GRIFFITH UNIVERSITY | INSTITUTE FOR GLYCOMICS

Institute for Glycomics
ANNUAL REPORT 2022

Our mission

Fighting diseases of global impact through discovery and translational science.

Contents

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.

INSTITUTE HIGHLIGHTS

3 MAJOR RESEARCH THEMES

- Cancer research program
- Infectious diseases research program
- Neurological disorders research program

OVER 200 INSTITUTE MEMBERS

- Professional staff
- Research students
- Research scientists
- Visiting scientists and adjunct appointments

COMMUNITY ENGAGEMENT

- **Community Bank Paradise Point** – supporting our Grand Ball, Summer Student Scholarship Scheme and Flow Cytometry Facility
- **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 world class research
- **Rotary District 9640** – a powerful partnership to end malaria

INCOME SOURCES FOR 2022

- Research grant funding – $6,414,286
- Industry, philanthropic & other support – $9,931,712

5 PATENTS

Filed on new Institute technologies

CLINICAL TRIALS

- **Phase 1 clinical trial** began in Canada – Institute vaccine for the prevention of **streptococcus A infection**
- **Phase 2 clinical trial** began in Australia – repurposed vaccine for prevention of **gonorrhoea**
- **Phase 1b clinical trial** run by Grand Medical continued in Australia – Institute drug for treatment of **sepsis**
- Preparing to enter a **Phase 1b clinical trial** with challenge in Australia – Institute vaccine for the prevention of **streptococcus A infection**

100+ PUBLICATIONS

per annum

PARTNERING

Engagement with over 45 industry partners for basic research, translation and commercialisation

15,160 CITATIONS

(over 10 years)

$1 for $1

In philanthropic funding supports our research

2022 PHILANTHROPIC ENGAGEMENT

- **Bourne Foundation** – supporting prostate cancer research and ovarian cancer research
- **GC Value Pty Ltd** – supporting our world class research
- **Order of St John of Jerusalem Knight Hospitaller the Commandery of SEQ Inc** – supporting our world class research
- **Victoria Racing Club** – supporting our world class research
- **Gold Coast Titans Community Benefit Fund Inc** – supporting our world class research
- **MyPayNow Pty Ltd** – supporting our world class research
- **Reuben Pelerman Benevolent Foundation** – supporting the Malaria Vaccine Project
- **Southern Paradise Foundation Pty Ltd** – supporting our world class research
- **National and General Operations Pty Ltd** – supporting our world class research
- **The Snow Foundation** – supporting the development of our streptococcus A vaccine

About us

The Institute's research is focussed on the identification of new preventions, cures and diagnostic methods for infectious diseases, cancer and neurological disorders. The Institute places a strong emphasis on translational research and commercialisation, to have a meaningful 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 biomedical research and '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

It was an exciting start to 2022 with the return to interstate and international travel following the COVID-19 pandemic, which allowed our researchers and business team to re-engage with our partners, collaborators and community in a face-to-face capacity.

The lessons we've learned from fighting this pandemic will no doubt shape our future for the better because we are now better prepared and even more resilient. And that's largely thanks to research.

Research – to search for answers, to search, and to search again. It's paramount. And it's the essence of what we do here at the Institute for Glycomics.

There were so many exciting highlights in 2022, all of which are outlined more comprehensively in the pages that follow these welcoming remarks.

To spotlight just a few, the Institute for Glycomics officially launched the Australian Cancer Research Foundation International Centre for Cancer Glycomics (ACRF I2CG) with a $2.6 million Australian Cancer Research Foundation grant; the ACRF I2CG is dedicated to deciphering the cancer glyco-code.

The Institute and Swiss-based company LimmaTech Biologics AG signed a landmark deal to develop a world-first gonorrhoea vaccine. Our researchers have developed a suite of vaccine technologies for the prevention of gonorrhoea, and potentially other diseases.

A team of international scientists from the Institute for Glycomics and the University of Alberta have started human clinical trials for a Strep A vaccine they hope will induce long-lasting immunity against the deadly pathogen which kills more than 500,000 people each year.

Our Institute's malaria vaccine researchers are one step closer to conducting human clinical trials for a malaria vaccine that can be freeze-dried for easy transportation to malaria endemic countries. The Malaria Vaccine Project, a joint fundraising partnership between Rotary District 9640 and Griffith University, has raised $1.34 million from Australian Rotary Clubs, the Medical Research Future Fund, and generous community donors over the past five years.

On the research training front, we are delighted to report that we had nine of our research students awarded their PhDs in 2022, which is an incredible achievement for them as they embark on their future careers and also a proud moment for their families and Institute supervisors.

Grant successes in 2022 were also remarkable, with Institute for Glycomics researchers awarded over $6,414,286 in research grant funding and $9,931,712 in industry, philanthropic and other support, which is all vital to the continuation of our vast range of research projects and clinical trials.

I would also like to extend my utmost appreciation to all our philanthropic donors and supporters. Community support and philanthropic donations are paramount to our fight against diseases of global impact. The generous contributions we receive from our donors enable us to purchase new equipment, advance our clinical trials, support our students through scholarship opportunities, aid our research scientists through funding of their various research projects, and so much more.

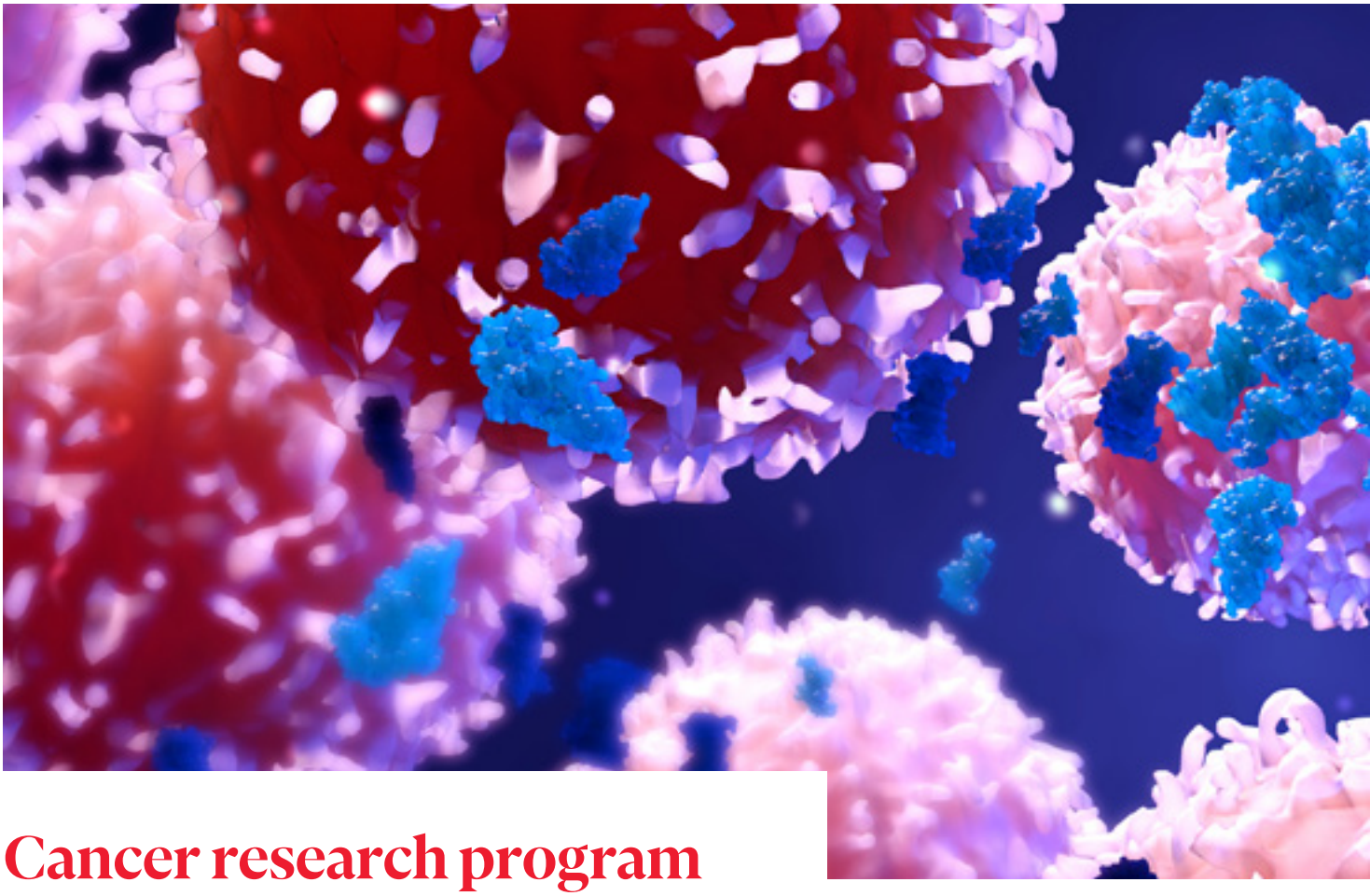
Here at the Institute for Glycomics, our mission is to fight diseases of global impact and we actively pursue this mission every day. Thank you for engaging in our journey and for your ongoing support!

Professor Mark von Itzstein AO
Foundation Director

REMARKABLE SCIENCE

Our world-renowned research 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.

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



Cancer research program

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020. 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 disease.

All human cells are extensively decorated with a range of complex sugar moieties (glycans), which form the host cell glycome (the cell's sugar language). These glycans are utilised as receptors for a variety of proteins, and the inter-cellular interactions between glycans and proteins play an essential role in how cells communicate with each other and their environment. Not surprisingly, they also play critical roles in maintaining health and in the pathogenesis of disease, including cancers.

Surprisingly, the language of glycan interactions, the glycome, remains poorly understood, particularly when compared to our knowledge of the genome (the language of genes) and proteome (the language of proteins). The technology required to deep-sequence the human glycome using human clinical tissue has only recently been developed, and the Institute for Glycomics is a pioneer in this field.

Extensive investment into the understanding of the cancer genome and proteome has led to tremendous advances in cancer care. Despite this, biomarkers for many cancers remain unidentified following proteomic and genomic analyses, suggesting that there is a gap in critical knowledge.

An increasing body of literature indicates that the cancer glycome is of equal importance to understanding disease pathogenesis as the genome and proteome. The glycome represents an underexploited aspect of cancer research, and in combination with the cancer genome and proteome, holds the key to diagnosing, treating and preventing cancers.

Close collaboration between clinical and translational research scientists is the key to success for any patient-oriented research. The Australian Cancer Research Foundation International Centre for Cancer Glycomics (ACRF I2CG) is a unique hub of exciting and revolutionary cancer glycomics research, where world-renowned experts in both the fields of basic science and clinical research combine resources, utilising state-of-the-art equipment and advanced technologies to decipher the changes to the glyco-code that occur in cancer.

Understanding the cancer glyco-code, which plays a major role in tumour development and progression, will lead to the translation and development of next generation precision diagnostics and therapies to fight cancer, a devastating disease that claims the lives of nearly ten million people globally each year. To deep mine the cancer glyco-code, advanced technologies are essential. The ACRF I2CG will meet this technology need, making it unique in Australia and a world-leading facility in cancer glycomics research. Advanced mass spectrometry equipment forms the centrepiece of the I2CG and complements the existing resources and capabilities within the facility, enabling the brightest scientific minds in cancer glycomics research to deep mine the cancer glyco-code down to a single cell level.

The goal of the ACRF I2CG is to identify the glycolanguage in these states in serum, tissue biopsies and *in vivo* in a clinical scanner of patients at high risk for cancer as well as those with a malignancy.

The team of glycomics experts 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.

This unique facility, with its diverse and multi-disciplinary team of researchers, underpins the opportunity to better understand the glyco-code. This understanding will lead to the translation of novel discoveries into clinical outcomes that will improve the lives of countless cancer sufferers around the world.

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 within I2CG made remarkable advances in 2022. Here are some of the highlights:

Official launch of the Australian Cancer Research Foundation International Centre for Cancer Glycomics

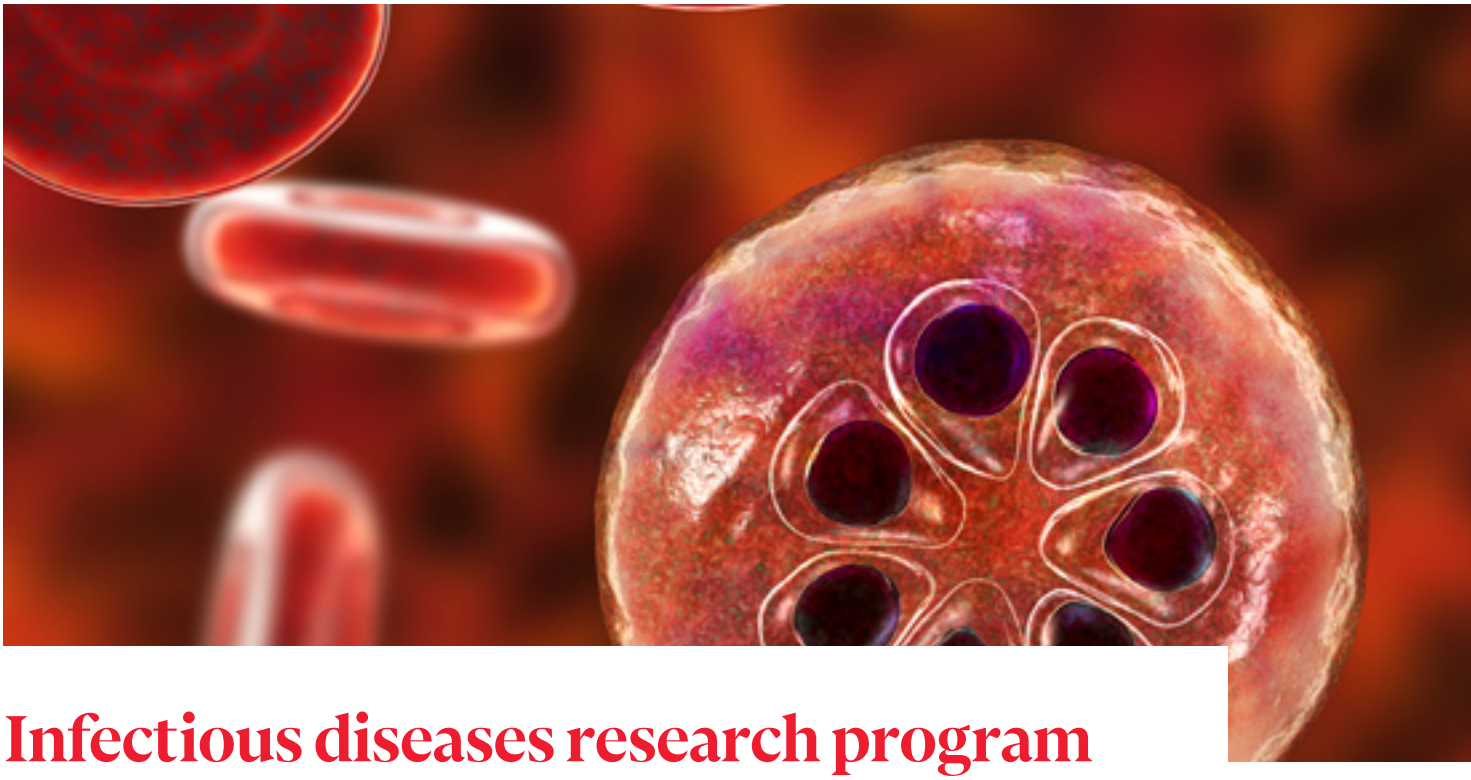
The Institute for Glycomics officially launched the Australian Cancer Research Foundation International Centre for Cancer Glycomics (ACRF I2CG) with a $2.6 million ACRF grant, which is dedicated to deciphering the cancer glyco-code.

Sugar modifications the key to unlocking ovarian cancer secrets

The ability to identify unique sugars that decorate ovarian cancer cells could help prevent the spread of cancer and improve treatment options for women. Dr Arun Everest-Dass from the Institute for Glycomics has been studying the metastatic cascade of ovarian cancer cells, which is one of the major reasons for a high death rate. During this metastatic cascade, tumour cells undergo changes to their state and behaviour, a phenomenon referred to as cell plasticity. Dr Everest-Dass and his team have used an advanced novel imaging technique available in the Institute for Glycomics to investigate the signalling pathways promoting this plasticity in the hopes of creating potential opportunities for the treatment of metastatic ovarian cancer. They identified unique sugars on the surface of the cell called 'glycolipids' which are involved in the spread of ovarian cancer. These sugar molecules may be potent therapeutic targets in the fight against the spread of ovarian cancer.

Grant successes:

- Ovarian Cancer Research Foundation Research Grant: $444,203 for the project titled *Discovery of novel serum glyco-markers to facilitate early detection of ovarian cancer*. Professor Michael Jennings; Professor Carolyn Mountford; Associate Professor Daniel Kolarich; Dr Lucy Shewell.
- Tour de Cure Mid-Career Research Grant: $49,834 for the project titled *Use of bodily fluids for the discovery of novel ovarian cancer glyco-biomarkers*. Dr Lucy Shewell.



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 also a global concern.

There's an urgent need to discover new approaches to address antibiotic-resistance and the lack of 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 in the innovative field of glycomics. 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 and 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

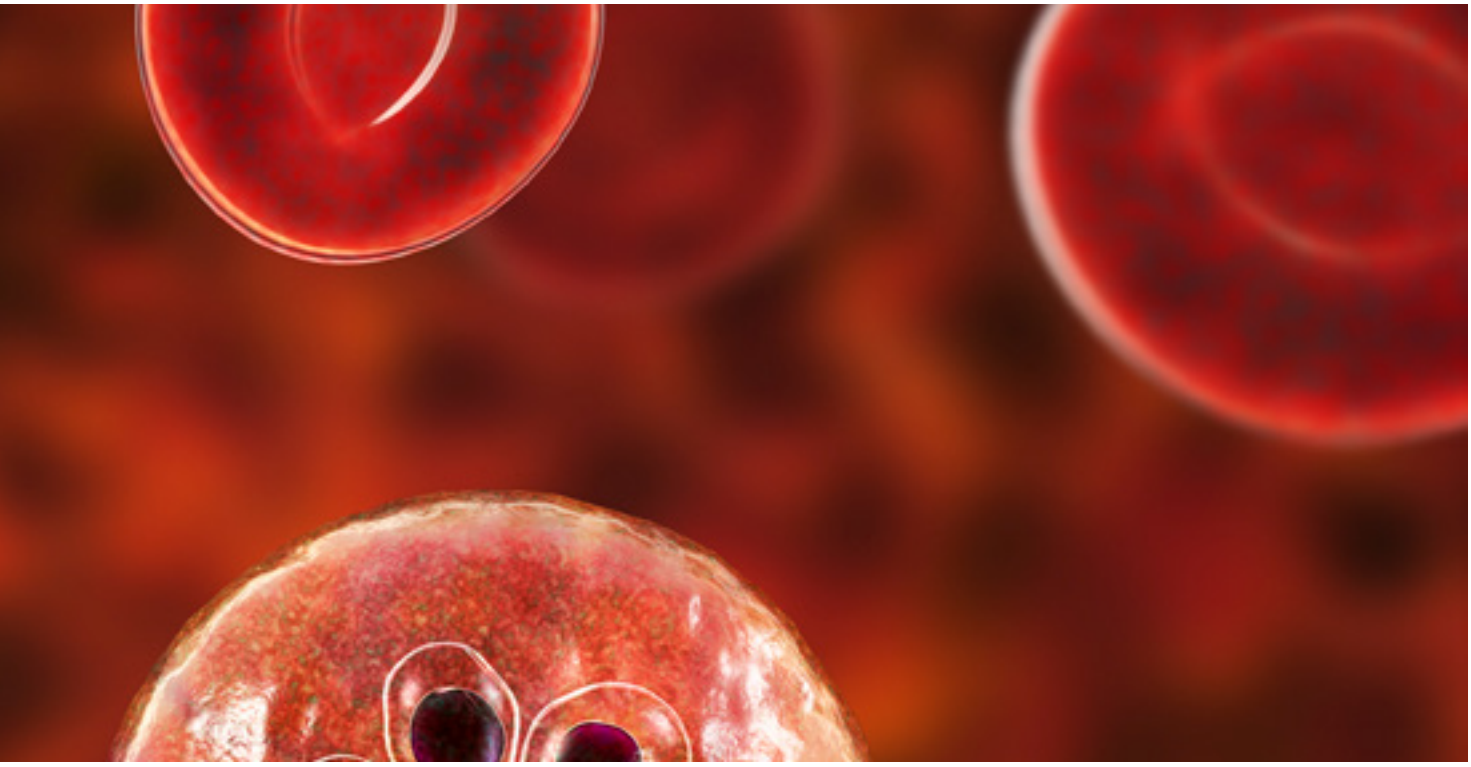
Diseases caused by viruses have plagued humanity for time immemorial. Unfortunately, drugs that combat viruses are extremely limited in number and are not broad spectrum. The Institute's conducts research into viral infections such as hand, foot and mouth disease (HFMD), human immunodeficiency virus (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. We seek 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 illnesses from a common superficial or mucosal infections 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 particularly at risk. The Institute is fighting invasive fungal infections through novel therapeutic approaches.



Some of the highlights of our infectious diseases research in 2022 include:

Griffith University and LimmaTech sign landmark deal to develop world-first gonorrhoea vaccine

Millions of lives are set to be changed for the better thanks to a landmark deal that was signed between Griffith University and Swiss-based company LimmaTech Biologics AG to develop a world-first gonorrhoea vaccine. Researchers from Griffith's Institute for Glycomics have developed a suite of vaccine technologies for the prevention of gonorrhoea, and potentially other diseases.

Strep A vaccine candidate in human clinical trials – Canada

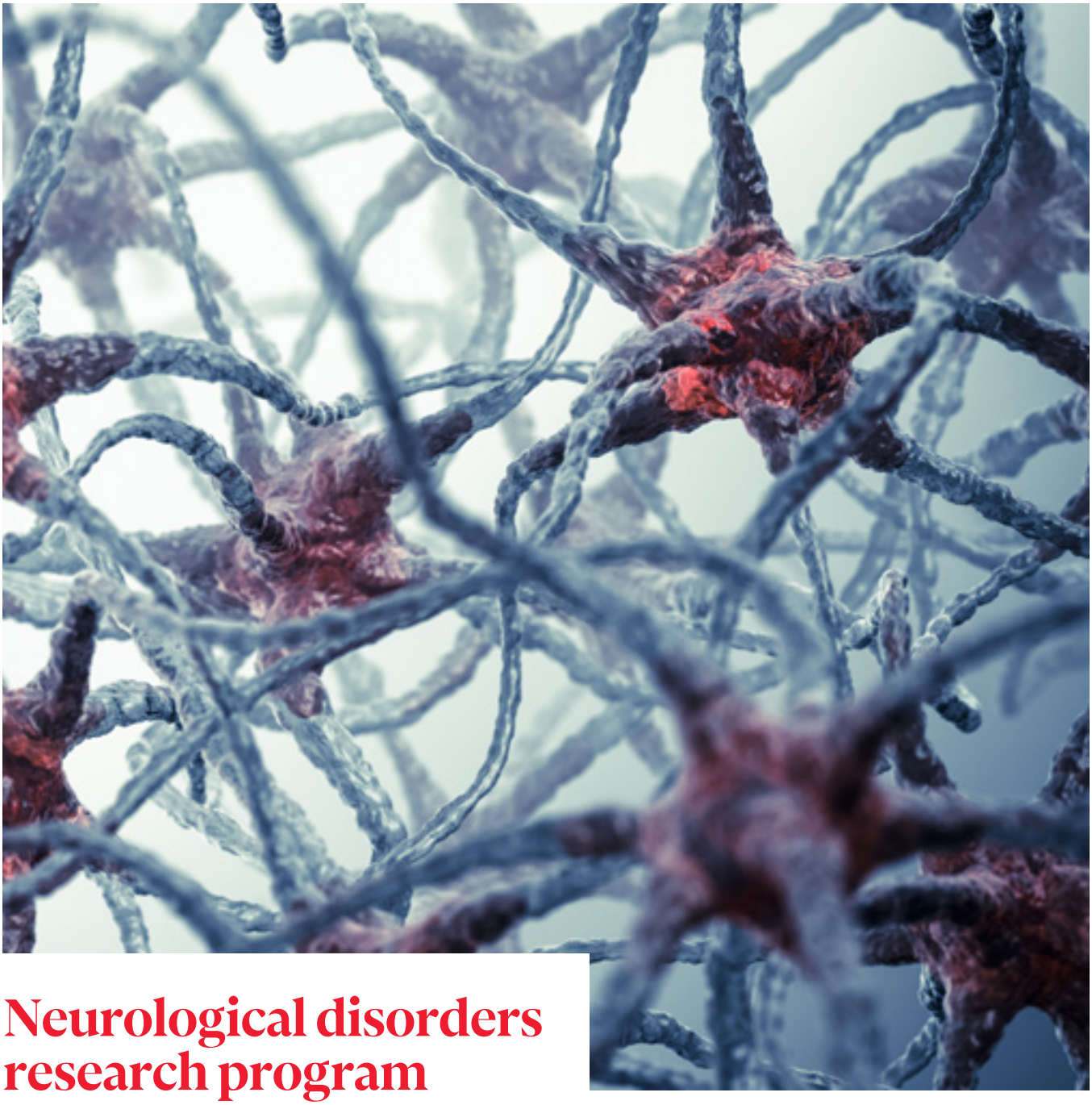
A team of international scientists from Griffith University and the University of Alberta have started human clinical trials for a Strep A vaccine candidate they hope will induce long-lasting immunity against the deadly pathogen which kills more than 500,000 people each year. Strep A is responsible for a significant number of non-invasive infections (tonsillitis, school sores) and invasive infections (necrotising fasciitis, toxic shock syndrome, kidney disease) which cause significant morbidity and mortality globally. Invasive Strep A diseases are responsible for more than 163,000 deaths each year. Additionally, post-streptococcal pathologies (including rheumatic heart disease [RHD] and post-streptococcal glomerulonephritis) are very significant, particularly amongst Indigenous Australians. Globally, RHD results in the loss of approximately 350,000 lives per year. There is currently no vaccine available and natural immunity to Strep A takes years and multiple infections to develop. It is hoped that our vaccine candidate will protect against multiple strains of Strep A and the many important diseases that can follow infection. If so, it could save over half a million lives per year.

Griffith University researchers lead human trials for malaria vaccine candidate

Griffith University's Institute for Glycomics' malaria vaccine researchers are one step closer to conducting human clinical trials for a malaria vaccine candidate that can be freeze-dried for easy transportation to malaria endemic countries. Announced on the five-year anniversary (March 23) of the Malaria Vaccine Project, the Phase 1 clinical trial will test the vaccine, PlasProtecT, in human volunteers in Australia to confirm its safety and efficacy. The Malaria Vaccine Project, a joint fundraising partnership between Rotary District 9640 and Griffith University, has raised $1.34M from Australian Rotary Clubs, the Medical Research Future Fund, and generous community donors over the past five years. Lead researcher Dr Danielle Stanisic said this whole parasite malaria vaccine was the first of its kind because it could be freeze-dried into a powder or frozen without losing its effectiveness. This means it can be easily deployed into malaria-endemic countries where there were an estimated 627,000 deaths due to the disease in 2020. Co-research lead and Laboratory Head, Professor Michael Good AO, said the approach taken with this vaccine should protect against the multitude of parasite strains circulating in the field.

Grant Successes:

- Associate Professor Thomas Haselhorst and Dr Christopher Day were awarded $523,000 in Australian Research Council Discovery Project funding for the project *Glycan-based prebiotic approaches to increase food safety in Australia*. They aim to develop a novel glycan-based prebiotic strategy to reduce *Campylobacter jejuni* colonisation in chicken and poultry by disrupting important glycan-glycan interactions. Outcomes of this proposal is a cost-effective antibiotic- and vaccine-independent animal feed supplement strategy that will decrease the risk of human food-borne illness and therefore promoting food safety and public health in Australia.
- Professor Kate Seib was awarded a $2,117,565 National Health and Medical Research Council (NHMRC) fellowship for the project *A comprehensive vaccine-based strategy to combat gonorrhoea*. The sexually transmitted infection gonorrhoea has a significant impact on global health, with 100 million cases/year, many of which are associated with infertility and increased HIV transmission. Due to increasing antimicrobial resistance and the absence of a vaccine, the WHO has classified gonorrhoea an urgent threat to public health that requires immediate action. Professor Seib's research aims to develop a vaccine to prevent gonorrhoea from becoming an untreatable 'superbug' in the near future.
- Institute for Glycomics researchers were awarded the following National Health and Medical Research Council (NHMRC) Ideas Grants:
  - Professor Johnson Mak (Chief Investigator) and Drs Belinda De Villiers and Arun Everest-Dass (Associate Investigators) were awarded $1,245,243 for the project *Unmask HIV latency through disruption of HIV synapses*, in collaboration with Professor Alan Wee-Chung Liew (Chief Investigator) and Dr Nicholas Condon, Professor Anthony Purcell, Dr Sri Ramarathinam (Associate Investigators).
  - Professor Michael Good, Associate Professor Manisha Pandey and Dr Penny Rudd were awarded $1,211,034 for the project *COMBAT – A combination B-and T-cell epitope vaccine to futureproof COVID-19 vaccine*.
  - Associate Professor Daniel Kolarich (Chief Investigator) was awarded $895,818 for the project *Personalising diagnosis and treatment of Pseudomonas aeruginosa infection*, in collaboration with Dr Timothy Wells (Chief Investigator) and Professor Daniel Chambers and Dr Larisa Labzin (Associate Investigators).
- Dr Caroline Chun Mei Thng was awarded a $121,193 NHMRC Postgraduate Scholarship for the project *Investigating Novel Prevention and Treatment Strategies for Gonococcal Control*, supervised by Professors Kate Seib and Michael Jennings.
- Institute for Glycomics researchers were awarded the following Australian Research Council (ARC) Discovery Projects grants:
  - Professor Kate Seib and Professor Michael Jennings were awarded $690,605 for the project titled *Decoding Bacterial Epigenetic Regulation*. This project aims to characterise bacterial epigenetic regulation by determining the mechanism of action and impact of bacterial DNA methylation. This project expects to generate new knowledge about fundamental aspects of bacterial gene regulation, using a novel combination of cutting-edge DNA and RNA sequencing, proteomic and bioinformatic approaches. The expected outcomes of this project will provide new tools to facilitate the integration of epigenomic analysis into genomic studies, exponentially increasing the volume and value of data gathered. This would provide significant future benefits to all academic, biotechnology, agricultural, veterinary and pharmaceutical applications that involve bacterial genomic analysis.
  - Dr Danielle Stanisic and Professor Michael Good AO were awarded $621,465 for the project titled *A next-generation whole parasite bovine Babesia vaccine* in collaboration with Professor Alicja Tabor. In Australia, Babesia parasites cause most of the severe and often fatal cases of cattle-tick fever, a globally significant tick-borne disease. It can be prevented by a live-attenuated parasite vaccine which has critical limitations of a 4-day shelf-life and risk of severe disease if administered to adult cattle. This project aims to evaluate in cattle a novel whole parasite *Babesia bovis* vaccine that cannot cause disease and can be preserved as an off-the-shelf product without losing efficacy. The expected outcome is a significantly improved vaccine for a major infectious disease that affects primary food production. As the disease imposes a major economic burden, it will have great benefit for the Australian livestock industry.
- Institute for Glycomics researchers Professor Michael Jennings and Dr John Atack were awarded a $1,096,030 ARC Linkage grant for the project titled *A Goldilocks live attenuated poultry vaccine for Infectious Coryza*.
- Professor Michael Good, Associate Professor Manisha Pandey and Dr Simone Reynolds were awarded a $450,921 Snow Foundation Grant for the project titled *Strep A vaccine to prevent rheumatic heart disease and invasive streptococcal disease*.
- Associate Professor Danielle Stanisic was awarded a $298,539 National Institutes of Health (NIH) grant for the project titled *Developing a multi-component vaccine harnessing potent antibody and cellular responses against the blood-stage of Plasmodium falciparum*.
- Professor Michael Good and Associate Professor Manisha Pandey were awarded a $670,831 Canadian Institute of Health Research grant for the project titled *A Phase 1 Clinical Trial of a Peptide-Based Group A Streptococcal Vaccine*.
- In collaboration with Dr Taylor, Dr John Atack from the Institute for Glycomics was awarded a $145,872 Menzies Health Institute Queensland grant for the project titled *Interplay between SARS-CoV-2 and major bacterial airway pathogens – implications for otitis media and chronic obstructive pulmonary disease*.



Neurological disorders research program

The Institute's neurological disorders research encompasses the following key issues:

Axon degeneration research

Axon degeneration represents a pathological feature of many neurodegenerative diseases that form a large part of the global disease burden including Alzheimer's disease, Parkinson's disease, motor neuron disease, and neuropathies. Elucidating the molecular mechanisms regulating the degeneration of injured axons may bring new therapies to a broad range of neurodegenerative diseases.

Mental health, PTSD, and pain research

Glycans play an integral role in the intercommunication of neurons in the brain. We know that for patients who experience pain, trauma and blast exposure, these glycans alter. Investigating this process, known as plasticity, is integral to better understanding, diagnosing and preventing acute neurological conditions transitioning to chronic disease.

Dr Thomas Ve's research – axon degeneration

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 neurodegenerative 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.

The enzyme SARM1 is a central player in axon loss. In healthy nerve cells, SARM1 is present but inactive. Disease and injury activate SARM1, which results in rapid breakdown of the essential "helper molecule" nicotinamide adenine dinucleotide (NAD+) and ultimately destruction of the axon. Interestingly, similar NAD+ consuming enzymes are also found in bacterial immune systems that provide protection against viral (phage) infections.

SARM1 is a potential therapeutic target for many neurodegenerative diseases but, in order to exploit the full promise of targeting SARM1, detailed knowledge of the catalytic mechanism and the molecular mechanisms upstream and downstream of SARM1 enzyme activity is required.

Dr Thomas Ve's research group at the Institute for Glycomics is using structural biology methods such as cryo-Electron Microscopy and X-ray Crystallography, combined with cell and chemistry-based approaches in collaboration with national and international partners, to characterise SARM1 and related bacterial enzymes at the molecular level; define how they are regulated; and explore the diversity and targets of their nucleotide signals.

The research will unravel general principles of nucleotide-based signalling across all domains of life and will lead to an improved understanding of the molecular mechanisms involved in SARM1 induced axon degeneration.

Importantly, the research will provide new strategies for design of targeted inhibitors of axon degeneration, which can be developed into therapeutic agents for neurodegenerative diseases.

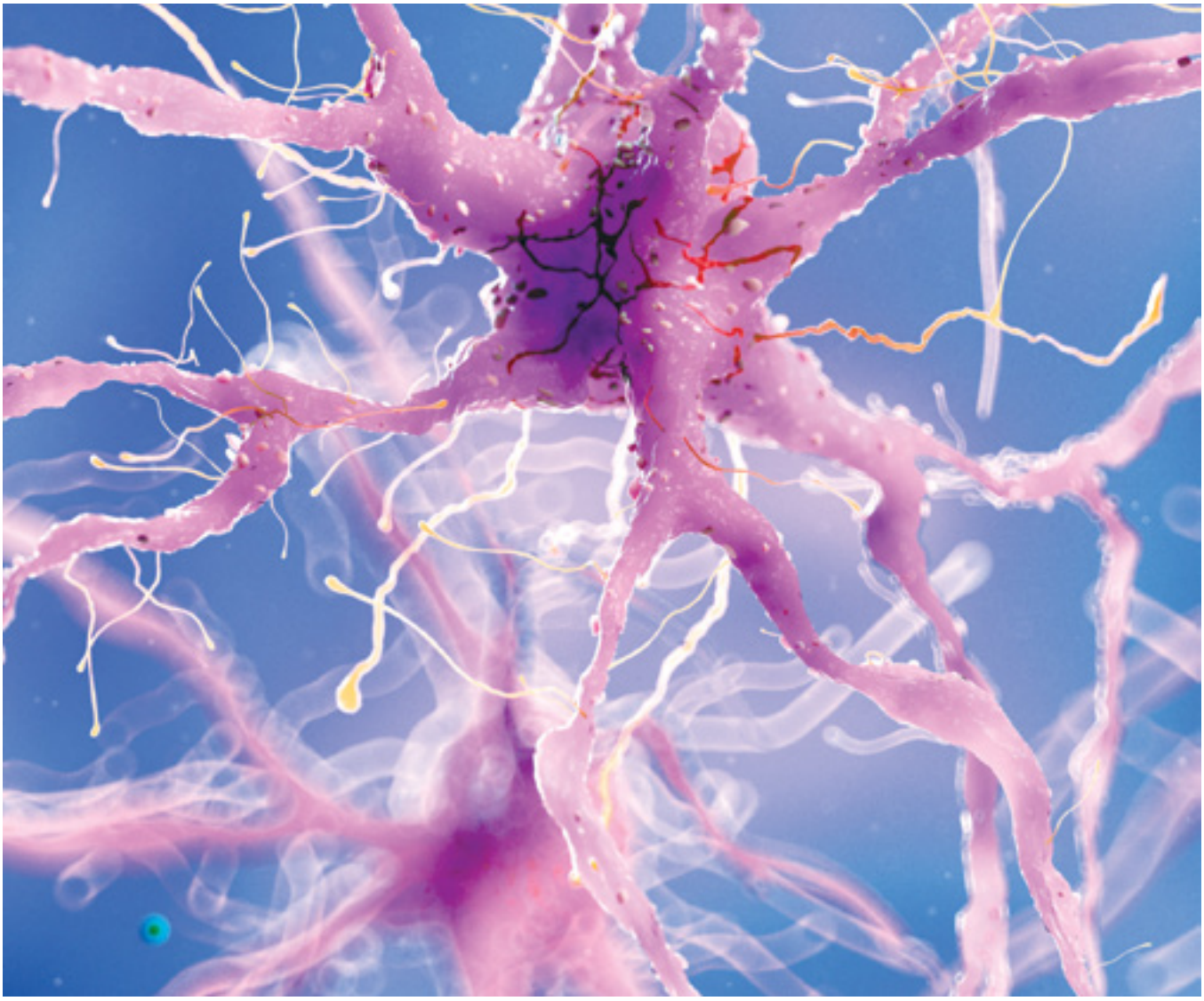
Translation of this research is supported by a long-term research collaboration with Dr Ve's industry partner Disarm Therapeutics, a wholly owned subsidiary of Eli Lilly and Company, whose mission is to create breakthrough disease-modifying therapeutics to treat patients affected by axonal degeneration.

Professor Carolyn Mountford's research – mental health, PTSD, and pain

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 neurochemical changes to the brain associated with pain, Post-Traumatic Stress Disorder (PTSD), injury from blast and impact. Her team has now completed a contract to the USA and Australian military to develop an approach to improve the health of soldiers.

Professor Mountford's research team uses clinical 3T scanners to monitor the effect of trauma and pain on the human glycome. They have assigned seven fucosylated glycans (Fuc-α(1–2) glycans) in the human brain. These glycans are affected differently in men and women. They are also affected differently by chronic pain, PTSD, and blast exposure. The 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.

This year a new assignment, a Fuc-α(1–6) glycan was possible due to a collaboration with Professor Thomas Haselhorst. This glycan is affected in artillery personnel post active firing exercises. Elucidating the precise carbohydrate chemistry that is underlying these conditions is integral to future clinical management with the long-term goal of prophylactic treatment to prevent the acute phase transitioning to the chronic phase which is considered to be irreversible.



Some of the highlights of our neurological disorders research in 2022 include:

New research identifies a bacterial 'Jekyll and Hyde' molecule involved in immune responses

Research by Associate Professor Thomas Ve and his team has played a key role in investigating a new molecule that protects bacteria against viruses and is associated with bacterial infection of plants. Associate Professor Ve said bacteria are on the watch for viral infections and have evolved a large repertoire of defence systems to protect themselves. Studying such defence systems have in the past led to powerful molecular tools that may one day be used for new treatments of diseases. The aim of the study was to look at bacterial enzymes that cleave a ubiquitous nucleotide called NAD (nicotinamide adenine dinucleotide) and produce new signalling molecules. These signalling molecules take part in a virus defence system called Thoeris. Associate Professor Ve's research shows one of these molecules – called 3'cADPR – is not only an activator of the Thoeris defence system but is also associated with suppression of the immune system in plants. Time will tell if this basic research leads to new technologies with the potential to treat or prevent diseases.

Molecular key may unlock new treatments for neurodegenerative disorders

Researchers have worked out how to successfully switch off a key pathway of nerve fibre breakdown in debilitating neurodegenerative disorders such as Parkinson's disease, traumatic brain injury and glaucoma. The study, led by Griffith University's Institute for Glycomics and Disarm Therapeutics, a wholly owned subsidiary of pharmaceutical company Eli Lilly, reveals the structural processes behind activation and inhibition of SARM1, a key molecule in the destruction of nerve fibres. As a trigger for nerve fibre degeneration, understanding how the enzyme SARM1 works may help treat several neurodegenerative conditions. In this study, the researchers show the molecular interactions that can switch SARM1 on and off. This gives a clear avenue for the design of new drug therapeutics.

The International Consortium for Anti-Infective Research (*i*CAIR®)

In 2017, the International Consortium for Anti-Infective Research (*i*CAIR®) was established. This is a major international partnership between Australia's Institute for Glycomics and Germany's Fraunhofer Institute for Toxicology and Experimental Medicine in Hannover, 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.

*i*CAIR® 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 preclinical 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, *i*CAIR® commenced a joint project to develop treatments against SARS-CoV-2, the virus also known as 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.

In 2022, *i*CAIR® was expanded into a preclinical research and development hub for human respiratory pathogens for pandemic response. With joint facilities on the Gold Coast and in Hannover, Germany, *i*CAIR® thrives to facilitate the progression of new antiviral drugs and vaccines from their inception to preclinical validation.

iCAIR
Bridging gaps in anti-infective R&D

REMARKABLE ACHIEVEMENTS

Professor Michael Jennings recognised as Australia's Field Leader in Biochemistry

Congratulations to Professor Michael Jennings, Deputy Director and Principal Research Leader at the Institute for Glycomics, who, in late 2022, was announced as Australia's Field Leader in Biochemistry (which captures the field of Glycobiology) by The Australian's Research Magazine 2023.

The Australian newspaper's Research supplement added a new feature, naming the top five universities and research institutions that are best equipped (by their research capacity and recent research achievements) to tackle Australia's top 10 research challenges, which The Australian selected as being: climate change, renewable energy, quantum technology, indigenous research, healthy ageing, food and agriculture, cybersecurity, disability and rehabilitation, media technology, and medical technology and devices.

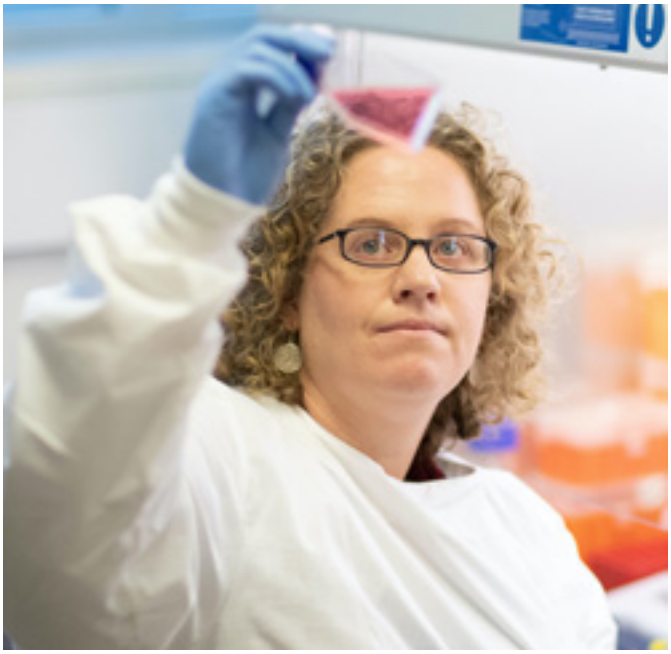
The Australian's Research supplement also named the top Australian researchers and research institutions in 250 fields of research over eight disciplines, with the aim of highlighting the excellence and relevance of Australia's research effort.

The selection was made objectively based on the number of citations given by peers to research published in top journals.

2022 Griffith University Postdoctoral Fellowship

Dr Tom Litfin was awarded a prestigious Griffith University Postdoctoral Fellowship in 2022. The two-year Griffith University fellowships are available to early career researchers with the objective of strengthening their research profile and capacity, giving the researchers the opportunity to become leaders in their field.

Tom's project is titled: *Exploiting the near-complete model structure proteome to shed light on unknown protein functions*. He will develop algorithms for lightning-fast, protein structure search in combination with recent advances in structure modelling to greatly expand the coverage of genome-scale function annotations. This project will enable detailed characterisation of human pathogens and potentially uncover novel drug targets to support the study of infectious diseases within the institute.



Institute for Glycomics staff promotions

The Institute for Glycomics celebrated the promotion of four of its researchers in 2022, in recognition of their outstanding contributions to research (pictured clockwise from top left):

- **Dr Manisha Pandey** was promoted to Associate Professor and Principal Research Fellow
- **Dr Danielle Stanisic** was promoted to Associate Professor and Principal Research Fellow
- **Dr Thomas Ve** was promoted to Associate Professor and Principal Research Fellow
- **Dr Ailin Lepletier de Oliveira** was promoted to Research Fellow Grade 2

Institute for Glycomics 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 2022 Research Excellence Awards winners were:

Excellence of an individual Early Career Researcher
Dr Victoria Ozberk

Excellence of an individual Mid-Career Researcher
Dr John Atack

Excellence in Research Supervision
Dr Manisha Pandey

Excellence of a Research Group/Team
Seib Group: Professor Kate Seib, Dr Evgeny Semchenko, Dr Taha, Dr Sherry Eskandari, Amber Chen and Valentin Slesarenko

Excellence in Research Impact
Associate Professor Lara Herrero

Excellence in Higher Degree Research – Director's Medal
Dr Oren Cooper

Peter Gallagher Memorial Glycomics Fellowship
In memory of Peter Gallagher, every year at the Glycomics Public Forum an internationally renowned researcher in the field of glycoscience is presented with the Peter Gallagher Memorial Glycomics Fellowship in recognition of their outstanding achievements in the field. In 2022, this prestigious Fellowship was presented to Professor Yvette van Kooyk.

Student awards and special achievements

Student Scholarship Awards

Each year, the Institute for Glycomics offers a number of prestigious student scholarships open to both honours and masters students wishing to undertake a research project within the Institute.

The 2022 Scholarships Presentation Evening was held on 6 April. Friends, family and peers heard from students James Gu and Jessica Halliday about their journey to the Institute and the impact of the scholarship on their future careers. We congratulate all scholarship recipients and thank our generous supporters: Community Bank Paradise Point, Warren and Sally von Bibra, and the Glycomics Circle.

Bendigo Bank Paradise Point Glycomics Summer Scholarships

The Institute for Glycomics Summer Scholarships are generously funded by the Community Bank Paradise Point Branch of Bendigo Bank.

The 2022 scholarships were presented by Brandon Hockley (Senior Manager, Community Bank Paradise Point, Pimpama and Ormeau) and Cassandra Hugonnet (Mobile Business Development Manager, Community Bank Paradise Point, Pimpama and Ormeau).

The winners were:

Vienna Anderson
Supervised by Associate Professor Daniel Kolarich

Georgina Avery
Supervised by Associate Professor Daniel Kolarich

Jessica Halliday
Supervised by Associate Professor Daniel Kolarich

Andre Jones-Dorr
Supervised by Associate Professor Manisha Pandey and Dr Victoria Ozberk

Moises Maninat Maduro
Supervised by Associate Professor Manisha Pandey and Dr Ailin Lepletier

Jeremy New
Supervised by Dr Chris Day

Francis Nguyen
Supervised by Associate Professor Danielle Stanisic

Jaemin Sim
Supervised by Dr Arun Everest-Dass and Dr Andrea Maggioni

Kirstie Starr
Supervised by Professor Victoria Korolik and Dr Bassam Elgamoudi

Hannah Ting
Supervised by Dr Arun Everest-Dass and Dr Andrea Maggioni

Jessica Halliday
Supervised by A/Prof Daniel Kolarich and Dr Darren Grice

Sally and Warren von Bibra Student Scholarships

Sally and Warren von Bibra are loyal supporters of the Institute for Glycomics and have been generously sponsoring this prestigious scholarship scheme since 2003.

Sally and Warren were both in attendance to present the scholarship to:

Xuanling (James) Gu
Bachelor of Science with Honours, for the project titled *Discovery of novel cmp-nana uptake proteins in pathogenic Neisseria*, supervised by Professor Michael Jennings and Dr Freda Jen.

Glycomics Student Scholarship

Congratulations to the winner of the 2022 Glycomics Student Scholarship:

Ronald (Zander) Coetzee
Masters of Medical Research, for the project *Characterisation of Vibrio cholerae host-bacterial interactions*, supervised by Professor Victoria Korolik.

Glycomics Circle Honours Scholarships

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 2022 Glycomics Circle Honours Scholarship awards were presented by Glycomics Circle and Institute for Glycomics Board of Advice member, Christine Lohman.

The winners were:

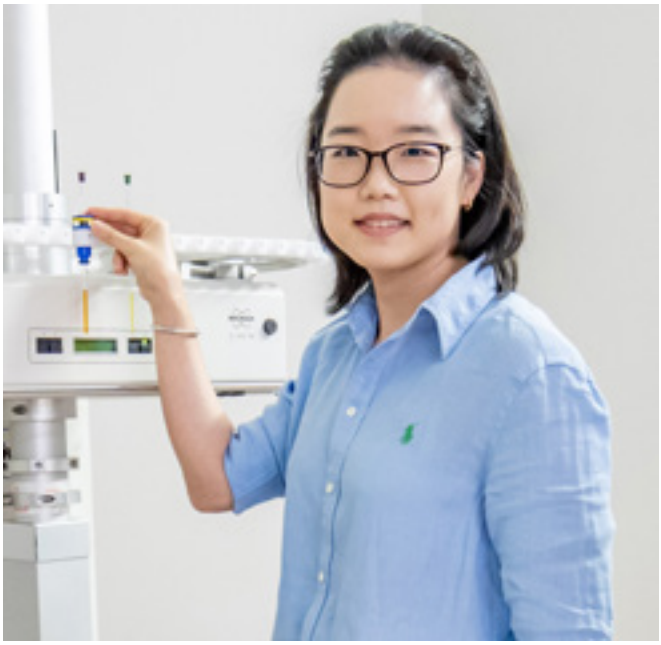
Nuala Ellaby
Masters of Medical Research, for the project *Defining the Glyointeractome of Acineobacter baumanii*, supervised by Dr John Atack.

Jessica Halliday
Masters of Medical Research, for the project titled *Understanding storage associated changes in platelet components using glycomics*, supervised by Associate Professor Daniel Kolarich and Dr Darren Grice.

Glycomics Circle Summer Scholarships

The 2022 Glycomics Circle Summer Scholarships were awarded to:

Ashley Hutton
Rosemary Tripp



Danielle Lee's Falling Walls Lab award

We congratulate Danielle Lee who presented her work at the Falling Walls Lab Brisbane and was awarded second place! This earned her the chance to present at the National round in Canberra to secure a place at the World event in Berlin.

The Falling Walls Lab gives students, entrepreneurs, early-career researchers and academics of all disciplines the chance to pitch an innovative idea in just three minutes, showcasing a breakthrough that creates a positive impact on science and society.

Danielle's pitch, titled *Breaking the Wall of Antifungal Resistance*, presented her innovative drug discovery project that involves developing a novel antifungal to combat invasive fungal infections – including the three candidates she has already identified.

Her Excellency the Honourable Dr Jeannette Young AC PSM, Governor of Queensland, presented Danielle with her award.

Institute for Glycomics 3 Minute Thesis competition

Three Minute Thesis (3MT) is an academic competition that challenges Higher Degree Research candidates to describe their research within three minutes to a general audience. The 3MT is held at many universities across Australia, New Zealand and Asia, culminating in an Asia-Pacific 3MT Final. The competition aims to professionally develop the presentation and research communication skills of all participants, honing their ability to effectively explain their research in a language that can be understood by a non-specialist audience.

The Institute for Glycomics' 2022 Three Minute Thesis (3MT) Glycomics Heats competitors were:

Jessica Halliday, Pauline Dizon, Amber Chen, Sam Heddes, Gael Martin and **Plabon Das**.

Congratulations to the following winners of the 2022 3MT Glycomics Heats:

Pauline Dizon, Honours/Masters/MMR Winner

Plabon Das, Pre-Confirmation Winner

Sam Heddes, Post Confirmation Winner

Amber Chen, Post Confirmation Runner Up

Gael Martin, winner of the People's Choice Award

Winter Okoth wins ASTMH Travel Award

Congratulations to Institute for Glycomics PhD student Winter Okoth who was selected as one of the recipients of the highly competitive American Society of Tropical Medicine & Hygiene (ASTMH) 2022 Annual Meeting Travel Award that is supported in part by the Bill & Melinda Gates Foundation.

Student completions

Date	Student	Thesis title	Supervisor/s
17 March	**Oren Cooper**	*Developing novel microarray technologies to explore complex biological interactions*	Associate Professor Joe Tiralongo and Dr Chris Day
17 May	**Jamie-Lee Mills**	*Modelling immunity to streptococcal skin and mucosal infections*	Professor Michael Good AO and Associate Professor Manisha Pandey
30 June	**Jack Everson**	*Nonulosonic Acids as potential inhibitors of pathogenic bacteria*	Professor Kate Seib and Associate Professor Milton Kiefel
5 July	**Md Solayman**	*High-throughput sequencing based probing of protein/RNA structures and functions*	Professor Mark von Itzstein AO, Professor Helen Blanchard, Professor Yaoqi Zhou and Dr Jian Zhan
19 July	**Eugene Madzokere**	*Alphavirus Phylodynamics and determinants underlying the evolution, infection and dispersal patterns*	Profesor Yaoqi Zhou and Associate Professor Lara Herrero
6 September	**Zachary Phillips**	*Detailed analysis of gene expression changes mediated by the SpnD39III system*	Professor Michael Jennings and Dr John Atack
12 September	**Taylor Garget**	*Novel methods for identifying and targeting cell-surface carbohydrates associated with disease*	Associate Professor Todd Houston and Associate Professor Milton Kiefel
12 October	**Joanna Musik**	*Substrate specificity of signal peptidase, LepB, as an adjunct to design of novel inhibitors*	Professor Michael Jennings and Dr Chris Day
1 December	**Vimbaishe Chibanga**	*Defining the glycointeractome of human parainfluenza viruses*	Professor Mark von Itzstein AO, Dr Patrice Guillon and Dr Larissa Dirr

TRANSLATION AND COMMERCIALISATION

Translation and commercialisation of world-leading science

Following in the footsteps of his success with Relenza, Professor Mark von Itzstein's vision when founding the Institute was to create an environment that enables the translation and commercialisation of world leading research, delivering life-saving diagnostics, preventions and cures to those who need them most. This vision remains a driver and focus for all of our members, from undergraduate students to Principal Research Leaders and Administrative support staff.

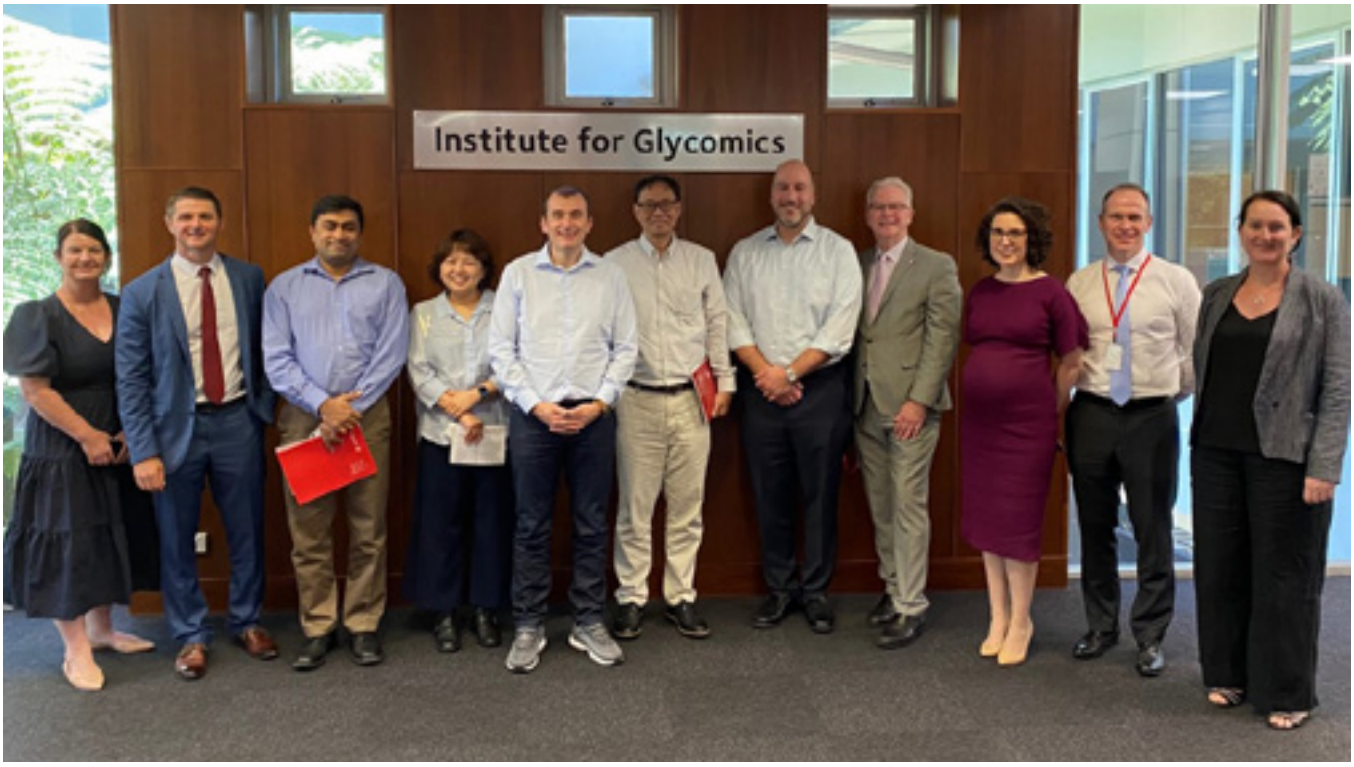
The Institute's Business Team, led by General Manager, Dr Chris Davis, has developed a robust platform for commercialisation of Institute technologies, with a particular focus on establishing deep partnerships with Industry through licensing and co-development programs. This approach provides multi-faceted 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, preclinical and clinical technology development and post-deal project management.

In 2022, a major deal was signed with Swiss biotech company LimmaTech Biologics to co-develop a vaccine against gonorrhoea. This deal, which includes five patented technologies invented by Institute researchers, showcases the benefit of the Institute's coordinated strategy for technology development and translation. This significant co-development deal is featured in the 'Commercialisation Case Study' section of this report.

We are also pleased to report that our Strep A vaccine has entered a Phase 1 clinical trial in Canada, through investment by our partners, the Li Ka Shing Institute of Virology at the University of Alberta. The outputs of this trial will feed directly into a Phase 1b (with challenge) clinical trial to be held in Australia immediately following. This subsequent challenge trial will assess the efficacy of the vaccine in human volunteers.

Institute assets continue to march through the clinical development pipeline. Grand Medical Pty Ltd, licensees of our drug candidate for sepsis, is continuing a Phase 1b study in Australia. Olymvax Inc., licensees of our Strep A vaccine in the China territory, are progressing manufacture of the vaccine in their facility, in parallel with a Phase 1/2 clinical trial application to the Chinese regulator, the NMPA. With China Grand Pharma, we continue a significant drug candidate selection programme *en route* to a Phase 1 clinical trial.

In 2023, we will continue our efforts to fight diseases of global impact by partnering with local and international biotech and pharma companies, moving our discoveries from the bench into the clinic and beyond.



Translational Science Hub opens in Queensland

Queensland will become a global mRNA vaccine hub with leading healthcare company Sanofi in partnership with Griffith University. This landmark deal will be transformational for SE Qld.

The $280 million Translational Science Hub will be established under an agreement between Sanofi, Griffith University, the University of Queensland and the Queensland Government.

Griffith University Deputy Vice Chancellor (Research) Professor Lee Smith says mRNA technology is helping launch a new generation of vaccines that instruct certain cells to produce proteins that are recognised by the immune system to mount a defence. "Over the past 24 months the world has seen the many benefits of the messenger technology platform (mRNA) through the development of the COVID-19 vaccines which have achieved remarkable results," Professor Smith said.

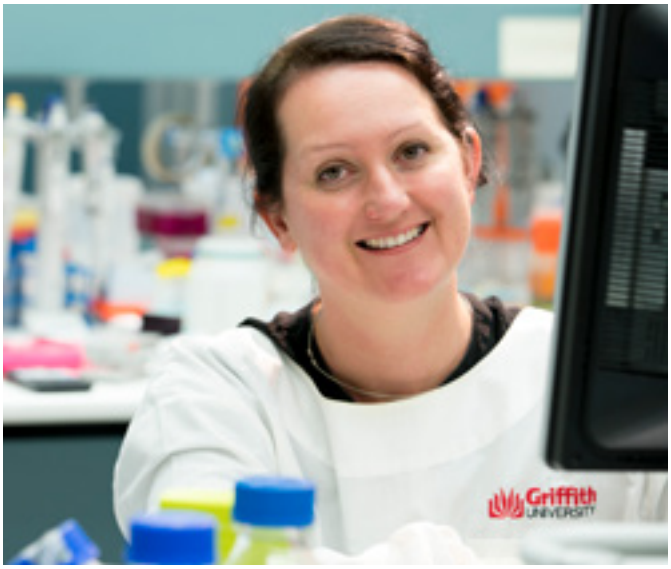
Premier Annastacia Palaszczuk said Queensland will be the only jurisdiction in Australia to have a centre of this kind. "Queensland has some of the best researchers in the world and the Translational Science Hub will give them the platform to develop life-saving vaccines," she said.

Deputy Premier and Minister for State Development Dr Steven Miles said the new Hub would help drive the development of new vaccines and health care solutions across the world. "The Translational Science Hub is a gamechanger that very few jurisdictions globally are capable of," Mr Miles said. "Queensland's best scientists will work with their global peers in the US and France on ground-breaking mRNA technology and vaccine development.

"The Translational Science Hub in Queensland will work closely with the Sanofi mRNA Centre of Excellence in France and the US to accelerate a new era of vaccine innovation," Global Head of Vaccine Research and Development, Sanofi, Dr. Jean-Francois Toussaint, said.

Vice Chancellor and President, Professor Carolyn Evans, said Griffith is delighted to be part of the partnership building on the strengths and capabilities of the University's existing biomedical leadership. "Our researchers are internationally recognised at bringing disease-specific mRNA expertise to developing new vaccines and therapies while our Clinical Trial Unit is a leader in testing safety and efficacy. We look forward to the work we undertake here in Queensland making a difference to global health outcomes," Professor Evans said.

The Translational Science Hub will be located across Queensland, utilising the laboratories and infrastructure at Griffith University and work alongside researchers at the Institute for Glycomics and other research Institutes.



Commercialisation case study

Griffith University and LimmaTech Biologics sign landmark deal to develop gonorrhoea vaccine

Millions of lives are set to be changed for the better thanks to a landmark deal between the Institute for Glycomics and Swiss-based company LimmaTech Biologics AG to develop a world-first gonorrhoea vaccine.

Gonorrhoea, for which no vaccine is available, is the second most common sexually transmitted infection globally with more than 105 million people infected each year. It disproportionately affects women with up to 80 per cent asymptomatic. Tragically, if left untreated, gonorrhoea can have severe implications including infertility in women and blindness in newborn babies. Alarmingly, gonococcal infection also dramatically increases the risk of contracting and transmitting human immunodeficiency virus (HIV). Rates of Gonorrhoea are 6.6 times higher in Australia's First Peoples compared to non-indigenous populations.

Researchers from the Institute have developed a suite of vaccine technologies for the prevention of gonorrhoea, and potentially other diseases.

Professor Michael Jennings said: "We have discovered gonococcal vaccine antigens that show great promise and the development program will harness LimmaTech platform technology to develop the vaccine product."

Professor Kate Seib said the absence of a gonococcal vaccine and the emergence of antibiotic-resistant and untreatable gonococcal strains posed an urgent public health threat.

"We are excited to partner with LimmaTech to help solve this global problem."

Institute for Glycomics Director Professor Mark von Itzstein said: "This is another example of the Institute's outstanding translation and commercialisation of its science that brings investment and long-term royalties to Australia."

Led by the Institute's Commercial Manager, Eloise Keeffe, Griffith negotiated and signed the exclusive licence and co-development agreement with LimmaTech Biologics to co-develop and commercialise the gonococcal vaccine candidate globally.

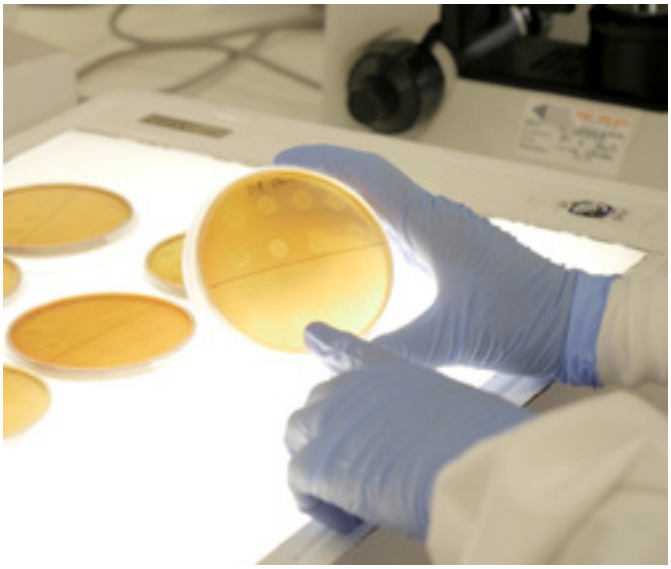
The deal comprises significant investment into research and development along with licence and milestone fees, and royalties on product sales.

This investment from LimmaTech brings new, highly skilled jobs to Queensland and new capability in advanced vaccine manufacture.

An outcome of engagement at BIO, a US-based business conference, this deal demonstrates the value of international engagement and enabling partners like Trade and Investment Queensland, with whom the Institute has a deep relationship.

LimmaTech Biologics AG Chief Scientific Officer Dr Michael Kowarik said: "Antibiotic resistance and rising rates of gonorrhoea infections worldwide demonstrate the need for a gonococcal vaccine that can protect against potentially life-threatening variants. Antibodies against our antigens are functionally active in a variety of relevant assays, demonstrating promising vaccine efficacy."

"Our collaboration with Griffith University will enable us to develop a much-needed vaccination option to address gonorrhoea and to advance other new vaccines for rapidly evolving global challenges."



Translation case study

Researchers find Strep A's Achilles heel with potential vaccine to prevent rheumatic heart disease

A team of international scientists from the Institute for Glycomics and the University of Alberta have started human clinical trials for a Strep A vaccine they hope will induce long-lasting immunity against the deadly pathogen which kills more than 500,000 people each year.

As a leading cause of infection-related death worldwide, Strep affects people of different ages and socio-economic levels. Pathology due to Strep A include the relatively benign streptococcal tonsillitis and school sores, and the very serious conditions of rheumatic heart disease, necrotising fasciitis ('flesh eating disease'), toxic shock syndrome, and kidney disease.

The Institute's researchers identified two small molecules (epitopes) found on every Streptococcus A strain and combined them into a vaccine candidate designed to enhance the body's immune response against even the most virulent strain.

Lead researcher Professor Michael Good AO from the Institute for Glycomics said previous Streptococcal A vaccine research had been slowed by the enormous diversity of the pathogen, but that his vaccine design is based on presenting key epitopes to the immune system that represent its Achilles heel.

"This gives us a novel strategy to finally make a successful vaccine to protect against multiple Strep A strains,'' he said.

"There is currently no vaccine available and natural immunity to Strep A takes years to develop.

"This is because there are multiple strains and it is a highly virulent organism that subverts immunity."

Distinguished Professor Lorne Tyrrell OC and Nobel Laureate Sir Michael Houghton from the Li Ka Shing Applied Virology Institute at the University of Alberta, who are sponsoring the clinical testing, said streptococcal disease was a major cause of global morbidity and that amongst First Nations people in Canada, invasive streptococcal disease was a significant cause of premature mortality.

"Our Li Ka Shing Applied Virology Institute is dedicated to preventing major viral and bacterial infections where there is serious unmet medical need," Sir Michael said.

"Professor Michael Good holds an adjunct position at the University of Alberta and we are delighted to be helping him and our colleagues at Griffith University in working to curb this dangerous global epidemic which afflicts many Canadians, including indigenous peoples."

Dr Manisha Pandey from the Institute for Glycomics said repeated infections can also cause auto-immune complications such as rheumatic fever and rheumatic heart disease.

"In Australia, Aboriginal and Torres Strait Islander peoples suffer the highest rate of rheumatic heart disease in the world."

The trials are taking place at the University of Alberta, Canada, within the NACTRC clinical trials centre led by Dr Lawrence Richter and Dr Michael Hawkes, and commenced in late 2022.

If the trial is successful, the vaccine could be available for children and people at high risk of disease within five years.

Institute for Glycomics Director Professor Mark von Itzstein AO said he was delighted the Institute for Glycomics has developed this important vaccine candidate from discovery to human clinical trials, with the potential to save many lives.

"It's a great example of the Institute's translational output and what we hope will be the world's first vaccine to market for prevention of diseases caused by Strep infection."

Internationalisation

Global collaboration has been at the forefront of our Institute's mission since inception. It is essential to achieving our vision to bring forward novel drugs and vaccines to the community.

As highlighted throughout this report, we continue to collaborate with other leading research organisations and industry worldwide who share our commitment to fighting diseases of global impact.

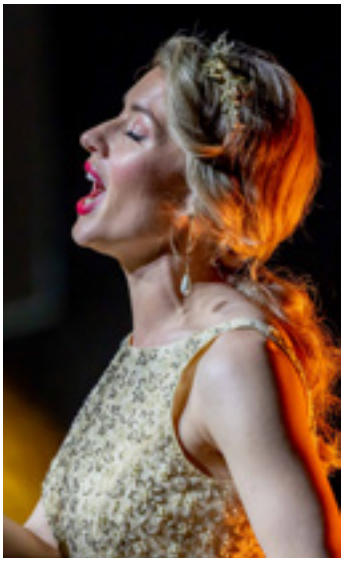
Our unique research expertise makes us the only institute of its kind in Australia and only one of a handful in the world. This is backed by a professional and flexible approach to collaboration that makes us an ideal partner for research and commercialisation.

Some examples of our international collaborative efforts include:

- **France** – investigating glycomics platforms to aid in vaccine development with industry partner Sanofi
- **Germany** – developing new solutions to respiratory disease through *i*CAIR®, the International Consortium for Anti-Infective Research, with partners Fraunhofer ITEM and the Hannover Medical School
- **Canada** – conducting a Phase 1 clinical trial on Professor Michael Good's Strep A vaccine candidate with clinical development partner the Li Ka Shing Institute
- **Switzerland** – co-developing a world-first vaccine for gonorrhoea with biotech partner Limmatech Biologics
- **USA** – identifying new therapeutics for neurodegenerative diseases with multinational industry partner Lilly
- **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
- **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
- **Tanzania** – developing new tools to investigate malaria infection in humans with partners at the Ifakara Health Institute
- **Japan** – understanding the glycomics of cancer with collaborative partners at Kumamoto University.

COMMUNITY ENGAGEMENT AND REMARKABLE SUPPORT






2022 Institute for Glycomics Grand Ball

The Institute for Glycomics Grand Ball is an annual black-tie event, held to celebrate the Institute's achievements and successes, and to raise much-needed funds for our ground-breaking research.

The 2022 Grand Ball was supported by Platinum Partner, Meriton Group; Gold Partner, Grand Medical; and Bronze Partners, FB Rice, Triple M Gold Coast and Griffith University.

More than 400 high-profile guests attending from the Gold Coast, Brisbane and surrounding areas, plus a number of interstate guests. The event was held on Saturday 6 August at RACV Royal Pines Resort on the Gold Coast, where guests enjoyed a delicious three-course meal, four-hour beverage package and live entertainment including performances by Opera Queensland, Griffith University's Young Conservatorium, Comedian Judith Lucy and local Gold Coast band McKenzie. There were exciting raffle prizes to be won, a live and silent auction and an exclusive after-party.

Guests mingled in the foyer prior to entering the ballroom and were treated to a polished performance by Griffith University's Young Conservatorium musicians which was the perfect accompaniment to a spectacular firework show overlooking the RACV Royal Pines Resort golf course.

Channel Nine Gold Coast News presenter, Eva Milic was the Master of Ceremonies and, coincidentally, was thrilled to win one of the luxury raffle prizes – an exquisite Pink Argyle Diamond pendant generously donated by Calleija Jewellers.

In a major highlight of the night, Eva had the pleasure of announcing a monumental $1 million donation from our valued supporters GC Value Pty Ltd.

Guests heard from Griffith University's Vice Chancellor, Professor Carolyn Evans and Institute for Glycomics Director, Professor Mark von Itzstein AO. Notable guests included Tom Derry AO, Chairman of the Australian Cancer Research Foundation (ACRF), and his wife Kristine. Sid Caitlin, Director of the Bourne Foundation was also in attendance.

Guests were treated to a stunning performance by Opera Queensland's Irena Lysiuk. Irena is a Queensland Conservatorium, Griffith University graduate and we were delighted to have her perform at our Grand Ball. Irena even inspired several guests to partake in a waltz as she performed her final act.

We would like to thank our wonderful community for supporting our biggest fundraising event of the year. We had many generous donations from the community in the form of raffle prizes and items which were auctioned on the night.

Funds raised from the raffle and auction, accompanied by the incredible $1 million donation given on the night, enabled us to raise an outstanding $1,181,000 which will go directly towards our research into finding new preventions and cures for debilitating childhood diseases.

Our focused research in these areas will lead to the discovery and development of new diagnostics, drugs and vaccines to combat such diseases, providing hope for the future of our children.

We would like to thank our sponsors, community partners, supporters, donors, colleagues and guests who all helped make our event a grand success.

Glycomics Week

The Institute for Glycomics celebrates Glycomics Week annually. This full week of events aims to:

- celebrate the Institute's growing significant research successes, and the impact this research has in the world of infectious diseases, cancer, neurological disorders, vaccine and drug discovery;
- acknowledge the invaluable assistance from the Institute's local, national and international friends, donors and supporters;
- continue to develop new engagements with local schools, companies and the community.

Glycomics Week encompasses both the **Glycomics Public Forum** and **Student Forum**. The Institute for Glycomics Grand Ball is also held during Glycomics Week every year, which is a fitting way to end a busy and exciting week of activities.

Glycomics Public Forum

As the name suggests, the Glycomics Public Forum is an annual forum held at the Institute for Glycomics which is open to the public to attend. The evening event includes a panel of experts from various fields that link back to the study of glycomics and its relevance to cancer and infectious diseases research.

Each year brings a new panel of experts discussing a new topic of conversation which has current relevance. The panel of experts' discussions are easy to understand, making this event suitable for anyone to attend, even if they do not come from a science background.

Guests are invited to ask the panel of experts questions and after the event enjoy some light canapes and refreshments, with the opportunity to meet the panel and our research scientists.

Our 2022 Public Forum attracted over 100 attendees who were treated to interviews and open question time with our four expert panellists on the topic *How does our immune system deal with infectious diseases and cancer?*

Professor Yvette van Kooyk and Professor Riccardo Dolcetti were joined by the Institute's very own Associate Professor Lara Herrero and Professor Michael Good. The Panel was interviewed by well-known ABC radio journalist Nicole Dyer.

The Panel answered many questions including:

1. How does immunotherapy work in cancer patients?
2. Is there a role for therapeutic cancer vaccines? Are they safe?

3. What are the outstanding questions in cancer-immunology?
4. Why is it talking so long to develop vaccines for malaria and streptococcus when COVID vaccines were developed in less than one year?
5. When you get a viral infection, what happens? What are the possible outcomes?

The Forum ended with drinks and canapes, and the opportunity for members of the public to meet with the panel members and our researchers.

The Peter Gallagher Memorial Glycomics Fellowship

In memory of Peter Gallagher, every year at the Glycomics Public Forum an internationally renowned researcher in the field of glycoscience is presented with the Peter Gallagher Memorial Glycomics Fellowship in recognition of their outstanding achievements in the field.

Peter Gallagher was a well-known personality of the Gold Coast community and the Australian Rugby League football fraternity. He was born in Townsville and first represented Queensland in rugby league at age 25 in 1962. He went on to represent Australia and captain the Kangaroos over the following decade. In retirement he was heavily involved in the Queensland Racing Industry. He was Vice Chairman of the Gold Coast Turf Club for ten years and then Chairman for a further five years. He was a driving force behind the Magic Millions Racing Carnival which is held annually on the Gold Coast.

Peter succumbed to cancer in 2004, aged 66. In February 2008, Gallagher was named in the list of Australia's 100 Greatest Players (1908–2007) which was commissioned by the NRL and ARL to celebrate the code's centenary year in Australia.

Peter Gallagher was a member of the Institute's Fundraising Taskforce for a number of years and was very enthusiastic in his support of the Institute and its research. When Peter passed away his family decided to set up the Peter Gallagher Memorial Fund to assist the Institute in its endeavours to combat debilitating diseases such as cancer, arthritis, diabetes and brain disorders as well as infectious diseases such as tuberculosis, rotavirus and avian influenza.

Our 2022 Peter Gallagher Memorial Glycomics Fellow and Glycomics Week international guest was Professor Yvette van Kooyk, Professor of Molecular Cell Biology and Immunology from Amsterdam UMC. Yvette gave the keynote address at our Student and Early Career Researcher Forum and was a panellist at our Public Forum. Yvette met with Institute staff and students and was very generous in sharing her knowledge and has forged many new collaborations.

Our second guest was Professor Riccardo Dolcetti, a clinician scientist with MD specialisations in Oncology and Clinical Immunology from the Peter MacCallum Cancer Centre in Victoria.

Glycomics Student Forum

The Glycomics Student Forum is an annual, student-organised event which provides our postgraduates with an opportunity to present their hard-earned research accomplishments to the wider Institute and community and hone their presentation skills in preparation for future conferences.

The Glycomics Student Forum additionally offers an ideal environment to learn about the efforts of our peers and welcome new faces, promoting growth of the Institute both professionally and socially.

Each year, we invite external suppliers/companies to sponsor this event and in return provide them with the opportunity to hold a Trade Display within the Institute for the duration of the day.

Our 2022 Student Forum was supported by 15 organisations who exhibited on the day. We had four PhD students and six Early Career Researchers give oral presentations and 13 students presented posters. Our judges, visiting international Professors Elisa Fadda and Subhash Vasudevan, remarked on the high quality of all presentations.

For a third year running, GO PINK month propels our breast cancer research to new heights

Breast cancer is one of the most common forms of cancer among women worldwide, with an estimated 2.1 million new cases diagnosed each year. In 2022, the Institute for Glycomics partnered with Sanctuary Cove Golf and Country Club for a third consecutive year, leading fundraising efforts throughout the month of October for breast cancer research.

The primary objective of this partnership is to raise funds for the Institute for Glycomics' research efforts in developing drugs, vaccines, personalised treatment, and early detection diagnostics for breast cancer. Additionally, the partnership aims to raise awareness of breast cancer and to educate the community on the importance of early detection and treatment.

Sanctuary Cove Golf and Country Club is a well-known and respected organisation in the community, known for their charitable efforts and commitment to making a positive impact on the lives of those affected by breast cancer. In an effort to further support this cause, 31 days of well-attended activities, events, golf clinics and pink promotional items were created to bring the community together in a collective effort to contribute to world-class breast cancer research happening right here on the Gold Coast.

Researchers at the Institute's Australian Cancer Research Foundation International Centre for Cancer Glycomics were provided an opportunity to attend various events throughout the month to share the research that they and their teams are undertaking. Engagement with our community is imperative to progressing our research and these events created a wonderful forum to answer questions from attendees and discuss some of our current research programs.

Over the past three years, the Sanctuary Cove Golf and Country Club has raised more than $150,000 for breast cancer research at the Institute for Glycomics. These funds have been used to support the Institute's research efforts in developing new drugs, vaccines, personalised treatment, and early detection diagnostics for breast cancer.

We are deeply grateful to Sanctuary Cove Golf and Country Club for their tireless fundraising efforts year on year, helping to propel our research forward as we move toward a cancer-free future for all.

Galloping for a cure: horse racing meets medical research in a race to save lives

Every season is racing season in the world of this powerhouse group known as Women in Racing and we are grateful for their long-term support as they celebrated their 17th year in existence.

The Women in Racing community, led by Directors and Institute for Glycomics Honorary Fellows Jennifer Bartels and Baslyn Beel, is known for its love of horse racing and commitment to making a positive impact on the world. One of the ways they do this is by supporting Equine Influenza, Hendra virus and other research and supporting women in research at the Institute for Glycomics.

Throughout the year, Women in Racing hosts a variety of events that provide plenty of opportunities for members of the community to don their fascinators and enjoy the thrill of horse racing. From millinery, bags and accessory stands, to live auction items and raffles, these events are always well-attended and sell out quickly.

The Women in Racing community doesn't just support horse racing for the fun of it. They also use these events to raise funds for the Institute for Glycomics, and their support has been instrumental in facilitating a $25,000 donation from the Victoria Racing Club via the Lexus Melbourne Cup Tour National Sweep.

"We are thrilled to be able to support the Institute for Glycomics in this way. Their work is vital in finding cures for diseases that affect so many people, and we are proud to be able to play a part in that," said Baslyn Beel

The Institute for Glycomics is renowned for its research in the field of cancer, infectious diseases, and neurological disorders. The funds raised by Women in Racing will go towards supporting their research efforts in developing new drugs, vaccines, personalised treatment, and early detection diagnostics for these diseases.

"We are incredibly grateful for the support of Women in Racing. Their contributions have been instrumental in helping us advance our research," said Institute for Glycomics Director, Professor Mark von Itzstein AO.

Women in Racing looks forward to continuing its support of the Institute for Glycomics and working towards a healthier future for all.

"We encourage everyone to 'Get up, get dressed and go racing – girls and guys' and, in doing so, help us make a difference in the fight against diseases of global impact," added Jennifer Bartels.

Raymond Swinburn James inducted as newest Honorary Fellow of the Institute

Raymond (Ray) Swinburn James, a philanthropic supporter and champion of Institute for Glycomics, has been inducted into the elite cohort of Honorary Fellows.

Ray has been a long-time supporter of the Institute for Glycomics, providing generous financial support to the Institute's research programs including the Malaria Vaccine Project. He has also been a vocal advocate for the importance of research at the Institute and the potential impact it can have on human health.

The Honorary Fellow award is a prestigious recognition given to individuals who have made a significant contribution to the Institute for Glycomics and its mission. Ray was honoured for his dedication to advancing the research and profile of the Institute and his commitment to improving human health. An intimate celebration was held for Ray amongst family, friends and members of the Institute for Glycomics.

In accepting the award, Ray said, "I am deeply honoured to be recognised as an Honorary Fellow of the Institute for Glycomics. The work being done at the Institute is crucial to our understanding of carbohydrates and their role in health and disease. I am proud to support this important research and look forward to seeing the impact it will have on human health in the future."

The Institute for Glycomics is grateful for Ray James' support and congratulates him on this well-deserved honour. His contributions have helped to advance research and specifically, the Malaria Vaccine Project, bringing us one step closer to a new vaccine with the potential to end malaria for good.

Ray is a true philanthropist, who understands the importance of supporting scientific research that can improve the lives of people around the world. His dedication to the Institute for Glycomics and its mission is an inspiration to us all, and we look forward to continuing to work with him in the future as our newest Honorary Fellow.

Empowering women in research: the Glycomics Circle paves the way for gender equality in science

The Glycomics Circle, a group of dedicated women at the Institute for Glycomics, is celebrating its 8th year of empowering women in research. This inspirational group, which pools its annual contributions together to provide scholarships, travel and conference support, early career researcher support, and publication support, has become a true lifeline for women in research, from career establishment to collaboration and leadership. Meeting quarterly, the Glycomics Circle connect with current and past support recipients, learning about their research and what the impact of their support means.

The Glycomics Circle was established eight years ago by The Honourable Leneen Forde AC with the goal of empowering women in the field of glycomics and promoting gender equality within the Institute for Glycomics. Over the years, the group has grown and expanded its reach, providing support for an increasing number of women at all stages of their careers.

This year, the Glycomics Circle has supported seven student scholarships, allowing women of all walks to pursue their studies and research without financial barriers. Travel support was also provided for an international student to attend the Institute and be mentored by some of the world's brightest minds in melanoma research.

In addition to providing financial support, the Glycomics Circle also serves as a community for women in the field, connecting them with one another by providing financial opportunities to attend conferences and events that promote collaboration and networking.

The Glycomics Circle is proud of the impact provided over the past eight years and is committed to continuing its mission of empowering women in research.

The Institute for Glycomics is grateful for the demonstrated impact that the Glycomics Circle has had over the past eight years and for the Circle's support of women in research. The Institute looks forward to continuing to work with the Glycomics Circle in the future and to see the transformation that their efforts will have on the lives and research progress of the next generation of female scientists.

The Glycomics Circle is a true inspiration to women in research and a shining example of how a small group of dedicated individuals can make a big difference, not just to research but also to the lives of women in research.

Community Bank Paradise Point backs world class research with support for the acquisition of a Flow Cytometer

Community Bank Paradise Point has been a proud, long-term supporter of the Institute for Glycomics across student scholarship support, COVID-19 research and the Institute for Glycomics Grand Ball. Building on our world-class research, Community Bank Paradise Point have committed philanthropic support to the purchase of a new flow cytometry instrument.

Flow cytometry is a powerful tool in medical research, capable of analysing the characteristics of cells and other particles in a sample. This technology is particularly useful for studying cancer and infectious diseases, as it can quickly and accurately identify cell populations that are abnormal or diseased.

The new flow cytometry facility, which will be launched in 2023, will become the central workhorse for the Institute's research teams across cancer and infectious diseases. The facility will enable researchers to analyse large numbers of cells quickly and accurately, providing valuable insights into the underlying causes of disease and potential new treatments.

Community Bank Paradise Point, through this generous support, will have a significant impact on the Institute's ability to advance discoveries and ultimately improve lives. Paradise Point Community Bank's focus on local impact is translated globally as we propel our research programs. This new flow cytometry facility is a testament to their commitment to community in supporting scientific research and discovery.

The Institute for Glycomics is grateful for the support of Community Bank Paradise Point and looks forward to the launch of the new flow cytometry facility in 2023. The Institute is confident that this new instrument will be a major asset for its research teams and will help to further advancements and discoveries.

Community Bank Paradise Point's philanthropic support of the Institute for Glycomics through the purchase of a new flow cytometry instrument is a sterling example of how community-based and focused organisations can make a global impact.

The Malaria Vaccine Project

There are six main species of malaria parasites that infect humans. Infection starts with the bite of an infected mosquito, injecting parasites that travel to the liver and reside there for a short period of time prior to emerging to infect red cells. The deadliest malaria species is *Plasmodium falciparum*, which is responsible for the deaths of approximately 627,000 people, mostly young children, each year. Pregnant women are also at significant risk as women lose the immunity they acquired as children when they become pregnant.

The Griffith University Malaria Vaccine Project aims to develop a vaccine that will reduce this suffering by inducing immunity that can effectively kill the malaria parasite stage found in the blood – it is this stage that is responsible for the pathology, morbidity and mortality of malaria.

The vaccine concept is novel and is based on a 'whole parasite' vaccine design, which results in a broad immune response that can target multiple strains of *P. falciparum*. All other vaccines currently in development that target the blood-stage of the parasite rely on a single protein from the parasite's surface as their basis. Unfortunately, these have all been unsuccessful as the stimulated immune response has been sub-optimal. Additionally, the parasite proteins included in the vaccine tend to vary substantially between different parasite strains which means the antibody response stimulated by the vaccine can only protect against a proportion of parasite strains. The whole parasite vaccine approach ensures all >5,000 proteins are included in the vaccine. Our Institute for Glycomics researchers have shown this vaccine approach can stimulate an immune response that offers broader protection against different malaria parasite strains and species.

Paddle to water: completing a solo paddle down the Murray to support the Malaria Vaccine Project

On 23 March 2022, Colin Welch, a member of the Rotary Club of Mermaid Beach, set out on a solo kayaking journey down the Murray River to raise funds to support the Malaria Vaccine Project at the Institute for Glycomics.

The journey was a gruelling one, spanning 2,350 kilometres and taking 49 days to complete. He met with many local Rotary Clubs along the way, all encouraging his success and helping in any way needed. Colin faced many challenges along the way, including weather conditions and equipment malfunctions, but he was determined to complete his journey and raise awareness and funds for the Malaria Vaccine Project.

Throughout his journey, Colin met many kind and generous people who helped him with repairs, shared meals, and provided the typical Aussie comradery. He camped on riverbanks for 33 nights, spent 8 nights in caravan park cabins, and 8 nights at the homes of friends who lived along the Murray River.

Despite the challenges, Colin persevered and successfully completed his journey, raising a total of $7,500 for the Malaria Vaccine Project.

Colin's journey was not only a physical one, but also a mental and emotional one. He said, "The most important thing is the adventure raised $7,500 for the Malaria Vaccine Project. I am so pleased to contribute to supporting the wonderful work done by Professor Michael Good AO, Dr Danielle Stanisic and the team".

The Malaria Vaccine Project is a vital research initiative that aims to develop a transportable form of the vaccine, which will be lifesaving for people living in remote areas and developing countries. The funds raised by Colin's journey will go straight to the laboratory bench, continuing the fight to end malaria for good.

The Institute for Glycomics and the Malaria Vaccine Project team would like to thank Colin for his dedication and commitment to raising funds and awareness for the project. His journey was a true testament to the power of one person and their ability to make a difference.

A celebration marking the Malaria Vaccine Project's 5th Anniversary

The Malaria Vaccine Project celebrated its fifth anniversary on 23 March 2022, with a major celebratory event held at Griffith University. More than 100 guests, including the Honourable Sir Peter Cosgrove, the Keynote Speaker, and Lady Cosgrove, attended the event at the Institute for Glycomics, where the project was launched on 27 March 2017.

The event was also connected with virtual attendees who were unable to attend in person. Vice Chancellor and President of Griffith University, Professor Carolyn Evans, Professor Michael Good AO, and Professor Emeritus Graham Jones AM, the Chairman of the Malaria Vaccine Project Committee, also gave speeches at the event.

During the event, Sir Peter Cosgrove reflected on the wonderful progress that had been made in the research during the intervening five years. Professor Good provided a roadmap for guests, outlining the path ahead for the research program and expressed his gratitude to Rotary and the Malaria Vaccine Project Committee for all the assistance across engagement and fundraising they have provided to the Research Program.

Guests also had the opportunity to view the research milestones achieved throughout the years listed in the program and took home a commemorative 5th Anniversary glasses-cleaning microfibre cloth.

In his closing speech, PDG Graham Jones AM, the Chairman of the Malaria Vaccine Project Committee, discussed the need for more funds to further progress important components of the research, including toxicology studies before clinical trials could begin on the new transportable form of the vaccine. To this end, he issued what he coined as 'Challenge 22' with the objective of raising $300,000 this year. Contributions from the event had seen the Project reach nearly a third of this challenge, with the matching support coming from Griffith University on the day.

Following the formal presentations, guests mingled in the courtyard of the Institute for light refreshments and a Fifth Birthday cake, ceremoniously cut simultaneously by Sir Peter Cosgrove, Professor Michael Good and PDG Graham Jones. The event was a great success and a testament to the hard work and dedication of the Malaria Vaccine Project team.

The Honourable Anna Bligh AC joins forces with Griffith University's Institute for Glycomics to fight malaria

Griffith University's Institute for Glycomics and Rotary are thrilled to announce The Honourable Anna Bligh AC will become the inaugural National Ambassador for its Malaria Vaccine Project.

Ms Bligh said malaria kills more than half a million people globally each year, and tragically, most of these deaths are young children.

"These statistics are both alarming and devastating. It's time we took more aggressive action to help solve this global issue," Ms Bligh said.

A team of scientists at the Institute for Glycomics, led by Professor Michael Good AO and Dr Danielle Stanisic, is developing a world-first 'whole parasite' blood-stage malaria vaccine which is currently in human clinical trials.

Principal Research Leader at the Institute for Glycomics Professor Good said: "The Griffith University Malaria Vaccine Project aims to develop a vaccine that induces immunity and effectively kills the malaria parasite stage that is found in the blood – it is this stage that is responsible for the pathology, morbidity and mortality of malaria.

"Our research has shown this unique vaccine approach can stimulate an immune response that offers broader protection against different malaria parasite strains and species, which is what makes it a novel vaccine design."

In 2015, Rotary District 9640 partnered with Griffith University with a desire to support the Malaria Vaccine Project.

Professor Emeritus Graham Jones AM formed the Griffith University Rotary Malaria Vaccine Project Committee with Mrs Sandra Doumany OAM and others from Australian Rotary clubs.

Chair of the Malaria Vaccine Project Committee Professor Emeritus Graham Jones said: "Since then, Rotary has helped Griffith University raise more than $2 million in funding to progress the vaccine through early clinical trials."

Griffith University Vice Chancellor and President Professor Carolyn Evans welcomed Ms Bligh to the passionate team of researchers and community members who are so dedicated to the fight against malaria.

"Thanks to unwavering community support, Institute for Glycomics researchers are now poised to commence a full Phase 1 study to assess vaccine safety and efficacy in human volunteers," Professor Evans said.

"We are one step closer to testing our malaria vaccine candidate in areas where it is needed most and, hopefully, one step closer to a future free from the disease."

Changing of the Guards: Professor Emeritus Graham Jones AM steps down as Malaria Vaccine Project Chair following five brilliant years

It was an evening of reflection and deep appreciation as we acknowledged and honoured outgoing Chair of the Malaria Vaccine Project Committee, PDG Graham Jones AM in an intimate celebration at the Institute for Glycomics on 6 December 2022.

There were many laughs and thought-provoking moments as we walked down memory lane, revisiting the inception of the project, the formation of the Committee, the aspirations of the research and the tremendous milestones achieved over the past five years. Some wonderful words were shared by Institute for Glycomics Director, Professor Mark von Itzstein AO, Vice President of Advancement, Mr Marcus Ward, Research Lead, Professor Michael Good AO, Graham himself, and lastly by incoming Chair, PDG Sandra Doumany OAM who delivered a special surprise message penned by Sir Peter Cosgrove.

Graham was inducted into the Malaria Vaccine Project Committee Lifetime membership and, while his fiery passion for the Project is still burning bright, he has agreed to step into the role of 'Roving Ambassador'. He has many places he'd like to visit, and we are sure he will enjoy some much-needed downtime while also projecting the message of the Malaria Vaccine Project globally.

A plaque of honour was unveiled in the Laboratory of Vaccines for the Developing World, acknowledging Graham's contribution and thought leadership in his position as Chair. This will serve as a prominent reminder to our research team, both current and new, that this great man has done great things. Graham will forever be a golden thread in this research project as he has been such a driving force throughout its history, which will continue to translate into the future as we move toward our goal to end malaria, for good.

Our Major Supporters and Honorary Fellows

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- Rotary Club of Murwillumbah
- Rotary Club of Hornsby
- Rotarians Against Malaria – PNG (Rod Seddon)
- Sanctuary Cove Golf a nd Country Club
- Charles Wang Family
- Community Bank Paradise Point, Branch of Bendigo Bank
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- Bourne Foundation
- Australian Lions Childhood Cancer Research Foundation
- Hay Family Benevolent Fund
- Rotarians Against Malaria – Australia
- Rotary International District 9640 – District Conference 2018
- Herb Elliott AC MBE
- Rob Deshon
- Ged Williams

Honorary Fellows

- Roma Blair
- Greg Dillon
- Mary Roosevelt
- Cr Dawn Crichlow OAM
- Jenny Wong, DUniv
- Warren von Bibra & Sally von Bibra
- The Hon Peter Beattie AC
- John Penglis
- James Wadham
- Dennis Standfield
- Bernard Ponting
- Lex Bell OAM
- Emeritus Professor Graham Jones AM
- The Hon Sam Doumany
- Beverly McIlwain
- The Hon Leneen Forde AC
- Harry Triguboff AO, DUniv & Rhonda Triguboff
- Baslyn Beel
- Jennifer Bartels
- Bob Gordon
- Lesley Woodford-Carr
- Charles Wang
- Raymond James

Community engagement case study

Streptococcus A vaccine and Streptococcus Toxic Shock Syndrome treatment on the horizon with support from The Snow Foundation

The Snow Foundation, established in 1991 to improve the lives of those experiencing disadvantage in the Canberra region and beyond, announced a second support term for a ground-breaking study on Streptococcus A and Strep Toxic Shock Syndrome (STSS) led by Professor Michael Good AO and his research team.

The Snow Foundation's focus is categorised into three areas:

- Health: Indigenous health, Ageing, Carers Disability
- Education Employment: Job pathways and education of social issues, and scholarships
- Social Welfare: Homelessness, domestic violence.

This research, under the direction of Professor Michael Good AO, which aligns with The Snow Foundation health pillar, aims to develop a vaccine for Streptococcus A, a bacterium that can cause severe invasive infections and STSS, a life-threatening condition, is of particular importance due to the high incidence rate of Streptococcus A infections in Indigenous populations worldwide.

This promising vaccine candidate entered human clinical trials in December 2022 in Canada, marking a significant step forward in the fight against Streptococcus A and STSS. The Snow Foundation's philanthropic support for this study highlights the critical role that private funding plays in advancing medical research and improving public health outcomes.

The Snow Foundation supports:

- Education and Employment: life skills, scholarships, awareness of social issues, employment
- Economic Justice and Safety: homelessness, domestic violence
- Health: Indigenous health, end-of-life care, addiction, disability, youth mental health prevention
- Philanthropy and For-purpose sector: capacity building and effectiveness

"Since 2011, we have been working with Aboriginal and Torres Strait Islander communities and other significant stakeholders and partners on rheumatic heart disease and crusted scabies to help bring an end to these preventable diseases that can lead to death. We are thrilled to partner with Professor Michael Good AO and Griffith University, to fund the development of a Streptococcal A vaccine. Putting an end to this preventable disease is not a simple task, but together, we are committed to advocating for the elimination of RHD. As a nation, we are a signatory to the World Health Assembly convention, to prevent and eliminate RHD by 2030."

We are so grateful for the support of The Snow Foundation and acknowledge their leadership, generosity and vision to bring this discovery forward, with the promising possibility to end Strep A and the many other diseases that are caused by it, in the near future for the Australian and global community.

SELECTED OUTSTANDING PUBLICATIONS

Van Den Bergh *et al.*

Drug Repurposing for Therapeutic Discovery against Human Metapneumovirus Infection

Antimicrob Agents Chemother **DOI:10.1128/aac.01008-22**

A drug normally used to prevent tissue rejection following organ transplants could be repurposed to help treat human metapneumovirus (HMPV) infection in children.

A team of Griffith University researchers, led by Dr Larissa Dirr, Dr Benjamin Bailly and Professor Mark von Itzstein AO from the Institute for Glycomics, has been testing an approved commercially available library of drugs to see which can inhibit HMPV, a common cause of pneumonia, in an *in vitro* cell model.

Dr Dirr said they tested the drugs to see if they blocked binding or replication of the virus and if they could be combined to achieve a stronger antiviral potency.

"Of these evaluated available drugs, we found five candidates with potent anti-HMPV activity and low cytotoxicity," she said.

"One of the drugs that shows strong antiviral activity is mycophenolic acid (MPA), an approved medicine that prevents tissue rejection following organ transplantation and is used for the treatment of certain autoimmune diseases.

"The anti-HMPV effect of MPA is caused by the depletion of guanosine, a nucleoside used in the synthesis of DNA and RNA."

Dr Bailly said HMPV is responsible for 10 to 12 per cent of paediatric hospitalisations and has a high mortality rate in immunocompromised people suffering from severe cases of pneumonia.

"To date, there is no approved drug or vaccine available on the market to treat these infections," he said.

"While our research is still at an early stage, if MPA proves to deliver promising results during our preclinical evaluation, then the process to get MPA on the market could be fast-tracked.

"The next step will be to test MPA in an *ex vivo* human airway epithelial model or an *in vivo* animal model.

"We're pleased with the results to date, particularly the required dose of MPA in the *in vitro* cell model is below the already approved human oral dose."

Director of the Institute for Glycomics and co-senior author on this paper, Professor Mark von Itzstein AO is delighted with the progress of this research.

"The repurposing of existing drugs presents a real opportunity to have useful drugs available to patients in a shorter amount of time," Professor von Itzstein said.

Manik *et al.*

Cyclic ADP ribose isomers: Production, chemical structures, and immune signaling

***Science* DOI:10.1126/science.adc8969**

Griffith University researchers have played a key role in investigating a new molecule that protects bacteria against viruses and is associated with bacterial infection of plants.

Dr Thomas Ve, a lead researcher at Griffith University's Institute for Glycomics and co-senior author on the new Science paper, said bacteria are on the watch for viral infections and have evolved a large repertoire of defence systems to protect themselves.

"Studying such defence systems have in the past led to powerful molecular tools that may one day be used for new treatments of diseases," Dr Ve said.

The aim of the study was to look at bacterial enzymes that cleave a ubiquitous nucleotide called NAD (nicotinamide adenine dinucleotide) and produce new signalling molecules.

"These signalling molecules take part in a virus defence system called Thoeris," Dr Ve said.

"Surprisingly, our research shows one of these molecules – called 3'cADPR – is not only an activator of the Thoeris defence system but is also associated with suppression of the immune system in plants."

The researchers used a suite of structural biology techniques such as nuclear magnetic resonance, cryo-electron microscopy and X-ray crystallography to reveal the chemical structures of these signalling molecules and how they are produced and function.

"We were able create three dimensional snapshots of how they are produced and how they activate the Thoeris defence system," Dr Ve said.

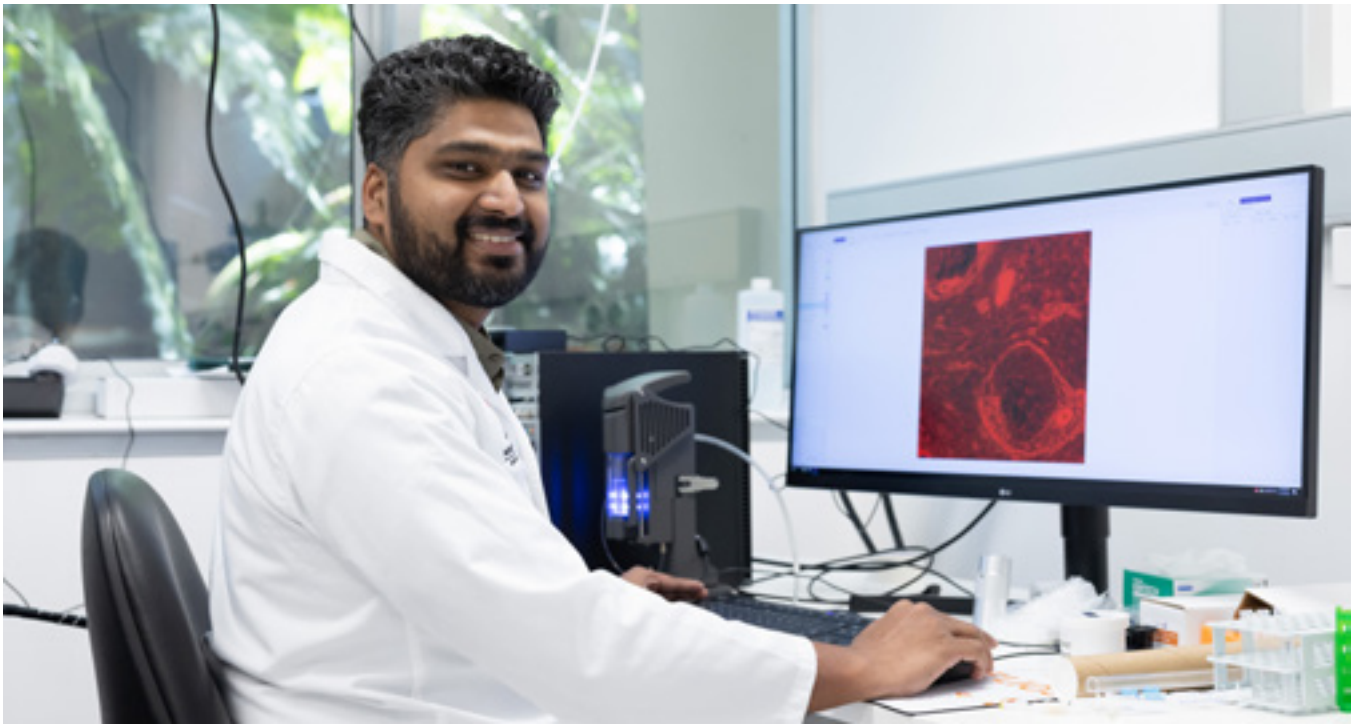
"Time will tell if this basic research leads to new technologies with the potential to treat or prevent diseases."

Institute Director, Professor Mark von Itzstein AO said this fundamental research brings substantial new insight to complex biology.

"This study published in the world-leading journal Science provides atomic level detail of an intricate biological process," Professor von Itzstein said.

"The study outcomes open up new areas of endeavour that could have significant biological impact."

Dr Ve's team worked in collaboration with the groups of Professor Bostjan Kobe at University of Queensland, Professors Aaron DiAntonio and Jeffrey Milbrandt at Washington University, St Louis, USA, Assistant Professor Ming Guo at University of Nebraska-Lincoln, USA, and Professor Murray Grant at the University of Warwick, UK.



Cumin *et al.*

Glycosphingolipids are mediators of cancer plasticity through independent signaling pathways

Cell Rep **DOI:10.1016/j.celrep.2022.111181**

The ability to identify unique sugars that decorate ovarian cancer cells could help prevent the spread of cancer and improve treatment options for women.

Research Scientist Dr Arun Everest-Dass from Griffith University's Institute for Glycomics has been studying the metastatic cascade of ovarian cancer cells, which is one of the major reasons for a high death rate.

"During this metastatic cascade, tumour cells undergo changes to their state and behaviour, a phenomenon referred to as cell plasticity," Dr Everest-Dass said.

"We used an advanced novel imaging technique available in the Institute for Glycomics to investigate the signalling pathways promoting this plasticity in the hopes of creating potential opportunities for the treatment of metastatic ovarian cancer.

"We identified unique sugars on the surface of the cell called 'glycolipids' which are involved in the spread of ovarian cancer.

"We found these sugar molecules may be potent therapeutic targets in the fight against the spread of ovarian cancer."

Institute for Glycomics Director and co-author on this study, Professor Mark von Itzstein AO, said the findings represent an important breakthrough in helping us advance our understanding of the progression of ovarian cancer and the identification of new targets for drug discovery.

"We have recently established the Australian Cancer Research Foundation International Centre for Cancer Glycomics in the Institute and this study exemplifies the breakthroughs that can be made to advance our knowledge of the progression of cancer," Professor von Itzstein said.

"Identifying the changes in the carbohydrate language in ovarian cancer cells provides us the real opportunity of identifying not yet explored drug discovery targets.

"Our newly established International Centre is unique in the world and will enable our researchers and collaborators to undertake some of the most advanced analyses of cancers that can be integrated with other data acquired from other techniques, for example, genomics studies.

"The integration of our data with other research studies is critical as it will truly provide us a more complete picture of what is going on in these cancers.

"This holistic approach has the prospect of opening many more new avenues for the discovery and development of new early-identification diagnostics and targeted therapies."

Ovarian cancer is the most lethal gynaecological malignancy worldwide with around 1400 new cases diagnosed each year in Australia.

The research was conducted at Griffith's Institute for Glycomics, University Hospital Basel and Hannover Medical School.

Brazel *et al.*

Dysregulation of Streptococcus pneumoniae zinc homeostasis breaks ampicillin resistance in a pneumonia infection model

Cell Rep **DOI:10.1016/j.celrep.2021.110202**

Institute for Glycomics researchers have been 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.

The team will 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.

Sexually transmitted disease gonorrhoea is caused by the bacterium *Neisseria gonorrhoeae* (Ng). Most gonococcal infections are asymptomatic and can lead to pelvic disease, infertility and increased risk of HIV co-transmission.

The recent emergence of multi-drug resistant superbugs means 'Ng' is now classified as an immediate public-health threat. No vaccine is available.

Led by Institute for Glycomics Director Professor Mark von Itzstein AO, the research team will build on their key discovery that 'Ng' is sensitive to zinc-binding compounds.

"Applying our extensive experience in the fields of drug discovery and Neisseria research, we aim to develop a novel class of antibiotics to treat gonorrhoea and other bacterial infections,'' Professor von Itzstein said.

Since the last entirely original class of antibiotics was discovered in the late 1980s, no new classes of antibacterial agents or drugs have been brought into medical use.

Professor Michael Jennings, Deputy Director of the Institute for Glycomics and a Chief Investigator on the grant, said that the World Health Organisation (WHO) estimated that there were 106 million cases of gonorrhoea worldwide annually.

"Since this disease was first treated with penicillin in the 1940s, this bacterium has become resistant over the decades to each successive class of antibiotics that have been developed.

"New antibiotics are now needed to treat the infections with multi-drug resistant strains that have emerged and are becoming more widespread," he said.

Professor von Itzstein said that their 'zinc-binder' drug candidate approach has found great use in tackling drug resistant *Streptococcus pneumoniae* and *Acinetobacter baumanni* infection, published recently in Cell Reports and mBio as part of collaborative research with University of Melbourne and University of Queensland.

"Building on our Institute's world-leading expertise in gonorrhoea research, this NHMRC grant will allow us to apply our zinc-binder drug discovery approach to drug resistant gonorrhoea infections and provides an exciting opportunity to develop a new solution for the treatment of a significant antibiotic-resistant infection, leading to commercialisation income for Australia," he said.

HIGHLIGHTS FROM OUR REMARKABLE RESEARCH LEADERS

A special welcome to Research Leader

Dr Santosh Rudrawar

Towards the close of 2022, we warmly welcomed Dr Santosh Rudrawar to our team of Research Leaders at the Institute for Glycomics.

Dr Rudrawar, a former Institute member and a Senior Lecturer in Griffith University's School of Pharmacy and Medical Sciences, has re-joined the Institute as a Research Leader.

Dr Rudrawar returned to Griffith University after being awarded an ARC Discovery Early Career Researcher Award and took up an academic appointment in the School of Pharmacy and Medical Sciences. He is an Organic Chemist, and his research focuses on medicinal and organic bimolecular chemistry in the context of neurodegenerative disease, cancer and antibiotic resistance.

Dr Rudrawar is a former ARC Discovery Early Career Researcher Award (DECRA) Fellow and has international standing in medicinal and pharmaceutical chemistry with extensive experience in drug discovery and development. He has developed expertise in synthetic organic chemistry, heterocyclic, carbohydrate and peptide chemistry whilst working in academia and pharmaceutical industry. He obtained his PhD in medicinal chemistry from National Institute of Pharmaceutical Education and Research (NIPER), India. He worked initially as a Postdoctoral Research Fellow at Institute for Glycomics, Griffith University and subsequently at the School of Chemistry, The University of Sydney.

Dr Rudrawar is currently Senior Lecturer and Program Director of the Bachelor of Pharmacology and Toxicology undergraduate program at School of Pharmacy and Medical Sciences, Griffith University and Research Leader at Institute for Glycomics, Griffith University.

Dr Rudrawar and his research group's focus:

The primary focus of Dr Rudrawar and his team will be on using the power of organic medicinal chemistry to address problems of medical significance. Dr Rudrawar has established internationally competitive research programs in cancer, neurodegeneration and bacterial infection (specifically bacterial resistance to antibiotics) and his research is providing a new perspective for basic research and new ideas for clinical treatment to both within Australia and internationally.

Taking inspiration from nature, the group developed first generation inhibitors of the O-GlcNAc transferase (OGT) enzyme – as bi-substrate analogues. The research group also developed novel bimodal glycopeptides derived from the alpha-synuclein sequence and identified novel small molecules which significantly inhibited alpha-synuclein aggregation. The Rudrawar group identified bioactive, structurally simplified muraymycin analogues acting against a range of clinically relevant bacterial pathogens.

Principal Research Leaders

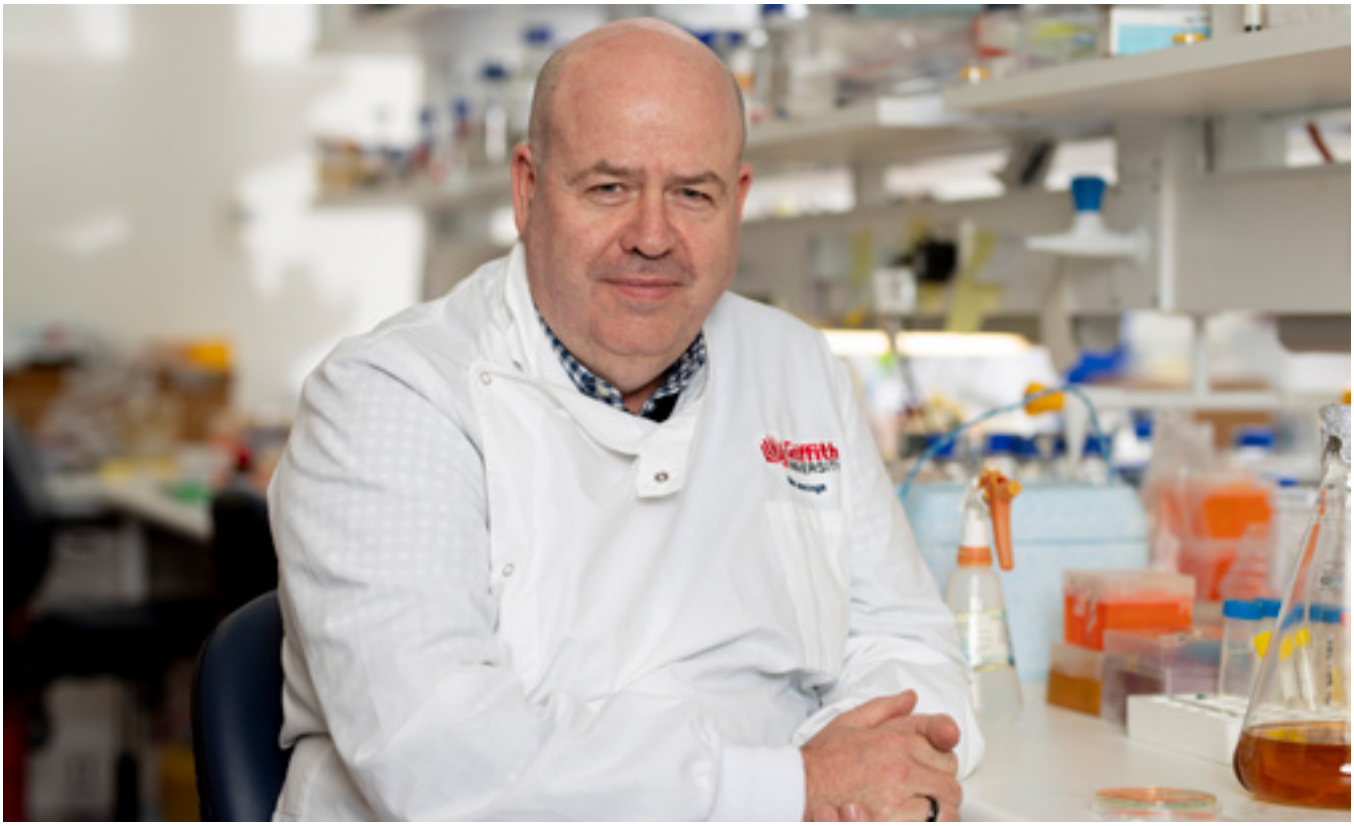
Professor Mark von Itzstein AO

The von Itzstein group undertakes interdisciplinary research towards the development of novel therapeutic agents, and investigation of the interactions of carbohydrates in both health and disease. Major research efforts of the group in the area of drug discovery – incorporating structure-informed design, synthetic chemistry, virology, and biology – are focused on viruses, in particular respiratory viruses, drug-resistant bacteria, and cancer.

Human parainfluenza viruses (hPIV) types 1 and 3 produce a broad spectrum of respiratory disease in the human population including in children, the elderly, and immune-system weakened individuals such as cancer patients on chemotherapy and transplant patients. The group has continued their research program on the development of drug candidates to treat and prevent hPIV infection, in partnership with Grand Medical Pty Ltd. In 2022, new compounds were identified that successfully inhibit replication of the virus through blocking the functions of a key viral protein, and which are now undergoing selection for further preclinical development.

Human metapneumovirus (HMPV) is as an important cause of pneumonia in infants, the elderly, and in immunocompromised individuals. In work towards identifying inhibitors of HMPV, led by Dr Larissa Dirr and Dr Patrice Guillon, a medium-throughput screening assay was developed, then used to screen a library of ~2,400 approved drugs for their effect on HMPV. This led to the identification of novel anti-HMPV drug candidates and provided promising new templates for anti-HMPV drug design (Van Den Bergh *et al., 2022, Antimicrob Agents Chemother*).

Towards development of new and alternative antimicrobial therapies, the von Itzstein group is studying a class of molecules know as ionophores – organic compounds that can complex biologically important metal ions. These compounds can disrupt or dis-regulate aspects of metal use or metal homeostasis in a microorganism. Studies reported in 2022 investigated the effects of the safe-for-human-use, zinc transporting ionophore PBT2. A study with Professor Michael Jennings and Dr Freda Jen at the Institute for Glycomics showed that Gram-negative *Neisseria* species were sensitive to killing by PBT2 alone (Jen *et al., 2022, Antimicrob Agents Chemother*). Studies in collaboration with the groups of Professor Mark Walker (Uni Queensland) and Professor Christopher McDevitt (Uni Adelaide, Uni Melbourne), showed that treatment with PBT2+zinc leads to renewed sensitivity to antibiotics in certain Gram-negative (De Oliveira *et al., 2022, mBio*) and Gram-positive (Brazel *et al., 2022, Cell Rep*; De Oliveira *et al., 2022, Antibiotics*) bacteria, both in cell studies and *in vivo* models of infection.



Professor Michael Jennings

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 2022 the Jennings group had major outcomes in two areas. Over several years our research group, in collaboration with Prof Kate Seib, have been developing technologies for vaccine to protect against multidrug resistant Neisseria gonorrhoeae infection. In a major commercial deal the Institute licensed these technologies to the Swiss Biotech company Limmatech. The new vaccine is being jointly developed in collaborative research program between Limmatech, the Seib and Jennings labs.

The Jennings lab, in collaboration with Dr Lucy Shewell, Dr Christopher Day and Assoc Prof Daniel Kolorich, has a research program on cancer diagnosis. This project is based a technology that we have developed to detect a cancer specific sugar called Neu5Gc. We have previously demonstrated that this sugar can be detected in all stages of ovarian cancer. In 2022 we published a study in BMC Cancer (https://pubmed.ncbi.nlm.nih.gov/35346112/) demonstrating that our technology can also detect Neu5Gc in patient blood at all stages of breast cancer. This exciting finding indicates that the Neu5Gc biomarker may be useful in diagnosis and screening in other cancers, and our lab was awarded a 3 year grant from the Bourne Foundation to investigate this marker in prostate cancer.

Professor Michael Good AO

2022 was an important year for the Good lab with major research achievements and significant promotions for staff members. The Strep A and Malaria Team Leaders, Manisha Pandey and Danielle Stanisic, respectively, have their own reports as they are now Research Leaders at the Institute, so I will only mention some of the highlights in this report. I congratulate both Manisha and Danielle on their leadership and celebrate their promotions (both to Associate Professor).

We commenced our Phase 1 vaccine trial for Strep A in partnership with our colleagues at the University of Alberta (Distinguished Professor Lorne Tyrrell and Nobel Laureate Sir Michael Houghton). I wish to acknowledge the tremendous effort of our Strep A Team as well as the University's General Manager, Dr Chris Davis and his team. This trial, which is underway, is testing Griffith's patented candidate Strep A vaccines ('J8', 'P*17', and 'K4S2') for safety and immunogenicity. Success in this trial will lead to an efficacy trial whereby vaccinees will be given a deliberate streptococcal infection to ask whether the vaccine can protect against a deliberate infection.

2022 also saw another major milestone as, with the great help of the Griffith University-Rotary Malaria Vaccine Committee, and key donors, we secured sufficient funds to commence our 'whole parasite' blood stage malaria vaccine trial. The first step will be to undertake formal toxicological assessment of the vaccine, and planning for that is currently well underway. Following that, a Phase 1 trial of volunteers is planned to assess safety and immunogenicity. Success there will likely lead to a follow-up trial in an endemic country where we have research collaborators, such as Uganda or Papua New Guinea.

As mentioned, planning for the malaria vaccine trial has been made possible by the enormous hard work of the Rotary Committee under the Chairmanship of Professor Emeritus Graham Jones AM. The Committee has raised or leveraged in excess of $2M. At the end of 2022, Graham signalled his intention to retire from the Committee and I wish to thank him most sincerely for his leadership, wise counsel and hard work over 7 years. Sandra Doumany OAM, an inaugural member of the Committee, has stepped into the role of Chair and I thank her too for all the hard work she has put in and for her willingness to take on this very important role. I also wish to thank the many individuals who have made significant donations to our vaccine research. It is always humbling when the public put their trust in us in this significant venture.

Professor Carolyn Mountford

Principal Research Leader Professor Carolyn Mountford MSc DPhil (University of Oxford) MS (Harvard University) was awarded full Professor of Radiology at Harvard Medical School in 2011. She and her team are world leaders in the development of magnetic resonance (MR) technology to address unmet clinical needs. Her translational research includes mental health, pain and women's health in the cancer field centres on MR technology.

The multidisciplinary team includes surgeons Professors Malycha, Bennett, Perrin and Wood; Radiologists Professors Santamaria and Jeavons; Mental health specialists Professors Crompton and Young; and bioinformatician and engineer Professor Irvine.

The Mountford research team uses clinical 3T scanners to monitotr 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-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, regulation of the nervous system development and neuronal processes.

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

Elucidating the precise carbohydrate chemistry that is underlying these conditions is integral to future clinical management and a new and important challenge in medicine.

Professor Mountford and her team have been a worldwide development site for Siemens since 1999. Glycomics has a research agreement with the company DatChem of which Mountford and Malycha are Founders. DatChem is a "Company in Residence at Griffith" providing a new and exciting model for Australian commercialisation.

In 2022, a new assignment, a Fuc-α(1–6) glycan was possible due to a collaboration with Professor Thomas Haselhorst. This glycan is affected in artillerymen post active firing exercises. Elucidating the precise carbohydrate chemistry that is underlying these conditions is integral to future clinical management with the long term goal of prophylactic treatment to prevent the acute phase transitioning to the chronic phase which is considered to be irreversible.

Professor Nicolle Packer

Professor Packer is a Principal Research Leader at the Institute for Glycomics and continues to work primarily with Associate Professor Daniel Kolarich and Dr Arun Everest-Dass and their teams.

The now well-established Advanced Mass Spectrometry Facility, which she helped establish, continues to provide researchers with state-of-the-art mass spectrometry instruments and expertise, benefitting postgraduate students, international interns and collaborators to the Facility primarily in the research area of the role of glycans in cancer, immunotherapy and infectious diseases. In 2022 as part of the successful ACRF funded International Centre for Cancer Glycomics (ACRF I2CG) this capability was substantially expanded with the purchase and installation of two new state-of-the-art mass spectrometers (Orbitrap Eclipse Tribrid MS and Hyperion Imaging Mass CyTOF) in the Facility.

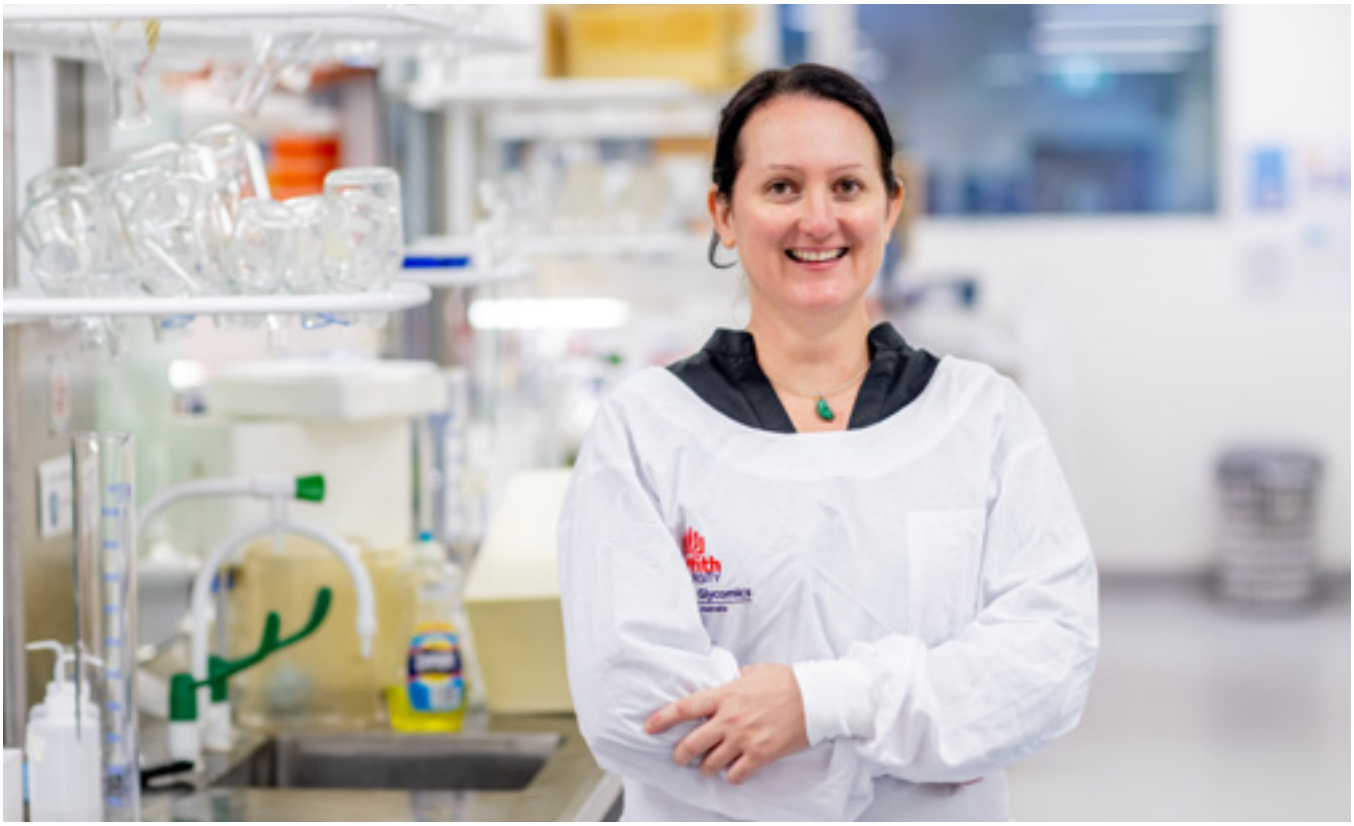
Professor Packer's and the Institute's previous collaboration with Dr Christina Bursill (SAHMRI Adelaide) in the ARC Centre for Nanoscale BioPhotonics (CNBP) has resulted in new funding from the Medical Research Future Fund (MRFF) scheme in which Professor Packer and Dr Arun Everest-Dass are Chief Investigators (CIC and CIE respectively). The MRFF Cardiovascular Health Mission grant on a 3 year project entitled *The Asialoglycoprotein Receptor 1 (ASGR1): a novel target for atherosclerosis* was funded for $999,989 headed by Dr Bursill as CIA at the University of Adelaide with a 2 year postdoctoral position created at the Institute for Glycomics.

In November 2022, the 4th AustralAsian Glycoscience Symposium was held on the Gold Coast with the Welcome and Opening Keynote session being held at the Institute for Glycomics before the next 3 days of the symposium at the Seaworld Resort. Packer was a member of the organising committee of the symposium, which was judged a great success by a survey circulated after the event. The meeting attracted over 140 national and international delegates from 16 countries and 13 companies exhibited their products. It was terrific to have our first face to face with colleagues from around Australia, Asia and the US on the Gold Coast.

The Australian Glycoscience Society (AGS) (ozglyco.org) was officially inaugurated at the AGS Symposium in November 2022. Packer was on the founding committee and was elected at the AGS symposium as an Ordinary Member of the first AGS Board. The Society will be instrumental in raising the profile of Australian glycoscience both nationally and internationally.

Packer publications affiliated with the Institute for Glycomics in 2022 include:

- Omenn GS, *et al*. The 2022 Report on the Human Proteome from the HUPO Human Proteome Project. *J Proteome Res*.
- Ghanimi Fard M, *et al*. Targeting cell surface glycans with lectin-coated fluorescent nanodiamonds. *Nanoscale Advances*
- Sumer-Bayraktar Z, *et al*. Membrane glycome is impacted by the cell culturing mode of neuroblastoma cells with differing migration and invasion potential. *Glycobiology*



Professor Kate Seib

Professor Kate Seib's research group focuses on discovery and development of drug and vaccine candidates for bacterial pathogens such as *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).

Key aspects of current research by the Seib group includes the pre-clinical characterisation and clinical evaluation of gonococcal vaccine candidates, as well as the use of mathematical modelling to assess the potential impact of different vaccines and vaccine implementation strategies on gonococcal prevalence. Research in the Seib lab is significantly contributing to disease prevention and is performed by highly talented postdoctoral researchers Dr Semchenko, Dr Taha, Dr Eskandari, Dr Padeniya, and PhD students Xiaofan Chen, Valentin Slesarenko and Dr Caroline Thng.

Highlights for the Seib group in 2022 include:

- A National Health and Medical Research Council (NHMRC) Leadership Level 2 Investigator Grant awarded to Professor Seib, entitled *A comprehensive vaccine-based strategy to combat gonorrhoea*.
- An Australian Research Council (ARC) Discovery Project Grant awarded to Professors Seib and Jennings, entitled *Decoding Bacterial Epigenetic Regulation*.
- A NHMRC Postgraduate Scholarship was awarded to Dr Caroline Thng to undertake a PhD entitled *Investigating novel prevention and treatment strategies for gonococcal control* with Professors Seib and Jennings.
- Research led by Professors Seib and Jennings resulted in the development of a suite of vaccine technologies for the prevention of gonorrhoea, and Griffith University signed an exclusive licence and co-development agreement with LimmaTech Biologics to co-develop and commercialise the gonococcal vaccine candidate.
- Professor Seib was an invited Plenary speaker at the International Union of Sexually Transmitted Infections (IUSTI) conference in Zimbabwe, and at the International Pathogenic Neisseria Conference (IPNC) in South Africa.
- Professor Seib contributed to the ongoing WHO global research priority setting exercise for sexually transmitted infections (STIs), and the development of the WHO Vaccine Value Profile for Gonococcal Vaccines.
- The Seib Group was awarded the 2022 Glycomics Research Excellence Award for 'Excellence of a Research Team'.
- Dr Semchenko presented his work on gonococcal vaccine development and gonococcal-host glycan interactions at conferences including IPNC, the *Neisseria gonorrhoeae* Research Society and 2022 Joint Australasian HIV & AIDS and Sexual Health Conferences.
- Dr Eskandari presented her work on vaccine induced immune responses at the Australia Society for Microbiology (ASM) National Conference.
- Dr Taha was elected to the Committee of the QLD Branch of the ASM.
- Amber Chen was an Institute for Glycomics' finalist for the 3-Minute Thesis (3MT) competition.
- Valentin Slesarenko was awarded an ASM summer vacation scholarship.

Research Leaders

Professor Johnson Mak

In 2022, the Mak lab said farewell to Ms Johana Luhur who moved back to Sydney to pursue her PhD training at the University of New South Wales, and they welcomed Mr Erwan Bremaud (France) who has joined the Mak lab to work on the virological synapses of HIV as part of his PhD training. Prior to joining the Mak lab in Australia, Mr Bremaud has already collaborated with the Institute for Glycomics as part of his Master's training under the guidance of Dr Cyril Favard at Montpellier Infectious Disease Research Institute in France. Mr Bremaud uses biophysical tools, such as fluorescence correlation spectroscopy, to demonstrate how HIV proteins navigate the heterogenous membrane terrain to gather (and to arrange) with other viral components to build an infectious progeny virus. Mr Bremaud's co-first author publication (from his MSc work in France) was accepted in *Biophysical* Journal at the end of 2022.

The Mak lab reported the mechanism of HIV synapses formation in prestigious journal *JACS Au* in 2022. HIV synapses enable cell-cell transmission to overcome anti-retroviral therapeutics and broadly neutralising antibodies. The Mak lab will evaluate the potential of interfering with the process of HIV synapse formation for the identification of novel therapeutics to eliminate HIV latently infected cells, thereby accelerating the goal of HIV eradication. In collaboration with Professor Alan Wee-Chung Liew (Griffith School of Information and Communication Technology), cross-disciplinary approach involving molecular virology, cell biology, and machine learning will be used to accelerate this discovery for its application at the clinic. A Mak lab led 4 year NHMRC Idea grant has been awarded to this team in 2022 for the work to be carried out in 2023.

In February 2022, the Mak lab published a study in high impact journal *Cell Reports* describing the first example of virus using a specific pair of non-electrostatic sugar molecules to virus facilitate attachment, thereby making them more readily infect target cells. Building from this paradigm-shifting discovery, the Mak lab is currently testing whether this mechanism is also being leveraged by different vaginal microbes to interact with HIV, such as 'non-invasive vaginal microbes' to soak up HIV to reduce HIV transmission or 'invasive vaginal microbes' to act as hitchhiking vehicles to enhance HIV transmissions.

In the context of HIV transmission, HIV must penetrate the highly organised mucosal surface of the female reproductive tract to engage with vulnerable immune cells that sit under the layers of skin (epithelial) cells. In collaboration with the Jennings lab (Dr Chris Day and Professor Michael Jennings), the Mak lab (Dr Belinda de Villiers and Professor Mak) has contributed to a 2022 *mBio* paper showing how HIV is able to interact specifically with a cervical epithelial cell's enriched human protein known as complement receptor 3 (CR3). Using patient derived surgical cervical tissue, this work provides evidence that human CR3 is likely to be involved in the sexual transmission of HIV.

The Mak lab has contributed to a University of Strasbourg led study published in *RNA Biology* illustrating the interplay between HIV RNA and protein that are critical to generate infectious virus particles.

Professor Victoria Korolik

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 resides 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 2022 highlighted by an article in *Microbiology Spectrum*.

Professor Joe Tiralongo

The current 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 2022, 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 2023. In addition, they 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 2021, the Tiralongo group's growing reputation in the emerging field of glyconanotechnology was further highlighted by a recent publication in *Biosensors and Bioelectronics* and *Nanoscale Advances*, two leading journals in the field. These studies highlight the potential of their glyconano approaches for the development of innovative biosensing technologies.

Additional highlights in 2022 included the completion of a PhD candidate (Dr Oren Cooper) who was subsequently awarded the 2022 Glycomics Directors Medal (supervised by Professor Tiralongo), best poster (Danielle Lee) and best oral presentation (Dr Oren Cooper) at the 4th AGS Conference, QLD representative in the National Falling Walls Lab 2022 Final (Danielle Lee) and the commencement of a PhD and Master's candidate.

Associate Professor Daniel Kolarich

The aim of the research efforts in the Kolarich Group is to elucidate the cell-level carbohydrate language – the glyco-code – in health and disease. Deciphering the glyco-code enables the advancement and translation of this knowledge into novel discoveries that lead to the development of novel diagnostics and therapies. For this purpose, major efforts are being undertaken in the development and validation of novel, out-of-the-box technologies and methodologies that make the glyco-code accessible and interpretable, to uncover its role and relevance in cell function, health and disease pathogenesis.

The Kolarich group collaborates with multiple national and international partners to decipher the glyco-code in cancer, immunotherapy and infectious diseases, but has also been leading the area of phyloglycomics (the science of understanding the evolutionary development of glycosylation across the difference species). This knowledge will help us to better understand, for example, how different viruses can cross species borders and become zoonotic pathogens that jump from animals to other species, e.g., humans.

2022 was an exciting year for the Kolarich group. Highlights include:

- As part of the Australian Cancer Research Foundation International Centre for Cancer Glycomics (ACRF I2CG), two new state-of-the-art mass spectrometers have been installed and are now operational (Orbitrap Eclipse Tribrid MS and Hyperion Imaging Mass CyTOF). The Kolarich group and other groups within the institute are excited about the novel possibilities these instruments provide to understand the glyco-code in health and disease.
- The Kolarich group has been successful in securing over $880,000 funding from the NHMRC for an Ideas grant project that will provide vulnerable patients such as cystic fibrosis patients or lung transplant patients that suffer from *Pseudomonas aeruginosa* infection with better diagnosis opportunities that will accelerate that they receive the best treatment. This project is done in close collaboration with the team around Dr Timothy Wells (University of Queensland).
- In November 2022, the 4th AustralAsian Glycoscience Symposium was held at the Gold Coast in QLD, which welcomed over 140 national and international delegates from 16 countries as well as 13 exhibitors to the Gold Coast. This symposium, chaired and organised by a team around Daniel Kolarich and Nicholas Scott (University of

Melbourne), was the first symposium of the Australian Glycoscience Society (AGS). After in-person conferences were mostly impossible in the wake of the COVID pandemic, this was the first opportunity in a long time for glycoscientists to meet and discuss the latest outcomes in person.

- In November, Associate Professor Kolarich was elected as the Vice President of the Australian Glycoscience Society. He was part of a team of dedicated colleagues from institutions across Australia that have been working behind the scenes to formally establish the AGS (ozglyco.org). The mission of the AGS is to advance the glycosciences in Australia and be an ambassador for Australian glycosciences across the world.
- The Kolarich group welcomed visiting students from Europe as well as new master's students that are doing exciting work deciphering the glyco-code in blood products and stem cells.

Associate Professor Todd Houston

The past year marked important milestones in our group as Taylor Garget was awarded his PhD degree for thesis work entitled *Novel methods for identifying and targeting cell-surface carbohydrates associated with disease* and he published two journal articles (*Tetrahedron Letters, Arkivoc*) and a book chapter.

Peter Sunde-Brown submitted his thesis for examination in December entitled *Synthesis of thiolactulose and 1-deoxymannojirimycin from D-fructose using the Mitsunobu Reaction*. He also published two journal articles in *Tetrahedron* and *Journal of Organic Chemistry*, each of which has already generated significant interest online.

Both young researchers should be commended for their hard work and perseverance through trying times of the pandemic. Their discoveries in the lab will continue to support further research efforts into fluorescent detection of disease-related carbohydrates and identification of more potent glycosidase inhibitors as potential drugs.

In addition, we have published a review article in the *European Journal of Medicinal Chemistry* that proposes a model to improve glycosidase inhibitor potency, and we are executing this strategy currently.

Associate Professor Thomas Haselhorst

Within the first few weeks of 2022, Dr Christopher Day and Associate Professor Thomas Haselhorst were busy setting up an ARC Discovery Project grant and Dr Oren Cooper was appointed in March 2022 as Postdoctoral Research Associate to work on this project. The main aim of this project is to engineer a novel agricultural prebiotic supplement to disrupt essential glycan-glycan interactions to overcome colonisation of *Campylobacter jejuni* in poultry. Over the remaining 10 months of 2022, Dr Cooper has collected some exciting *in-vitro* and *in-silico* data and the group are preparing results for publication in 2023. Dr Cooper also presented his first oral lecture at an international conference (4th Australasian Glycoscience Symposium & 9th Warren Workshop) and was awarded Runner-up (2nd place) for the best oral presentation in the Early Career Research category.

In 2022, the Haselhorst group welcomed Jacinta Martin as a master's student from the School of Nursing and Midwifery. Jacinta has a strong bioscience background and will work alongside Dr Cooper and Dr Day on *Campylobacter jejuni* adherence assays. The group hopes Jacinta will stay beyond her Master's degree and continue her research as a PhD candidate in 2023. A new Honours student, Joseph Parr, enrolled in 2022 and is jointly supervised by Associate Professor Haselhorst and Associate Professor Yun Feng (Griffith Institute for Drug Discovery, GRIDD). Joseph is interested in natural product isolation and NMR spectroscopy and will commence his studies in 2023.

Danielle Lee, PhD candidate in the Haselhorst group had a very successful year. Danielle was able to prove that three discovered antifungal compounds act exactly as *in-silico* binding data has suggested. Compounds will be tested *in-vivo* in 2023 at Medical School Hannover during Professor Tiralongo's sabbatical and a patent application is In preparation. Danielle's 3 Minute Thesis (3MT) success from 2021 (Institute for Glycomics winner, and Griffith University 3MT Finalist) resulted in her attending the Falling Walls Lab competition in Brisbane with contestants from QLD, NT and WA. Danielle was awarded second best contestant in Queensland and was able to present at the national (online) round in Canberra. Danielle participated as one of top 10 contestants in Australia. At the end of 2022, Danielle presented her first oral lecture at an international conference (4th Australasian Glycoscience Symposium & 9th Warren

Workshop) and was awarded Runner-up (2nd place) for the best oral presentation in the student category.

PhD candidate, Shane Prenzler has worked hard in his final year developing novel Siglec-1 inhibitors and he is preparing results for his thesis and publication.

The Haselhorst group published 5 articles in 2022 and a highlight was Dr Cooper's ground-breaking research article in *Nanoscale Advances* (jointly with the Tiralongo group), showing that the linkage preference of Siglec-1 for α(2,3)-linked sialic acid can be altered by increasing the multivalency of sialic acid ligands present on nanoparticles (carbon dots). This is the first time that a high glycan concentration directly affects linkage specificity and our glycoengineered carbon dots represent a novel high affinity molecular probe with multiple applications in sialoglycoscience and medicine.

Associate Professor Haselhorst continued his strong 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 Dr Rudrawar from the Institute for Glycomics, 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.

Associate Professor Haselhorst was heavily involved in organising the Australian-German Science and Innovation Day with ~100 attendees from academia, government and industry that was held at the BMW Design Academy at QUT. Associate Professor Haselhorst was speaker and panel member, discussing recent success in securing funding from Universities Australia and German Academic Exchange Service (DAAD). Associate Professor Haselhorst also continued his role as assessor for the National Health and Medical Research Council (NHMRC), as research ambassador for the German Academic Exchange Service (DAAD) and as QLD representative of the Australian Association of Alexander von Humboldt Fellows. Editorial board member duties also continued for Scientific Reports (Nature Publishing Group) and Magazine of the Australian and New Zealand Society for Magnetic Resonance (Industry section). Associate Professor Haselhorst was appointed to the editorial board for Frontiers in Molecular Biosciences (Glycoscience section).

In November 2022, Associate Professor Haselhorst was selected as assessor and referee for the MSCA4Ukraine initiative in partnership with the European Union and the Alexander von Humboldt Foundation. The MSCA4Ukraine scholarship supports high-profile researchers and scientists who have fled the Ukraine and are unable to conduct research at their Ukrainian home universities and institutes, strengthening Ukrainian universities and research institutions and their cooperation and exchange with the international research community with total funds of €25 million. Selection of candidates will commence in 2023.

Associate Professor Lara Herrero

In 2022, the Herrero group continued the focus on public health and community. Associate Professor Herrero continued be a community leader in disseminating scientifically accurate information. To that end she has continued to shape public perception about viruses and the diseases they cause by being a frequently requested expert on local/national radio, TV and newspapers, including increasing public awareness on the importance of public health actions and vaccines. In 2022, Associate Professor Herrero continued to be Griffith's most read author for *The Conversation* with an additional seven articles written. The Herrero group published a further five peer-reviewed scientific articles.

The Herrero Lab graduated two PhD students and welcomed a further two students into the group with PhD student Tracy Koo and MD research student Chloe Scott. The lab also welcomed flavivirus researcher Wesley Freppel and experienced research assistant Mei Fong Ho, both who provide critical skills in virology and infectious diseases research.

Associate Professor Herrero was the convenor for Australasia Virology Society (AVS) 2022 conference, held on the Gold Coast in December 2022. AVS serves as the premier virology event in the Asia-Pacific which aims to promote collaboration and the careers of our regions early career scientists. The conference was an outstanding success with over 300 attendees from all over the world.

Associate Professor Milton Kiefel

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 environmental sustainability.

In 2022, the Kiefel group continued to explore the synthesis of a new class of natural products with anticancer activity, and this resulted in some exciting preliminary data using cell-based assays. The PhD student completing these studies is nearing the end of their PhD project, but the results they have found will form the basis of continued studies in this area. In collaboration with Dr Freda Jen, we have expanded our studies into the synthesis of building blocks for the development of antibacterial vaccines, and now have a PhD student working on this project. The Kiefel group continues to be interested in developing novel compounds with potential antibacterial activity.

The Kiefel group has also continued exploring the development of molecules that have the ability to "switch" between two states when exposed to specific wavelengths of light, and this has resulted in the discovery of compounds with unique fluorescent emissive properties that have potential application as organic light-emitting diodes and in biological imaging. This work has shown for the first time that small molecules can be emissive in the near ultraviolet region of the spectrum, and further studies will investigate potential applications of these compounds. An offshoot of these findings has been the commencement of a new study within the Kiefel group looking into the detection of sugars with sensors designed to be measured using NMR spectroscopy (instead of current fluorescent approaches that tend to be susceptible to the surrounding environment). This work has produced some interesting preliminary data.

In conjunction with colleagues at Griffith, the Kiefel group has continued their investigations into natural products with interesting biological activity, including compounds with activity for treating Parkinson's Disease and also anti-inflammatory activity. We are also using NMR spectroscopy to screen natural product extracts for characteristic signals that may point to biological activity.

Associate Professor Danielle Stanisic

In 2022, the malaria research group was awarded significant funding that will enable them to progress several key research projects. A National Institutes of Health R01 grant was jointly awarded to Associate Professor Danielle Stanisic and Assistant Professor Prakash Srinivasan (Johns Hopkins University) to develop and evaluate a multi-component blood-stage malaria vaccine candidate.

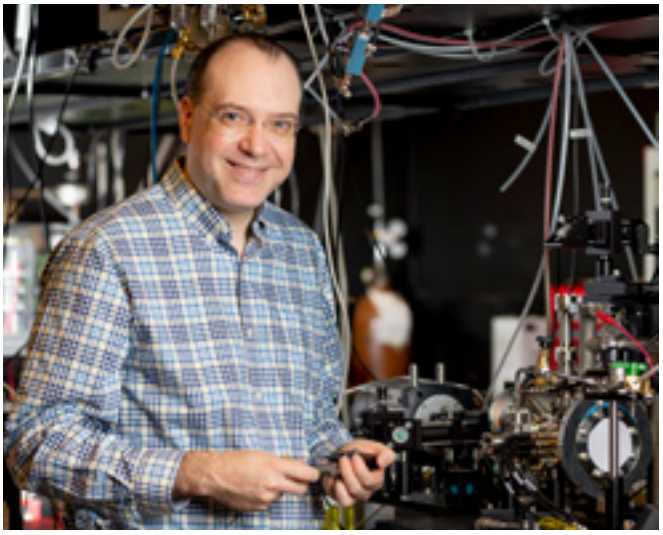
An ARC Discovery grant was awarded to Associate Professor Danielle Stanisic, Professor Michael Good AO and Professor Ala Tabor (University of Queensland). This grant will be used to evaluate a whole parasite blood-stage babesiosis vaccine candidate in cattle trials. Babesiosis is caused by a parasite that is related to the malaria parasite and is spread by ticks. The whole parasite liposomal vaccine that the research team will make for the cattle trials has a similar design to the malaria vaccine that they are developing.

They received a substantial philanthropic donation from Mr Ray James. This critical funding will enable the completion of the formal toxicological studies for their malaria vaccine candidate in the coming months. The Malaria Vaccine Project Committee, which was formed as a joint Rotary-Griffith University partnership, has continued to raise critical funding to enable the Phase 1 clinical trial for the malaria vaccine candidate.

Work has continued on the field-deployable whole parasite malaria vaccine in preparation for the upcoming formal toxicological study and then the Phase 1 trial which they hope will commence in the second half of 2023. These studies were undertaken by Dr Reshma Nevagi, Ms Mei-Fong Ho, Ms Maddie Walton and Ms Winter Okoth (PhD student). Ms Heidi Plater has continued to maintain their GMP-compliant cleanroom and quality system, both of which are critical for the vaccine manufacturing activities at Griffith University.

In 2022, the Stanisic group published a major review in the prestigious journal, *Trends in Parasitology*, discussing the prospects for a human vaccine against babesiosis. As well as infecting cattle (as mentioned above), it infects and causes disease in humans, particularly in the US and Europe. The lab is continuing to work on a human vaccine to target the Babesia parasite in collaboration with Dr Sanjai Kumar from the US FDA, with the plan to progress the vaccine candidate towards clinical development.

In 2022, the group bid farewell to Ms Mei-Fong Ho and Ms Maddie Walton who have been working as Research Assistants in the malaria lab for several years. They also welcomed Mr Mark Burgess (Research Assistant) and Ms Priyanka Som (Research Assistant) who will work on the Malaria Vaccine Program. Ms Alex Johnston, a new PhD student, who previously completed her honours degree withing the Institute for Glycomics, also joined the team. Her project is focused on developing a potency assay for the malaria vaccine as well the immunology studies in the upcoming Phase 1 vaccine trial.



Associate Professor Erik Streed

The Streed Biophysics 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.

Current collaborations with the Tiralongo group involve Master of Biotechnology student Anchal Rawat in levitating ionised yeast cells as a novel platform for biochemical investigation as well as with Dr Oren Cooper on nanometer-scale high-sensitivity optical readout of biofunctionalised microfabricated cantilevers.

The biophysics lab continues its position as the premiere photonics lab on the Gold Coast campus, hosting materials science investigations on Silicon Carbide sensors which resulted in the award of an ARC Discovery Project with Associate Professor Dzung Dao as well as remote quantum networking through our intra-campus fibre optic link supported by a 2022 Queensland Defence Science Alliance HDR capability grant to former biophysics student Michael Hencz.

Associate Professor Manisha Pandey

The Pandey Strep A Team under the mentorship of Professor Michael Good continued to progress streptococcal translational research and achieved a significant milestone. After several years of tremendous teamwork, the Strep A vaccine entered a Phase 1 clinical trial in Canada. This Investigator led trial is in collaboration with Li-Ka Shing Institute of Virology, University of Alberta. This has been a very exciting milestone for the entire group, and they look forward to generating some exciting data from the trial samples.

An NHMRC funded Ideas grant which is focussed on developing a 2nd generation COVID-19 vaccine is making progress and generating some exciting data. The project involves collaboration between Griffith researchers and researchers from the University of Melbourne. A manuscript arising from this work is currently in preparation. The team published their research work in several peer reviewed high impact factor journals including *MBio, npj Vaccines, Small* and *Spectrum*. The research outcomes also led to generation of IP and patent applications. Dr Pandey, in her adjunct appointment at USQ and as an associate supervisor, also successfully supervised a PhD student Ms Leanne Dooley. Ms Dooley's PhD project resulted in two publications. Several work experience students were also trained in the laboratory by various team members.

This year, the research efforts of the team members were recognised by various awards/promotions. Dr Pandey and Dr Lepletier, in recognition of their contributions to research and overall achievements, were promoted to Associate Professor and Research Fellow 2, respectively. Dr Pandey and Dr Ozberk also received the Glycomics award for 'Excellence in Research Supervision' and 'Excellence in Research as an Early Career Researcher', respectively. Another highlight of the year was the winning of the bid to host Lancefield International Symposium in Brisbane in 2025 with Dr Pandey and Professor Good as Co-Chairs.

The group welcomed Ms Jacqueline Kaden into the team. Jackie is enthusiastically working across various research activities involving microbiology, immunology as well as optimisation of *in vitro* assays.

Associate Professor Thomas Ve

Dr Ve's group is using an integrated approach combining structural techniques such as X-ray crystallography, NMR and cryo-EM with chemistry, biochemistry and cell-based functional assays. The major focus of the research involves characterising the biology and translational potential of a novel class of enzymes that breakdown the essential metabolite NAD+.

2022 was a productive year for the Ve group – together with collaborators from the US, the UK, the University of Queensland and the Institute for Glycomics, the group published new research in *Science, Molecular Cell*, and *PloS Pathogens*. The group unraveled an inhibition mechanism for neurodegenerative disease therapeutic target SARM1 and determined the first inhibitor-bound and active-state structures of this protein using cryo-EM and crystallography. The group also determined chemical structures of novel cyclic nucleotides using NMR and crystallography and demonstrated that one of these nucleotides is an antiviral signaling molecule.

2022 grant successes included:

- The ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF) grant titled *Nanocrystal Electron Diffraction Facility will see the establishment of an Australia-first dedicated micro-crystal electron diffractometer*. This UQ-led collaborative initiative includes a strong Griffith University team (Professor von Itzstein, Associate Professor Ve, Dr Larissa Dirr and Dr F. Sainsbury) and will enable Griffith researchers to determine structures using nanometre-size crystals.
- The Griffith University Research Infrastructure Program grant titled *An Advanced Protein Crystallisation Facility for Griffith University* will provide automatic imaging capabilities for the high-throughput crystallisation facility at the Institute for Glycomics.

In 2022, Dr Biswa Mishra joined the team as a Research Fellow. He will be using his protein NMR expertise across a range of ongoing projects within the group.

Dr Ve presented the group's research at the 47th Lorne Conference on Protein Structure and Function while Dr Yun Shi from the group presented at the Fragment-Based Drug Discovery Down Under Conference and Discovery On Target. As a testament to his grant successes and strong research output, Dr Ve was promoted to Associate Professor in 2022.

Dr Darren Grice

The Grice research group has a multi-disciplinary organic chemistry focus on (i) determining the chemical structures and biological activity of naturally occurring compounds, principally carbohydrates from Gram-negative bacteria and fungi for therapeutic application; and (ii) designing and synthesizing organic and carbohydrate-based molecules with potential as novel anti-cancer agents.

(i) Throughout the year work continued in collaboration with Griffith researchers on isolating and structurally identifying surface carbohydrates from Gram-negative bacteria. The bacteria studied are known to be involved in diseases affecting humans and cattle. An outstanding new PhD student was recruited internationally late in the year to begin work early in 2023 on further developing the group's 'pilot' human middle-ear vaccine candidate, directly related to this larger project. Four years of philanthropic funding from Earbus Foundation of Western Australia has been secured for this project.

In 2022, a Master of Medical Research student continued work in collaboration with Professor Joe Tiralongo and an industry partner on isolating and identifying carbohydrate structures in medicinal mushrooms (fungi) with immunostimulatory activity.

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

Additionally, results were published on completed international collaborative work on the design and synthesis of carbohydrate-based molecules with potential to act as potent therapeutics for Acute Lymphoblastic Leukemia, with further publications in preparation on this work (*Journal of Medicinal Chemistry* (2022) 65,5975-89).

Dr John Atack

In 2022, the Atack lab saw its first PhD student graduate – Zachary Phillips was awarded his PhD in August for his thesis titled *Analysis of Phase-variable Genes in Human-adapted Bacterial Pathogens*. Newly minted Dr Phillips examined how random gene expression in *Streptococcus pneumoniae* and non-typeable *Haemophilus influenzae* can affect the design of future vaccines and treatments against these major human pathogens. PhD student Nusrat Nahar continued her excellent progress, and submitted her thesis in November 2022, with excellent examiner comments already received. Nusrat will be conferred her PhD in 2023 and should be rightly proud of her achievements. Nusrat made several novel findings concerning gene regulation in the pig pathogen *Acinetobacter pleuropneumoniae*, which will have implications for developing new vaccines for this organism.

Ashley Fraser commenced her PhD in the lab in 2022, returning to continue her honours work studying gene expression in non-typeable *Haemophilus influenzae*. This year also saw Nuala Ellaby commence as a Master of Medical Research (MMRes) student in the lab, where she is examining how *Acinetobacter baumannii*, a bacterial pathogen that shows resistance to nearly all antibiotics, is able to interact with the human host. It is hoped that this work eventually leads to new ways to treat infections and provide some much-needed alternatives to antibiotics.

Dr Atack was made a full Research Leader in the Institute this year, recognising his achievements in the previous years. Dr Atack also won the Institute for Glycomics research excellence award for a mid-career researcher. In a new line of investigation, Dr Atack was awarded an internal grant with collaborators at MHIQ to understand how COVID-19 affects susceptibility to secondary bacterial infections, which are emerging as a major risk for patients recovering from COVID. Dr Atack commenced his role as Chairperson of the Australian Society for Microbiology (ASM) Queensland Branch – an important position, allowing him to promote microbiology, and push its importance in health and education. Dr Atack was also appointed as an editor at the prestigious journal Microbiology, the flagship journal of the Microbiology Society (UK). These editorial positions are highly competitive, and his appointment recognises his growing standing in the field.

Dr Chris Day

The Day laboratory focuses on understanding host-pathogenic interactions reliant on carbohydrates and uses expertise in bioanalytical techniques to widely collaborate on a range of projects. Through this work, an engineered bacterial toxin subunit, SubB2M, is being translated as cancer diagnostic/treatment monitoring test.

In 2022, the Day lab was a part of the publication of nine research outputs including papers in *mBio, Plos Pathogens, Cell reports* and *BMC Cancer*. These publications included work on SubB2M detection of biomarkers in breast cancer (*BMC Cancer*), novel interactions in HIV (*mBio, Cell reports, JACS Au*) and the investigation of *E. coli* adherence proteins (*Plos Pathogens*).

The Day Lab also had great success in 2022 with the awarding of multiple grants to the collaborative team of the Jennings, Shewell, Day and Kolarich labs to further study the bacterial toxin SubB. The modified toxin SubB2M is being developed as a diagnostic/treatment monitoring method for a range of cancers including breast and ovarian.

Dr Oren Cooper joined Dr Day and Associate Professor Haselhorst as the postdoctoral researcher for the ARC Discovery Project grant. This work will further the role of glycan-glycan interactions in the colonisation of chickens with bacteria that can cause foodborne disease. These studies may provide a potential molecule that will reduce pathogenic bacterial carriage in chickens.

Dr Greg Tram who works with Dr Day and Professor Jennings on the NHMRC toxin Ideas grant was awarded the Griffith University Postdoctoral Research Fellowship to further extend the work of the NHMRC project into the study of additional toxins.

Associate Research Leaders

Dr Ian Peak

The Peak research group has a multi-disciplinary focus. Their projects include (i) determining the genetic and biosynthetic mechanisms for bacterial synthesis of carbohydrates from Gram-negative bacteria, investigating the potential for use as vaccines, as well as fundamental understanding of how some bacteria may protect against disease, and (ii) investigating mammalian responses to molecules produced by bacteria, furthering knowledge of disease processes and attempting to exploit these molecules to improve health outcomes.

(i) Throughout the year, work continued in collaboration with Griffith researchers on solving the structures of carbohydrates from bacteria that live in the upper respiratory tract of humans and other mammals. These bacteria contribute to disease or may be involved in protecting against more virulent pathogens. The Peak group contributes analysis and investigation of the genes involved in making these structures. With Dr Grice, they recruited an outstanding international PhD candidate to commence in 2023. This student will continue their work on a vaccine that targets diseases of the middle ear. This is funded through generous contributions from Earbus Foundation of Western Australia. In addition, a PhD candidate, co-supervised by Dr Grice and Dr Wilson (of Griffith's Health Group) has uncovered the similarity and differences in carbohydrates produced by closely related bacteria from the upper respiratory tract of humans, and agriculturally important animals. She is due to complete her studies in early 2023.

(ii) A Master of Medical Research student commenced in 2022 to investigate how bacterial molecules might be exploited in affecting disease outcomes. He is jointly supervised with a pharmacist, and he is testing bacterial compounds and derivatives which have been newly-synthesized by a collaborating organic chemist from Griffith's Health Group. As well as potentially providing improvements to health, this project also extends the fundamental understanding of how bacteria and mammals talk to each other. These fundamental advances in knowledge may lead to new ideas in targeting or reducing the burden of disease caused by bacteria.

Dr Freda Jen

Dr Freda Jen's research focus is on developing vaccines and treatments for gonococcal disease. In 2022, Griffith University and LimmaTech Biologics signed a landmark deal to develop a gonorrhoea vaccine. Two of their discovered gonococcal vaccine antigens are under co-development with LimmaTech Biologics to develop a world-first gonorrhoea vaccine.

The group continued to work on targeting a bacterial glycan to make new vaccines for *Haemophilus influenzae* and *Neisseria gonorrhoeae* which are supported by the award of a NHMRC Ideas Grant to Dr Freda Jen and Associate Professor Milton Kiefel since 2021.

For gonorrhoea treatment, with von Itzstein's group, they completed and published a significant study that a drug candidate for Alzheimer's and Huntington's disease, PBT2, can be a candidate therapeutic for multidrug-resistant *Neisseria gonorrhoeae* infections (Jen *et al*., 2022, *Antimicrob Agents Chemother*) which contributed to an awarded NHMRC Development Grant to Professor von Itzstein and Professor Jennings in 2022 to develop new antibiotics for gonorrhoea infections. Dr Jen presented this work at Australian Society Microbiology and International *Neisseria gonorrhoeae* Research Society conferences.

PhD student, Adeana Scoot, graduated from her PhD thesis and moved on to a teaching position. PhD student, Yuan Zhang, submitted her thesis and published her first author publication in *Trends in Microbiology* (IF 18.2). Honours student, James Gu, received a first-class honors degree identifying the biochemical origin of the guinea pig serum *L-asparaginase* and its genesis and export. Dr Jen was promoted to Associate Research Leader in recognition of her outstanding contribution to research.

Dr Patrice Guillon

Dr Patrice Guillon's research group is dedicated to exploring the glyco-interactions between respiratory viruses (such as hPIV, IAV, RSV, HMPV, and SARS-CoV-2) and their hosts.

Cells and viruses are covered with glycans, or carbohydrate molecules, which make up the glycome of an organism. Each glycome is unique, dynamic, and highly diverse, with glycan specificities for each cell type, tissue, and species. Viruses can use these specific glycans to attach and enter host cells. Moreover, glycan binding proteins (lectins) expressed at the surface of particular host cell types can recognise and bind glycan motifs decorating viruses. This key-lock recognition mechanism may act in favour of the host by triggering an immune response against the virus, but also in favour of the virus by initiating infection. Studying these multiple levels of interaction can reveal key targets for antiviral drug design and vaccination strategies against respiratory viruses.

The group is particularly interested in discovering new antiviral inhibitors based on sialic acid (glycan), and uses techniques such as X-ray crystallography, nuclear magnetic resonance spectroscopy, and virological methods to achieve this goal. The group also employs advanced cellular models (primary human airway epithelial cells differentiated at air-liquid interface) as a surrogate for human tissue to validate the action of inhibitors and study the biology of respiratory viruses in the context of the host.

In 2022, Dr Guillon's research group continued its collaboration with industry partner China Grand Medical to develop the first drug candidate against human parainfluenza virus. The collaboration led to the identification of low-nanomolar inhibitors that are now advancing to pre-clinical testing.

Among the academic highlights for 2022, the group had four publications in peer-reviewed international scientific journals and two PhD candidates, Dr Vimbaishe Chibanga and Dr Annelies Van Den Bergh, successfully submitted their theses and obtained their degrees. Additionally, Dr Van Den Bergh received the Award of Excellence in a Research Thesis for her PhD.

Dr Guillon has recently been promoted to Assistant Research Leader in recognition of his outstanding research and project management achievements.

Dr Penny Rudd

Dr Penny Rudd's group focuses on RNA viruses with a particular interest for *Togaviridae, Coronaviridae* and *Paramyxoviridae* families of viruses. Research areas focus on better understanding virus-host interactions and to ultimately develop treatment strategies to limit pathogenesis.

The start of 2022 saw the commencement of a NHMRC funded project *COMBAT – A combination B-and T-cell epitope vaccine to futureproof COVID-19 vaccine* in collaboration with Dr Manisha Pandey. The year was spent optimising the animal model and performing the first challenge experiments in Griffith University's state-of-the-art PC3 facility.

Other significant collaborations include the National Centre for Neuroimmunology and Emerging Diseases (NCNED), the University of Queensland and the University of North Carolina Chapel Hill. These exciting research projects resulted in several grant applications that were submitted to both governmental and philanthropic agencies with some outcomes still pending.

Dr Rudd presented some of her most recent work at the 11th Australasian Virology Society meeting held on the Gold Coast in December 2022. Her talk described how she used digital spatial imaging, available as a core facility at Griffith University, to characterise the immune influx that occurs during both Chikungunya and O'nyong nyong virus infections.

Last year also saw a research study by a PhD student supervised by both Dr Rudd and Associate Professor Lara Herrero published in the journal *Viruses* – Lim, X.Y., Webster J.A., Rudd, P.A. and Herrero L.J. Pathways activated by infected and bystander chondrocytes in response to Ross River virus infection, *Viruses*, 2022, Dec 31;15(1):136,. This study investigated the transcriptomic profiles of RRV-infected and uninfected bystander cells to learn more about the direct and indirect effects of RRV on disease pathogenesis in human primary chondrocyte cells.

Dr Rudd also welcomed a new PhD student, Yong Qian Koo, who will be studying important host factors that contribute to arboviral disease.

Dr Evgeny Semchenko

Dr Semchenko (BSc, Hons, PhD, MASM) is an expert in the field of pathogenic Neisseria and a member of the Seib research group. His key interest is investigating glycan-dependent host-pathogen interactions, which he uses to guide the discovery of new vaccine antigens and drug targets. Dr Semchenko's current research focuses on solving the urgent problem of multi-drug resistant gonorrhea by developing new drugs, and vaccines to curb morbidity and spread of the infection.

Dr Semchenko was promoted to Associate Research Leader in recognition of his significant contributions to research. Highlights for 2022 include:

- Dr Semchenko led the communications team and was on the organising committee for the Molecular Biology of Bacterial Pathogens Conference (BacPath). He was also appointed as an Early and Mid-Career Representative (EMCR) for the Australian Society for Microbiology.
- Dr Semchenko presented his research at several conferences including his work characterising the role of the gonococcal NHBA vaccine candidate at the International Pathogenic Neisseria Conference (IPNC, South Africa); characterisation of 4CMenB vaccine-induced antibodies to *Neisseria gonorrhoeae* at the Joint Australasian HIV & AIDS and Sexual Health Conferences (ASHM, QLD); and his NIH Development Research Project grant work on functional evaluation of serum samples to aid vaccine development at the Sexually Transmitted Infections Cooperative Research Centers (STI-CRC) Annual Meeting (USA).
- Dr Semchenko is a co-investigator on the research team with Dr Jen, Professor Seib and Professor Jennings, which developed a suite of vaccine technologies for the prevention of *N. gonorrhoeae*. In 2022, the team had licenced and signed a co-development agreement with LimmaTech Biologics to develop and commercialise the gonococcal vaccine candidates.

Dr Lucy Shewell

Dr Lucy Shewell's research focuses on the development of novel cancer diagnostics based on the detection of a sugar biomarker, Neu5Gc. In 2022, Dr Shewell led the study showing the detection of elevated serum Neu5Gc levels in ovarian and breast cancer published in *BMC Cancer*. She also led the study showing elevated serum Neu5Gc levels in patients with melanoma published in *BBRC*.

Dr Shewell was an invited speaker at the Sialoglyco 2022 conference in Nagoya, Japan, where she presented the team's work on ovarian and breast cancer. She was also a keynote speaker at the 4th Australasian Glycoscience Symposium.

In 2022, Dr Shewell, along with Professor Michael Jennings, Dr Christopher Day and Associate Professor Daniel Kolarich, was awarded $325,000 from the Bourne Foundation to investigate biomarkers in prostate cancer.

Dr Shewell was promoted to Senior Research Fellow at the beginning of 2022 and was appointed as an Associate Research Leader within the Institute for Glycomics.

Early Career Research Leaders

Dr Mehfuz Zaman

The Zaman group had an excellent 2022, with multiple projects moving forward, funded generously by the National Health and Medical Research Council (NHMRC) and other funding sources. Highlights include:

- The upper respiratory tract (URT) is the major entry site for multiple pathogens including Influenza A-B, *Streptococcus pyogenes* (Streptococcus A, GAS) and coronaviruses. The group is making progress in their pioneering 'modular' multi-pathogen vaccine platform using liposomes (phospholipid vesicles). The liposomal delivery system allows the incorporation of both viral and bacterial peptide epitopes (a part of a protein recognised by antibodies and cells of the immune system) to prevent URT infection.
- They have identified liposomal formulation can be stored as lyophilised powder and reconstituted prior to immunisation, yielding a stable product that potentially does not require a cold-chain from production to needle-free administration.
- Incorporating lipid-linked sugars (glycolipids) enhance secretory immunoglobulin A (IgA)-mediated mucosal immunity that may reduce infectivity of human secretions and transmission.
- A project to establish in-house pre-clinical models for viruses causing hand, foot and mouth disease (enterovirus 71) is coming to fruition. In the future this model will enable the group to evaluate novel anti-infective strategies to prevent enterovirus 71 infection.
- PhD student Trairong Chokwassanasakulkit has begun his candidature to lay the foundation for excellent progress in the lab.
- Dr Zaman was promoted to Early Career Research Leader, recognising his significant achievements in research.

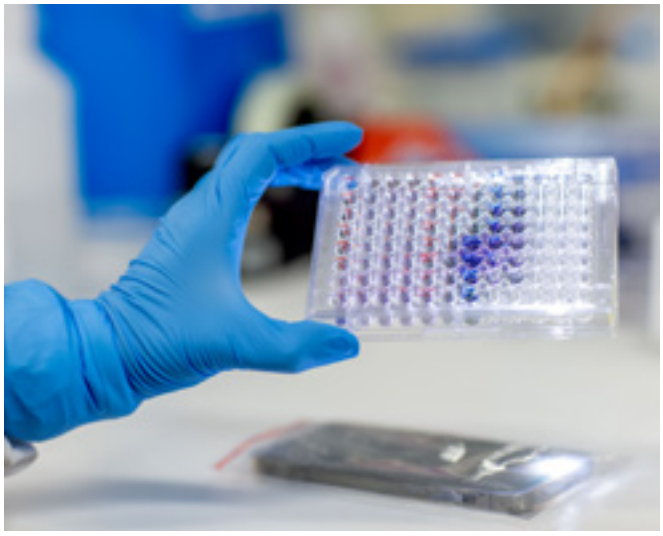
Dr Larissa Dirr

Dr Larissa Dirr is an NHMRC Early Career Research Fellow with expertise in structural biology, virology and glycoscience. The research program has a major translational focus on the discovery of new therapeutics against a range of human respiratory viruses. Recent key achievements include the discovery and development of anti-parainfluenza drug-like molecules and novel hit candidates against human metapneumovirus and SARS-CoV-2.

2022 was a great year, highlights include:

- The ARC Linkage Infrastructure, Equipment and Facilities Scheme (LIEF) grant entitled '*Nanocrystal Electron Diffraction Facility*' will establish an Australia-first dedicated micro-crystal electron diffractometer. The new equipment will provide new capabilities by enabling structure determination using nanometre-size crystals. This UQ-led collaborative initiative includes other Glycomics team members (Professor von Itzstein and Associate Professor Ve).
- A successful equipment grant entitled '*An Advanced Protein Crystallisation Facility*' will see the installation of Rock Imager 1000, an entire automated system that will allow high-throughput screening of crystal plates at the Institute for Glycomics.
- Former student Dr Vimbaishe Chibanga was awarded her PhD for the thesis entitled *Defining the glycointeractomes of human parainfluenza viruses* where she studied the mechanisms by which human parainfluenza viruses bind to sugars on our cells in order to infect us.
- Former student Dr Annelies van den Bergh received the award of excellence in her research PhD thesis entitled *The human metapneumovirus and i ts interactions with host cell surface receptors*.
- PhD student Olivia Tan Hui has made major progress and will submit her thesis in early 2023 and PhD student Plabon Das is making further advancements in his research project.

- Publications highlights include one invited review published jointly with Professor von Itzstein in the high-ranking journal *Antiviral Research*, highlighting the human metapneumovirus fusion protein as a promising antiviral drug target.
- A study of former PhD student van den Bergh was published in *Antimicrobial Agents* and *Chemotherapy* describing the discovery of new hit candidates for the treatment of human metapneumovirus, where currently no drug is available on the market.
- Dr Dirr was awarded the Ross Smith Early Career Research Medal at the Queensland Protein Group Symposium held at the Institute for Glycomics in November.
- Visiting student Jessica Weeland from Medical School Hannover in Germany has been part of the team. She was involved in the evaluation of new drug like molecules for respiratory syncytial virus (RSV) that causes approximately 160,000 deaths worldwide each year.



Plenary, Keynote, and Invited Lectures in 2022

Date	Conference	Location	Research Scientist
11-14 August	ASM 2022	Sydney, Australia	Prof Kate Seib
8-13 May	14th Australian Peptide Conference 2022	Gold Coast, Australia	A/Prof Manisha Pandey
4-7 September	23rd IUSTI World Congress	Victoria Falls, Zimbabwe	Prof Kate Seib
9-14 October	International Pathogenic Neisseria Conference (IPNC)	Cape Town, South Africa	Prof Kate Seib
24-30 September	Gordon Research Conference on Signal Transduction in Microorganisms	Ventura, USA	Prof Victoria Korolik
5-8 September	Sialoglyco 2022	Nagoya, Japan	Dr Lucy Shewell
17-20 October	Discovery on Target	Boston, USA	Dr Yun Shi
4-8 December	HUPO 2022	Cancun, Mexico	A/Prof Daniel Kolarich
6-9 December	34th Biennial Conference of the Society of Crystallographers (Crystal34)	Bendigo, Australia	A/Prof Thomas Ve
25-26 October	Immunology Networking Symposium	Brisbane, Australia	A/Prof Daniel Kolarich
29 November	Cytiva Biacore User Workshop	Brisbane, Australia	Dr Lauren Hartley
22-25 November	4th Australasian Glycoscience Symposium and 9th Warren Workshop for Glycoanalytics	Gold Coast, Australia	Dr Arun Everest-Dass

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 700m^2 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 (e.g., 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 1350m^2 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, fungi 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, fungi 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 180m^2 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 repurposed 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:

- Glycobioanalytical 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

Protein Production Laboratory

The capacity of the Institute's protein production suite has been expanded over the last year. Additional equipment has been established for cloning and expression in either *E. coli* (bacterial) or insect cell models. This equipment includes additional PCR, electrophoresis equipment and incubators.

To aid in downstream processing, two high performance centrifuges have been installed, each capable of accommodating six litres of material. Enhanced fast flow chromatography purification and lateral flow equipment has also been commissioned. This additional capacity allows researchers to scale up protein production and purification across different expression systems for further testing or analysis such as crystallisation studies.

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.






Official opening of the Australian Cancer Research Foundation International Centre for Cancer Glycomics

In 2022, the Institute for Glycomics launched the Australian Cancer Research Foundation (ACRF) International Centre for Cancer Glycomics with a $2.6 million ACRF grant, which is dedicated to deciphering the cancer glyco-code.

The centre enables the Institute's researchers to determine changes to the glycomics (carbohydrates/sugars) and their interactions with proteins and lipids (molecules that contain hydrocarbons and make up the building blocks of the structure and function of living cells) in a number of cancers.

"Our research will provide major advances in the early diagnosis of significant cancers, including skin, ovarian and breast cancer," Institute for Glycomics Director Professor Mark von Itzstein AO said.

"This unique facility, with its diverse and multi-disciplinary team of researchers, will underpin the opportunity to better understand the glyco-code and lead to the translation of novel discoveries and clinical outcomes that will improve the lives of countless cancer sufferers around the world."

Advanced mass spectrometry equipment forms the centrepiece of the ACRF International Centre for Cancer Glycomics, including the Orbitrap Eclipse Tribrid MS and the Hyperion Imaging Mass CyTOF.

"These two state-of-the-art instruments have been added to and complement the existing resources and capabilities within the facility, enabling the brightest scientific minds in cancer glycomics research to deep mine the cancer glyco-code down to a single cell level," Professor von Itzstein said.

The goal of the ACRF International Centre for Cancer Glycomics is to identify the glyco-language in cellular states that precede malignant transformation in serum, tissue biopsies and *in vivo* in a clinical scanner of patients at high risk for cancer as well as those with a malignancy.

The team of glycomics experts work with surgeons, radiologists, scientists, and high-risk cancer clinics to develop early markers in high-risk cohorts and therapeutics based on inhibition of relevant protein targets.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2022 PUBLICATIONS AND GRANTS

2022 Publications

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2022 Grants

Grant name	Year*	Project	Investigators	Total funds awarded $AUD
NHMRC – Investigator Grant	2023	*A comprehensive vaccine-based strategy to combat gonorrhoea*	Kate Seib	2,117,565
NHMRC – Ideas Grant	2023	*Unmask HIV latency through disruption of HIV synapses*	Johnson Mak, Alan Wee-Chung Liew	1,245,243
ARC Linkage – Projects (and/or APAI)	2022	*A Goldilocks live attenuated poultry vaccine for Infectious Coryza*	Michael Jennings, John Atack	1,096,030
NHMRC – Ideas Grant	2023	*Personalising diagnosis and treatment of Pseudomonas aeruginosa infection*	Daniel Kolarich	895,818
ARC Discovery Projects (including Fellowship)	2023	*Decoding Bacterial Epigenetic Regulation*	Kate Seib	690,605
ARC Discovery Projects (including Fellowship)	2023	*A next-generation whole parasite bovine Babesia vaccine*	Danielle Stanisic, Michael Good	621,465
The Snow Foundation Grant	2022	*Strep A vaccine to prevent rheumatic heart disease and invasive streptococcal disease*	Michael Good, Simone Reynolds, Manisha Pandey	450,921
Ovarian Cancer Research Foundation Research Grant	2023	*Discovery of novel serum glyco-markers to facilitate early detection of ovarian cancer*	Michael Jennings, Carolyn Mountford, Daniel Kolarich, Lucy Shewell	444,203
National Institutes of Health (NIH) – USA	2022	*Developing a multi-component vaccine harnessing potent antibody and cellular responses against the blood-stage of Plasmodium falciparum*	Danielle Stanisic	298,539
MRFF – Cardiovascular Health Mission	2022	*The Asialoglycoprotein Receptor 1 (ASGR1): a novel target for atherosclerosis*	Arun Everest-Dass	213,180
NHMRC – Postgraduate Scholarships	2023	*Investigating Novel Prevention and Treatment Strategies for Gonococcal Control*	Caroline Thng, Kate Seib, Michael Jennings	121,193
NHMRC Research Equipment Grant Support	2023	*NHMRC Standard Equipment Grant 2023*	Thomas Ve	64,069
Tour de Cure – Mid-Career Research Grant	2023	*Use of bodily fluids for the discovery of novel ovarian cancer glyco-biomarkers*	Lucy Shewell	49,834
ARC Linkage – Infrastructure (LIEF)	2023	*Nanocrystal Electron Diffraction Facility*	Thomas Ve, Frank Sainsbury, Larissa Dirr, Mark von Itzstein	not disclosed

Grant name	Year*	Project	Investigators	Total funds awarded $AUD
MRFF – Genomics Health Futures Mission Grant	2022	*Pathways to Benefit for Indigenous Australians in Genomic Medicine*	Simone Reynolds	not disclosed
Menzies Health Institute Queensland	2022	*Interplay between SARS-CoV-2 and major bacterial airway pathogens – implications for otitis media and chronic obstructive pulmonary disease*	A Taylor, John Atack	145,872
NHMRC – Ideas Grant	2022	*COMBAT – A combination B-and T-cell epitope vaccine to futureproof COVID-19 vaccine*	Manisha Pandey, Penny Rudd, Michael Good	1,211,034
University of Alberta	2022	*A Phase 1 Clinical Trial of a Peptide-Based Group A Streptococcal Vaccine*	Michael Good, Manisha Pandey	not disclosed
DONATIONS				
Australian Lions Childhood Cancer Research Foundation Donation	2022	*Developing a novel diagnostic and treatment options for sarcoma*	Mark von Itzstein, Daniel Kolarich, Arun Everest-Dass	not disclosed
The Bourne Foundation Donation	2022	*Developing a novel diagnostic and treatment options for sarcoma*	Mark von Itzstein, Daniel Kolarich, Arun Everest-Dass	not disclosed
The Bourne Foundation Donation	2023	*Improvement of the Prostate Specific Antigen (PSA) test, and novel biomarker discovery, by detection of a cancer-specific carbohydrate, Neu5Gc*	Michael Jennings, Lucy Shewell, Daniel Kolarich, Christopher Day	not disclosed
Paradise Point Community Bank Donation	2022	*Flow Cytometer Instrument*	Mark von Itzstein	250,000

**Year of funding commencement*

REMARKABLE PEOPLE

Membership in 2022

Leadership Team

Director: Professor Mark von Itzstein AO
Deputy Director: Professor Michael Jennings
General Manager: Dr Chris Davis
Associate Director (Research): Professor Kate Seib
Associate Director (Education and Engagement): Professor Victoria Korolik

Administration, Operations and Business Teams

Dr Lauren Hartley-Tassell
Harshani Jayasinghe
Eloise Keeffe
Nina Kristensen
Libby McMahon
Erica Luan
Leanne O'Donoghue
Philip Hodgson
Dr Chris Davis
Dr Ben Bailly
Sarah Lukic
Heather Weekes
Jenni Dyason
Sonia McKay
Jaime Perry
Violetta Yudina
Nancy Callaghan
Faith Rose
Dr Carie-Anne Logue
Dr Michael Batzloff
Scott Feely
Dr Jack Everson
Dr Catherine Tindal

Research Group Leaders

Dr John Atack
Dr Chris Day
Dr Thomas Ve
Associate Professor Thomas Haselhorst
Associate Professor Lara Herrero
Professor Kate Seib
Professor Carolyn Mountford
Professor Nicolle Packer
Associate Professor Daniel Kolarich
Professor Michael Good
Professor Michael Jennings
Professor Mark von Itzstein
Associate Professor Todd Houston
Professor Victoria Korolik
Professor Johnson Mak
Dr Ian Peak
Dr Manisha Pandey
Dr Danielle Stanisic
Associate Professor Erik Streed
Dr Darren Grice
Associate Professor Milton Kiefel
Associate Professor Joe Tiralongo

Adjunct and Visiting Appointments

Associate Professor Nic Crampton
Associate Professor Lewis Perrin
Associate Professor E. Russell Vickers
Associate Professor Simon Wood
Ms Jillian Borthwick
Mr Darren Lukas
Dr Kirby Vosburgh
Professor Ralf Altmeyer
Professor Ian Bennett
Professor Helen Blanchard
Professor David Crompton
Professor Nicholas Farrell
Professor John Irvine
Professor Soerge Kelm
Professor Peter Malycha
Professor Mario Pinto
Professor Gorane Santamaria
Professor Peter Seeberger
Professor Subhash Vasudevan
Professor Yueudong Yang
Professor Ross Young
Professor Xing Yu
Professor Yaoqi Zhou
Dr Matthew Campbell
Dr John Lancashire
Ms Laura Mariano
Mr Jason Beard
Dr James Fink
Dr John Gerrard
Ms Lorraine (Laurie) Kear
Mr Nathan Tosh
Ms Rosanna Tremewan
Ms Julia Watson
Professor Emeritus Ifor Beacham
Professor Emeritus Sue Berners-Price
Professor Natkunam Ketheesan
Dr Emil Johansson
Dr Jessica Browne
Dr Elisa Fadda

Research Scientists

Callum Bennett
Lisa Rich
Brody Mallard
Dr James Carter
Lindsay Gee
Heidi Plater
Dr Luke Blakeway
Natali Naude
Wesley Freppel
Priyanka Som
Jill Wallus
Darrell Bessette
Sarah Blanchard
JohanaLuhur
Maddison Walton
Mark Burgess
Mei Fong Ho
Jacqualine Kaden
Dr Tamim Mosaiab
Dr Dylan Farr
Dr Oren Cooper
Dr Belinda de Villiers
Dr Larissa Dirr
Dr Bassam Elgamoudi
Dr Sharareh Eskandari
Dr Ailin Lepletier
Dr Thomas Litfin
Dr Biswa Mishra
Dr Joanna Musik
Dr Reshma Nevagi
Dr Victoria Ozberk
Dr Thilini Padeniya
Dr Jessica Poole
Dr Rajaratnam Premraj
Dr Yun Shi
Dr Crystall Swarbrick
Dr Greg Tram
Dr Yaramah Zalucki
Dr Ibrahim El-Deeb
Dr Arun Everest-Dass
Dr Patrice Guillon
Dr Andrea Maggioni
Dr Alpesh Malde
Dr Simone Reynolds
Dr Penny Rudd
Dr Evgeny Semchenko
Dr Lucy Shewell
Dr Taha
Dr Ameha Woldu
Dr Mehfuz Zaman
Dr Matthew Campbell
Mei Fong Ho
Ainslie Calcutt
Jessica Dooley
Stephanie Holt
Veronika Masic
Dr Robin Thomson
Dr Freda Jen
Dr Grant Hansman

Research Students

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Shaiv Ranjith
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(James) Xuanling Gu
Alex Johnston
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Samuel Chambers
Ronald Coetzee
Jessica Halliday
Lily Howell
Jacinta Martin
Finn McMahon
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Thangira Usavamaytee
Eduardo Vasquez
Isabelle Watson
Nuala Ellaby
Anchal Rawat
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Tiana Hippolite
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Trairong Chokwassanasakulkit
Plabon Das
Ashley Fraser
Danielle Lee
Chengpeng Li
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Nusrat Nahar
Sam Nozuhur
Winter Okoth
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Vimbaishe Chibanga
Joanna Musik
Zachary Phillips
Md Solayman
Olivia Tan Hui
Oren Cooper
Taylor Garget
Eugene Madzokere
Elina Panahi
Samuel Heddes
Caroline Thng
Peter Sunde-Brown
Jing Wang
Yuan Zhang
Lauren Cochrane
Xavier De Bisscop
Arjuna Abitbol
Alex Johnston
Sini Hannele Kirjavainen
Yong Qian (Tracy) Koo
Shane Prenzler
Xiaofan (Amber) Chen
Gael Martin
Jack Everson
Annelies Van Den Bergh
Elisa Lim
Benjamin Lange
Moises Alfredo Maninat Maduro
Benjamin Navratil
Emily O'Neill
Samantha Palmer
Matthew Rowe
Shai Strampel
Luke Taylor
Kristi Ter Horst
Ashleigh Wellins
Benafsha Yosufi
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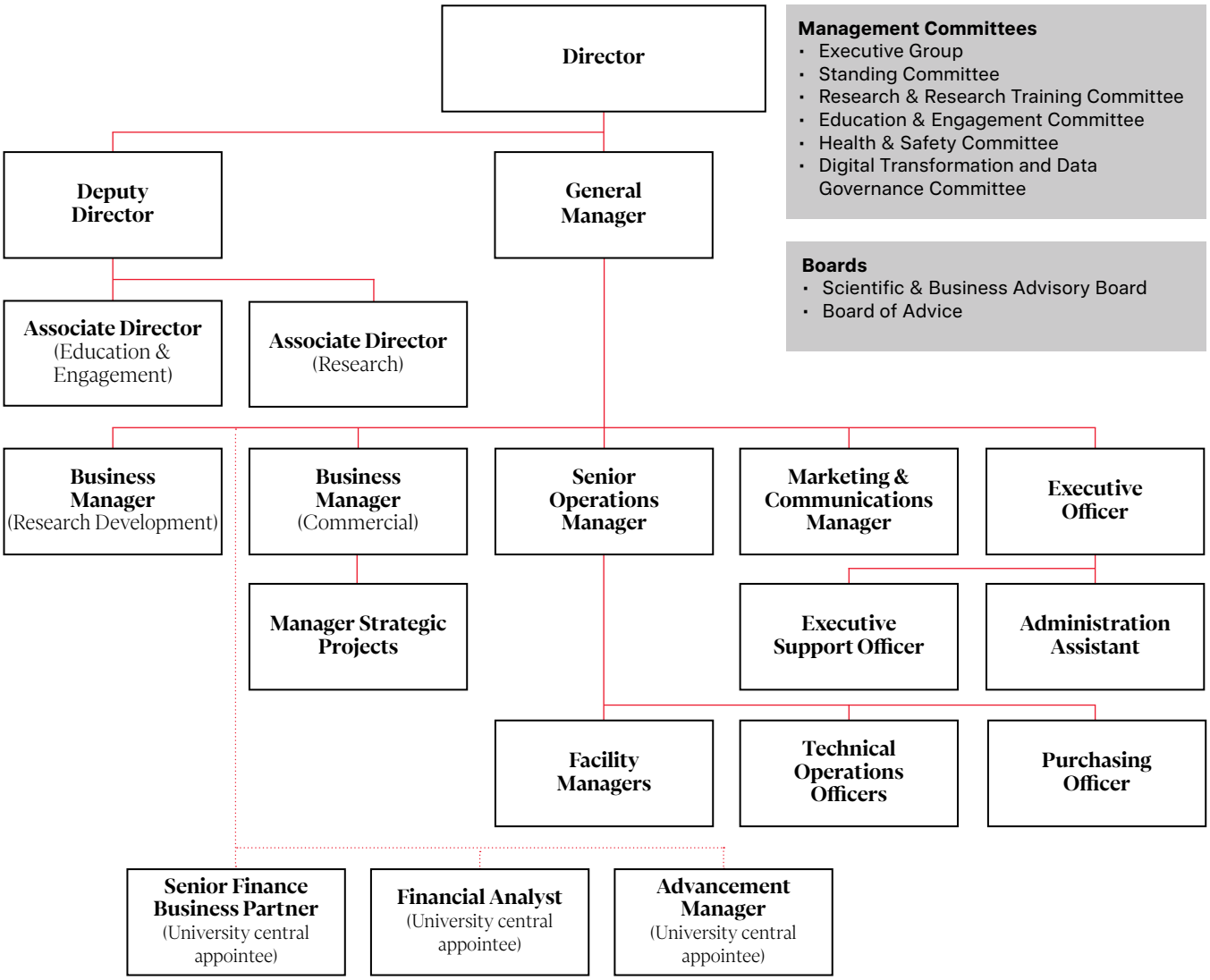
Menace Gallagher
Selena Guglielmi
Danial Iskandari
Chloe-Jay Byrne
Rachael Djordjevic
Thanh Huynh
Jasmeen Kaur
Maina Macharia
Sean Miller
Megan Young
Ashley Hutton
Sukwhee Kim
David Song
Kirstie Starr
Dominique Marando
Eric Minotte
Chloe Scott
Simon Batley
Kaleb Goodson
Leonard John Yarcia
Samantha Donaldson
Sean Luckman
Rohan Sharma
Andre Jones-Dorr
Kayden Kwah
Jessica Weeland
Sven Cleeves
Sandy Gerschler
Sam Van Hoof

Institute for Glycomics Organisational Structure



Our 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.

Our Board of Advice

The Honourable Robert Borbidge AO

Mr Pat Crotty

Mr Luke O'Dwyer

Mr Paul Sanders

Ms Christine Lohman MBA, FAICD, FPRIA

Mr Sam O'Connor MP

Ms Rachel Hancock

Mr Clayton Glenister

Ms Karen Phillips

Ms Lucy Cole

Mr William Matthews

Mr Geoffrey Thomas AO

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 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.

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.

Ms Karen Phillips

Karen's background spans 26 years of extensive experience in sectors including media, tourism, strategic partnership management, women in business, and non 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. She is Executive Director of both Queensland Women in Business and the Women in Business Awards of Australia.

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 William Matthews

Will has led a diverse career as an auditor and senior consultant across international trade and finance, health care, tourism, and non-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.

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.

Our vision for the future

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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