memory of their founder, Mr Arthur Bourne, a hard-working, ethical entrepreneur with an engineering flair who was committed to playing his part in progressing medical research discoveries and cures for the future of global health.

“As directors of Bourne Foundation we see this capital expenditure as a vital piece of the research puzzle and which will provide significant assistance in discoveries made at the Institute for years to come. We are honoured to contribute and play our part in this world-leading research ‘ confirmed Sid Catlin and Mark Northeast.

“This tremendous support from Bourne Foundation will continue to propel our discoveries well into the future, contributing to global health for generations to come. As Director of Institute for Glycomics, I am delighted that Bourne Foundation have linked arms with our research and look forward to a long and successful partnership”

PROFESSOR MARK VON ITZSTEIN AO





Rotary – The driving force behind the Malaria Vaccine Project

There are approximately 3.2 billion people currently living in malaria endemic areas worldwide. Every year, there are more than 200 million cases of malaria and in 2020, there were 627,000 deaths attributed to the disease. Alarmingly, most of these deaths are young children.

Vaccination is the key to shifting the fight against malaria towards the ultimate and ambitious goal of eradication. Despite global efforts there is no effective malaria vaccine available.

Researchers at the Institute for Glycomics have developed a novel malaria vaccine candidate called PlasProtecT[®], which is currently in human clinical trials. PlasProtecT[®] consists of whole malaria parasites that are grown in the laboratory under strictly controlled conditions. The parasites are treated so that they can no longer replicate or cause infection. These treated parasites are then administered as a vaccine to raise an immune response without causing disease. The body is then primed to fight malaria parasites that may enter the body in the future, preventing malaria infection.

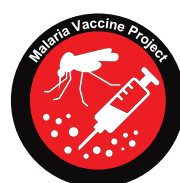
The Rotary Clubs of Southport, Broadbeach, Hope Island and the Rotary Satellite Club of Southport, in partnership with Griffith University, initiated a fundraising project to support the work of Professor Michael Good, Dr Danielle Stanisic and their team.

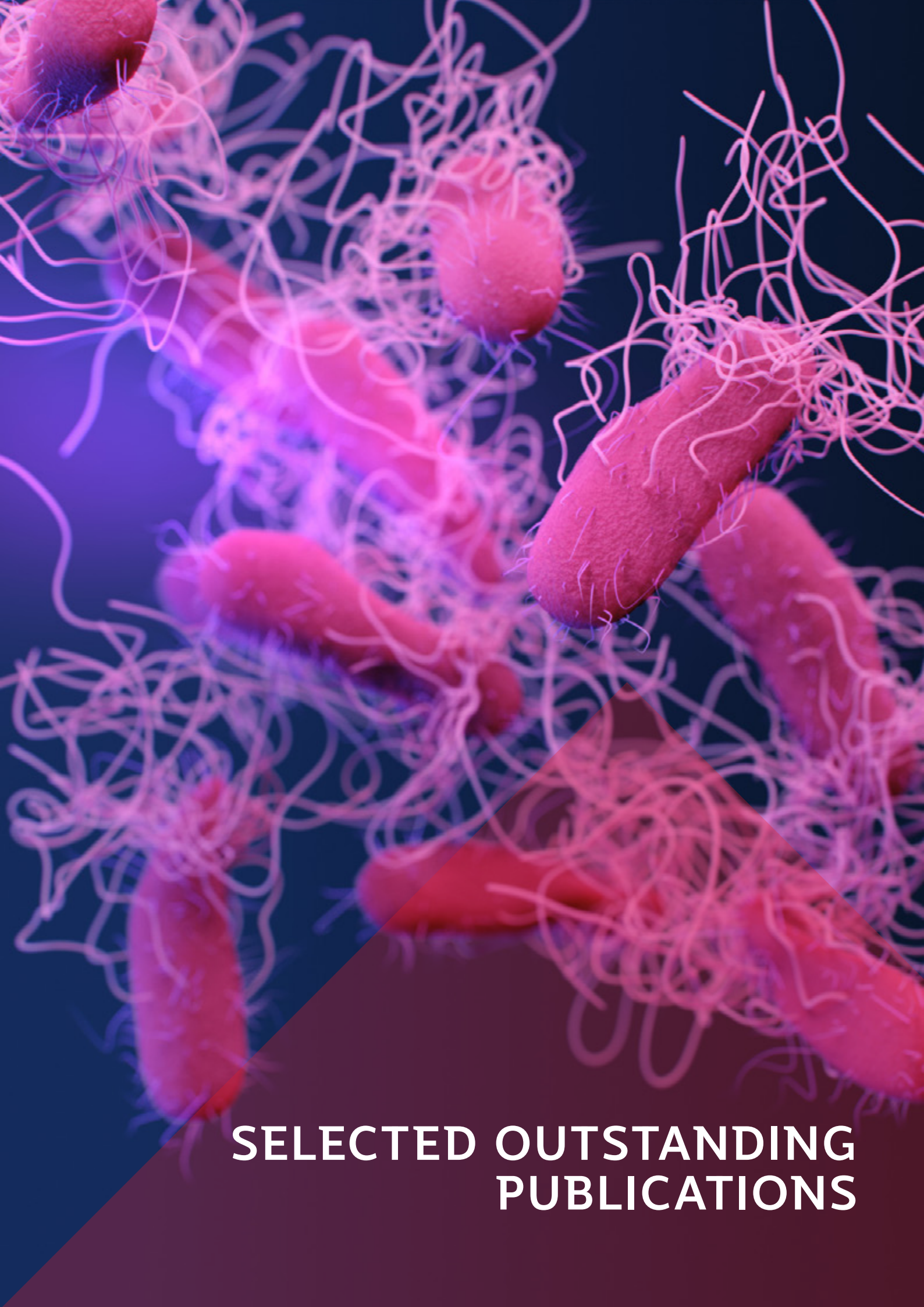
The fundraising project has been registered by Rotary Australia Benevolent Society (RABS) and endorsed by the National Committee of Rotarians Against Malaria (RAM). In 2017, Rotary and the Institute for Glycomics formally established the Malaria Vaccine Project, which is managed on behalf of the two partners by the Malaria Vaccine Committee. This Committee is charged with raising funds for the research.

In a major breakthrough towards the delivery of an efficient malaria vaccine, the research team have discovered their whole parasite malaria vaccine can be freeze-dried into a powder without losing its efficacy, making it suitable for deployment into malaria-endemic countries.

The researchers plan to hold a Phase I human clinical trial to evaluate this field-deployable form of the vaccine in 2022-2023. Following this, the next step will be to evaluate the vaccine overseas in malaria endemic countries. 📧

2022 will mark the 5th anniversary of this partnership and we wholeheartedly thank Rotary for being a driving fundraising force in progressing this vital research.





**SELECTED OUTSTANDING
PUBLICATIONS**



Ozberk et al.

Prime-Pull immunization with a bivalent M-Protein and Spy-CEP peptide vaccine adjuvanted with CAF[®]01 liposomes induces both mucosal and peripheral protection from covR/S mutant Streptococcus pyogenes.

mBio 12: e03537-20. doi:10.1128/mBio.03537-20

Using a novel technology, Institute for Glycomics researchers are closer to the development of a new vaccine aimed at preventing the deadly Streptococcus A (Strep A), which kills more than 500,000 people globally per year.

“Strep A colonises the upper respiratory tract and skin. Repeated infections can cause auto-immune complications and progress to invasive and immune-mediated diseases such as rheumatic fever and rheumatic heart disease,” says lead researcher Dr Manisha Pandey.

“There is currently no vaccine available as immunity to Strep A in humans takes years to develop. This is because it is highly virulent and subverts innate and acquired immunity.”

The researchers identified two small proteins from Strep A and combined them with a potent adjuvant (immunological agent) to enhance the body’s immune response. Immune responses generated against these proteins induce enduring immunity and protect the host in the respiratory tract as well as elsewhere in the body for long periods of time.

“In this study, we have demonstrated for the first time, the efficacy of a Strep A vaccine that can provide protection against multiple strains, including highly virulent strains at both the mucosal and skin entry points,” says Dr Victoria Ozberk, co-first author on the study.

“The demonstration by the toxicology study that the vaccine is safe to be used in humans is very encouraging and gives us high hopes regarding the success of this vaccine.”

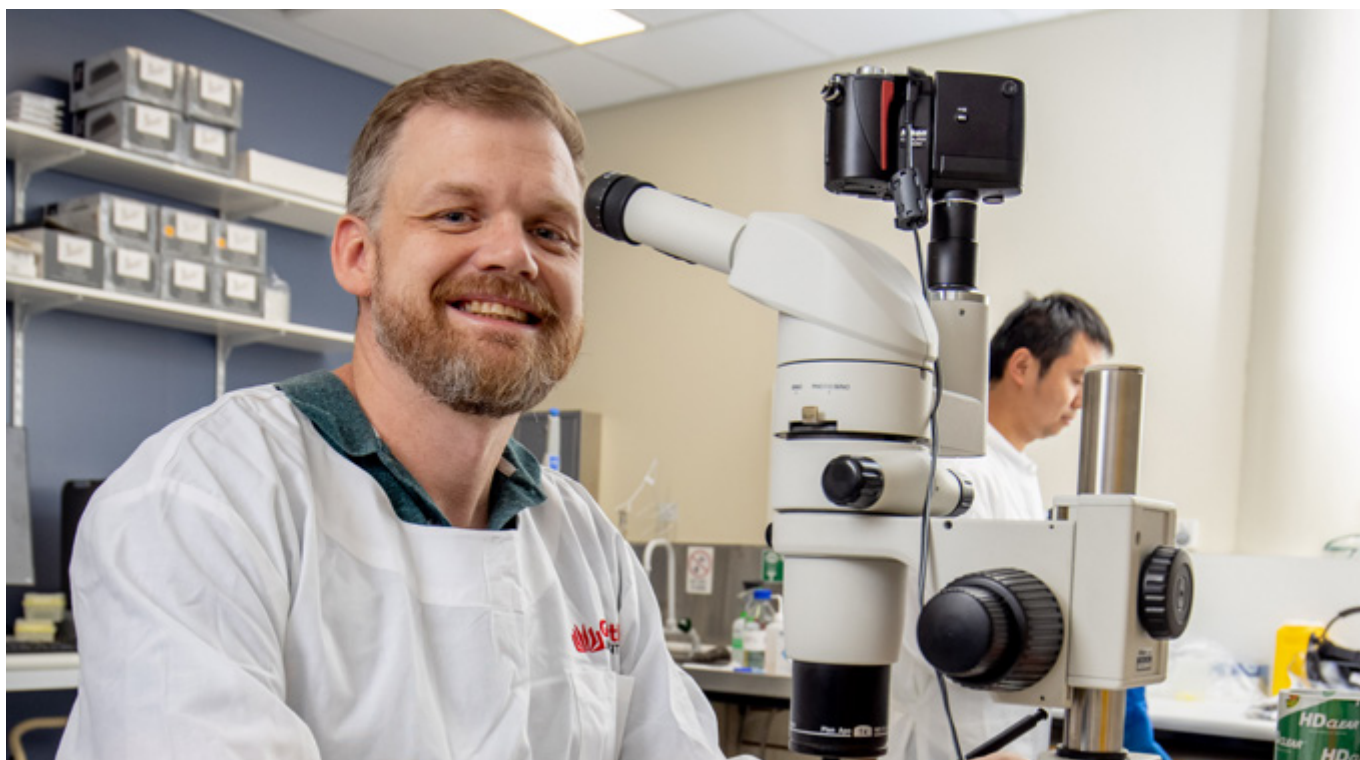
In pre-clinical studies, the researchers found two standard intramuscular vaccinations followed by an intranasal vaccine boost induces vaccine-specific antibodies that protects the throat and skin from Strep A.

Professor Michael Good, laboratory head for the streptococcal vaccine research said the group had been working closely with colleagues in Denmark for many years to advance the novel technology and the team was now well positioned to proceed with clinical trials.

He said that streptococcal disease was a significant problem for Indigenous Australians who suffered the highest rates of disease in the world.

“A vaccine would have a transformative effect on the health of remote Indigenous communities. I thank the Heart Foundation, the Snow Foundation, the Lowitja Institute, the National Foundation for Medical Research and Innovation and the Australian Government through the NHMRC for their ongoing support over many years.”

The study has been published in **mBio** and researchers hope to proceed to clinical trials in early to mid-2022.



Figley et al.

SARM1 is a metabolic sensor activated by an increased NMN/NAD(+) ratio to trigger axon degeneration.

Neuron 109: 1118-1136.e11. doi:10.1016/j.neuron.2021.02.009

An Institute for Glycomics research team has discovered how a therapeutic target common among debilitating neurodegenerative disorders is activated, which could help accelerate drug development.

In a study published in the journal **Neuron**, the researchers from the Institute for Glycomics, the University of Queensland and Washington University, analysed the structure and function of a protein called SARM1, which is involved in the destruction of nerve fibres. They found that the protein is a sensor that responds to the levels of specific molecules derived from metabolism.

“SARM1 is a potential therapeutic target for many neurodegenerative diseases,” said lead author Dr Thomas Ve.

“When nerve fibres are damaged, whether by injury, disease or as a side effect of certain drugs, SARM1 is called into action which sets off a series of events in the cell that trigger them to self-destruct.

“This destruction likely plays an important role in multiple neurodegenerative conditions, including peripheral neuropathy, Parkinson’s disease, amyotrophic lateral sclerosis (ALS), traumatic brain injury and glaucoma.”

Dr Ve and joint first author on the paper, Dr Yun Shi used NMR spectroscopy, a biophysical tool to analyse interactions between proteins and small molecules, to demonstrate that two important metabolites in nerve cells compete for binding to the SARM1 protein, and the ratio of these two metabolites determines whether SARM1 becomes activated.

Dr Ve and collaborators also used structural biology tools – Cryo-electron Microscopy and X-ray Crystallography – to determine three-dimensional structures of the SARM1 protein which enabled them to pinpoint exactly where these two metabolites bind to SARM1 and how they regulate SARM1 activation.

Dr Ve, also an Australian Research Council Future Fellow and NHMRC Investigator, said the new structural information about SARM1 had the potential to accelerate the development of drugs that target neurodegenerative diseases.

“We are very excited by these findings as they greatly advance our understanding of how SARM1 is activated.

“It provides clues as to how one might block activation of this protein using structure-guided approaches to prevent nerve fibre loss in neurodegenerative diseases.”

Director, Professor Mark von Itzstein welcomed this important breakthrough. “New strategies towards solving neurodegenerative diseases have become increasingly important due to the enormous impact on the quality of life of those that suffer with these conditions”.

The team worked in collaboration with the group of Professor Bostjan Kobe at University of Queensland, and the groups of Professors Aaron DiAntonio and Jeffrey Milbrandt at Washington University, St Louis, USA. It also involved Dr Ve’s industry partner Disarm Therapeutics, a wholly-owned subsidiary of Eli Lilly & Co, whose mission is to create breakthrough disease-modifying therapeutics to treat patients affected by axonal degeneration.



Day et al.

Multidisciplinary approaches identify compounds that bind to human ACE2 or SARS-CoV-2 spike protein as candidates to block SARS-CoV-2-ACE2 receptor interactions.

mBio 12: e03681-20. doi:10.1128/mBio.03681-20

Medications used to treat dry eye, cystic fibrosis and a medical dye may guide future strategies for treatment of COVID-19 according to new Institute for Glycomics research published in **mBio**.

Co-led by Professor Michael Jennings and Associate Professor Thomas Haselhorst, the researchers used a combination of computer-based and biophysical methods to search for drugs that block the binding of SARS-CoV-2 (the virus causing COVID-19) to cells. These drugs work by interacting with either the virus surface protein spike, or its cell receptor ACE2.

“As well as vaccines, potent drugs to treat COVID-19 are urgently needed,” said researcher Dr Christopher Day.

“Due to time and the cost of developing new drugs, our researchers have been pursuing drug re-purposing – using drugs that have already been approved for other therapeutic purposes.”

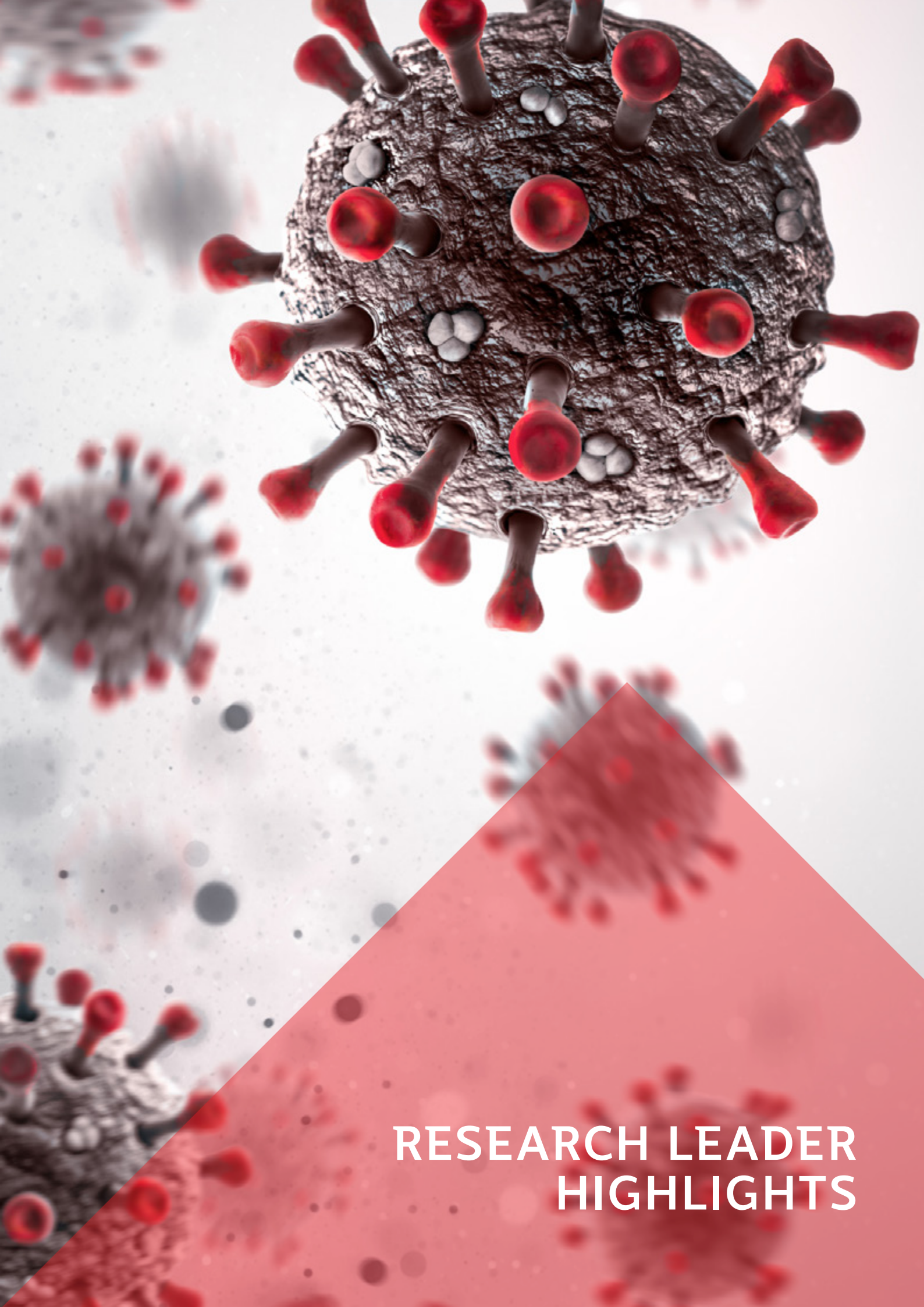
The researchers identified and tested several drugs in vitro against SARS-CoV-2 infection, using a well-established cell model.

“Three of them – Evans blue (medical dye), sodium lifitegrast (dry eye) and lumacaftor (cystic fibrosis) – were found to block virus infection of cells in culture and therefore may be further evaluated for re-purposing as therapeutics or to guide the development of new drugs,” said co-author Dr Benjamin Bailly.

Work is about to commence to test the effectiveness of these drugs in advanced, ex vivo human respiratory cell models, facilitated by the Australian-German Fraunhofer International Consortium for Anti-Infective Research (iCAIR®) initiative.

“All identified drugs in this study have potential to provide blueprints for the development of new antiviral compounds for the treatment of COVID-19,” Dr Day said.

“The promising outcome of this research is thanks to significant funding received from the Queensland Government and the City of Gold Coast. Each provided \$100,000 to the Australian node of iCAIR®’s COVID-19 project to develop treatments against SARS-CoV-2,” said co-author and Director Professor Mark von Itzstein.



**RESEARCH LEADER
HIGHLIGHTS**



Professor Mark von Itzstein

Principal Research Leader, Director

In 2021, the von Itzstein group continued their research towards development of novel therapeutic agents, and investigation of carbohydrate interactions in both health and disease. In particular, they brought their expertise in structure-informed drug design, synthetic chemistry, virology, and biology, to collaborative translational research projects.

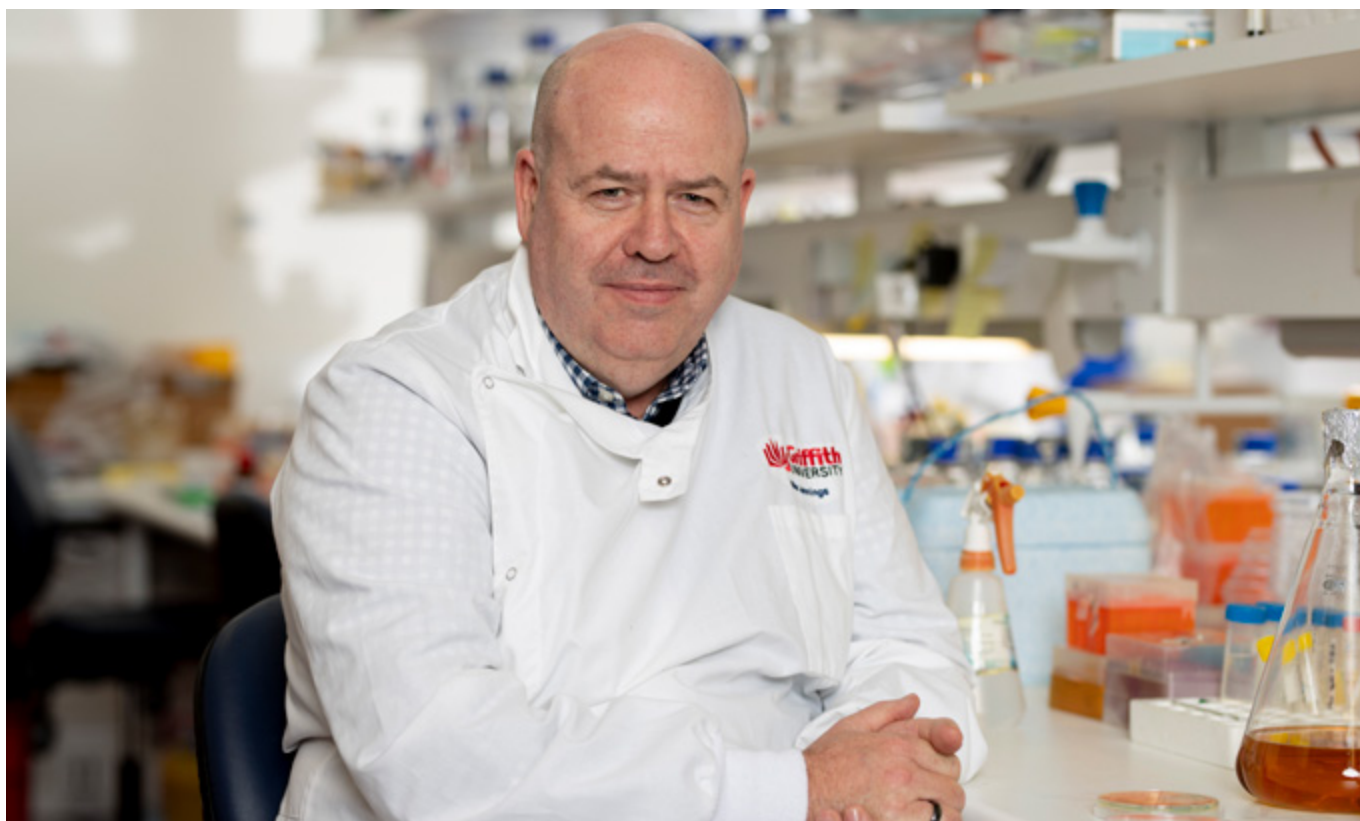
A major focus for the group was continuation of the co-development program with Grand Medical Pty Ltd, for discovery of drug candidates to treat and prevent human parainfluenza virus (hPIV) infections. Human parainfluenza viruses 1 and 3 produce a broad spectrum of disease in the human population including in children, the elderly and immune-system weakened individuals such as cancer patients on chemotherapy and transplant patients. In 2021, the lead optimisation program resulted in identification of a novel drug candidate - that both blocks the functions of a key viral protein and inhibits virus replication with a high level of potency, which has been selected for further pre-clinical development.

Virology research also continued with influenza, SARS-CoV-2, and dengue viruses, enterovirus 71, and human metapneumovirus. In investigating virus-host cell entry mechanisms, in a collaboration with Prof Sue Berners-Price it was shown that a platinum complex, TriplatinNC, was able to shield cells from attack by enterovirus 71 and human metapneumovirus, through blocking the virus' cell-surface receptors, sulfated glycosaminoglycans (Bailey *et al.*, 2021, *Chem Commun*). This offers potential new directions for 'metalshielding' in antiviral drug development.

The group's research in the development of antibacterial ionophores ('ionobiotics') – organic compounds that complex biologically

important metal ions, such as zinc – has continued in collaboration with Prof Michael Jennings and his team at the Institute for Glycomics, and with Prof Mark Walker (Uni Queensland) and Prof Andrew McDevitt (Uni Melbourne). With the Jennings group, the ionophore PBT2 was shown to make pathogenic *Neisseria gonorrhoeae* susceptible to killing by natural cationic antimicrobial peptides (Jen *et al.*, 2021, *J Antimicrob Chemother*). Future work in this area, including the development of new families of ionophores, will be supported for 3 years from 2022 by the award of an NHMRC Development Grant to Prof von Itzstein and Prof Jennings, with key investigators Dr Freda Jen and Dr Ibrahim El-Deeb, for the project titled, "*Targeting the Achilles heel of multi-drug resistant Neisseria gonorrhoeae with drugs that disrupt metal homeostasis*". Research with Prof Walker and Prof McDevitt on the use of ionophores to break bacterial resistance to antibiotics also continued in 2021, in particular showing the efficacy of the approach against clinically-important bacteria involved in respiratory infections.

Finally, Prof Mark von Itzstein is part of a multidisciplinary team, including University of Queensland researchers, led by Prof Kate Schroder, were awarded a five-year (\$5 million) NHMRC Synergy Grant, to commence in 2022. The Synergy Grant, awarded for the project "*Mining the host-pathogen interface to deliver a drug pipeline for treating intractable and emerging infections*", brings together five internationally recognised leaders in their respective fields of research as Chief Investigators, with a team of Associate Investigators and Early Career Researchers, including with industry expertise (Novartis, Pfizer, CSL, Bioasis Technologies), to synergistically develop and progress therapeutic agents to treat microbial infections.



Professor Michael Jennings

Principal Research Leader, Deputy Director

The Jennings research group focuses on understanding how carbohydrates influence key steps in infectious disease and using this information to find new strategies to prevent and treat disease.

In 2021, the Jennings Group had several grant successes including:

- National Health and Medical Research Council (NHMRC) grant funding to develop new antibiotics for the treatment of multi-drug resistant gonorrhoea infections with Professor Mark von Itzstein. The study was published in journals *Cell Reports* and *mBio*.
- US Department of Defense grant for research into the development of a novel diagnostic test for the early detection of breast cancer with Dr Lucy Shewell and Dr Chris Day in collaboration with the University of Adelaide and University of Queensland.
- Australian Research Council (LIEF) grant for the project titled: An integrated analytical network for protein characterisation with Associate Professor Daniel Kolarich, Professor Mark von Itzstein, Dr Larissa Dirr and Dr Arun Everest-Dass and QUT led team.
- NHMRC Ideas grant for the project titled Structure and biophysical analysis aided design of novel toxoid vaccines for a major class of bacterial toxins with Dr Chris Day
- A Tour de Cure Research, Support and Prevention Senior Research Grant for the project titled “*Characterising a newly discovered blood biomarker with potential use in the diagnosis and monitoring of ovarian cancer*” with Dr Lucy Shewell and A/Prof Daniel Kolarich

A study with Dr Chris Day revealing novel COVID-19 drugs was published in *mBio* in March 2021 with Associate Professor Haselhorst as joint-senior author. The joint groups were able to identify several new compounds that block SARS-CoV-2 from interacting with Angiotensin-Converting-Enzyme 2 (ACE2) by using a combination of in-silico screening (Haselhorst group) and an SPR re-purposing drug screening (Jennings/Day group). The efficacy of the compounds was validated using a SARS-CoV-2 viral assays in collaboration with Professor Mark von Itzstein’s laboratory.



Professor Carolyn Mountford

Principal Research Leader

Professor Carolyn Mountford MSc DPhil (University of Oxford) MS (Harvard University) is a world leader in the development of magnetic resonance (MR) technology to address unmet clinical needs. Her translational research in the neuro field centers on MR technology. This is used to identify changes to the brain associated with Post-Traumatic Stress Disorder (PTSD), injury from blast and impact, and acute and chronic pain. Her team is under contract to the USA and Australian military to develop this approach to improve the health of soldiers. In the area of women's health, it is a preoperative diagnosis for ovarian lesions; and the capacity to monitor how far the breast tissue of a woman at high risk for breast cancer has deviated from normal.

Carolyn graduated with two degrees from Somerville College Oxford and was awarded full Professor of Radiology at Harvard Medical School in 2011. Professor Mountford and her team have been a worldwide development site for Siemens since 1999.

The Mountford research team uses clinical 3T scanners to monitor the effect of disease, pain and cancers with particular interest on the control and role of the human glycome. They have assigned seven fucosylated glycans in the human brain, which are affected differently by chronic pain, PTSD, and blast exposure. These Fuc- $\alpha(1-2)$ glycans have been shown in animal models by a Caltech team to be implicated in the mechanisms underlying neuronal development, learning and memory, regulation of the nervous system development and neuronal processes. There are pools of substrates for these glycans that offer opportunity for preventing the acute phase of trauma and pain becoming chronic. Elucidating the precise carbohydrate chemistry that is underlying these conditions is integral to future clinical management and a new and important challenge in medicine.

When it comes to human cancers, different fucosylated glycans have been shown to be markers of the capacity to metastasize, spread through the human body; again, the elucidation of which glycans these are and how they are involved in allowing a cancer to metastasize are integral to stopping the spread.



Emeritus Professor Sue Berners-Price

Principal Research Leader

The focus of research in the Emeritus Professor Sue Berners-Price group has been to develop projects under the new research theme of Metalloglycomics – the study of metal ions and metal-based drugs with oligosaccharides.

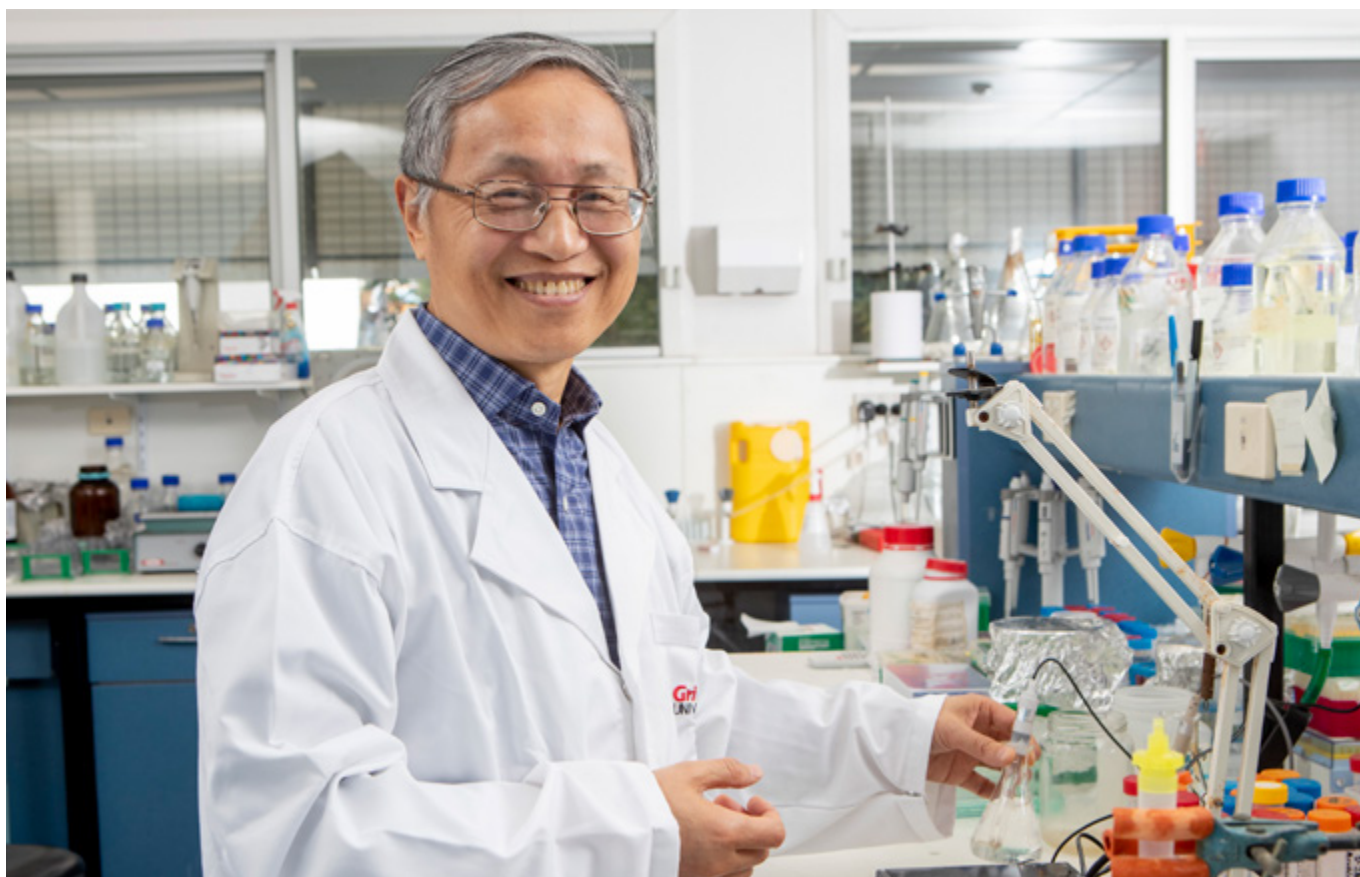
Recent highlights include a study published in the leading journal *Angew Chemie* that showed that a polynuclear platinum complex, TriplatinNC, inhibits metastasis, and this may be attributable to a modulation of the geometry of a sugar component of heparan sulfate, an important component of the extracellular matrix. (*Gorle et al., (2021), Conformational Modulation of Iduronic Acid-Containing Sulfated Glycosaminoglycans by a Polynuclear Platinum Compound and Implications for Development of Antimetastatic Platinum Drugs. Angew. Chem. Int. Ed.*)

In order to shed light on the interaction of heparan sulfate with TriplatinNC, the research team led by Research Fellow Dr Anil K. Gorle and in collaboration with Professor Nicholas Farrell (Virginia Commonwealth University and Massey Cancer Center Richmond, Virginia, USA), used the pentasaccharide fondaparinux (FPX), as a model for heparan sulfate. A combination of computer calculations and experimental NMR data showed that TriplatinNC changes the geometry of a specific sugar component of heparan sulfate (a sulfated iduronic acid). The six-membered ring of the iduronic acid can adopt two different spatial conformations: a chair form or a twist-boat form. In free FPX, the chair and twist-boat forms

are in a 35:65 ratio. In the presence of TriplatinNC, this shifts to 75:25. In the now preferred chair form, there is a pocket into which the platinum drug fits very well, allowing it to bind strongly. The result of the strong bonding of heparan sulfate by TriplatinNC is to effectively block it from being split by heparanase.

A tumour cell line in a synthetic extracellular matrix served as a model for triple-negative breast cancer, which is an aggressive form of cancer that is especially hard to treat. Treatment with heparinase initiated significant cell migration in the model. Prior treatment with TriplatinNC significantly reduced cell migration – an effect not seen with cisplatin. The anti-metastatic activity of TriplatinNC was also confirmed in tests with mice. TriplatinNC thus demonstrates dual activity. In addition to a cytotoxic effect caused by its action on DNA, it has an anti-metastatic effect caused by interference with the functionality of heparan sulfate. This opens new possibilities for the design of anti-metastatic platinum anticancer agents.

In 2021, Professor Sue Berners-Price was conferred as Professor Emeritus by The University Council.



Professor Yaoqi Zhou

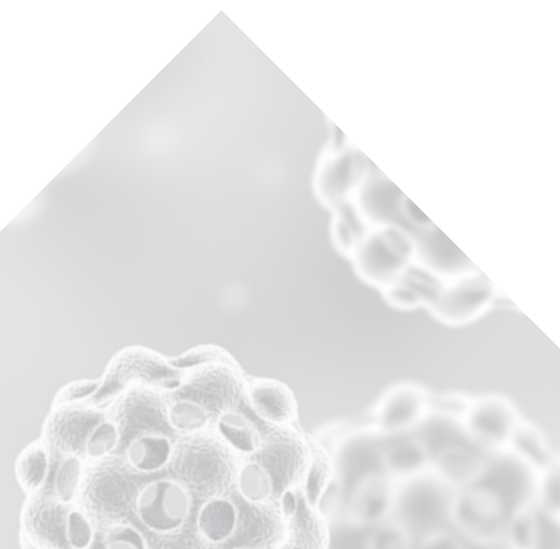
Principal Research Leader

The highlight of Professor Zhou's 2021 research is related to RNA structure prediction.

Non-coding RNAs-like proteins, relied on their structures to perform their functions. Unlike proteins, the structures of RNAs are usually not as stable as proteins and thus are more difficult to determine by experimental techniques such as X-ray crystallography, nuclear magnetic resonance, and cryogenic electron microscopy. As more and more non-coding RNAs are found increasingly important in all essentially biological processes and related to more than 1000 human diseases, it becomes increasingly urgent to develop computational methods for accurate prediction, just like recent success of AlphaFold2 for protein structure prediction. In three articles published in 2021, Professor Zhou's group has made significant progresses in three areas of RNA structure prediction: development of an automatic pipeline for RNA homology search and direct evolutionary coupling analysis (Bioinformatics, 37, 3494–3500 (2021)), a new method for RNA base-pairing structure prediction (Bioinformatics, 37, 2589–2600 (2021)) and a RNA-tailored energy function for structural refinement (Nature Communications, 12-2777 (2021)). These studies mark a significant progress in RNA structure prediction from secondary to tertiary structure.

2021 also marks the year that Professor Zhou's annual citation count neared 1500, according to Google Scholar. This is a continuation of year-on-year growth since 2017. This fast-paced increase of citations reflects the growing impact of Professor Zhou's work in his field of structural bioinformatics and structural biology.

Sadly, in 2021 we bid farewell to Yaoqi who has left the Institute for Glycomics to lead a major initiative in Shenzhen, China and wish him all the best in his endeavours.





Professor Nicolle Packer

Principal Research Leader

Professor Nicolle Packer has a 0.25FTE position at the Institute for Glycomics and continues to work primarily with Associate Professor Daniel Kolarich and his team. The now well-established Advanced Mass Spectrometry Facility, which she helped establish, has been highly successful in providing researchers with state-of-the-art mass spectrometry instruments and expertise, graduated postgraduate students and attracted international interns and collaborators to the facility.

The invitation to bring the Institute for Glycomics into the ARC Centre for NanoScale Biophotonics (CNBP) in 2020 has had positive outcomes this year in terms of bringing glycobiochemistry into new biologies as well as linking physics nanoparticle aspects of CNBP into glycan biomarker discovery, and has resulted in co-publications and grant opportunities.

Grants awarded in 2021, as a result of the Institute for Glycomics being a node of CNBP with the University of Adelaide, UNSW, and Macquarie University were:

- a project with Defence Science & Innovation: Performance Patch.
- a Heart Foundation Vanguard Grant Award with University of Adelaide on the role of the asialoglycoprotein receptor (ASGR)1 in atherosclerosis.
- a project with the Australasian Pork Research Institute Ltd (APRIL) on mucin glycosylation as a predictive marker of reproductive state in the sow.

In addition, Professor Packer is a Co Investigator on the Australian Cancer Research Foundation (ACRF) establishment of the ACRF International Centre for Cancer Glycomics at the Institute.

Follow up grant applications were submitted with participation in two large proposals to the MRFF Cardiovascular Health Mission and a NHMRC Ideas Grant for consideration in 2022.

In 2021, Professor Packer published a number of papers along with A/Professor Kolarich and others at the Institute. They were also co-editors on two glycobiochemistry themed issues:

- a Special Issue on Glycomics and Glycoproteomics in the new RSC journal, *Molecular Omics*
- a Themed Issue on Glycobioinformatics published in the *Beilstein J Org Chem*; and
- Professor Packer, A/Professor Kolarich and A/Professor Thaysen-Andersen, who are the co-chairs of the Human Glycoproteomics Initiative (HGI) of the Human Proteome Organisation (HUPO), conducted a global interlaboratory comparison of the performance of glycobioinformatics tools, in order to help standardise the mass spectrometric data interpretation for glycoproteomics. The results of this study were published in *Nature Methods*.

Other papers were published in *Theranostics*: investigating the glycoproteome of a form of leukaemia and *Biochem Soc Trans*: The Hitchhiker's Guide to Glycoproteomics – a review on the basics of glycoproteome analysis.

As part of her aim of increasing the focus of glycomics in the research community, Professor Packer is co-editor of the 4th edition of the premier textbook in the field, "Essentials of Glycobiochemistry" *Cold Spring Harbour Laboratory Press* in which she also co-authored two chapters.

Packer is also an elected Australasian representative of the HUPO Executive Council and is co-chair of the HUPO Biology/Disease Human Proteome Project. In 2021 she was invited to be a Fellow of the Royal Society of Chemistry (UK) (FRSC) and was awarded the HUPO Distinguished Achievement in Proteomic Sciences Award that recognises a scientist for distinguished scientific achievements in the field of proteomic science.

In recognition of the need to further develop glycobioinformatics tools for the glycobiochemistry field, Professor Packer was an Advocate of the NIH funded Glygen project (Glycobiochemistry) and is Data Advisor to the Swiss GlyConnect database development at ExpASY and of the integrated Japanese GlyCosmos project, as well as founding member of the international GlySpace Alliance.



Laboratory of Vaccines for the Developing World

Professor Michael Good DUniv Principal Research Leader and Laboratory Head

Group A streptococcus/rheumatic heart disease

The Streptococcus group continued to progress streptococcal translational research and achieved some significant milestones. A major step in the Strep A vaccine development program has been the granting of approval by Canadian regulatory authority to conduct a Phase 1 clinical trial in Canada, an Investigator led clinical trial in collaboration with Li-Ka Shing Institute of Virology, University of Alberta. The clinical trial preparation team involving Dr Simone Reynolds, Ms Jessica Dooley and Ms Ainslie Calcutt completed successful GMP manufacturing of the first batch of vaccines suitable for Phase 1 clinical trial.

The group is also developing a vaccine for COVID-19 utilising a peptide-based vaccine approach encompassing minimal B cell epitopes from the RBD region of SARS-CoV2. This led to some exciting findings which were published in the Journal of Clinical and Translational Immunology. A team effort, led by Dr Manisha Pandey, involving researchers from Glycomics and Monash University led to a successful NHMRC Ideas grant which will undertake proof of concept study for the development of a 2nd generation COVID-19 vaccine.

The team published their research work in several peer reviewed high impact factor journals including mBio, Scientific Reports, Clinical and Translational Immunology, Advanced Healthcare materials and Lancet Microbe. The 2021 highlights include several grant and fellowship successes, which include NHMRC Ideas grant (with Dr Penny Rudd as Co-CI), Griffith University Post-Doctoral Fellowship

to Dr Victoria Ozberk, the Griffith University New Investigator grant and WRAP funding awarded to Dr Ailin Lepletier. Snow Foundation have continued their support for the Strep A vaccine program which will enable Dr Simone Reynolds to continue her project management of the clinical trial into the future and develop GLP assays to assess samples from the upcoming and future clinical trials. Engagement with Olymvox for vaccine manufacture has continued.

Jamie-Lee Mills, a PhD student, submitted her thesis and moved on to take up a full-time position elsewhere in Griffith. Jamie has been an integral part of the lab since 2016 when she undertook a 3rd year research project and progressed to doing Honours and then PhD. We are looking forward to her graduation ceremony. The Strep research program was briefly joined by Dr Darrell Bessette, who supported research activities involving immunological assessment of immunity following Strep A vaccination and/or experimental infection in humans, in addition to investigating immunity to COVID-19. Darrell's contribution is gratefully acknowledged, and he will be missed.



Dr Manisha Pandey
Associate Research Leader and Team Leader: streptococcus research

Malaria

One of the major highlights for the Laboratory of Vaccines for the Developing World Malaria Team led by Dr Danielle Stanisic in 2021 was the publication of critical pre-clinical studies in the prestigious journal, *mBio*, demonstrating the efficacy of a field-deployable form of the whole parasite malaria vaccine. This vaccine contains whole blood-stage parasites formulated with lipids and other immunomodulatory molecules to enhance the effectiveness of the vaccine. Freeze-drying or freezing of the vaccine formulation did not impact on its effectiveness, demonstrating compatibility with deployment into the field.

Pre-clinical development of the field-deployable whole parasite vaccine continued in 2021. Studies were undertaken by Dr Reshma Nevagi, Ms Mei-Fong Ho, Ms Maddie Walton and Ms Winter Okoth (PhD student) to further optimise the vaccine formulation to ensure its suitability for use in clinical trials. The Malaria Team, including Ms Heidi Plater, are currently finalising the GMP-compliant manufacturing process for this vaccine formulation to enable evaluation in clinical trials. Following the completion of formal toxicological studies, it is hoped that the vaccine will enter Phase 1 trials at the end of 2022.

The immunological assessments for the Institute's world-first clinical trial assessing the effectiveness of the novel chemically attenuated whole parasite vaccine were completed in 2021. A manuscript describing this study is currently being finalised. This work was made possible through financial support provided by Rotary and the National Foundation for Medical Research and Innovation.

In 2021 we bid farewell to Mr Taymin Du Toit Thompson who graduated with a Masters in Medical Research. His thesis described the development and first evaluation of a novel whole parasite



Dr Danielle Stanisic
Associate Research Leader and Team Leader: malaria research

transmission-blocking malaria vaccine in pre-clinical malaria models, and it received outstanding comments from his thesis examiners. This work involved an important collaboration with scientists at the National Institutes of Health in the US and further experiments will be undertaken with them in 2022 to finalise a manuscript for publication.

Early in 2021, research from Dr Hanan Al-Nazal's thesis was published in the prestigious international journal, *Cell Host and Microbe*. This publication describes the pre-clinical development of a novel whole parasite vaccine for babesiosis. The *Babesia* parasite is related to the malaria parasite, is a major issue for Australia's livestock industry as well as also infecting and causing disease in humans, particularly in the US and Europe. This work is being continued in the laboratory in collaboration with Dr Sanjai Kumar from the US FDA with the plan to progress the vaccine candidate towards clinical development.

Collaborative studies continued with Associate Professor Diana Hansen at the Walter and Eliza Hall Institute of Medical Research to undertake immunologic profiling on convalescent samples from patients recovering from COVID-19. These samples were collected in collaboration with clinicians at the Gold Coast University Hospital. A number of manuscripts describing this work are currently being prepared.

Ongoing collaborations with Professor Stephanie Yanow (Uni Alberta) continue, with the aim being to develop a vaccine for pregnancy-associated malaria by identifying epitopes from PvDBP (from *P. vivax*) that recognize cryptic epitopes on Var2CSA of *P. falciparum* and block binding of *P. falciparum* infected red cells to the CSA ligand found in placental tissue. This research is funded by grants from NIH and the Canadian Institutes of Health Research.



Professor Johnson Mak

Research Leader

Professor Johnson Mak's research group have research interests in assembly of entry and assembly of HIV. With a goal to fill the knowledge gaps in these areas, and to explore the translational potential of their findings, they tackle some of the most critical issues in HIV, including establishing an efficacious HIV vaccine; developing novel antivirals; and exploring practical preventive options for women. The team utilises lessons learnt in HIV biology toward SARS-CoV-2 research in attempt to fast pace both preventive and treatment options for our community.

In 2021, the Mak lab welcomed Ms Sarah Blanchard to work on an Australian Centre for HIV and Hepatitis (ACH2) funded project for the development of rapid diagnostics on Human T-cell Leukemia Virus Type 1 under the co-guidance of Dr Belinda de Villers and Professor Johnson Mak. HTLV-1 is disproportionately having an adverse impact toward some of the indigenous population in Central Australia. Dr Belinda de Villers and Professor Johnson Mak received additional funding from ACH2 in late 2021 to further these diagnostics tools development against HTLV-1 and hepatitis B virus (HBV). HBV is another virus-infectious disease impacting on the culturally and linguistically diverse community.

Using a viral vector system, the Mak lab contributed to a study on immune responses in COVID-19 patients (led by Dr Manisha Pandey and Professor Michael Good) and to identify antiviral candidates against SARS-CoV-2 (led by Dr Christopher Day, Associate Professor Thomas Haselhorst and Professor Michael Jennings). These two studies were published in *Clinical and Translational Immunology*, and *mBio*, respectively.

The Mak lab contributed to an Oxford University led study published in *Cell Reports* identifying an immune target of incoming HIV that enables infected cells to be destroyed prior to infected cells to establish virus production. The Mak lab is also part of another study published in *eLife* (led by colleagues at University of Montpellier) showing HIV hijack cellular machinery to induce membrane curvature, thereby allowing the formation of progeny viruses with its spherical shape.

Four other studies were accepted or published online in December 2021, these include two Mak lab led studies published in high impact journals *Cell Reports* and *JACS Au*, plus two other collaborator led studies in *mBio* and *RNA Biology*.

The Mak lab study in *Cell Reports* describes the first example of how a virus can use a specific pair of sugar molecules to facilitate attachment, thereby making them more readily able to infect target cells. The Mak lab is testing whether this mechanism can be leveraged to reduce virus transmission and/or to lessen virus-induced severity of diseases.

The Mak lab's *JACS Au* publication describes how, instead of sugar, virus utilises a trail of salts to guide its movement during progeny virus production and release. This process of virus release is known as virological synapse, and it helps HIV to operate in a covert fashion to overcome anti-HIV drugs and immune attack. Now that the mechanism of this HIV stealth operation is revealed, the Mak lab is exploring the potential to interfere with this process of HIV synapse formation to reveal the infection status of HIV cells to achieve a cure for HIV.



Professor Victoria Korolik

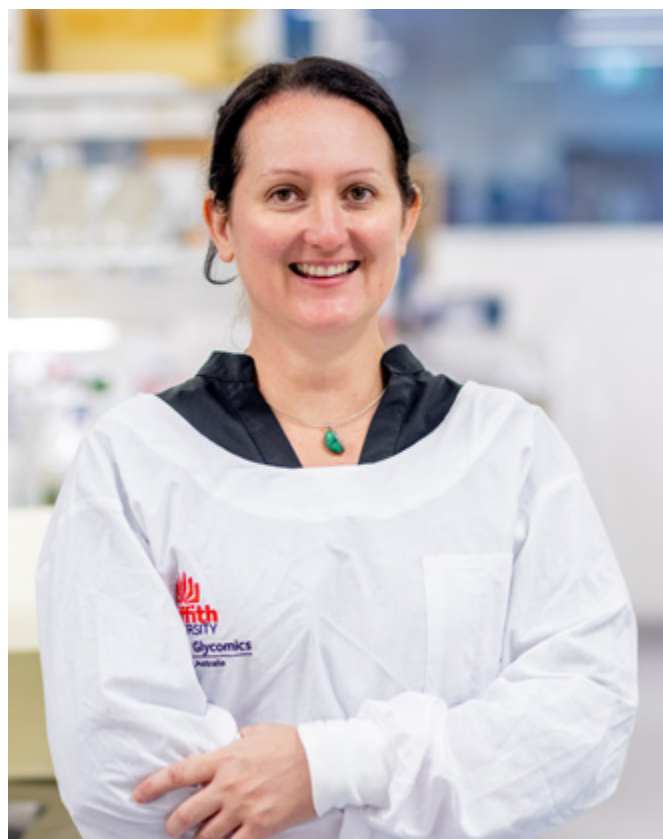
Research Leader, Associate Director (Education and Engagement)

Victoria Korolik is a Professor of Microbiology at the School of Medical Science and she teaches Microbiology in the second year of many Health degrees. Her research sits within the Institute for Glycomics and her group is currently focused on studying the role of bacterial movement in human disease and interactions of microbes with their host.

The Korolik group is currently focused on studying the role of bacterial chemotaxis in pathogenicity and bacteria-host interactions, specifically, on deciphering ligand binding specificities of transmembrane chemosensory proteins of *Campylobacter jejuni*, *Campylobacter fetus* and *Helicobacter pylori*.

Recent breakthroughs of the Korolik group are highlighted by the discovery of a novel class of bacterial chemosensors with broad ligand specificities that may be related to sensing of the host molecules, and thus, may play a role in host-bacterial interactions.

The group is currently developing a new research area focused on biofilm formation and its role in disease transmission for campylobacters. Two new areas of research are being established in collaboration with University of California, involving glycan-binding proteins and host-bacterial interaction of *Vibrio cholerae*. The group published significant refereed papers in 2021 highlighted by articles in the *Science suite* journal, *Science Signaling* and *MBio*.



Professor Kate Seib

Research Leader, Associate Director (Research)

Professor Kate Seib's research group focuses on discovery and development of vaccine candidates for bacterial pathogens including *Neisseria gonorrhoeae* (causes the sexually transmitted infection gonorrhoea, which can lead to infertility), *Neisseria meningitidis* (causes sepsis and meningitis) and *Moraxella catarrhalis* and *Non-Typeable Haemophilus influenzae* (causes middle ear infections and exacerbations of chronic obstructive pulmonary disease).

Highlights of 2021 include Professor Seib's ongoing consultation with the World Health Organization to guide future development of a much-needed gonococcal vaccine, and her appointment to the WHO Technical Advisory Group for Sexually Transmitted Infection Research Priority Setting (2021-2023). Her research group has published work characterising novel drug and vaccine candidates for gonorrhoea, and modeling the potential public health impact of a gonococcal vaccine. She presented this work at international conferences including the 21st IUSTI World Congress (Plenary Speaker) and the Joint Australasian HIV&AIDS and Sexual Health Conferences. Professor Seib also continues to lead two clinical trials for gonorrhoea prevention, in collaboration with Gold Coast, Sydney and Melbourne sexual health clinics.

The group was also successful in gaining ongoing funding from a philanthropic group for drug development for gonorrhoea and Dr Evgeny Semchenko was awarded an additional NIH Mentored Developmental Research Project (DRP) grant. Research from the Seib lab, performed by highly talented postdoctoral researchers Dr Semchenko, Dr Taha, Dr Eskandari, and students Xiaofan Chen and Valentin Slesarenko will significantly contribute to disease prevention.



Professor Joe Tiralongo

Research Leader

The current research focus of Professor Joe Tiralongo's research group is studying the function and biosynthesis of carbohydrates in the context of fungal biology including the effect of fungal polysaccharides on the human immune response and anti-fungal drug discovery, as well as the use of nano- and micro-technology to study complex glycobiology important in human health and disease.

In 2021, highlights from the Tiralongo group included the continuation of a significant collaboration with Integria Healthcare, funded through both Griffith University and Integria Healthcare, which has generated a US patent, and new important data that will form the basis for a major Australian Research Council grant application in 2022. In addition, we welcomed a new PhD and Master's student who will be working on related aspects of this project.

Following on from high-impact publications in 2020, the Tiralongo group's growing reputation in the emerging field of glyco-nanotechnology was further highlighted by a recent publication in *Biosensors and Bioelectronics* one of the leading journals in the field. These studies highlight the potential of our glyco-nano approaches for the development of innovative biosensing technologies. An additional recent publication in the prestigious journal, *Proceedings of the National Academy of Science USA*, further highlights our sustained contributions in the field of glyco-microtechnology.

The Tiralongo research group's work in the stem cell field in collaboration with Professor Justin Cooper-White at the University of Queensland, has made significant progress that has further highlighted the significance and potential of carbohydrates in stem cell biology and regenerative medicine. This work is currently being funded through an Australian Research Council grant.

Additional highlights in 2021 include the completion of two PhD candidates, the awarding of the 2021 Glycomics Research Excellence award in Research Supervision to Prof. Tiralongo, and the commencement of a PhD and Master's candidate.

A/Professor Thomas Haselhorst

Research Leader



Associate Professor Thomas Haselhorst's group had a very productive year in 2021 beginning with several publications including:

- an NMR study in collaboration with Prof/s S. Berners-Price and M. von Itzstein published in *Angewandte Chemie*, describing the conformational modulation of iduronic acid-containing sulfated glycosaminoglycans by antimetastatic platinum drugs.
- a study in collaboration with Prof M. Jennings and Dr C. Day revealing novel COVID-19 drugs published in *mBio* (see page 15).
- two review articles published jointly with Dr Santosh Rudrawar. One review article in the *International Journal of Pharmaceutical* has already received 21 citations. Mr Shane Prenzler, PhD candidate, published a review article describing the various roles played by Siglec-1 in *International Reviews of Immunology*.

The group received joint funding of an ARC Discovery grant with Dr C. Day, to further describe and decipher glycan-glycan interactions. Dr Oren Cooper will be appointed as research fellow to tackle the complexity of these glycan interactions.

Ms Danielle Lee, PhD candidate, has further progressed the identification of novel antifungal treatment options to combat invasive Aspergillosis in collaboration with A/Prof Joe Tiralongo's research group. This project is part of the international research alliance iCAIR® (see page 17). In 2021, the Haselhorst/Tiralongo groups identified 4 novel compounds with high antifungal activity and patent application is in progress.

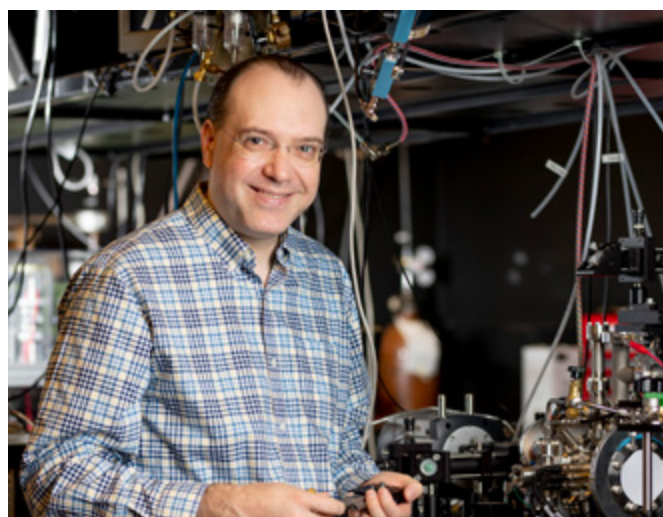
The group continued engagement with German collaborators through the Australia-Germany Joint Research Cooperation Scheme, an initiative of Universities Australia and the German Academic Exchange Service (DAAD) for the support of international academic co-operation. In collaboration with researchers at the University of Bremen and Griffith University's School of Pharmacy and Pharmacology, the Haselhorst group has continued the development of a dual functional drug delivery system with targeted cell specificity and enhanced cellular uptake for the treatment of B cell-derived lymphomas.

Hadieh Eslampanah Seyedi graduated from her PhD thesis and is wished all the best for her future career.

A/Prof Haselhorst had a 40% teaching commitment and fulfilled several roles such as NHMRC grant panel member, organising committee member and host of the *Australian-German Science and Innovation Day*, research ambassador for the *German Academic Exchange Service*, QLD representative of the Australian Association of Alexander von Humboldt Fellows, editorial board member of *Scientific Reports* (Nature Publishing Group) and editor of the *Magazine of the Australian and New Zealand Society for Magnetic Resonance*. He also convened '*2102NSC - Spectroscopic and Molecular Analysis*' and received a teaching commendation for outstanding contribution to the student experience for this course.

A/Professor Erik Streed

Research Leader



Associate Professor Erik Streed's Biophysics research group is a joint laboratory between the Institute for Glycomics and the Centre for Quantum Dynamics, which aims to foster the application of techniques from quantum physics to application in the life sciences and multi-disciplinary work more broadly.

The group specialises in ion trapping from single atoms to whole cells, and spectroscopy and microscopy development across the near UV-VIS-Near IR bands. Recent work has included the development of a super-resolution enabled zeptoNewton scale 3D Force sensor based on a single atom and development of quantum communications hardware. His Gold Coast lab hosts numerous commercial and purpose built spectrometers, monochromators, lasers, and speciality lamps.

The Streed Group is interested in developing new ways to investigate the properties of cells, subcellular structures, and large biomolecules using ion trapping techniques from quantum physics. The group's yeast cell levitation project, open to Honours students, involves culturing and fluorescent labelling of yeast cells, loading yeast cells into an ion trap, and then measuring the physical properties and manipulating the cell using electrical, hydrodynamic, and laser methods. The project is a collaboration with engineering professor Igor Agranovski on optical sensing of bioparticles and an opto-mechanical biosensing collaboration on Oren Coopers cantilever technology.

A/Professor Todd Houston

Research Leader



Associate Professor Todd Houston's research group have identified potent antitubercular compounds and novel sensors for cell-surface carbohydrates by synthesis of both bioactive and fluorescent molecules; discovered novel catalytic reactions through the study of boron interaction with carbohydrates; and discovered new immune modulating molecules, through the development of unique drug delivery systems.

The Houston group made significant research progress in 2021 as they were able to better juggle the uncertainties surrounding the Covid19 pandemic. Dylan Farr was awarded his PhD for his thesis work on antitubercular compounds entitled "*Design and Synthesis of Novel Glycolipid Therapeutics and Drug Delivery Systems Targeting Mycobacterium tuberculosis*". Taylor Garget made fundamentally significant discoveries in the development of fluorescent receptors for carbohydrates and Peter Sunde-Brown has developed highly efficient syntheses of disaccharide derivatives as potential Galectin-3 ligands to disrupt this protein's involvement in cancer progression. The group published invited book chapters in two high profile series – Comprehensive Heterocyclic Chemistry and Comprehensive Glycoscience – reflecting the breadth of our research endeavours. Based on our numerous successful lines of research, the group anticipates 2022 to be even better again.

A/Professor Daniel Kolarich

Research Leader



Associate Professor Daniel Kolarich's Group core interests are in understanding the glyco-code in health and disease and how this knowledge can be translated into novel diagnostic and therapeutic applications in precision cancer treatment. The Kolarich group collaborates with national and international partners to crack the glyco-code in different cancer types such as leukaemia, head and neck cancer, ovarian cancer or breast cancer, but also in cardiovascular and infectious diseases. In our Glycome Evolution program we are also currently establishing the first comprehensive glycome map of across the Vertebrate subphylum.

2021 highlights include:

- A major grant was awarded by the Australian Cancer Research Foundation (ACRF) to establish the ACRF International Centre for Cancer Glycomics (see page 9).
- A major funding pledge from a global private foundation and The Australian Lions Childhood Cancer Research Foundation towards a 3-year sarcoma research project.
- The ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF) grant titled: *An integrated analytical network for protein characterisation* will see the installation of the first Australian high-throughput Capillary gel electrophoresis system at the Institute for Glycomics. This UQ-led collaborative initiative includes a strong Glycomics team (A/Prof D. Kolarich, Prof M. von Itzstein, Prof M. Jennings, Dr L. Dirr and Dr A. Everest-Dass) and will enable the glycomics analysis of >1000 samples/day.
- An ARC-LIEF grant led by QUT (and together with colleagues from Griffith Institute for Drug Discovery, Griffith University) for the project titled: *A cyclic ion-mobility mass spectrometer for resolving molecular isomers*.
- Civic Solutions Inc donation for the project titled: *Understanding the mechanisms of chemotherapy resistance in Leukaemia*.
- Tour de Cure Research, Support and Prevention Senior Research Grant with Prof M. Jennings and Dr L. Shewell for project titled: *Characterising a newly discovered blood biomarker with potential use in the diagnosis and monitoring of ovarian cancer*.
- 2021 Research Excellence Awards winners in the Research Team/Group with Dr C. Day, Dr L. Shewell and Prof M. Jennings.
- 10 publications including the first multi-omics study of MLL-rearranged B-cell precursor acute lymphoblastic leukemia.

A/Professor Lara Herrero

Research Leader



Associate Professor Lara Herrero's research group utilises a One Health approach to make advancements in understanding and treating vector borne diseases, which combines field work, modelling and lab-based research. The group have made unique discoveries around pathogen dissemination/transmission in the arthropod vector and pathogenesis in the human host. Additionally, using primary human cells and mouse model of disease, they are assessing new glycotherapeutic treatment strategies as antivirals and targeted disease treatments for viral inflammatory disease.

Due to the ongoing COVID-19 pandemic in 2021, the Herrero group had a major focus on public health and community outreach.

A/Prof Herrero continued to assist in ensuring accurate information was relayed by media on SARS-CoV-2 as an virology/medical expert on local/national radio, TV and newspapers. She increased public awareness on the importance of public health actions and vaccines, leading to significant public health outcomes including increased vaccination rates across the country.

In 2021 A/Prof Herrero became Griffith's most read author for 'The Conversation' with >4.5 million global reads and 10 articles published in 2021/22. Her article entitled '*The symptoms of the Delta...*' is the Conversations most read article in Australia and the 2nd most read internationally (>2.5 million).

A/Prof Herrero, along with collaborators Prof von Itzstein, Prof Schroder (UQ), Prof Walker (UQ) and Em Prof Smith (UQ) were awarded a NHMRC Synergy (\$5M) for their work on developing novel therapies for emerging pathogens. As testament to her strong research and translational output, A/Prof Herrero was also recognised as one of three 2021 Finalists in the Women in Technology (WiT) Outstanding Contribution to Science.

Due to COVID-19, AVS meeting was converted to a one-day symposium, which A/Prof Herrero convened (co-ordinating >200 attendees, chairs and international speakers). The day was a huge success with all speakers providing key tips for career success to mentor the next generation. Mentoring continued with the Herrero group having two PhD thesis submissions in 2021 with students Elisa Lim and Eugene Madzokere reaching their thesis milestone.

A/Professor Milton Kiefel

Research Leader



Associate Professor Milton Kiefel's research group focuses on developing new chemistry methodology that facilitates the synthesis of molecules with potential applications in medicine and sustainability.

In 2021, the Kiefel group continued to focus on developing new approaches towards novel chemical entities that have potential biological activity. Research into further expanding our novel approach towards the synthesis of a new class of natural product with anticancer activity has provided some exciting preliminary data with cell-based assays. Following the award of an NHMRC grant in late 2020 in collaboration with microbiologist Dr Freda Jen, the Kiefel group commenced investigations into the large-scale synthesis of key building blocks that will form the basis of research aimed at investigating the development of antibacterial vaccines. This research is a key component of a broader research program investigating potential new antibacterial agents.

The Kiefel group has ventured into a new area of research exploring small molecules that can "switch" between two physical states under specific wavelengths of light. This research has resulted in developing molecules with unique fluorescent capabilities that could prove beneficial in the design of new sensors, solid-state lasers, and biological imaging devices. This fundamental research is also exploring the possibility of using these compounds to aid drug delivery. In conjunction with colleagues at Griffith, the Kiefel group has also expanded their investigations into the synthesis of natural product analogues with biological activity, exploring potential derivatives for treating Parkinson's Disease and also anti-inflammatory activity.

Dr Darren Grice

Research Leader



Dr Darren Grice's research group has a multi-disciplinary organic chemistry focus. Research work centers on:

1. Determining the chemical structures and biological activity of naturally occurring compounds, principally carbohydrates from Gram-negative bacteria and fungi; and
 2. Designing and synthesizing organic and carbohydrate-based molecules with potential as novel anti-cancer agents.
1. In 2021, work continued in collaboration with A/Prof Jenny Wilson and Dr Ian Peak on isolating and structurally characterising antigenic surface carbohydrate structures from the Moraxellaceae family of Gram-negative bacteria. These bacteria are known to be involved in diseases affecting humans and cattle. We received year 1 Philanthropic funding (4 year funding) to support and engage an outstanding PhD student to further develop our human middle-ear vaccine candidate. Unfortunately, due to COVID-19 restrictions, this work has been on hold.

In 2021 research students continued work in collaboration with Professor Joe Tiralongo and Integra Healthcare P/L on isolating and identifying carbohydrate structures in medicinal mushrooms (fungi) with immunostimulatory activity.

2. Research work continued during the year on the design and synthetic assembly of novel PROTACS. These large PROTAC molecules are capable of binding to cancer-associated proteins (via a 'warhead') and then harnessing one of the body's natural clean-up processes to destroy these proteins. In collaboration with Professor Mark von Itzstein, research students carried out work on assembling a library of these complex molecules, for biological testing.

Dr Thomas Ve

Research Leader



Dr Thomas Ve's research group is using structural information obtained on proteins of medical and biotechnological relevance to better understand their functions and identify new therapeutic strategies and biotechnological applications.

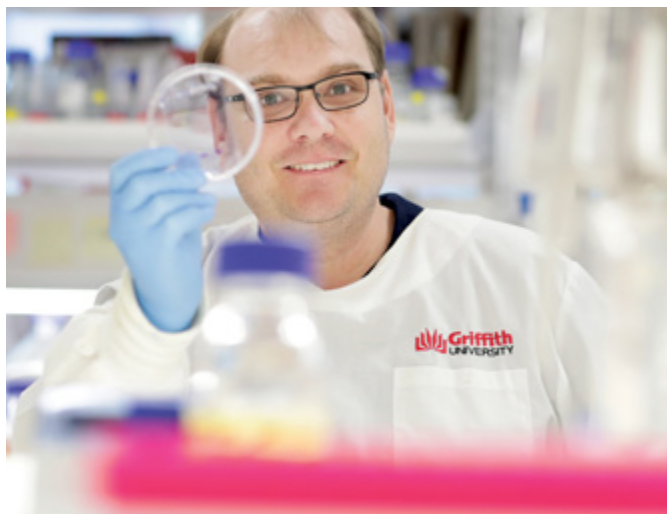
The group is using an integrated approach combining structural techniques such as X-ray crystallography and cryo-EM with biochemical/biophysical and cell-based functional assays. The major focus of the research involves characterising the biology and translational potential of a novel class of glycohydrolases that breakdown the essential metabolite NAD⁺. One member of this enzyme family, SARM1 is a key executioner of axon degeneration and an attractive drug target for many neurodegenerative diseases including peripheral neuropathy, Parkinson's disease, amyotrophic lateral sclerosis, traumatic brain injury and glaucoma. Several other members of this enzyme family play an important role in bacterial defence systems against viruses, but the mechanism of how they use NAD⁺ to provide resistance against viral infection has not yet been explored. Mechanistic understanding of bacterial antiviral defence systems has previously led to the development of revolutionary biotechnological tools such as restriction enzymes and the genome-editing technology CRISPR-Cas9. Understanding the mechanism of new defence systems such as the ones that breakdown NAD⁺ may provide a foundation for developing new exciting molecular tools. This research is also complemented by work on proteins involved in innate immunity signalling pathways, and viral host-cell entry and inhibition.

In 2021 Dr Yun Shi and Dr Premraj Rajaratnam joined the team as Research Fellows and will use their chemical biology and medicinal chemistry expertise across a range of ongoing projects. The group also welcomed Eduardo Vasquez who started his Master of Medical Research (co-supervised by Dr Darren Grice). His project is focused on nucleotide signalling by bacterial defence systems.

With collaborators from the US, the UK and UQ, the group published new research in *Neuron*, *Nature Communications*, *eLife*, *Pharmaceuticals*, and *Experimental Neurology*. They also unraveled a SARM1 inhibition mechanism and determined the first inhibitor-bound and active-state structures of SARM1 using cryoEM and crystallography. Dr Ve presented the group's research at the Twenty-Fifth Congress and General Assembly of the International Union of Crystallography, the Australian Biochemistry Lunch seminar series and local meetings such as the Brisbane Immunology Networking Symposium. As a testament to his grant successes and strong research output Dr Ve was appointed as a Research Leader in 2021, and he was a recipient of the 2021 Glycomics Research Excellence Award for mid-career researchers.

Dr Chris Day

Associate Research Leader



Dr Christopher Day's research group focuses on understanding host-pathogenic interactions reliant on carbohydrates and uses expertise in bioanalytical techniques to widely collaborate on a range of projects.

In 2021, the Day group was a part of the publication of 10 research outputs including papers in Science Signaling, Plos Neglected Tropical Diseases and mBio. During 2021, Dr Day was promoted to Senior Research Fellow.

The Day group continued to develop the SubB based cancer diagnostic/prognostic tests with the Jennings group. This work included analysis of samples for a joint US Department of Defense grant, a BTB connect grant and a commercial partnership. The Day group also continued to progress an NHMRC Ideas Grant that was awarded to the Day and Jennings groups in collaboration with Professor Torres from New York University for the study of novel methods of producing bacterial toxoids for use in vaccines. Dr Greg Tram, a post-doctoral researcher in the Day group was awarded a Griffith University Post-Doctoral Research Fellowship to work on the NHMRC Ideas grant project.

The Day group also had grant success with the awarding of an ARC Discovery Project grant with A/Prof Haselhorst to study glycan-based inhibitors of bacterial glycolipid-based adherence. This grant aims to develop a diet-based additive to reduce the incidence of chicken associated food borne illness such as Campylobacter.

Dr John Atack

Associate Research Leader



Dr John Atack's group had a great 2021, with multiple projects coming to fruition, and success for all members.

Post-doc Dr Greg Tram published two major studies:

- A project published in *mSphere* demonstrated how randomly switching expression of multiple proteins, systems called phasevarions, influences traits involved in disease and alters resistance to antibiotics, in the zoonotic pathogen *Streptococcus suis*. This knowledge will direct and inform both vaccine and treatment development for a pathogen important in agriculture and human disease.
- A project published in *ACS Infectious Diseases* demonstrated, for the first time, that a major *A. baumannii* protein involved in binding to the human host interacts with glycans on human cells and proteins. This knowledge will allow development of agents to block this interaction and treat infections for which traditional antibiotics are rapidly becoming ineffective.

Greg also published an invited review in the high-ranking journal *Advances in Microbial Physiology*, summarising the factors that *Streptococcus suis* uses to cause disease.

PhD students Zak Phillips and Nusrat Nahar continued their excellent progress in the lab. Zak had a major paper accepted in the journal *Infection and Immunity* and is progressing toward submitting his thesis mid-2022 and becoming the first PhD graduate from the Atack lab. Nusrat is also finalising her PhD studies and published her first first-author publication, a review in *Advances in Microbial Physiology*, concerning important virulence factors in *A. pleuropneumoniae*.

Honours student Ashley Fraser achieved a first-class honours degree characterising a novel vaccine candidate in non-typeable *Haemophilus influenzae*. Ashley will be welcomed back in 2022 as a recipient of a Griffith University PhD scholarship.

Dr Atack was promoted to Senior Research Fellow recognising his significant achievements in research and was awarded the 2021 Australian Society for Microbiology (ASM) Frank Fenner award (see page 22). John was also appointed chairperson of ASM Queensland – an important position, allowing him to promote microbiology, and push its importance in health and education.

Dr Ian Peak

Research Leader



Dr Ian Peak's research group focuses on bacterial pathogenesis, and innate immune responses and strategies to reduce disease. One research theme addresses a cause of childhood ear infections, *Moraxella catarrhalis*. In particular, addressing the biology of host-bacterium interactions, the ecobiology of the upper-respiratory tract, and vaccine approaches. Another major theme is the host response to secreted bacterial molecules, seeking to understand how quorum sensing molecules affect host immune responses to bacterial pathogens. A third stream of research investigates the structure and genetics of LPS biosynthesis.





OUR FACILITIES



OUR FACILITIES

The Institute for Glycomics' state-of-the-art infrastructure and equipment, coupled with our expert scientific personnel, facilitate our world-class research. Our impressive facilities, resources and services are also available to external research groups and industry.

The Institute for Glycomics has developed a multi-disciplinary translational approach for our equipment and facilities to allow us to cater for the diverse activities of our world-class researchers. Institute resources and facilities allows researchers to identify, synthesise, develop and evaluate novel diagnostics, drugs and vaccines.

Some of the impressive facilities within the Institute for Glycomics include:

Medicinal Chemistry Laboratories

The Institute houses over 700m² of medicinal chemistry laboratory space that allow our researchers to synthesise novel therapeutics. These laboratories are equipped to allow our researcher to perform and optimise complex chemical reactions safely. The facilities include high vacuum rotatory evaporators, purification and chromatography equipment and active-extraction fume cupboards with scrubbers.

The medicinal chemistry laboratories also contain two dedicated hazard laboratories that house our microwave reactor and hydrogenator.





Computational Chemistry and Visualisation

The Institute for Glycomics houses state-of-the-art computational chemistry and visualisation equipment. This equipment allows researchers to perform biomolecular simulations to visualise and understand molecular interactions at an atomic level to better facilitate structure-based drug discovery in a range of therapeutic areas.

The facility is supported by workstations with software for computing (eg YASARA, GROMOS) and visualisation (eg Chimera, PyMol). In addition, visualisation is supported by an exclusive 3D projector located within our lecture theatre to allow researchers to visualise and discuss computational models at a group level. Researchers can also access a 432-core high performance computing cluster with NVIDIA Tesla V100 GPUs.

This allows researchers to conduct biomolecular simulations employing molecular dynamics, quantum mechanical and free energy calculations; refine and validate of X-ray and NMR structures; investigate drug – glycoprotein interactions structures and the virtual screening of compound libraries and guided lead optimisation.

Physical Containment Level 2 Laboratories

Once new and novel therapeutics have been synthesised and purified the Institute for Glycomics has over 1350m² of Physical Containment Level 2 (PC2) laboratory facilities available for basic biology research, diagnostic and vaccine discovery and development, and the in vitro analysis and evaluation of lead compounds. These facilities are located across several floors of different buildings and host a range of equipment and facilities that allow our researchers to conduct experiments with a range of biological pathogens (bacteria, viruses, and parasites) that cause significant morbidity and mortality in humans and/or animals.

The Institute is also dual certified by the Office of the Gene Technology Regulator (PC2) and the Department of Agriculture, Water and the Environment (BC2) laboratory providing the capability to work with Biosecurity material.

PC2 spaces are equipped with biological safety cabinets, incubators, centrifuges and other laboratory equipment with core areas suited to allow rapid reconfiguration for either bacterial, virus or parasite focused research.



Physical Containment Level 3 (PC3) Facility

The Institute for Glycomics houses the only Physical Containment Level 3 (PC3) facility at Griffith University.

The 180m² plus facility is dual certified by the Office of the Gene Technology Regulator (PC3) and the Department of Agriculture, Water and the Environment (BC3) and capable of handling high risk pathogens.

The facility consists of dedicated laboratory and animal facilities (in collaboration with the Bioscience Service Centre) that allows our researchers to safely evaluate new therapeutic drugs or potential vaccines for viruses and bacterial pathogens that currently pose a significant risk to humans or the environment.

The multi-level facility is designed so that each laboratory space is individually HEPA filtered which can be operated independently of adjacent areas.

Each space is equipped with Biological safety cabinets, incubators and associated laboratory equipment to allow rapid reconfiguration for either virus or bacterial pathogen research. This flexibly allows the researcher to respond to new and emerging pathogens, such as SARS-CoV-2. The Institute commenced a SARS-CoV-2 project in March to evaluate novel and re-purposed drugs for COVID-19.

Specialist Facilities

These core laboratories are supported by a range of specialised facilities and equipment. Co-localisation of these services enhances both basic and translational research outcomes through direct interaction of research and technical staff.

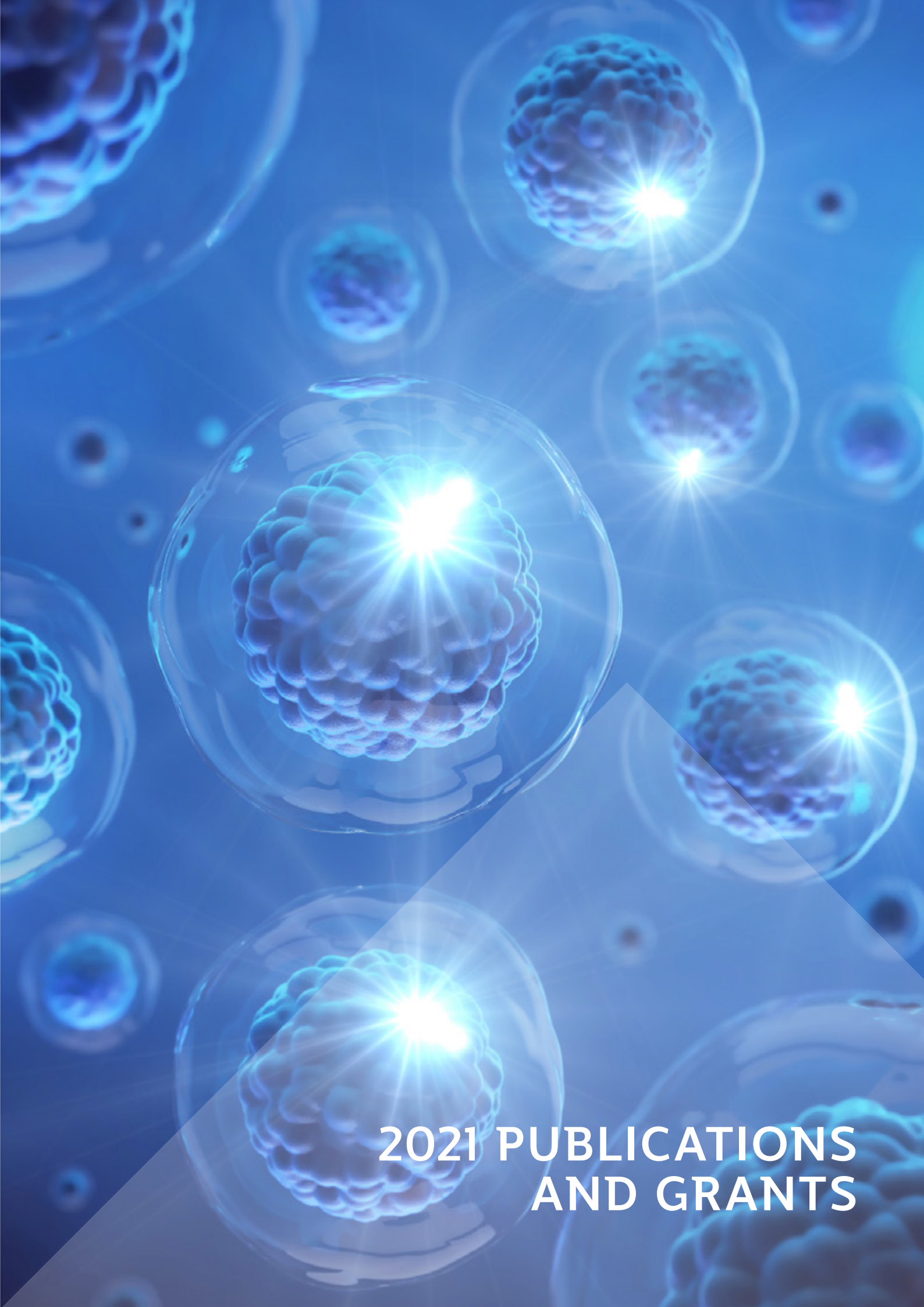
Specialist facilities within the Institute include:

- Glycobiological Facility (Glycomics Array Facility and a Bioanalytical Suite)
- Advanced Mass Spectrometry Laboratory including the ACRF International Centre for Cancer Glycomics
- Separations Science Facility provides an analytical and preparative chromatography (HPLC/ FPLC) and mass spectrometry services
- ZymeBank provides enzymes essential for glycan synthesis in high quality and purity
- Nuclear magnetic resonance (NMR) spectroscopy
- Protein X-ray crystallography
- Advanced microscopy and imaging
- Research facilities with capacity to handle radioactive isotopes.
- Biophysics laser laboratory

The Institute is ideally located to access University facilities that further promote translational research outcomes including:

- Dual-certified Physical Containment Level 3 (PC3) and Biosecurity Containment Level 5.3 (BC3) higher-containment facilities.
- Bioscience Resource Facility
- Cleanroom facilities for production of clinical material
- Human Clinical Trials Facility

Institute facilities are managed by a small but flexible administration team that is involved in all aspects of the Institute's operation. This operational flexibility allows the team to respond to the rapidly changing research agenda while meeting the necessary regulatory and safety requirements faced by an organisation focused on translational research.



**2021 PUBLICATIONS
AND GRANTS**

2021 PUBLICATIONS

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NEW GRANTS AWARDED*/COMMENCING IN 2021

Grant name	Project	Institute Investigator/s	Total funds awarded
NHMRC Synergy Grant*	<i>Mining the host-pathogen interface to deliver a drug pipeline for treating intractable and emerging infections</i>	Prof Mark von Itzstein A/Prof Lara Herrero	\$5,000,000
Australian Cancer Research Foundation Grant*	<i>The ACRF International Centre For Cancer Glycomics</i>	Prof Mark von Itzstein	\$2,600,000
NHMRC - Investigator Grant	<i>An interdisciplinary approach towards antiviral therapy discovery</i>	Prof Mark von Itzstein	\$2,028,000
NHMRC - Synergy Grant*	<i>Mining the host-pathogen interface to deliver a drug pipeline for treating intractable and emerging infections</i>	Prof Mark von Itzstein Led by QUT	\$2,000,000
NHMRC - Ideas Grant*	<i>COMBAT - A combination B- and T-cell epitope vaccine to futureproof COVID-19 vaccine</i>	Prof Mark von Itzstein	\$1,211,034
NHMRC Development Grant*	<i>Targeting the Achille's heel of multi-drug resistant Neisseria gonorrhoeae with drugs that disrupt metal homeostasis</i>	Prof Mark von Itzstein Prof Michael Jennings Dr Freda Jen Dr Ibrahim El-Deeb	\$1,116,525
NHMRC - Investigator Grant	<i>Structural biology and therapeutic targeting of axon degeneration</i>	Dr Thomas Ve	\$1,077,324
FHNW Innosuisse Research Grant*	<i>Impulse A Novel Vaccine Platform for Antimicrobial Resistant Bacteria</i>	Prof Michael Jennings Prof Kate Seib	\$887,661
NHMRC - Ideas Grant	<i>A gonococcal vaccine on the horizon: Using human data from a cross-protective meningococcal vaccine to guide gonococcal vaccine development</i>	Prof Kate Seib	\$838,059
ARC Future Fellowships	<i>Molecular basis of nucleotide signalling by TIR domain containing proteins</i>	Dr Thomas Ve	\$835,817
ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF)*	<i>An integrated analytical network for protein characterisation</i>	A/Prof Daniel Kolarich, Prof Mark von Itzstein Prof Michael Jennings Dr Larissa Dirr Dr Arun Everest-Dass with UQ-led team	\$727,596
NHMRC - Ideas Grant	<i>Vaccine to prevent Influenza Virus and Bacterial super-infection</i>	Dr Mehruz Zaman	\$717,623
ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF)*	<i>A cyclic ion-mobility mass spectrometer for resolving molecular isomers</i>	A/Prof Daniel Kolarich with QUT led team	\$630,880
NHMRC - Ideas Grant	<i>Structure and biophysical analysis aided design of novel toxoid vaccines for a major class of bacterial toxins</i>	Prof Michael Jennings Dr Chris Day	\$616,941
NHMRC - Ideas Grant (AI Participant)	<i>Determining immune dynamics during controlled primary infection in humans</i>	Dr Danielle Stanistic Prof Michael Good Led by JCU	\$579,823
NHMRC - Ideas Grant (AI Participant)	<i>Targeting a bacterial glyco-Achilles heel to make new vaccines for Haemophilus influenzae and Neisseria gonorrhoeae</i>	Dr Freda Jen	\$534,326

NEW GRANTS AWARDED*/COMMENCING IN 2021

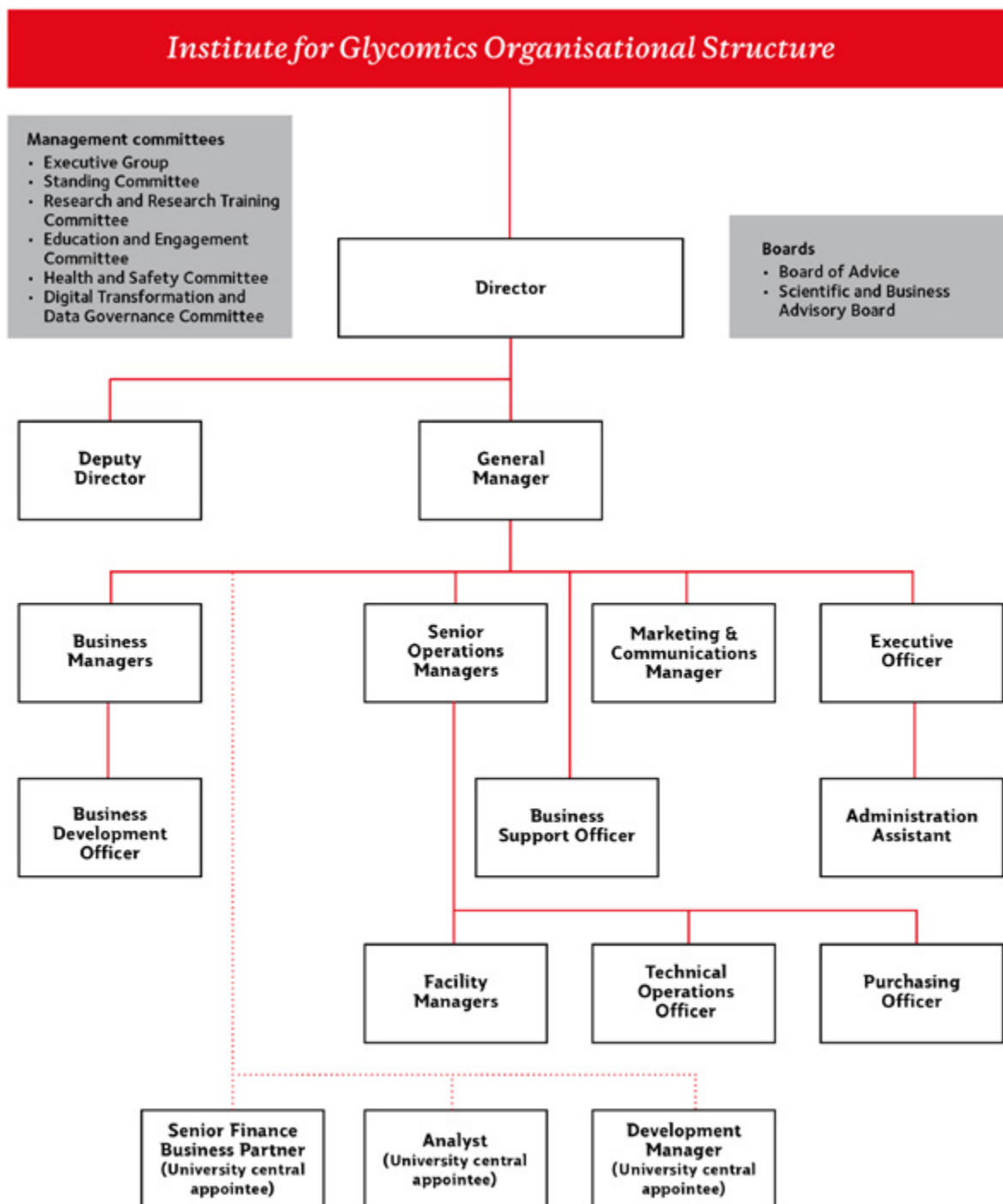
Grant name	Project	Institute Investigator/s	Total funds awarded
ARC Discovery Project*	<i>Glycan-based prebiotic approaches to increase food safety in Australia</i>	A/Prof Thomas Haselhorst and Dr Christopher Day	\$523,000
Australian Centre for HIV and Hepatitis Virology Research Grant	<i>Refinement of HTLV-1 POC for Remote Settings</i>	Dr Belinda de Villiers	\$100,000
Australian Centre for HIV and Hepatitis Virology Research Grant	<i>Rapid diagnostic and prognostic assay for HTLV-1 and lymphocytosis, for patients in the Australian outback</i>	Dr Belinda de Villiers Prof Johnson Mak	\$100,000
Australian Centre for HIV and Hepatitis Virology Research Grant	<i>Rapid diagnostic and prognostic assay for HTLV-1 and lymphocytosis, for patients in the Australian outback</i>	Dr Belinda de Villiers	\$94,850
Metro South Hospital and Health Service Collaboration	<i>Collaboration with imaging research and development programs</i>	Prof Carolyn Mountford	\$91,000
Folke Hermansens Fond Grant	<i>Identifying pre-operative oral carbohydrate intake mediated glycomic changes in breast cancer patient tissues and serum</i>	Dr Arun Everest-Dass Stavanger University	\$75,000
Civic Solutions Inc Donation	<i>Understanding the mechanisms of chemotherapy resistance in Leukaemia</i>	A/Prof Daniel Kolarich	\$49,998
BIOIndustry Partner	<i>Bio properties collaborative partner</i>	Prof Michael Jennings	\$30,000
Tour de Cure Research, Support and Prevention Senior Research Grant	<i>Characterising a newly discovered blood biomarker with potential use in the diagnosis and monitoring of ovarian cancer.</i>	Prof Michael Jennings Dr Lucy Shewell A/Prof Daniel Kolarich	\$25,000
Advance Queensland Womens Research Assistance Program (WRAP) Grant	<i>Advance Queensland - Women's Research Assistance Program</i>	Dr Ailin Lepletier de Oliveira	\$6,500
Australian Lions Childhood Cancer Research Foundation	Developing a novel diagnostic and treatment options for sarcoma	Prof Mark von Itzstein A/Prof Daniel Kolarich Dr Arun Everest-Dass	\$738,000
Bourne Foundation Donation	NMR Spectroscopy instrument	Prof Mark von Itzstein	\$1,800,000
Bourne Foundation Donation	PhD Student Support	Dr John Atack	\$30,000
Thyne Reid Foundation	Developing new drugs and a vaccine to protect against antibiotic resistant gonorrhoea	Prof Kate Seib	

REMARKABLE PEOPLE



REMARKABLE PEOPLE

We have over 200 researchers, students and support staff contributing to our world-class research, all of whom possess a wide range of knowledge within their various fields of expertise. Ground-breaking biomedical research requires a host of exceptional people coupled with state-of-the-art facilities.





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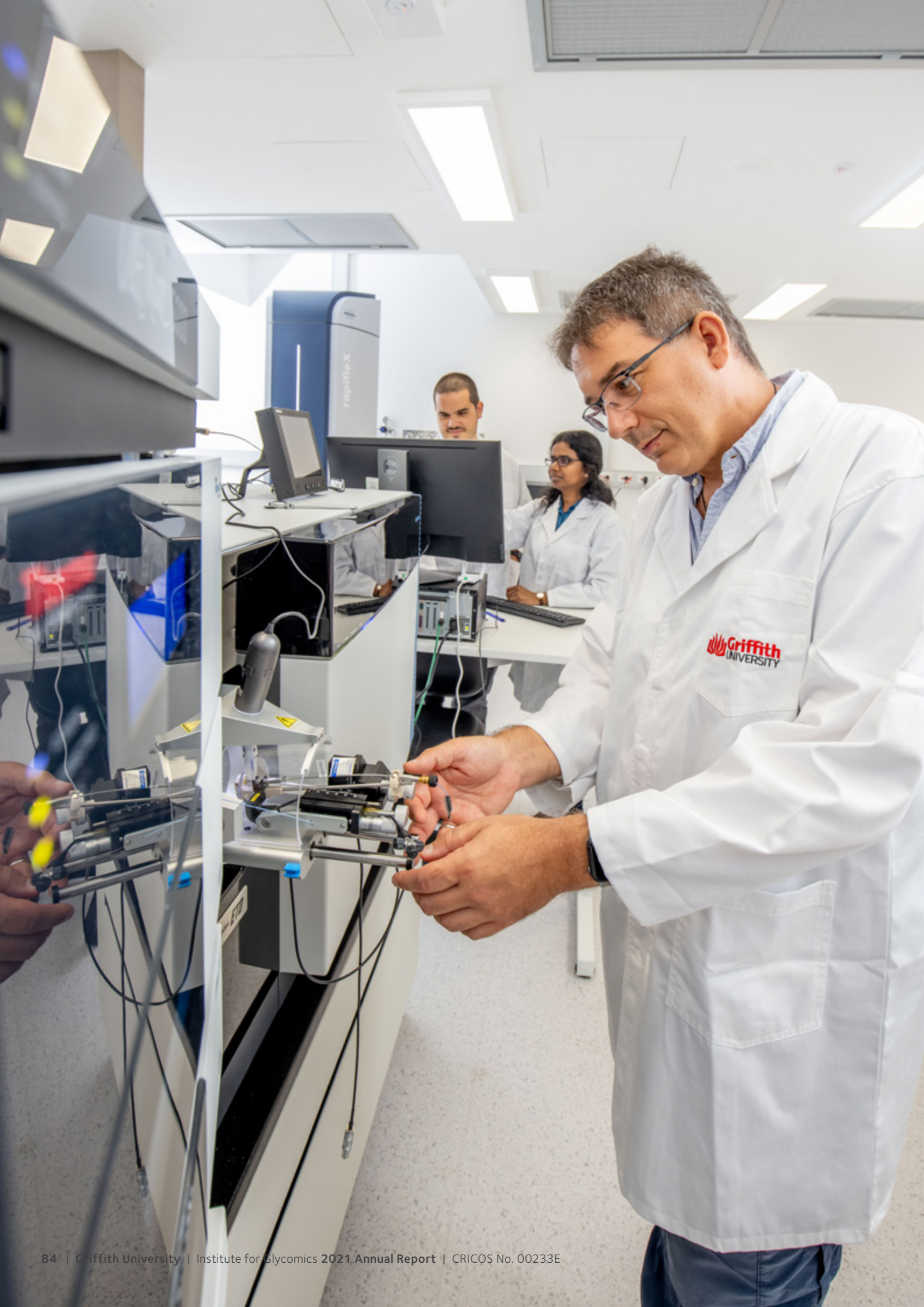
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Professor Yaoqi Zhou
Professor Nicolle Packer
Professor Johnson Mak

Professor Victoria Korolik
Professor Kate Seib
Professor Joe Tiralongo
Associate Professor Todd Houston
Associate Professor Thomas Haselhorst
Associate Professor Daniel Kolarich
Associate Professor Erik Streed
Associate Professor Lara Herrero

Associate Professor Milton Kiefel
Dr Darren Grice
Dr Thomas Ve
Dr Ian Peak
Dr Christopher Day
Dr John Atack
Dr Manisha Pandey
Dr Danielle Stanisic



Adjunct and Visiting Appointments

Dr James Fink	Professor John Gerrard	Associate Prof Nic Crampton	Professor Gorane Santamaria
Professor Nicholas Farrell	Professor Soerge Kelm	Professor David Crompton	Mr Nathan Tosh
Professor Peter Seeberger	Professor Yaoqi Zhou	Professor John Irvine	Dr Kirby Vosburgh
Professor Yuedong Yang	Dr Jessica Browne	Ms Lorraine Kear	Ms Julia Watson
Professor Subhash Vasudevan	Emeritis Professor Ifor Beacham	Mr Darren Lukas	Associate Prof Simon Wood
Professor Xing Yu	Mr Jason Beard	Professor Peter Malycha	Professor Ross Young
Professor Helen Blanchard	Professor Ian Bennett	Ms Laura Mariano	
Dr John Lancashire	Ms Jillian Borthwick	Associate Prof Lewis Perrin	

Research Scientists

Dr Tamim Mosaib	Dr Reshma Nevagi	Dr Taha	Ainslie Calcutt
Dr James Carter	Dr Crystall Swarbrick	Dr Rosanna Tremewan	Lindsay Gee
Dr Md. Farhadul Islam	Dr Greg Tram	Dr Thilini Padeniya	Mei Fong Ho
Dr Evgeny Semchenko	Dr Ailin Lepletier de Oliveira	Dr Jian Zhan	Brody Mallard
Dr Benjamin Bailly	Dr Yaramah Zalucki	Dr Simone Reynolds	Helen Mostafavi
Dr Yun Shi	Dr Patrice Guillon	Dr Mehfuz Zaman	Lisa Rich
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Dr Rajaratnam Premraj	Dr Thomas Litfin	Dr Penny Rudd	Valentin Slesarenko
Dr Bassam Elgamoudi	Dr Andrea Maggioni	Dr Chi-Hung Lin	Maddison Walton
Dr Sharareh Eskandari	Dr Alpesh Malde	Dr Robin Thomson	Veronika Masic
Dr Belinda de Villiers	Dr Tiago Oliviera	Stephanie Holt	Emily Cooper
Dr Grant Hansman	Dr Ibrahim El-Deeb	Jessica Dooley	Johana Luhur
Dr Dylan Farr	Dr Chih-Wei Chang	Callum Bennett	Jill Wallus
Dr Victoria Ozberk	Dr Lucy Shewell	Darrell Bessette	Heidi Plater
Dr Peng Xiong	Dr Matthew Campbell	Sarah Blanchard	Heath Dean
Dr Jessica Poole	Dr Arun Everest-Dass	Xavier De Bisscop	

Research Students

Xiaofan (Amber) Chen	Md Solyman	Ryan Adam	Yasin Mojtahedinyazdi
Vimbaishe Chibanga	Peter Sunde-Brown	Vienna Anderson	Jeremy New
Oren Cooper	Olivia Tan Hui	Georgina Avery	Francis Nguyen
Plabon Das	Annelies Van Den Bergh	d'Artagnan Barnard	Samantha Palmer
Hadieh Eslampanah Seyed	Jing Wang	Cody Bateson	Francis Pulik
Jack Everson	Yuan Zhang	Simon Batley	Jenny Rose Quiatchon
Dylan Farr	Zhe Zhang	Akarsha Bhola	Tahlia Ralph
Taylor Garget	Arjuna Abitbol	Samuel Brown	Shaiv Ranjith
Samuel Heddes	Allysha Bishop	Elise Browne	Forrester Savell
Danielle Lee	Ashley Fraser	Jamie-lee Brundyn	Rohan Sharma
Chengpeng Li	Alex Johnston	Pauline Dizon	Jaemin Sim
Elisa Lim	Alexandra Olling	Samantha Donaldson	Kirstie Starr
Eugene Madzokere	Shrey Patel	Jake Esposito-Leftwich	Shai Strampel
Gael Martin	Tarran Roles	Arshi Fatema	Jerry Sung
Jamie-lee Mills	Emily Smith	Jessica Halliday	Saran Takemura
Abarna Murugan	Sandeep Balaganessh	Sarah Hayes	Peter Tennekoon
Joanna Musik	Xavier De Bisscop	Lily Howell	Hannah Ting
Nusrat Nahar	Sarah Dunn	Ashley Hutton	Alyce Topping
Sam Nozuhur	Taymin du Toit-Thompson	Ella Jackman	Rosemary Tripp
Elizabeth O'Hara	Tiana Hippolite	Lewis Jarvis	Muanza (Gad) Tshitenga
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Elina Panahi	Thangira Usavamaytee	Maduro	
Zachary Phillips	Eduardo Vasquez	Jordan McKeown	

OUR BOARD OF ADVICE



The Honourable Robert Borbidge AO (Chair)

The Honourable Robert Borbidge was the 35th Premier of Queensland and served in the State Parliament for just over 20 years.

Rob is Chairman of a number of business boards and was appointed to Chair the Legacy Committee for the 2018 Commonwealth Games. He is a Trustee of the Currumbin Wildlife Hospital.



Mr Pat Crotty (Deputy Chair)

After a long career in the Queensland Police Service, Pat served as the State Secretary of the National Party of Australia QLD from 1997 – 2002.

Pat has spent the past 14 years working in real estate on the Gold Coast and currently works at Vertullo Professionals Real Estate at Paradise Point.



Mr Luke O'Dwyer

Luke is a former Australian rugby league professional. Luke was signed as a foundation member of the Gold Coast Titans.

Following his football career, Luke moved into a Business Development role with the GC Titans. Luke is now General Manager of Phone A Flight.



Mr Paul Sanders

Paul has built a reputation as one of the leading Sport Administrators in Australasia known for his leadership skills and ability to drive positive cultural change.

Paul is a Griffith University Graduate, Member of the Professional Golfers Association of Australia and a Director of the Board of Sanctuary Cove Body Corporate Services Pty Ltd.



Ms Christine Lohman MBA, FAICD, FPRIA

Christine has more than 35 years' experience specialising in corporate and financial relations. She owned and operated one of Queensland's leading public relations companies providing strategic communication counsel to ASX listed companies and Government. She is a non-executive director of the Australian Industry Trade College Ltd and is Deputy Chair of the Australian Institute of Company Directors Gold Coast Regional Committee.



Mr Geoffrey Thomas AO

Geoffrey currently owns Maleny Manor the most awarded wedding venue in Queensland, Settlers Rise winery and Carbrook Nursery. Geoffrey's business ventures have covered many Owner/ Executive Chairman positions including Capitalcorp Financial Services, Australian Capital Home Loans, Capitalcorp Finance and Leasing, Austcorp Finance and Leasing.



Mr William Matthews

Will has led a diverse career as an auditor and senior consultant across international trade and finance, health care, tourism, and not-for-profit sectors in Australia and Asia Pacific. Will is the founder and Director of Sovereign Family Offices, Queensland's most in-depth administrative, private care, crisis and lifestyle management service for high net worth individuals and their families, specialising in serving clients with dementia and limited capacity. Will is a passionate community leader, mentor and seniors advocate and currently serves on the boards of several not-for-profits and advisory committees.



Ms Lucy Cole

Lucy is a respected business identity included in the official list of "100 most influential Gold Coasters". Her high-profile brand is associated with the finest in residential real estate and recognised continually in the Gold Coast Business Excellence awards. Lucy is actively involved with many community groups, charities, schools, universities and hospitals supporting them in major fundraising programs and is a benefactor to the Home of the Arts.



Mr Sam O'Connor MP

Sam was elected to the Queensland Parliament as the Member for Bonney in 2017. He is a passionate advocate for the community he represents, which includes Griffith University, and works hard to engage more people in our political system.

Sam holds a Bachelor of Science in Biomedical Science, so he has a particular interest in the promotion and communication of science with the general public.



Ms Rachel Hancock

Rachel was appointed editor of the Gold Coast Bulletin at the end of 2018, moving her family to the Coast from Brisbane where she was deputy editor of The Courier Mail and Sunday Mail. She started her career in South Australia, where she held several roles including Day Editor, Deputy Editor (Saturday) of The Advertiser and Deputy Editor of Adelaide's Sunday Mail. She was also the first female editor of one of the country's most quirky and successful tabloids, the NT News.



Ms Karen Phillips

Karen's background spans 26 years of extensive experience in sectors including media, tourism, strategic partnership management, women in business, and not-for-profit. She is also a professional speaker and trainer having worked with some of the world's leading brands, heads of state and national companies. Karen is a passionate advocate and contributor to both Queensland and the Gold Coast. Over the past two decades she has served on a selection of key community boards. In 2018 Karen was awarded Gold Coast Citizen of the Year for distinguished service to the Gold Coast community.



Mr Clayton Glenister

Clayton is Managing Partner of MBA Lawyers, one of the Gold Coast's longest-running law firms established in 1970. Recognised as an industry leader for body corporate law and management rights in Queensland and New South Wales, Clayton's expertise also spans corporate, commercial, property and business law, thus providing a broad focus across vital sectors of the city's economy. Clayton is a proud advocate for the Gold Coast, taking on community and corporate roles that reflect his belief in its future. One of these roles is as a Director of the Southport Sharks.

SCIENTIFIC AND BUSINESS ADVISORY BOARD



Dr George Morstyn

Dr George Morstyn has more than 25 years' experience in the biotechnology industry and currently holds the role of Non-Executive Director at Actinogen Medical, an ASX-listed, biotechnology company developing a novel therapy for neurological diseases associated with dysregulated brain cortisol.



Associate Professor Mark Smythe

Associate Professor Mark Smythe is Principal Research Fellow at the University of Queensland's Institute for Molecular Bioscience. His research interests include combinatorial chemistry and molecular design, protein-protein interactions, molecular design and combinatorial chemistry.



Professor Ross Coppel

Professor Ross Coppel is currently Deputy Dean and Director of Research of the Faculty of Medicine, Nursing and Health Sciences at Monash University. His laboratory is involved in research into malaria and tuberculosis infection. He is also Director of the Victorian Bioinformatics Consortium.



REMARKABLE SUPPORT

Thank you to the supporters who make our discoveries possible! The Institute acknowledges the Australian Government through funding from schemes including the National Health and Medical Research Council and the Australian Research Council, the Queensland Government, City of Gold Coast; as well as local philanthropists for their continuous support of our research programs.

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The Hon Leneen Forde AC

Baslyn Beel

Jennifer Bartels

Harry Triguboff AO DUniv and Rhonda Triguboff

Robert Gordon

OUR VISION FOR THE FUTURE

As our 21st Birthday year draws to a close we can reflect on a year of truly remarkable achievements and successes.

We look forward to continuing our research with enthusiasm and determination in the year ahead to discover and develop next generation drugs, vaccines and diagnostics in our fight against diseases of global impact.



Contact us

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CRICOS No. 00233E

21st
BIRTHDAY

 **Griffith** UNIVERSITY
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Queensland, Australia