

INSTITUTE FOR GLYCOMICS

Annual Report
2020



Griffith
UNIVERSITY

Institute for Glycomics

Queensland, Australia

Our Vision

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



CONTENTS

4	About the Institute for Glycomics	50	Research leader highlights
5	Director's report	70	Our facilities
8	Institute highlights	75	2020 publications
10	Remarkable science	82	New grants awarded/commencing in 2020
24	Remarkable achievements	85	New philanthropic grants in 2020
32	Translation and commercialisation	86	Remarkable people
34	Commercialisation case study	88	2020 membership
35	Internationalisation	95	Remarkable support
36	Community engagement	96	Plenary/keynote/invited lectures
41	Community engagement case studies		
44	Selected outstanding publications		

Our Mission

Fighting diseases of global impact through discovery and translational science.



ABOUT THE INSTITUTE FOR GLYCOMICS

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.

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

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

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

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

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.



DIRECTOR'S REPORT

I am proud to announce that in 2020 we celebrated our 20th Anniversary, an impressive milestone that highlights 20 years of truly remarkable research.

While we were set to celebrate this achievement with the local and broader community during the course of the year, as for many others, those plans were placed on hold for 12 months due to the COVID-19 pandemic. The unexpected arrival and unprecedented impact of the pandemic has made the world a very different place, aptly demonstrating that we are in a continuous and unpredictable battle against diseases, most of which have a devastating effect across the globe.

The public now better understands that diseases don't discriminate against age, race, or gender, but affect us all. What makes this common enemy so dubious and dangerous is that diseases are not something we can visibly see or predict but leave severe consequences in their wake.

This is why RESEARCH is so vitally important.

The tireless efforts of our researchers to discover and develop new vaccines to prevent, and treatments to cure, diseases is our only hope to protect humanity from their ongoing threat.

Saying that, our researchers have not wasted any time to act against COVID-19 and our teams are working around the clock to fight this and other insidious diseases, as is our focus here at the Institute for Glycomics – to fight the world's most devastating diseases.

Despite the constant threat of research shutdown, ever-fluctuating restrictions, and a reduced workforce capacity due to COVID-19, our researchers were still able to achieve some remarkable research outcomes in 2020.

Here are some of the highlights:

Four teams of expert scientists from the Institute for Glycomics joined forces to target the virus SARS-CoV-2 to discover new vaccines and drugs to prevent or cure COVID-19. The teams are led by Institute group leaders Professor Michael Good AO, Professor Michael Jennings, Professor Johnson Mak and myself, all world-renowned research scientists in our various fields of infectious diseases research. This multi-pronged approach between highly skilled infectious diseases experts in the Institute and Queensland Health Departments, including Gold Coast University Hospital and Forensic Scientific Services, coupled with our Institute's state-of-the-art research facilities and equipment, provides much hope in the fight against COVID-19. Read more about our fight against coronavirus in the 'Remarkable Science' section of this report.

An anti-Alzheimer's drug candidate, that has been repositioned as an anti-infective, is proving effective at treating some of the most persistent, life-threatening antibiotic-resistant bacteria. Researchers from Griffith University, The University of Queensland and The University of Melbourne have discovered that a drug candidate, originally developed for Alzheimer's, is effective at disrupting and killing a class of drug-resistant bacteria that cause infections such as pneumonia, bloodstream infections and meningitis. Read more about this research in the 'Selected Outstanding Publications' section of this report.

A new experimental drug to treat sepsis has now entered the next stage of clinical trials in patients in Australia after successfully completing Phase 1a trials in healthy volunteers. The sepsis drug candidate, co-invented by researchers at the Institute for Glycomics and The Australian National University (ANU), was licensed to China Grand Pharma's Australian-based subsidiary Grand Medical Limited who is currently developing the drug candidate. Read more about this research in the 'Selected Outstanding Publications' section of this report.

An early detection test for ovarian cancer is closer to becoming a reality thanks to generous funding from The Bourne Foundation and Tour de Cure. Despite decades of research, there is currently no easily accessible, non-invasive and reliable early detection test to diagnose ovarian cancer, which leads to poor survivability rates. Our preliminary findings show that it's possible to detect a sugar in the blood of ovarian cancer patients that is not present in the blood of cancer-free women. Read more about this in the 'Commercialisation Case Study' section of this report.

In 2020, Principal Research Leader Professor Yaoqi Zhou was awarded \$570,000 for his collaborative research project titled 'RNA structure prediction by deep learning and evolution-derived restraints' by the Australian Research Council (ARC). Dr Thomas Ve was awarded an ARC Future Fellowship of \$818,952 for his project titled 'Molecular basis of nucleotide signalling by TIR domain containing proteins'.

In other pleasing funding news, the Institute for Glycomics was awarded two National Health and Medical Research Council (NHMRC) Investigator Grants worth more than \$3.5 million to 1) develop new antiviral drugs for viruses that cause either seasonal epidemics or pandemics (Professor Mark von Itzstein AO, \$2 million) and 2) develop new therapeutic strategies against neurodegenerative conditions (Dr Thomas Ve, \$1.53 million).



Additionally, the NHMRC awarded the Institute for Glycomics \$2.66 million in Ideas Grant funding to support four vital research projects: 1) Professor Michael Jennings and Dr Christopher Day were awarded \$608,424.50 for the project titled '*Structure and biophysical analysis aided design of novel toxoid vaccines for a major class of bacterial toxins*' with Dr Victor Torres, New York University; 2) Associate Professor Kate Seib was awarded \$826,490 for the project titled '*Gonococcal vaccine development guided by a cross-protective meningococcal vaccine*' with Dr Caroline Thng, Gold Coast Health; 3) Dr Mehruz Zaman was awarded \$707,717 for the project titled '*Vaccine to prevent influenza virus and bacterial super-infection*' with Associate Professor Victor Huber, University of South Dakota; 4) Dr Freda Jen and Dr Milton Kiefel were awarded \$526,949.60 for the project titled '*Targeting a bacterial glyco-Achilles heel to make new vaccines for Haemophilus influenzae and Neisseria gonorrhoeae*'. Further information on these research projects can be found in the 'Remarkable Science' section of this report.

Our malaria vaccine candidate, which is currently in human clinical trials, continues to progress despite the hindrances caused by the COVID-19 pandemic. In early 2020, MBA Lawyers – a long established and well-respected law firm based on the Gold Coast – signed a Memorandum of Understanding to become a major corporate sponsor of the Malaria Vaccine Project. The Malaria Vaccine Project is a partnership between Rotary District 9640 and Griffith University's Institute for Glycomics which aims to raise funds to support the Institute's world-first human clinical trials of our whole parasite blood-stage malaria vaccine. More on our Malaria Vaccine Project can be found in the 'Community Engagement' section of this report.

In 2020, we were delighted to welcome a new Principal Research Leader to the Institute, Professor Carolyn Mountford MSc DPhil (University of Oxford) MS (Harvard University). Professor Mountford is the Institute's new Professor of Radiology and Neuroglycobiology. She is a world leader in the development of magnetic resonance (MR) technology to address unmet clinical needs. Her translational research in the neuro field centres on MR technology to identify changes to the brain associated with Post-Traumatic Stress Disorder (PTSD), injury from blast and impact, and pain. In the cancer area, it is a preoperative diagnosis for ovarian lesions. For breast, the capacity to determine how far the breast tissue of a woman at high risk for breast cancer has deviated.

During the course of the year, we launched our new quarterly e-newsletter, The Glycomics Tribune, as well as a new educational blog, GlycoBuzz, to promote further engagement with the local and broader community.

The Glycomics Tribune provides a quarterly update on our latest research news, events and achievements. GlycoBuzz is an educational blog created for the general public, covering interesting topics authored by our Institute professionals. Find out more about these new initiatives and how you can subscribe to them in the 'Community Engagement' section of this report.

I would like to take this opportunity to thank our loyal community supporters and donors for their continued support in 2020, despite being faced with an extraordinarily challenging year.

As a fine example of perseverance and utter determination to push past the obstacles, Rotary was still able to raise an incredible \$119,500 for the Malaria Vaccine Project in 2020!

Community support and philanthropic donations are vitally important in 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. Not just for ourselves, but for our families, our friends, our community, our nation, and the world."

"That is a profound responsibility, and one which we take very seriously."

Professor Mark von Itzstein AO
Founder and Director, Institute for Glycomics,
Griffith University

INSTITUTE HIGHLIGHTS



3 Major Research Themes

- Cancer research program
- Infectious diseases research program
- Neurodegenerative diseases research program



200+

Institute Members



Income Sources for 2020

- Research grant funding \$6,639,125
- Industry, philanthropic & other support \$10,043,387

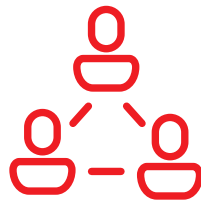


\$1 for \$1

in philanthropic funding supports our research

NEW PHILANTHROPIC ENGAGEMENT

- **Tour de Cure** Supporting our ovarian cancer research
- **Bourne Foundation** Supporting our ovarian cancer research
- **Hay Family Benevolent Fund** Supporting our melanoma research
- **Sanctuary Cove Golf and Country Club** Breast Cancer Awareness month partners
- **Griffith University Film School** A Griffith University cross-collaboration



Community Engagement

- **PARADISE POINT COMMUNITY BANK** Supporting our COVID-19 research and Summer Student Scholarship scheme
- **WARREN AND SALLY VON BIBRA** Supporting our Honours Student Scholarship scheme
- **SANCTUARY COVE GOLF AND COUNTRY CLUB** Joining forces to fight breast cancer
- **GLYCOMICS CIRCLE** Empowering women in science
- **WOMEN IN RACING** Supporting our glycomics research
- **ROTARY DISTRICT 9640** A powerful partnership to end malaria

4 Patents

filed on new Institute technologies



Partnering

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



17,931 Citations over 10 years

Clinical Trials



- **Pilot Phase 1b clinical trial with challenge completed at Griffith University (with support from Rotary)** – Institute vaccine for the prevention of malaria
- **Health Canada CTA submission for Phase 1 clinical trial in Canada in 2021** – Institute vaccine for the prevention of Group A Streptococcus
- **Preparing to enter a Phase 1b clinical trial in collaboration with Murdoch Children's Research Institute (with support from Heart Foundation)** – Institute vaccine for the prevention of Group A Streptococcus
- **Preparing to enter a Phase 2 clinical trial (with support from NHMRC)** – Repurposed vaccine for the prevention of gonorrhoea
- **Phase 1b clinical trial initiated by Grand Medical Ltd** – Institute drug for the treatment of sepsis



100+ Publications per year

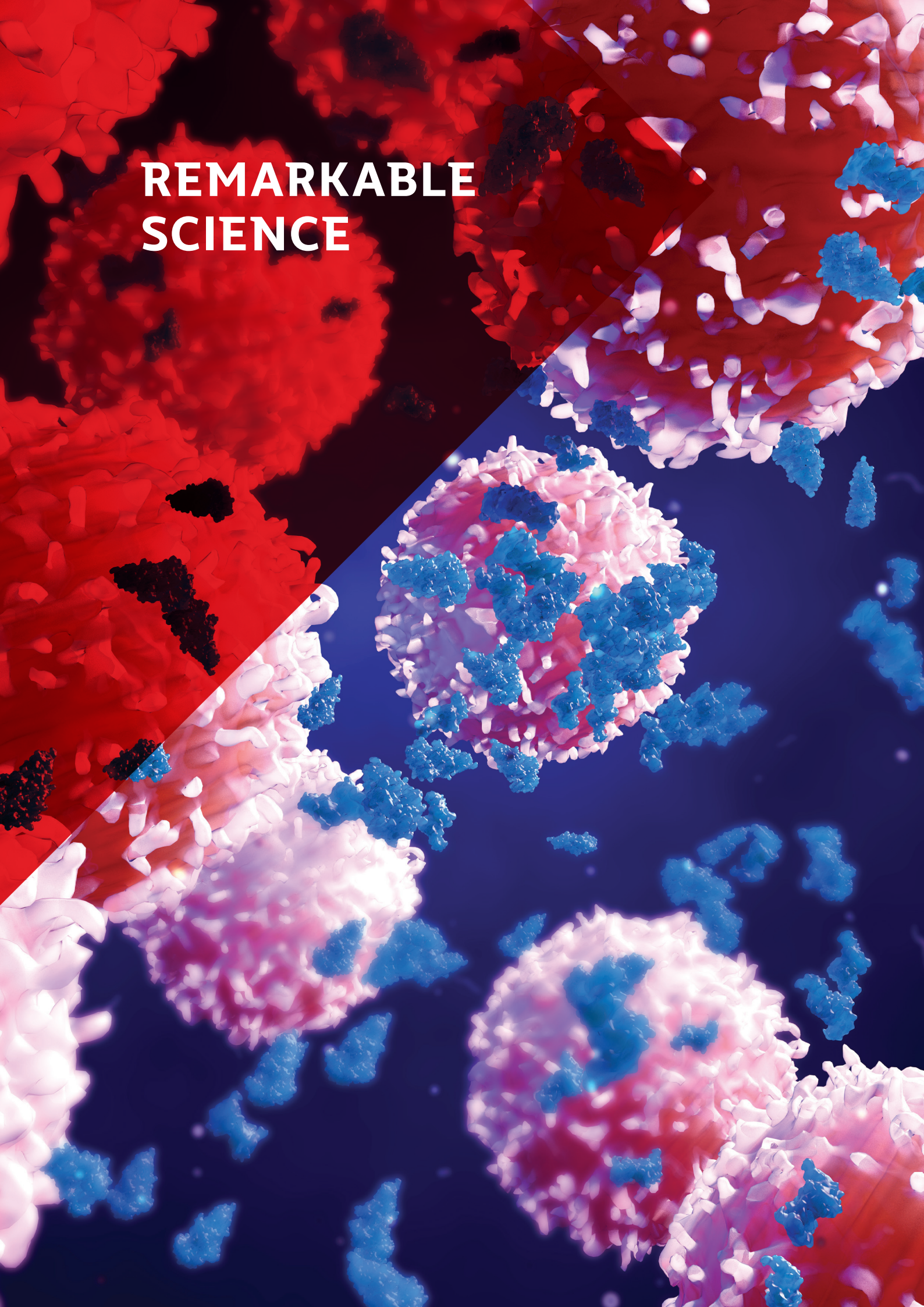


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Genetic
Ten
Six
Five
Product Inside

REMARKABLE SCIENCE



REMARKABLE SCIENCE

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

Cancer research program

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

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

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

As the only research institute of its kind in the southern hemisphere, the Institute for Glycomics is already an epicentre of glycomics research globally, and houses many world-leading carbohydrate researchers. The A2CG brings together the Institute's experts in cancer research, while providing an ideal platform for collaboration with other leading cancer researchers and clinicians around the world.

A project with the vision and scale of the A2CG requires substantial human resource, technical knowledge and specialisation. By combining core expertise and infrastructure, the A2CG is a world-class platform for mapping cancer glycomics and glycoproteomics and translating these discoveries into novel diagnostics and therapies.

The state-of-the-art equipment and infrastructure, coupled with the brightest scientific talent in the field of cancer glycomics and glycoproteomics, makes the A2CG an exciting hub of truly revolutionary cancer research.

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

In collaboration with other experts from around the globe, our researchers within A2CG made remarkable advances in 2020. Here are some of the highlights:

- Griffith University researchers have discovered a novel approach that could lead to the personalised design of anticancer drugs that resist metastasis (tumour spread) in triple-negative breast cancer. Our researchers, in collaboration with researchers at Virginia Commonwealth University in the US, have proposed a completely unique approach to metal-based cancer therapy by way of protecting important signalling sugars on the surface of tumour cells, thereby preventing cancer metastasis. This discovery paves the way for developing metal-based anti-cancer drugs with less side effects that could potentially avoid drug resistance.
- Research into the development of an early detection test for ovarian cancer at the Institute for Glycomics has been given a \$300,000 funding boost from The Bourne Foundation and a further significant funding pledge from Tour de Cure. With no substantial improvement in ovarian cancer survival rates over the past two decades, the key to ovarian cancer survival lies in the development of better diagnostic methods. Our research findings have shown that it is possible to detect a sugar, called Neu5Gc, in the blood of ovarian cancer patients that is not present in the blood of cancer-free women. The significant value of this technology as a tool for early cancer diagnosis, as well as a tool for monitoring treatment and disease, was recognised by Australian listed diagnostics company BARD1. An exclusive licensing deal was negotiated with BARD1 to co-develop and commercialise the technology as a novel cancer diagnostic. This technology is a potential game-changer for detecting cancer.

Infectious diseases research program

Infectious diseases pose some of the world's most significant health challenges, claiming over 17 million lives globally every year.

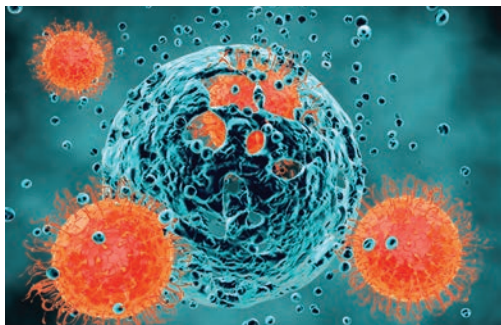
There is an overwhelming need to find new ways to combat diseases caused by bacterial, viral, parasitic and fungal pathogens. The increasing emergence of antibiotic-resistance is also a global concern.

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

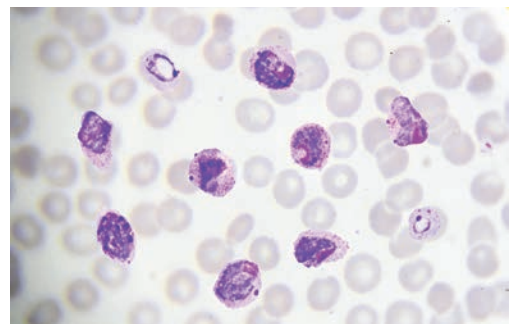


Viral infections

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

Parasitic infections

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

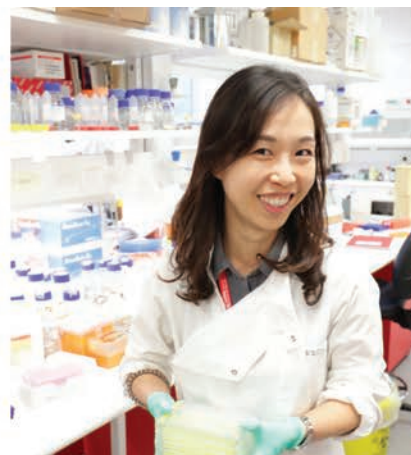


Fungal infections

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

Some of the highlights of our infectious diseases research in 2020 include:

- Professor Mark von Itzstein AO was awarded an NHMRC Investigator Grant to the value of \$2 million to develop new antiviral drugs for viruses that cause either seasonal epidemics or pandemics. Acute viral infections caused by human influenza viruses (flu), human parainfluenza viruses (croup, bronchitis, pneumonia) and human enteroviruses (hand, foot and mouth disease) are a significant health burden on a global scale. This Investigator Grant support package will target the carbohydrate (sugar)-related pathways essential in the lifecycle of the three viruses to find potential drug candidates.
- Institute for Glycomics was awarded \$2.66 million in Ideas Grant funding from the NHMRC to aid four vital research projects:
 - » Professor Michael Jennings and Dr Christopher Day were awarded \$608,424.50 for the project titled '*Structure and biophysical analysis aided design of novel toxoid vaccines for a major class of bacterial toxins*' with Dr Victor Torres, New York University. Cholesterol dependent cytolysins (CDCs) are bacterial toxins produced by many important human pathogens including Group A Streptococcus (Strep A) and Pneumococcus. Strep A infections cause a range of diseases including pharyngitis, Scarlet fever and necrotising fasciitis. If left untreated, they can also lead to rheumatic fever, reactive arthritis and rheumatic heart disease. Our researchers have developed an innovative way of inactivating CDCs based on new knowledge of how they target human cells and will use this knowledge, and this vital funding, to facilitate the development of novel vaccines.
 - » Associate Professor Kate Seib was awarded \$826,490 for the project titled '*Gonococcal vaccine development guided by a cross-protective meningococcal vaccine*' with Dr Caroline Thng, Gold Coast Health. *Neisseria gonorrhoeae*, the bacteria responsible for the sexually transmitted infection gonorrhoea, causes more than 100 million new infections each year and is an urgent public health threat. Control of gonorrhoea depends on the development of a vaccine due to the continuing increase of antibiotic resistance and the staggering outcomes of infection, including infertility and increased transmission of HIV. The bacteria causing gonorrhoea and meningococcal B disease are very similar, and our preliminary studies indicate that a widely licensed meningococcal vaccine, 4CMenB, induced antibodies that cross react with gonorrhoea. This grant enables our researchers to further investigate if the meningococcal vaccine can protect against gonorrhoea and determine the gonococcal antigens and type of immune response needed to mediate protection against gonorrhoea, thus guiding the development of a gonococcal vaccine.
 - » Dr Mehfuz Zaman was awarded \$707,717 for the project titled '*Vaccine to prevent influenza virus and bacterial super-infection*' with Associate Professor Victor Huber, University of South Dakota. Patients with viral infections of the upper respiratory tract involving the influenza virus can sometimes develop further bacterial infections such as those caused by *Streptococcus pyogenes* (Strep A), as well as other types of bacterial pathogen. Known as 'super-infections', the severity of such bacterial infections is significantly increased despite the availability of influenza vaccines, antiviral treatments, and antibiotics. This grant will help facilitate the development of a novel multi-pathogen vaccine candidate against major upper respiratory tract pathogens – Influenza A and bacterial pathogens responsible for super-infections.
 - » Dr Freda Jen and Dr Milton Kiefel were awarded \$526,949.60 for the project titled '*Targeting a bacterial glyco-Achilles heel to make new vaccines for Haemophilus influenzae and Neisseria gonorrhoeae*'. *Neisseria gonorrhoeae* causes the sexually transmitted infection gonorrhoea. *Haemophilus influenzae* is responsible for diseases such as middle ear infections in children, sinusitis in adults, and acute bronchitis in individuals, and is the major cause of exacerbations of chronic obstructive lung disease. Unfortunately, these two pathogens are becoming increasingly multi-drug resistant. These diseases are a major health and economic burden, and in the absence of new drugs, a vaccine to prevent these diseases has emerged as a major unmet need in human health. This grant will enable the development of a new vaccine that targets a bacterial-specific sugar that we have discovered is the Achilles heel of these bacteria.





- Professor Yaoqi Zhou was awarded \$570,000 by the Australian Research Council (ARC) for the joint project titled '*RNA structure prediction by deep learning and evolution-derived restraints*'.
- Dr Belinda de Villiers was awarded an Advance Queensland COVID-19 Industry Research Fellowship to the value of \$90,000 for her project titled '*Evaluation of COVID-19 antiviral and vaccine candidates, using a non-infectious virus-like particle platform*'.
- Vital COVID-19 research has been supported by the Queensland Government and the City of Gold Coast, each providing \$100,000 (total \$200,000) to the Australian node of Fraunhofer iCAIR® (Fraunhofer International Consortium for Anti-Infective Research) COVID-19 project.
- A new experimental drug to treat sepsis has now entered the next stage of clinical trials in patients in Australia after successfully completing Phase 1a trials in healthy volunteers. The sepsis drug candidate, co-invented by researchers led by Professor Mark von Itzstein AO at the Institute for Glycomics and Professor Christopher Parish at The Australian National University (ANU), was licensed to China Grand Pharma's Australian-based subsidiary Grand Medical Limited who is currently developing the drug candidate.
- An experimental Alzheimer's disease treatment, repositioned as an anti-infective agent, is proving effective at treating some of the most persistent, life-threatening antibiotic-resistant bacteria. Researchers from Griffith University, The University of Queensland and The University of Melbourne have discovered that the drug called PBT2 is effective at disrupting and killing a class of drug resistant bacteria – known as Gram-negative bacteria – that cause infections such as pneumonia, bloodstream infections and meningitis.

Neurodegenerative diseases research program

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

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

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

The science behind neurodegenerative diseases

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

When axons are damaged, whether by injury, disease or as a side effect of certain drugs, a program is triggered to make axons self-destruct. This destruction likely plays an important role in multiple 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.

Our unique research approach - Dr Thomas Ve

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.

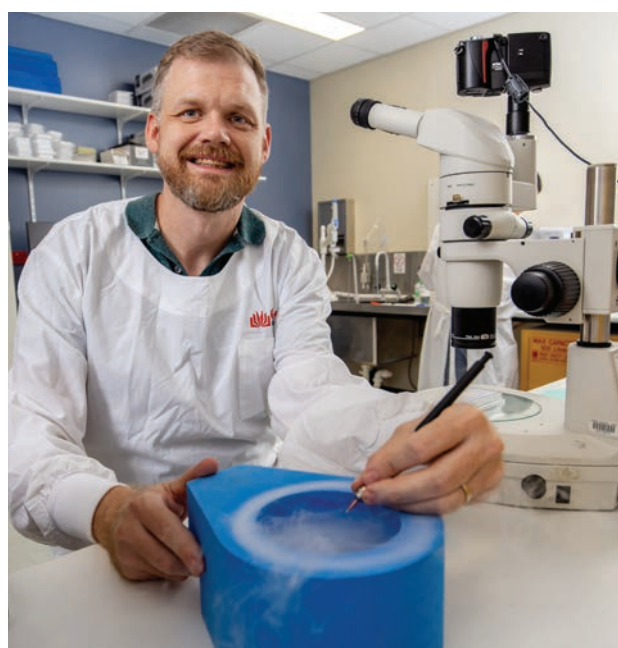
SARM1 is a potential therapeutic target for many neurodegenerative diseases but, in order to exploit the full promise of targeting SARM1, detailed knowledge of the catalytic mechanism and the molecular mechanisms upstream and downstream of SARM1 enzyme activity is required.

Dr Thomas Ve's research group at the Institute for Glycomics is using structural biology methods such as cryo-EM and X-ray Crystallography, combined with cell and chemistry-based approaches through national and international collaborators, 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.



Our unique research approach - Professor Carolyn Mountford

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

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

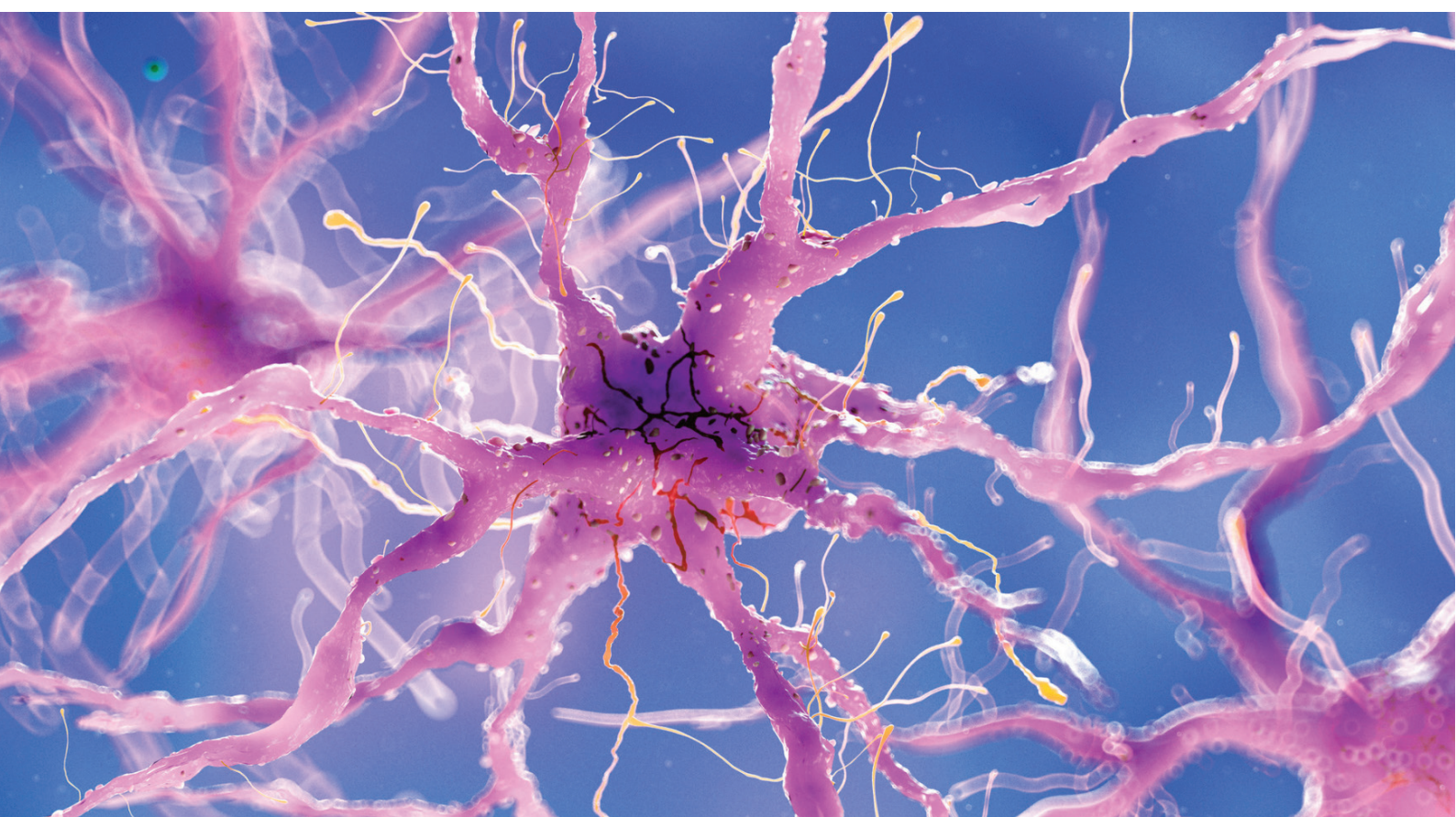
Professor Mountford's research team uses clinical 3T scanners to monitor the effect of disease and pain on the human glycome.

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

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

Some of the highlights of our neurodegenerative diseases research in 2020 include:

- Dr Thomas Ve was awarded an NHMRC Investigator Grant to the value of \$1.53 million to aid his research into neurodegenerative diseases research. His program of research aims to develop new therapeutic strategies against neurodegenerative conditions such as amyotrophic lateral sclerosis (ALS), Parkinson's disease, peripheral neuropathies and traumatic brain injury. When the normal functions of nerve fibres (axons) are compromised by insults such as trauma or chemical toxicity, they breakdown and die. Axon loss is common in some of the most prevalent neurological diseases, including peripheral neuropathies, ALS, MS, traumatic brain injury, Parkinson's disease and glaucoma, but there are no current treatments that effectively target axonal breakdown. Dr Ve and his team will focus on analysing proteins involved in neurodegeneration including one called SARM1, a key executioner of axon degeneration. In healthy nerve cells, SARM1 is present but inactive. However, disease and injury can trigger SARM1 activation resulting in rapid breakdown of the "helper" molecule known as NAD⁺, and ultimately lead to destruction of the axon. Dr Ve's research aims to develop inhibitors that prevent axon degeneration. If this can be achieved, it can ultimately lead to new treatments for patients suffering a variety of neurological conditions.
- Dr Thomas Ve was awarded an Australian Research Council (ARC) Future Fellowship of \$818,952 for his project titled '*Molecular basis of nucleotide signalling by TIR domain containing proteins*'.





The International Consortium for Anti-Infective Research

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

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

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

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

iCAIR® is working on the development of anti-infective therapies that take new treatment options all the way from the identification of potentially beneficial substances to the 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, iCAIR® commenced a joint project to develop treatments against SARS-CoV-2, the virus that causes COVID-19. The joint project aims to find cures for COVID-19 through drug-repurposing screens using advanced *ex vivo* human models, develop new drugs based on these findings, and discover new vaccines to prevent the disease.





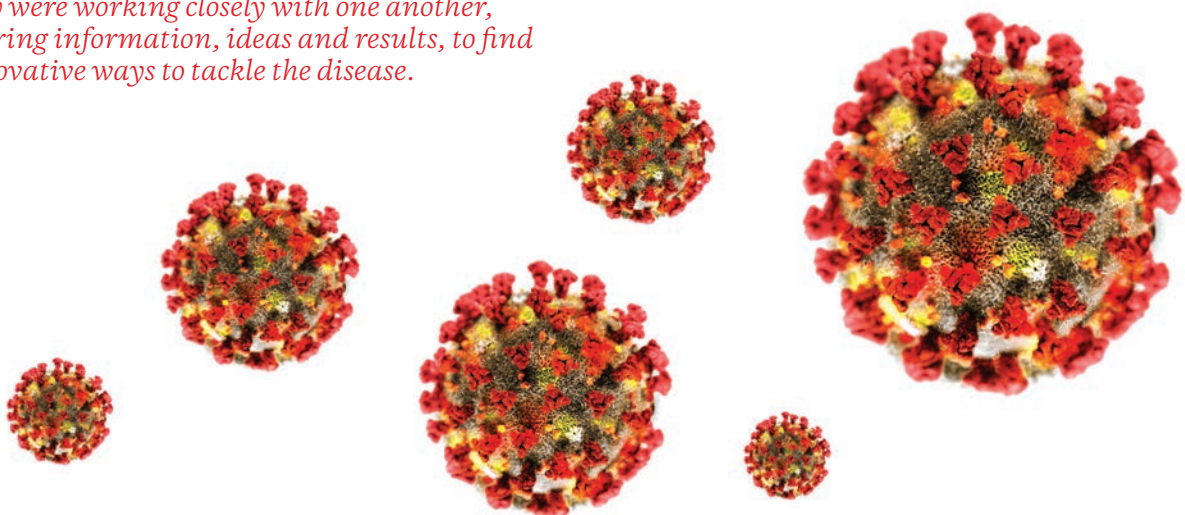
Our fight against COVID-19

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

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

Professor von Itzstein AO, Founder and Director of Institute for Glycomics, said that although each team possesses a specific focus and strategy, they were working closely with one another, sharing information, ideas and results, to find innovative ways to tackle the disease.

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



Professor Mark von Itzstein AO and team

Professor von Itzstein and his research team including Drs Patrice Guillon, Larissa Dirr, Ben Bailly, Andrea Maggioni, Ibrahim El-Deeb and Chih-Wei Chang and other institute researchers are using advanced *ex vivo* human respiratory system models to evaluate existing drugs, and combinations, as drug candidates to prevent or treat COVID-19.

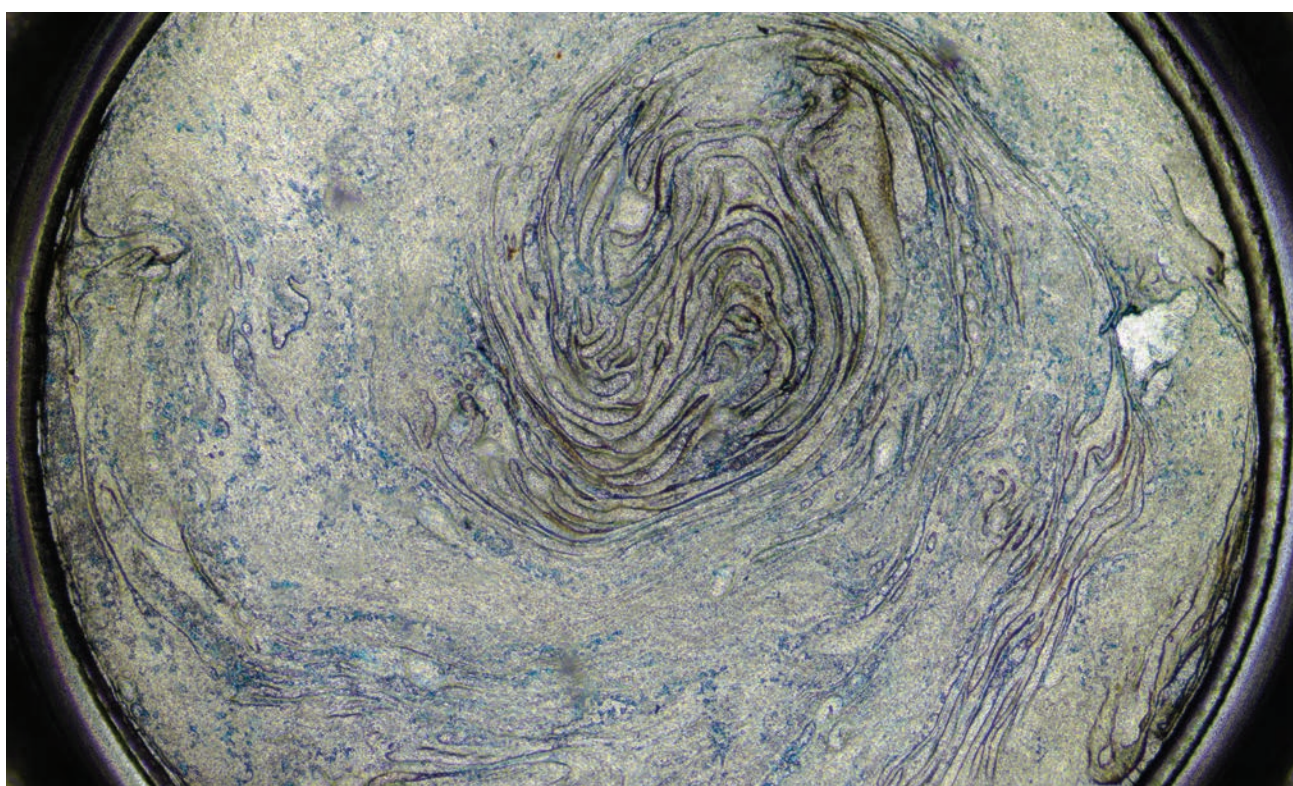
The team is working in collaboration with Queensland Health Departments including Gold Coast University Hospital clinicians and Forensic Scientific Services as well as iCAIR®.

Professor von Itzstein, who led the team that designed the world's first approved designer anti-influenza drug Relenza®, said his research group's approach to finding

a cure for COVID-19 was unique in the country as the human respiratory models they employ were the closest to a real human airway system, without working in a human patient.

“Our approach to the rapid discovery of therapeutics against COVID-19 in collaboration with our Queensland Health collaborators and our German colleagues in iCAIR® gives us the best chance to deliver a successful outcome in finding a cure against this pandemic virus. We need a cure today,” he said.

Image caption: Human Airway Epithelial cells infected with SARS-CoV-2; infected cells are stained in blue



Professor Michael Good AO and team

Professor Michael Good AO and his research team are working closely with the other research teams within the Institute for Glycomics, as well as with colleagues at the Gold Coast University Hospital and China's Olymvax Biopharmaceuticals Inc. to develop a vaccine for COVID-19.

Professor Good said, “It is important that many different approaches to developing a vaccine proceed in parallel.”

Professor Good and his team, based within the Institute's Laboratory of Vaccines for the Developing World, are building on many years of vaccine development experience in streptococcus and malaria research to

identify critical target points on the coronavirus that may be susceptible to immune attack and to use that information to develop a highly focussed vaccine.

“All of our combined immunological, virological and clinical expertise will be required for success, but the need for hard work will not be an impediment.

“Our country is facing a health, societal and economic upheaval, but the cause is biological, and vaccination is known to be the most cost-effective way to fight infectious agents and improve public health.”

Professor Johnson Mak and team

Professor Johnson Mak and his research team are working to establish a rapid assay system to evaluate potential drug and vaccine candidates that can prevent the entry of SARS-CoV-2 (the virus that causes COVID-19). This system is currently being used in collaboration with the other research teams within the Institute for Glycomics for the development of therapeutics.

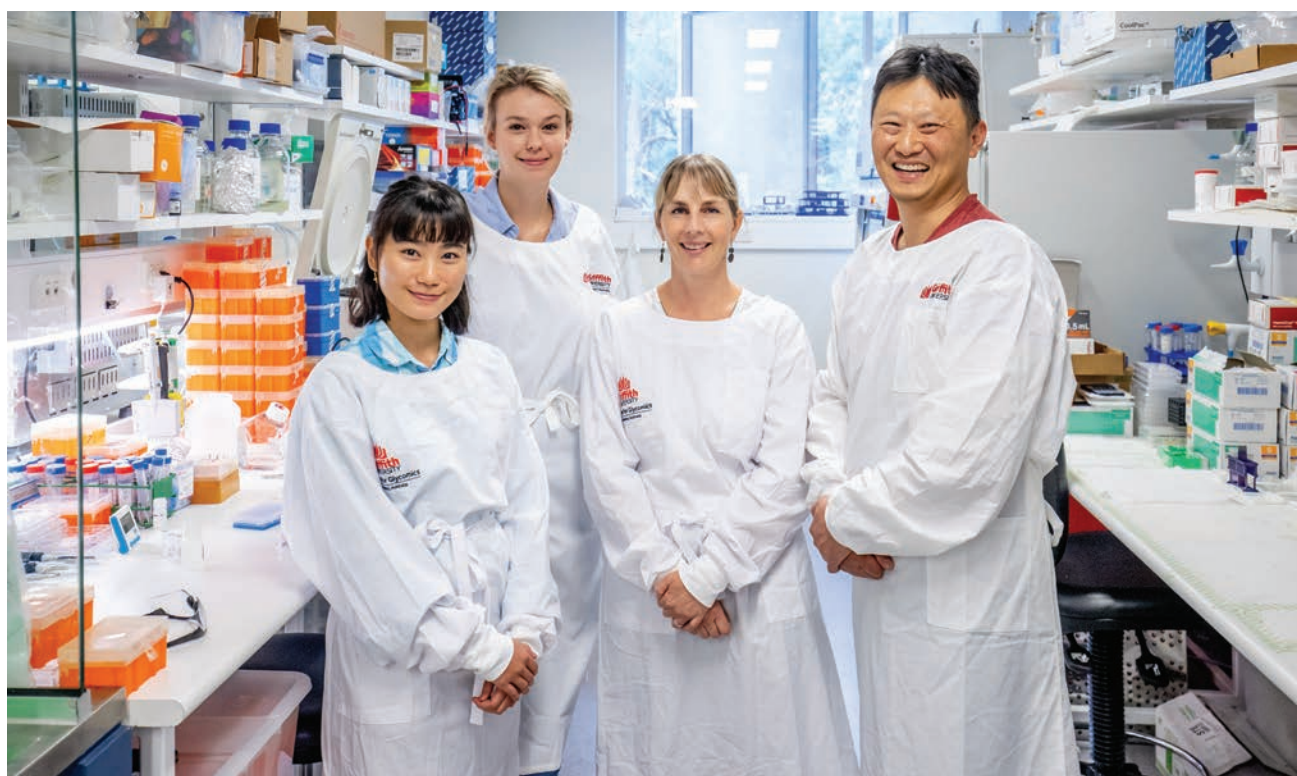
Professor Johnson Mak said that while many drug and vaccine candidates have been suggested to have therapeutic potential in the treatment of COVID-19, the relatively low number of individuals who acquire severe infection make it difficult to properly evaluate the effectiveness of all these drug and vaccine candidates in clinical trials.

“A laboratory-based evaluation system will help to filter out less-promising candidates early on, thereby enabling us to place our resources behind the most promising therapeutic strategy,” he said.

To complement this approach, the research team will work closely with Associate Professor Alan Wee-Chung Liew at Griffith Institute of Integrated Intelligent Systems and fellow Institute Research Leader Associate Professor Thomas Haselhorst in an attempt to use artificial intelligence and structural biology to fast track the development of novel antiviral drug candidates for COVID-19.

“My research team has nearly 30 years of experience in virology research. The collective expertise of our team and our collaborators, both within and external to Griffith University, will help to accelerate our efforts to identify effective therapeutic strategies,” Professor Mak said.

“We are confident that we can positively contribute to the greater global efforts to resolve the crisis situation we are currently facing.”



Professor Michael Jennings and team

Professor Michael Jennings and Dr Christopher Day have developed propriety biophysical drug screening approaches that allow for the rapid screening of known drugs that can be repurposed to target crucial steps in infectious disease processes.

“These approaches, in combination with computational biology approaches led by fellow Institute Research Leader, Associate Professor Thomas Haselhorst, are currently being applied to find solutions to COVID-19,” Professor Jennings said.

State-of-the-art research facilities and capabilities

Dr Michael Batzloff, Senior Operations Manager at the Institute for Glycomics, said their facilities were fully equipped to deal with the virus.

“The Institute has a number of Physical Containment Level 2 and Level 3 (PC2 and PC3) facilities. These laboratory facilities are designed in accordance with Australian standards and they allow us to conduct research on high-risk pathogens such as SARS-CoV-2.

“Access to the PC3 facility is strictly controlled and all work can be monitored remotely. These state-of-the-art facilities allow us to conduct SARS-CoV-2 research in

controlled negative pressure rooms, ensuring there is no risk to staff or the environment.

“The Institute is taking all the necessary safety precautions to ensure that our vital research continues, whilst abiding by critical hygiene, safety and social distancing measures.”

Professor von Itzstein said Institute researchers were working around the clock to fight the disease and, as a translational medical research institute, were delighted to bring their virology, drug and vaccine discovery expertise to bear against this deadly virus.



Philanthropic Support - ‘The Modern Day Village’

For decades, the statement ‘it takes a village’ has related to raising children, however the foundations of the statement can be applied perfectly to research.

As Australia and the world locked down and braced for COVID-19, they looked to medical professionals and researchers to create a solution. Unfortunately, the puzzle has been much more difficult to solve than picking between a red pill and a blue pill.

Local supporters within our community, together with the City of Gold Coast and Queensland Government, were swift to react and support the Institute for Glycomics’ response, rallying around our four teams of experts and collectively donating a total of \$265,704 to aid our COVID-19 research.

We extend our sincerest appreciation to the community who form the foundation of our modern day village.

Professor Michael Good AO appointed member of the National COVID-19 Health and Research Advisory Committee

In 2020, Professor Michael Good AO became a member of the National COVID-19 Health and Research Advisory Committee.

The National COVID-19 Health and Research Advisory Committee was established to provide advice on Australia's health response to the COVID-19 pandemic to the Commonwealth Chief Medical Officer. Members of the Committee were selected to provide a range of expertise and perspectives and include respected community leaders and parliamentarians, clinicians and researchers from a variety of disciplines (infectious disease, public health, emergency response, hospital care, primary care, social science and bioethics), and persons able to represent the voices of older people, people with disability, Aboriginal and Torres Strait Islander people, younger people and people with mental health concerns.

The membership includes representation from all states and territories and from rural and remote Australia.

The Committee:

- provides rapid and evidence-based advice (or expert advice in the absence of evidence) on Australia's health response to the COVID-19 pandemic with the aim of preventing new cases, optimising the treatment of current cases, and assisting in

optimising overall health system readiness to deal with the pandemic as it progresses

- members have the capacity to provide rapid advice to the Committee on key issues (one-page briefs)
- has the capacity to recommend seeking rapid advice from members of the Australian health and medical research sector
- is able to provide feedback on what measures appear to be working and what measures are not, in different parts of the country
- may need to recommend to the CMO to quickly bring together experts to respond to requests for advice on public health risks and health management issues related to the COVID-19 pandemic
- will be available, in consultation with the CMO, to provide environmental scanning and advice on key issues as they arise, including the effectiveness of public health measures overseas, availability of ventilators and ICU beds, appropriateness of delivery and use of PPE, monitoring the effectiveness of the roll out of Telehealth item numbers, progress on rapid testing and vaccines, post-viral issues, and monitoring of key outcomes.

For more, please visit www.nhmrc.gov.au





The image features a microscopic view of several cells, likely in the process of division, with prominent nuclei and chromatin. A large, semi-transparent red diagonal shape is overlaid on the left side of the image, creating a strong visual contrast. The text 'REMARKABLE ACHIEVEMENTS' is positioned within this red area.

REMARKABLE ACHIEVEMENTS

Institute for Glycomics

Fighting Diseases of Global Impact



Professor Mark von Itzstein AO awarded Gold Coast Citizen of the Year

Griffith University's Director and Head of Research for the Institute for Glycomics Professor Mark von Itzstein AO was honoured with the Gold Coast Citizen of the Year award at the city's 2020 Australia Day awards.

The Institute celebrated its 20-year anniversary in 2020, a fact which humbles Professor von Itzstein AO as much as news of the award.

"I am honoured to accept the award on behalf of all members of the Institute, as it is the team that has driven the success of our translational research in fighting diseases of global impact," he said.

"The Gold Coast community is our partner and we have the responsibility of making a difference to health outcomes for them.

"I have been overwhelmed by the extent of the community's support and it makes a real difference to our capacity to undertake world-leading research.

"I would also like to gratefully acknowledge Griffith University for the amazing investment and support that has been provided to the Institute.

"The vision that we started it with 20 years ago has not changed, and as a unique leading medical research institute in the country, we strive to discover solutions to difficult diseases."

Professor von Itzstein led the research team that discovered the world's first drug for influenza, Relenza.

Professor von Itzstein said the Institute's achievements over the last 20 years were also made possible by generous financial contributions from the Queensland State Government and City of Gold Coast.

Prior to being awarded Gold Coast Citizen of the Year in 2020, Professor von Itzstein was made an Officer of the Order of Australia in 2019.

Professor von Itzstein AO attended a personalised ceremony on 6 July 2020 at Queensland Government House, where he was officially presented with his AO award after various delays due to the onset of the COVID-19 pandemic.

Dr Lara Herrero recognised at Gold Coast Women in Business Awards

Dr Lara Herrero, research leader at the Institute for Glycomics, was honoured with the Creating Change Award at the 2020 Gold Coast Women in Business Awards.

The highly prestigious Women in Business Awards of Australia recognises and honours exceptional businesswomen and industry achievers who are making a difference across Queensland.

“I am both honoured and humbled to receive this award in recognition of my research expertise and leadership in helping to create change that is good for the environment and community,” Dr Herrero said.

“Research is a team effort, and I am fortunate to lead a remarkable team of scientists who have contributed greatly to this work so far. I am very grateful to my team and the Institute for Glycomics and Griffith University for the ongoing support.”

Dr Herrero’s research focuses on vector-borne diseases; primarily mosquito-transmitted viruses which cause a range of clinical manifestations including encephalitis, arthritis, arthralgia and myalgia.

She is particularly interested in alphaviruses associated with arthritis such as chikungunya virus (CHIKV) and

Ross River virus (RRV), having suffered from RRV arthralgia herself.

“We have discovered a potential new treatment for viral arthritis which has successfully completed phase II clinical trials and is now entering phase III clinical trials,” Dr Herrero said.

Director of the Institute for Glycomics, Professor Mark von Itzstein AO, said the award was very well deserved for a research leader who has so aptly demonstrated the importance of translational research.

“It’s wonderful to see our researchers recognised for their many years of hard work and research efforts, which mostly happens behind the scenes and out of the spotlight.

“On behalf of everyone at the Institute for Glycomics, I would like to congratulate Dr Herrero on this outstanding achievement. We are very proud!”

The annual Women in Business Awards of Australia initiative was created to honour women who possess vision, innovation, entrepreneurial drive, leadership, individuality and tenacity, with the ultimate goal being to present role models for other women to aspire to.



Celebrating research excellence at the Institute for Glycomics

Some of Griffith University's most outstanding researchers were honoured at the Institute for Glycomics Research Excellence Awards at the beginning of 2020.

Awards from the following schemes were presented at the event:

1. 2020 Glycomics Research Excellence Awards
2. 2020 Glycomics Honours Scholarships
3. 2020 Glycomics Masters Scholarship
4. 2019/2020 Bendigo Bank Paradise Point Glycomics Summer Scholarships

2020 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 winners were:

- Excellence in Higher Degree Research – The Director's Medal: Dr Jessica Poole
- Excellence in an Early Career Researcher: Dr Farhadul Islam
- Excellence in a Mid-Career Researcher: Dr Manisha Pandey
- Excellence Award for Research Supervision: Professor Mark von Itzstein AO
- Excellence in Research Engagement: Professor Michael Good AO
- Excellence in Research Leadership: Professor Sue Berners-Price



2020 Glycomics Honours Scholarships

- 2020 Sally & Warren von Bibra Honours Scholarship – Ms Holly O’Donnell
- 2020 Glycomics Circle Honours Scholarships – Ms Laura Blechner and Ms Rose Manakil

2020 Glycomics Masters Scholarship

The Glycomics Masters Scholarship is a new scholarship scheme established in 2020 to provide support to an outstanding student who is undertaking their master’s program within the Institute for Glycomics.

This prestigious scholarship was awarded to Mr Jason Lee.



2019/2020 Bendigo Bank Paradise Point Glycomics Summer Scholarships

The Glycomics Summer Scholarship scheme provides second- and third-year undergraduates with an opportunity to discover the exciting world of research.

The winners were:

Kisshanpyar Anand, Neeraj Bhatnagar, Peter Blakeley, Riccardo Cecchin, Alasta Firkins, Stephen Jiang, Ropafadzo Muchabaiwa, Nayma Tarik, and Huaying Xu.



Acknowledgement of the Glycomics Champions

Also acknowledged on the awards night were the members of the Glycomics Champions program, which is a community outreach training and engagement program established in 2019. It provides Higher Degree Research students and research scientists with an opportunity to reach out to the broader community and attract high quality research students by hosting tours and promoting the Institute's remarkable research. The Champions were acknowledged and thanked for their contributions to this very successful program.

The Institute's Glycomics Champions:

- Michael Batzloff
- Joanna Musik
- Kathirvel Alagesan
- Vimbaishe Chibanga
- Tiago Oliveira
- Ibrahim El-Deeb
- Hadieh Eslampanah
- Victoria Ozberk
- Danielle Stanisic
- Arun Everest-Dass
- Manisha Pandey
- Jack Everson
- Dylan Farr
- Evgeny Semchenko
- Oren Cooper
- Johnson Mak
- Lucy Shewell
- Tamim Mosaib
- Catherine Tindal



Student Completions in 2020

5 March 2020, **Greg Tram**, "*Characterisation of Bacterial Biofilm Formation*", supervised by Professor Victoria Korolik and Dr Christopher Day

28 February 2020, **Daniel Earley**, "*Development of Novel Heparan Sulfate Analogues as Antiviral Agents*", supervised by Professor Mark von Itzstein AO and Dr Robin Thomson

24 February 2020, **Hanan Ahmed Najem Al-Nazal**, "*Immunity to Babesiosis and Discovery of Next Generation Vaccines*", supervised by Professor Michael Good AO and Dr Michael Batzloff

12 August 2020, **Brijesh Jakasaniya Aka Patel**, "*Structure Based Design of Inhibitors Targeting Galectin-8*", supervised by Professor Helen Blanchard, Associate Professor Todd Houston and Dr Chandan Kishor

Professor Sue Berners-Price wins 'Excellence in Research Leadership' award

Professor Sue Berners-Price, Principal Research Leader at the Institute for Glycomics, was honoured with the 'Excellence in Research Leadership' award in the 2020 Vice Chancellor's Research Excellence Awards at Griffith University.

Professor Berners-Price is an acknowledged world-leader in the field of medicinal inorganic chemistry. As a Principal Research Leader at the Institute for Glycomics, she has spearheaded the development of a new area of endeavour – metalloglycomics.

A major advance has been the new perspective she has provided to gold-based therapeutics, showing they can be rationally designed as versatile drugs for a range of human diseases caused by dysfunction of selenol and thiol containing proteins.

Professor Berners-Price has played a major leadership role in nurturing the development of bioinorganic chemistry and medicinal inorganic chemistry internationally. She is the current President of the Society of Biological Inorganic Chemistry and the recipient of the 2018 Asian Biological Inorganic Chemistry Outstanding Achievement Award.

She is also an internationally recognised leader in graduate research education and the immediate past convener of the Australian Council of Graduate Research.



Dr Michael Batzloff wins 'Excellence in Enhancing Research' award

Dr Michael Batzloff, Senior Operations Manager at the Institute for Glycomics, was awarded with the 'Excellence in Enhancing Research' award in the 2020 Griffith University Vice Chancellor's Awards for Excellence in Professional and Support Staff Service.

Dr Batzloff was recognised for his commitment to providing a safe and productive research environment, his involvement in research committees, and efforts in rapidly adapting to challenges and new opportunities brought about by COVID-19.



2020 Nobel Prize Winner: Dr Michael Houghton

The Institute for Glycomics would like to recognise and congratulate University of Alberta virologist, Dr Michael Houghton, who was awarded the 2020 Nobel Prize in Physiology or Medicine for his discovery of the hepatitis C virus, for which he is now developing a vaccine.

His discovery with colleagues Qui-Lim Choo and George Kuo in 1989 opened a new field of viral hepatitis research that led to improved blood safety, and hepatitis C treatment to the point where the viral infection can now be cured in virtually all patients.

Dr Houghton is a key collaborator and sponsor of the Institute for Glycomics' Strep A vaccine clinical trial that is underway in Canada.

Dr Houghton is working with the Institute's team, including Professor Michael Good AO, Dr Manisha Pandey and Dr Simone Reynolds, to undertake the Phase I trial to assess the safety and immunogenicity of the Strep A vaccine.

Strep A is the cause of multiple diseases including strep throat, rheumatic heart disease and toxic shock.

TRANSLATION AND COMMERCIALISATION

A young woman with dark hair pulled back, wearing a white lab coat and green nitrile gloves, is smiling at the camera. She is holding a pipette with a yellow tip, which is dispensing a small amount of yellow liquid into a small white container. The background is a blurred laboratory setting with various pieces of equipment. A large red diagonal shape is overlaid on the top left of the image, containing the text 'TRANSLATION AND COMMERCIALISATION'. The lab coat has a logo on the left chest that reads 'Griff UNIVE Queensland' with a stylized red and white graphic to the left of the text.

Griff
UNIVE
Queensland

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.

Consequently, as the world looked to biotech and pharma in 2020 to solve the ever-growing challenges associated with the spread of SARS-CoV-2, we focussed our expertise to rapidly deliver drug and vaccine candidates, along with research infrastructure, to support the global initiative. Two patents were filed on a suite of repurposed drug candidates, identified via our novel screening program; and a third patent was filed on a novel peptide-based vaccine candidate. A second vaccine candidate provided opportunity to expand our partnership with Olymvax Biopharmaceuticals and the candidate is currently under development via a new partnership with a local New Zealand biotech.

The Institute's Business Team, led by the General Manager, 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 2020, two major commercial deals were signed. A commercial investment and benefit share agreement with our partners at The Li Ka Shing Institute of Virology at the University of Alberta supports the ongoing development of our Strep A vaccine and enables a Phase 1 clinical trial to be conducted under Canada Health's Clinical Trial Application. It is expected that this trial will begin in 2021 and the clinical outputs will feed directly into a Phase 1b (with challenge) clinical trial to be held in Australia immediately following. Additionally, with our partners at University of Adelaide, a licence deal was struck with an Australian biotech company BARD1 Ltd for the licence and co-development of a novel diagnostic for human cancer. The commercialisation of this technology successfully demonstrates the benefit of the Institute's coordinated strategy for technology development and translation and is profiled in the 'Commercialisation Case Study' section of this report.

Institute assets continue to march through the clinical development pipeline. We are pleased to report that Grand Medical Pty Ltd, licensees of our drug candidate for sepsis, began a Phase 1b study in Australia. Additionally, our vaccine candidate for malaria successfully completed a pilot Phase 1b (with challenge) study, run at Griffith University with the support of our funding partners, Rotary.

In 2021 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.



COMMERCIALISATION CASE STUDY

Glycomics partnership with Australian listed company BARD1 Life Sciences Ltd

A partnership between the Institute for Glycomics, University of Adelaide and Australian listed biotech company BARD1 Life Sciences Ltd (ASX: BD1) is working to develop specific diagnostics for detection and monitoring of multiple cancers including ovarian and breast cancer.

Early detection and treatment of cancer offers substantial improvement in patient outcomes and survival, but accurate and reliable early-stage diagnostics are lacking from a clinician's toolbox. New cancer markers are continuously being discovered; however they are typically useful for only a single cancer type, stage of disease, or cohort of people and lack the specificity to be developed into a robust diagnostic tool.

Researchers at the Institute for Glycomics and University of Adelaide have exploited knowledge of a potential pan-cancer biomarker sugar (Neu5Gc) that presents in the human system in significant levels only in the presence of cancer. They have developed a research-grade diagnostic test that detects this sugar in blood with high selectivity and specificity, using an engineered protein SubB2M. Proof of principle studies have demonstrated the ability of the SubB2M assay to detect Neu5Gc in all stages of ovarian cancer compared to cancer free controls (DOI:10.1016/j.bbrc.2018.11.001).

In 2020, this technology was exclusively licenced to Australian biotech company BARD1 for use in human cancer. The deal comprises upfront research and development costs and licence fees plus development and sales milestone fees and royalty on product sales. BARD1 together with the Institute of Glycomics and Adelaide University researchers are working to translate the initial findings in ovarian cancer into a range of commercial pathology laboratory tests for monitoring and screening of these cancers. This program is an outstanding success story of the Institute's progressive and multifaceted approach to developing technologies *en route* to market. The initial platform discovery and development was funded by a National Health and Medical Research Program Grant on bacterial infectious diseases. The Institute's interdisciplinary research environment enabled an application information on a bacterial toxin to be applied to the development of cancer diagnostics. The Institute's Business Team enabled licensure of the technology to BARD1, who maintain a co-development program with the Institute, jointly funded by BARD1 and the Australian Federal Government via a Biomedical Translation Bridge grant, designed to support commercialisation of Australian Bio- and Med-Tech. The co-development program aims to translate the technology into commercial, clinical-grade pan-cancer and cancer-specific diagnostics by linking Neu5Gc detection with known cancer biomarkers, such CA125 for ovarian cancer and CA15.3 for breast cancer.

In parallel, funding via philanthropic partners The Bourne Foundation and Tour de Cure, as well as the US Department of Defense (W81XWH-20-1-0527), supports ongoing fundamental research to use the SubB2M technology to identify new and improved cancer markers for specific diseases such as breast cancer. There remains opportunity for both the Institute and BARD1 for new discoveries under these programs to be translated into commercial diagnostics via the established translation pathway created during the co-development program.

BARD1 Life Sciences Ltd is a leading Australian-based diagnostics company with an innovative portfolio of diagnostic technologies and products. The Company is focused on developing and commercialising best-in-class diagnostic solutions based on its BARD1, SubB2M, Molecular NETs and hTERT platforms for healthcare professionals and patients. The cancer diagnostics portfolio includes the commercialised hTERT test used as an adjunct to urine cytology testing and development-stage tests for ovarian, breast, lung, prostate and pancreatic cancers. The Company is also commercialising its Molecular NETs platform for sample preparation and is launching its proprietary EXO-NET™ exosome capture tool for use in research for exosome-based diagnostics and therapeutics.

Both the Institute and BARD1 are excited by the opportunities presented by the partnership and look forward to expanding this technology to new cancer types, particularly those where early detection diagnostics are not currently available.



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

Some examples of our international collaborative efforts include:

- **Germany** – developing new solutions to respiratory diseases through iCAIR®, the International Consortium for Anti-Infective Research, with partners Fraunhofer ITEM and the Hannover Medical School
- **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** – discovering new biomarkers for cancers with collaborators at the University of Basel through a unique approach with the view to develop new cancer diagnostics
- **USA** – Identifying new therapeutics for respiratory infections with an Australian-based biotech and their US-based commercial partners
- **Mainland China** – developing a world-first therapeutic for human parainfluenza with industry partner China Grand Pharma, based in Wuhan, through their Australian entity Grand Medical Ltd
- **Hong Kong** – identifying the chemotherapeutic properties of Traditional Chinese Medicines (TCM) with Hong Kong-based TCM physicians
- **Denmark** – developing new vaccines for infectious diseases in humans and animals with Statens Serum Institute
- **Singapore** – developing new drugs against dengue virus infection with collaborative partner National University Singapore
- **New Zealand** – developing new vaccines for infectious diseases in humans with our NZ Immunotherapies company partner
- **South Korea** – developing new vaccines for infectious diseases in humans with a South Korean company partner



COMMUNITY ENGAGEMENT



Glycomics Circle – Running rings of empowerment around women in science

Established in 2015 by the former Chancellor of Griffith University, the Honourable Leneen Forde AC, a small group of likeminded women rallied together to create a movement of empowerment; shattering the stigma and barriers of women in STEM and creating opportunities to enrich and progress their research.

In 2020, the Glycomics Circle celebrated five years in operation with good news travelling fast and boasting five new ladies to strengthen the Circle further. Meeting quarterly, the Glycomics Circle hears first-hand from recipients how their support is impacting the research of female scientists within the Institute for Glycomics. This is extremely rewarding and reiterates just how important this initiative is in the lives of our female cohort.

These remarkable women are a beacon of light; their generosity shines brightly throughout the Institute, continually recognised and acknowledged long after their funding cessation.

In early 2020, we were deeply saddened to hear about the passing of one of our greatest supporters and Honorary Fellows of the Institute, Ms Beverly McIlwain. As a passionate supporter of the Glycomics Circle, her remarkable contribution to empowering women in science at the Institute will continue to enrich the lives of our female researchers.

“Bev received the Institute’s highest accolade a few years ago, becoming an Honorary Fellow of the Institute for Glycomics. This recognition speaks to her passion and commitment to our Institute’s vision to be the world-leading research institute in our field of research. Bev’s name is enshrined forever on our Honorary Fellows Board in acknowledgement of her major contribution to the Institute. Her passion in supporting the Institute’s research has been transformative and while she is sorely missed, I have no doubt that Bev’s legacy will live on in the many initiatives she supported.” – **Professor Mark von Itzstein AO**

The Glycomics Circle provided two Honours Student Scholarships this year valued at \$5,000 each.

The recipients of these awards were:

- **Ms Laura Blechner** for her project titled ‘Pre-entry priming of HIV – redefining the entry process of virus for the development of a novel HIV vaccine and defining the virus entry processes’, supervised by Professor Johnson Mak and Dr Belinda de Villiers
- **Ms Rose Manakil** for her project titled ‘Levitating ionised yeast cells in a linear ion trap’, supervised by Associate Professor Erik Streed

Since its inception, the Glycomics Circle has raised over \$155,000 which has been utilised to support early career researchers, honours and masters scholarships, and travel and conference participation. The ultimate goal of the Glycomics Circle is continued expansion, enabling us to create more opportunities to support our women in STEM.

If you would like to become a member of the Glycomics Circle and support our wonderful women in science, please contact us: glycomics@griffith.edu.au





Introduction of the Glycomics Tribune and GlycoBuzz

In 2020, we launched our new quarterly e-newsletter, The Glycomics Tribune, as well as a new educational blog, GlycoBuzz, to promote further engagement with the community.

Sent out at the end of each quarter, The Glycomics Tribune e-newsletter provides an update to our supporters and the general public on our latest news, research projects, events, and special achievements at the Institute for Glycomics. We invite you to view our past, and subscribe to our future, quarterly newsletters by visiting griffith.edu.au/institute-glycomics/about-us/the-glycomics-tribune.

GlycoBuzz is the Institute for Glycomics' new educational blog, where our researchers and support staff cover interesting topics from their areas of research, or activity related to our industry, using language that's easy for the general public to understand. To view our latest blog articles and subscribe to GlycoBuzz, please visit blogs.griffith.edu.au/glycomics.

Rotary – The driving force behind the Malaria Vaccine Project

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

Vaccination is the key to shifting the fight against malaria from sustained control to eradication. Despite global efforts there is no effective malaria vaccine available.

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

The Rotary Clubs of Southport, Broadbeach, Hope Island and the Rotary Satellite Club of Southport—Griffith

University have initiated a fundraising project to support the work of Professor Michael Good AO, Dr Danielle Stanisic and their team at the Institute for Glycomics.

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



Rotary District Governor Harry Bolton and Shauna Bolton support the Malaria Vaccine Project

Rotary International District 9640 encompasses over 50 clubs and a large coastal and inland region bordered by Grafton, Gold Coast, Goondiwindi and Glen Innes. Over many years, the partner of the District Governor, Shauna Bolton, has raised funds for special projects like polio eradication, numeracy and literacy, food-plant solutions, and oral surgery for children in developing countries.

In 2019–20, Shauna chose the Malaria Vaccine Project as her ‘partner program’. She understood the challenges that malaria brought to places like Africa and Papua New Guinea and the unending death toll of young children that it produced every year.

District Governor (DG) Harry and Shauna Bolton visited the malaria research laboratory at the Institute for Glycomics, where Dr Danielle Stanisic described the research and demonstrated what the scientists were doing in the laboratory. The Malaria Vaccine Project provided Shauna with media resources and brochures and she spoke about the research and Rotary’s fundraising efforts at every club in the District. Moreover, she invited clubs and members to join her in supporting the Project. Shauna impressively raised \$19,000 in a year that was beset with drought, bushfires and water problems especially in her own region near Tenterfield.

DG Harry Bolton added his support when his District Conference at Tenterfield had to be cancelled. He invited all those who had paid pre-conference monies to donate

that money directly to the Malaria Vaccine Project. This initiative raised a further \$9,000 and was most opportune as Professor Michael Good AO was to have been a keynote speaker on the conference program.

Our special thanks go to DG Harry and Shauna Bolton for their major contribution to the malaria vaccine research; not only in terms of the \$28,000 raised but most of all for the passion they both demonstrated in promoting a promising malaria vaccine for this terrible disease.

A global pandemic won't even stop them!

Despite a challenging year of cancelled events and postponed opportunities, Rotary has shown that the power of people who are driven to make a difference will surpass any obstacle.

Amidst the chaos of the global pandemic, Rotary were still able to raise a total of \$119,500 for our Malaria Vaccine Project in 2020!

Thanks to their ongoing and tireless support, a malaria vaccine for the world is one step closer to becoming a reality. Thank you to all Rotarians for helping us pave the way to a malaria-free future!

By working together, we can end malaria and, quite literally, save millions of lives globally.



COMMUNITY ENGAGEMENT CASE STUDY

Sanctuary Cove and the Institute for Glycomics – A community partnership to support breast cancer research

Griffith University's Institute for Glycomics joined forces with the Sanctuary Cove precinct in a community partnership to raise funds to support vital breast cancer research during Breast Cancer Awareness Month in October 2020.

The Institute for Glycomics is home to the Australian Centre for Cancer Glycomics (A2CG), a unique national resource dedicated to cancer glycomics research.

"Our unique research approach centred around glycomics makes us the only institute of its kind in Australia and one of only a handful in the world," said Director Professor Mark von Itzstein AO.

"With the brightest scientific talent in the field of cancer glycomics, the A2CG is an exciting hub of truly revolutionary cancer research."

The Sanctuary Cove precinct presented a series of events throughout Breast Cancer Awareness Month to raise awareness and funds for the devastating disease, which impacts more than two million women every year globally.

Sanctuary Cove Golf and Country Club Executive General Manager Paul Sanders said "the fundraising events were an opportunity for the local community to band together and support a cause quite literally close to our chests".

"Sanctuary Cove is open for business and we're operating under COVID-Safe plans, so these events are a great opportunity to connect as a community while supporting vital breast cancer research and at the same time commemorate those who have lost their battle with the disease.

"The Institute for Glycomics comprises over 200 multidisciplinary researchers and support staff who work tirelessly every day to find new ways to diagnose, prevent and cure cancer. We're really pleased to be able to come together through a unique, local partnership to support this research happening right here on our doorstep."

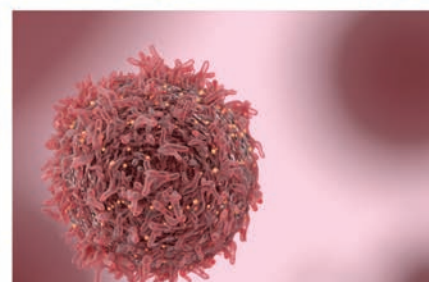
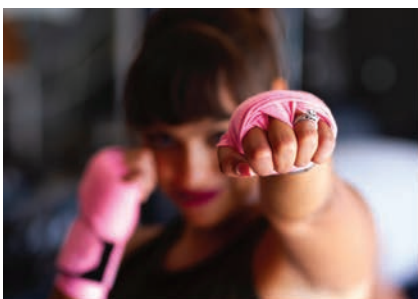
The pink-themed, month-long calendar of events at Sanctuary Cove offered a multitude of things to do for every age. Major fundraisers included a Splash of Pink – Fashion and High Coffee Event, group fitness challenges, Sanctuary Cove's Biggest Morning Tee, a golf clinic, tournaments and more.

The community partnership raised over \$30,000 to aid the Institute's breast cancer research.

"This is a remarkable achievement and we are extremely grateful to Sanctuary Cove for their support and outstanding fundraising efforts," said Institute Director Professor Mark von Itzstein AO.

"This outcome really illustrates just how powerful local partnerships can be when a community bands together with a shared vision."

Paul Sanders said that many of the events were a sell out with Sanctuary Cove members and locals alike, eager to step out to support such a worthy cause.



COMMUNITY ENGAGEMENT CASE STUDY

Community Bank Paradise Point, Bendigo Bank – A partnership empowering education and research

Support comes in many ways, shapes and forms, and Community Bank Paradise Point, Bendigo Bank has portrayed this precisely and consistently for the past 7 years.

Our history with Community Bank Paradise Point, Bendigo Bank commenced in 2014 and has continued to build over the years, offering significant support that aligns with their reinvestment strategies, strengthened by the local community.

The past year has been like no other, with the coronavirus pandemic creating a landscape that has never been experienced in this lifetime and scientists working around the clock to bring forward a response with the hope of reinstating normality.

When the Institute for Glycomics pledged their alliance to the fight against SARS-CoV-2, the virus that causes COVID-19, to discover new vaccines and drugs to prevent or cure the disease, Community Bank Paradise Point were swift to link arms with our researchers.

A donation of \$10,000 was pledged towards the purchase of critical equipment that could not only be applied for this immediate purpose but could also be utilised long-term across a magnitude of research projects.



Professor Mark von Itzstein AO expressed his appreciation of Community Bank Paradise Point's ongoing support.

"We are extremely grateful for this generous donation toward our research. Philanthropic donations, government and community support enable us to fast track our research efforts, utilising state-of-the-art

equipment and an expert team of some of the greatest scientific minds in the field of infectious diseases."

The vital funding enabled the acquisition of an Avanti J-15R centrifuge, a new piece of equipment housed within the Institute's Physical Containment Level 3 (PC3) Facility. The high-speed refrigerated centrifuge is used to separate virus from culture media, and this particular model has the added features of bio-containment lids for working with highly infectious pathogens such as SARS-CoV-2.

Additionally, Community Bank Paradise Point have continued their annual sponsorship of the 'Bendigo Bank Paradise Point Glycomics Summer Scholarship program', granting ten bright stars the opportunity to conduct a research project and further their research studies under the expert guidance of world-renowned research leaders at the Institute for Glycomics. The provision of these opportunities significantly impacts the career path of students and nurture the future of research.

"The Institute for Glycomics is profoundly grateful to Community Bank Paradise Point for their ongoing and vital support. This is a partnership that is helping us shape the world's future scientists, and one that is positively influencing our critical fight against some of the world's most devastating diseases, such as COVID-19," said Professor von Itzstein AO.

"The Institute for Glycomics is not only conducting world-class research, but educating, nurturing and developing our future scientists; providing a strong foundation for the future of global health. Community Bank Paradise Point, Bendigo Bank places utmost importance in supporting our community, reinvesting in programs across the health, education, environment and other worthy causes. Our long-standing support of the Institute for Glycomics is testament to their capacity to deliver on their vision of developing novel drugs, vaccines and diagnostics. I am proud and inspired by this amazing team, that through our sponsorship, we can create opportunities to advance research and enrich the lives of students as they navigate their career paths."

Brandon Hockley | Branch Manager



 Griffith
UNIVERSITY



**SELECTED
OUTSTANDING
PUBLICATIONS**



O'Meara et al.

Neutralizing the pathological effects of extracellular histones with small polyanions, Nat Commun DOI: 10.1038/s41467-41020-20231-y

A new experimental drug to treat sepsis has now entered the next stage of clinical trials in patients in Australia after successfully completing Phase 1a trials in healthy volunteers.

The sepsis drug candidate, co-invented by researchers led by Professor Mark von Itzstein AO at the Institute for Glycomics and Professor Christopher Parish at The Australian National University (ANU), was licensed to China Grand Pharma's Australian-based subsidiary Grand Medical Limited who is currently developing the drug candidate.

"From an outstanding collaboration with Professor Parish, his team at ANU and others, it's exciting to see our innovative experimental drug, STC3141, now being trialled on sepsis patients. It had previously passed safety and tolerability measures in Phase 1a clinical trials," Professor von Itzstein, Director of the Institute for Glycomics and co-inventor of the technology, said.

Researchers at the Institute for Glycomics used a sugar-based approach to synthesise the small-molecule experimental drug, STC3141, which can treat sepsis by reversing organ damage.

"Sepsis is known to affect millions of hospitalised patients across the world each year and occurs when the body's immune response to an infection attacks and injures its

own tissues and organs," Professor von Itzstein said.

"When sepsis is not recognised early and managed promptly, it can lead to septic shock, multiple organ failure and death."

Dr Chih-Wei Chang, a research scientist at the Institute for Glycomics, was a joint first author on the study.

"We have been able to synthesise the experimental drug at large scale using innovative chemistry, that can be translated to an industry-scale setting," Dr Chang said.

It is estimated that in 2017 there were 48.9 million cases and 11 million sepsis-related deaths worldwide, which accounted for almost 20% of all global deaths. That year, almost half of all global sepsis cases occurred in young children.

"The translational outcomes of the sepsis experimental drug candidate would be of global magnitude and would significantly reduce the burden on the healthcare system in managing sepsis infections," Professor von Itzstein said.

"We look forward to monitoring the progress of the current trials in patients who are presently suffering from this debilitating disease."

Gorle et al.

Conformational modulation of iduronic acid-containing sulfated glycosaminoglycans by a polynuclear platinum compound and implications for development of antimetastatic platinum drugs. Angew Chem, Int Ed DOI: 10.1002/anie.202013749

Griffith University researchers have discovered a novel approach that could lead to the personalised design of anticancer drugs that resist metastasis (tumour spread) in triple-negative breast cancer.

Traditional chemotherapy includes metal-based drugs like Cisplatin, commonly used to treat breast and ovarian cancers. However, many of these traditional chemotherapies have severe side effects and cancers treated by these types of drugs are prone to drug resistance.

In a paper published in the journal *Angewandte Chemie*, researchers from the Institute for Glycomics in collaboration with researchers at Virginia Commonwealth University in the US, have proposed a completely unique approach to metal-based cancer therapy by way of protecting important signalling sugars on the surface of tumour cells, thereby preventing cancer metastasis.

Lead researcher Dr Anil Gorle said their approach was founded on the discovery that metastasis of triple-negative breast cancer cells can be halted by influencing the sugar language of the cancer using the platinum-based compound TriplatinNC, developed by joint co-author Professor Nicholas Farrell.

“This discovery paves the way for developing metal-based anti-cancer drugs with less side effects that could potentially avoid drug resistance,” Dr Gorle said.

“About 10–20% of breast cancers are triple-negative breast cancers and studies have shown that this form of breast cancer is more likely to spread beyond the breast and is also more likely to recur after treatment.”

Joint co-author of the study, Professor Sue Berners-Price, a world-leader in the field of medicinal inorganic chemistry, led the development of a new area of endeavour – metalloglycomics – a systematic study of the interaction of defined platinum-based compounds with sugars present on cell surfaces.

“It is important to target the fundamental pathways through which cancers spread to other parts of the body,” Professor Berners-Price said.

“This study showed that carbohydrate protection by platinum drugs is one such approach to develop anticancer drugs that will prevent metastasis by limiting the primary tumour to a relatively localised site and allow for effective drug intervention on that site.”

Director of the Institute for Glycomics and co-author, Professor Mark von Itzstein AO said, “The utility of the metalloglycomics concept in this study has provided the key to unlocking the door to new approaches to fight triple-negative breast cancers through the development of translational medicine.

“This could offer an alternative, less aggressive therapeutic approach to fighting the disease, as opposed to the more drastic approaches used today such as radiotherapy and chemotherapy.”





De Oliveira et al.

Repurposing a neurodegenerative disease drug to treat Gram-negative antibiotic-resistant bacterial sepsis, Sci Transl Med 12 (570): eabb3791

An experimental Alzheimer's disease treatment is proving effective at treating some of the most persistent, life-threatening antibiotic-resistant bacteria.

Researchers from Griffith University, The University of Queensland and The University of Melbourne have discovered that the drug called PBT2 is effective at disrupting and killing a class of bacteria – known as Gram-negative bacteria – that cause infections such as pneumonia, bloodstream infections and meningitis.

Griffith University's Professor Mark von Itzstein AO from the Institute for Glycomics said the new treatment was effective, and offered a range of other benefits.

"Based on its use as an experimental Alzheimer's treatment, there's been a significant amount of solid science done on this drug already. We know, for example, that clinical studies of PBT2 show that it is safe for use in humans," Professor von Itzstein said.

UQ's Professor Mark Walker said the metal transport drug may offer a last line of defence against some of the world's most difficult to treat superbugs.

"The emergence of antibiotic-resistant superbugs is an urgent threat to human health, undermining the capacity to treat patients with serious infection," Professor Walker said.

"Alternative strategies to treat such multi-drug resistant bacteria are urgently needed.

"Led by UQ's Dr David De Oliveira, our team hypothesised that, by using this experimental Alzheimer's treatment to disrupt the metals inside these bacteria, we would also disrupt their mechanisms of antibiotic

resistance.

"This was shown to be the case, with the Alzheimer's drug – combined with the antibiotic polymyxin – successfully tackling antibiotic-resistant superbugs like *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa* and *Escherichia coli*."

"This could sharpen, so to speak, some of the weapons we thought we'd lost in our fight against antibiotic-resistant bacteria," Professor von Itzstein said.

The University of Melbourne's Associate Professor Christopher McDevitt, from the Peter Doherty Institute for Infection and Immunity (Doherty Institute), said the drug had already proved effective beyond the petri dish.

"Animal studies show that the combination of polymyxin and PBT2 kills polymyxin-resistant bacteria, completely clearing any infection," Associate Professor McDevitt said.

"Hopefully in the not-too-distant future people will be able to access this type of treatment in the clinic.

"New techniques are critical in addressing this building threat to human health, and this treatment is an additional weapon in our arsenal to fight the accelerating threat of antibiotic resistance.

"If these new solutions aren't developed, it's estimated that by 2050, antimicrobial-resistant bacteria will account for more than 10 million deaths per year.

"This new treatment could help turn the tide on antibiotic resistance."

Shewell et al.

All major cholesterol-dependent cytolysins use glycans as cellular receptors. Sci Adv 6: eaaz4926

New Griffith University research has found that sugars decorating human cells allow toxins, produced by disease-causing bacteria, to bind to human cells and cause damage or death.

The family of toxins known as cholesterol-dependent cytolysins (CDCs), are produced by bacteria such as *Streptococcus pneumoniae*, group A Streptococcus and *Listeria monocytogenes*, which cause pneumonia, invasive group A Strep disease (including what is known as flesh-eating disease) and listeriosis.

These toxins damage human cells by forming pores in the membrane which cause the cells to break open.

In a paper published in *Science Advances*, the Institute for Glycomics researchers leading an Australian and international team found that cell specific sugars are the targets for eight major CDCs and not only cholesterol, as previously thought.

Lead researcher Dr Lucy Shewell said they could stop the toxins causing damage to human blood cells by adding in the binding sugars.

“By adding sugars in solution with the toxins, the toxins are effectively mopped up before they do any damage to the red blood cells.

“The CDCs still need cholesterol in the membrane to allow them to form the final pore, but they need to bind to the sugars to recognise the cells they kill,” Dr Shewell said.

“Our research has shown that it is actually specific sugars on the cell surface which are the binding targets for these toxins. We have also identified the part of the toxin responsible for sugar binding.

“Understanding to which sugars these toxins bind gives us greater insight into which cells they damage and can allow us to develop therapeutics to block their harmful action.”

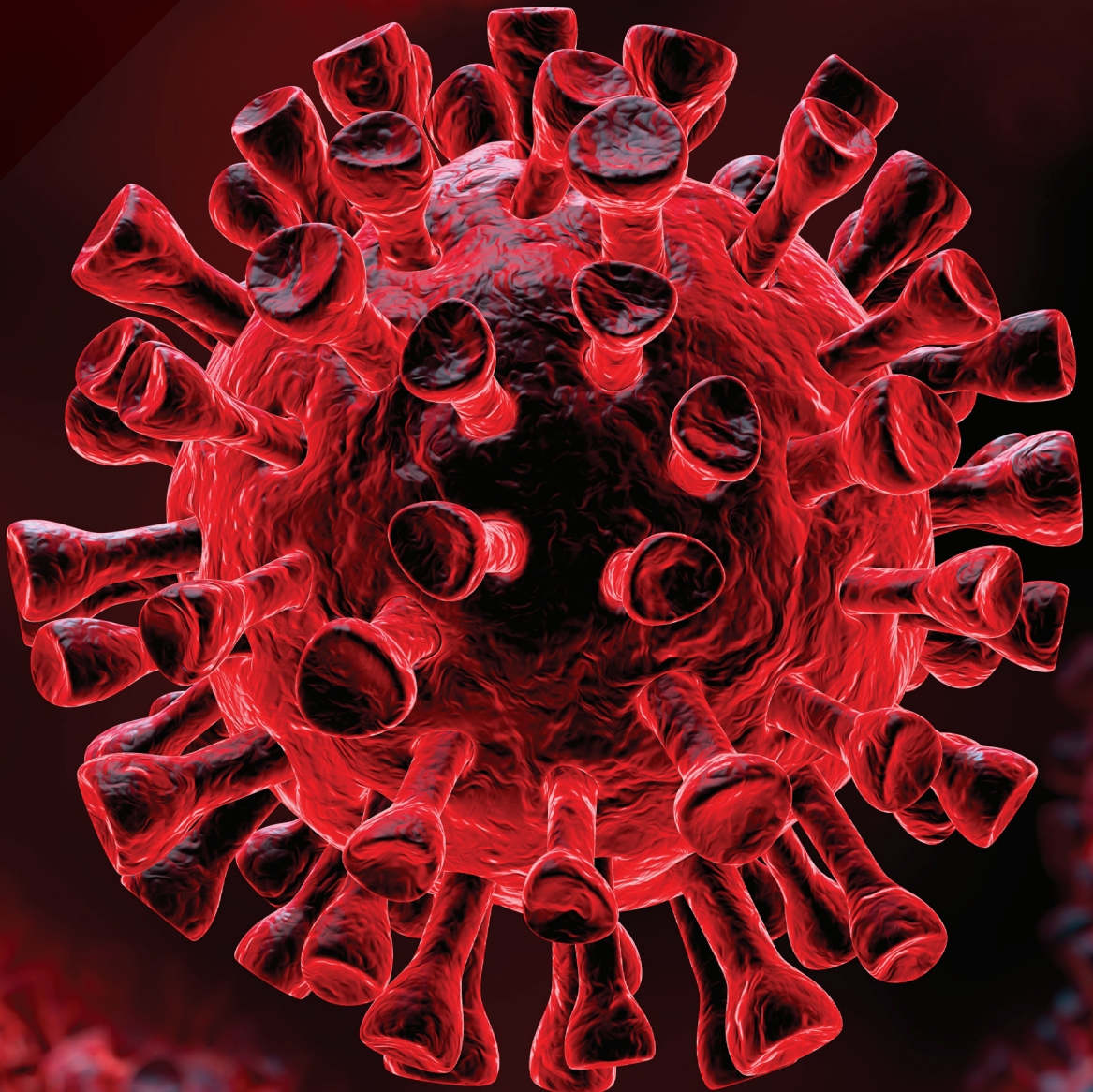
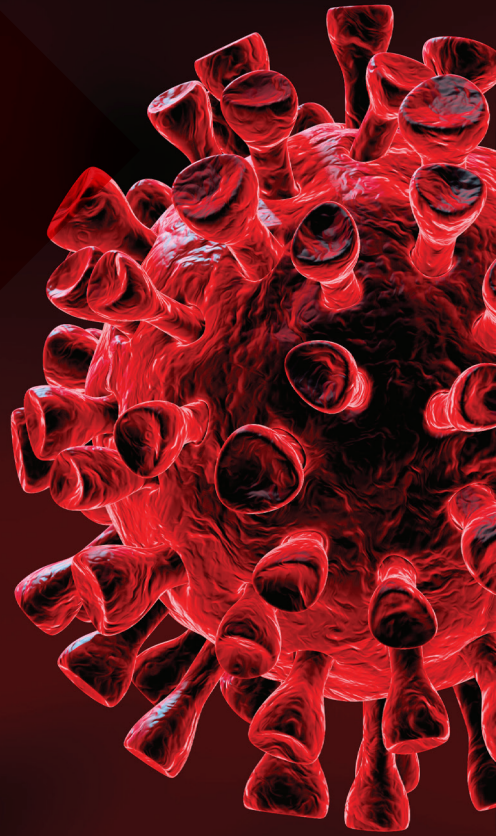
Corresponding author of the study, Professor Michael Jennings said, “This research provides new information that will guide development of small molecule drugs and new vaccines that target these toxins.”

Professor Mark von Itzstein AO, Director of the Institute for Glycomics, said this was another excellent example of how the Institute’s unique research approach centred around ‘glycomics’ can pave the way to new translational outcomes in their ongoing fight against some of the most debilitating diseases.





RESEARCH LEADER HIGHLIGHTS



WELCOME



Professor Carolyn Mountford

Principal Research Leader

We are delighted to announce that in mid-2020 we welcomed a new Principal Research Leader to the Institute for Glycomics research team. Professor Carolyn Mountford is the Institute's new Professor of Radiology & Neuroglycobiology.

Professor Carolyn Mountford MSc DPhil (University of Oxford) MS (Harvard University) is a world leader in the development of magnetic resonance (MR) technology to address unmet clinical needs. Her translational research in the neuro field centres on MR technology to identify changes to the brain associated with Post-Traumatic Stress Disorder (PTSD), injury from blast and impact, and pain. In the cancer area it is a preoperative diagnosis for ovarian lesions. For breast, the capacity to determine how far the breast tissue of a woman at high risk for breast cancer has deviated.

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

develop this approach to improve the health of soldiers.

Professor Mountford and her research group's focus:

The Mountford research team uses clinical 3T scanners to monitor the effect of disease, pain and cancers on the human glycome. They have assigned seven fucosylated glycans in the human brain, which are affected differently by chronic pain, PTSD, and blast exposure. These Fuc- α (1-2) glycans have been shown in animal models by a Caltech team to be implicated in the mechanisms underlying neuronal development, learning and memory, regulation of the nervous system development and neuronal processes. Elucidating the precise carbohydrate chemistry that is underlying these conditions is integral to future clinical management.

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. The team is very much looking forward to being a part of the Institute for Glycomics.



Professor Mark von Itzstein AO Principal Research Leader, Director

The von Itzstein research group has continued to advance their co-development program with Grand Medical Pty Ltd on the discovery of drug candidates to treat and prevent human parainfluenza virus (hPIV) infection.

This virus remains a significant clinical problem that impacts a broad spectrum of the human population including children, the elderly and immune-system weakened individuals such as cancer patients on chemotherapy and transplant patients, alike. They are now in lead drug candidate optimisation to improve compound potency, drug-like characteristics and drug candidate selection, so that they can move into the next stage of pre-clinical trials.

In 2020, their research, in collaboration with Professor Christopher Parish (ANU), that targets sepsis (O'Meara *et al.*, von Itzstein & Parish, *Nature Communications*, 2020) made significant advances. Sepsis is one of the most significant clinical manifestations of uncontrolled infection and often results in multiorgan failure that leads to death. Their drug candidate mCBS (Investigational Product Name: STC314) successfully passed through Phase 1a human clinical trials in 2020 and is now set to

enter the next level of human clinical trials with sepsis as a target disease.

Excitingly, their collaborative research program with Professor Mark Walker (UQ) towards the development of ionobiotics that break drug resistance to current antibiotics has had further major breakthroughs over the last twelve months. In 2020, they published (De Oliveira *et al.*, von Itzstein & Walker, *Science Translational Medicine*, 2020) their most recent findings that highlight the potential for combining ionobiotics with next-generation drugs (next generation polymyxins) as a viable treatment for severe infections caused by **pandrug-resistant Gram-negative pathogens**.

Finally, in 2020 the award of a five-year NHMRC Investigator grant entitled "*An interdisciplinary approach towards antiviral therapy discovery*" valued at \$2 million, was announced. This grant will commence in 2021 and support the Group's antiviral drug discovery efforts, particularly to combat diseases such as influenza and hand, foot and mouth disease. Moreover, the grant will also support the development of **broad-spectrum antiviral agents** that act on a range of viruses that cause disease in the respiratory tract.

Professor Michael Jennings

Principal Research Leader, Deputy Director

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

In 2020, the group published a landmark study showing that carbohydrates can act as cellular receptors for a class of toxins called cholesterol dependent cytolysins. This paper published in *Science Advances* opens the door to new strategies to block toxin action in a range of bacterial diseases (e.g. pneumonia, meningitis, sepsis).

Further work on this area will be supported by an NHMRC Ideas Grant awarded to Professor Jennings and Dr Christopher Day at the end of 2020.

The Jennings group also had a commercial outcome when a new technology for detecting ovarian cancer from blood samples was licenced to the ASX-listed company

BARD1. This technology is based on adapting a bacterial toxin that recognises a cancer specific sugar structure for use in cancer diagnosis and grew from a long-term collaboration between the Jennings lab and the University of Adelaide.

Repurposing existing drugs to block carbohydrate interactions to treat bacterial infections is a key strategy used by the lab, and in 2020 the group published a study in *MBio* reporting the discovery of two drugs that can treat multi-drug resistant *Neisseria* infections (STIs).





Professor Michael Good AO Principal Research Leader

This last year the Good laboratory, while continuing their malaria and streptococcus research, has contributed to the fight against COVID-19.

They undertook a detailed study of the immune response to the virus and modelled the effect on society of developing a vaccine. This work, in collaboration with the University of Alberta in Canada, showed that a vaccine that was 50% effective and taken by only 50% of the population would stop deaths in highly endemic countries providing that social distancing was still practised. Clearly, the research group is hoping for a vaccine that is more effective and is taken by far more than 50% of the population. This would reduce the need for social distancing. In a separate study, they identified regions ('epitopes') of the Spike protein's receptor binding domain (RBD) that were critical for inducing neutralizing antibodies. Crucially, two of these epitopes were in areas of the RBD that were invariant between the major circulating strains of the virus. This research provides new avenues for designing effective vaccines.

With the strong support of Rotary, the Good group is moving ahead towards a third malaria vaccine trial. Their preliminary data demonstrate that they can induce highly effective protective T-cell responses in humans following vaccination with their whole parasite vaccine. They are now refining their technology in mouse models prior to their next human study.

The studies with malaria have spawned an important offshoot study with Babesia – a parasite closely related to malaria parasites and responsible for serious illness in humans, livestock and domestic animals. Using a murine model, they have developed a whole parasite vaccine for babesiosis using liposome technology and are hoping to test this approach in both humans and cattle.

Their streptococcal vaccine work is nearing the point of a major Phase I study in Canada funded partially by the Li Ka Shing Institute, University of Alberta. This will be a dose-ranging study of their lead vaccine, which will be followed by a 'challenge' study in which vaccinated volunteers will be given a deliberate infection. This challenge study will be in collaboration with the Murdoch Children's Research Institute with funding from the Heart Foundation. Their streptococcal vaccine research is underpinned by extensive investigation of the mechanism of natural and vaccine-induced immunity to the organism.

As well as acknowledging their significant funders, Professor Michael Good AO would like to thank Drs Manisha Pandey and Danielle Stanisic for their great leadership of the streptococcal and malaria teams. He also thanks the post-docs, research assistants and students in the lab and Mrs Sonia McKay for her expert administrative assistance.

Professor Sue Berners-Price

Principal Research Leader

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

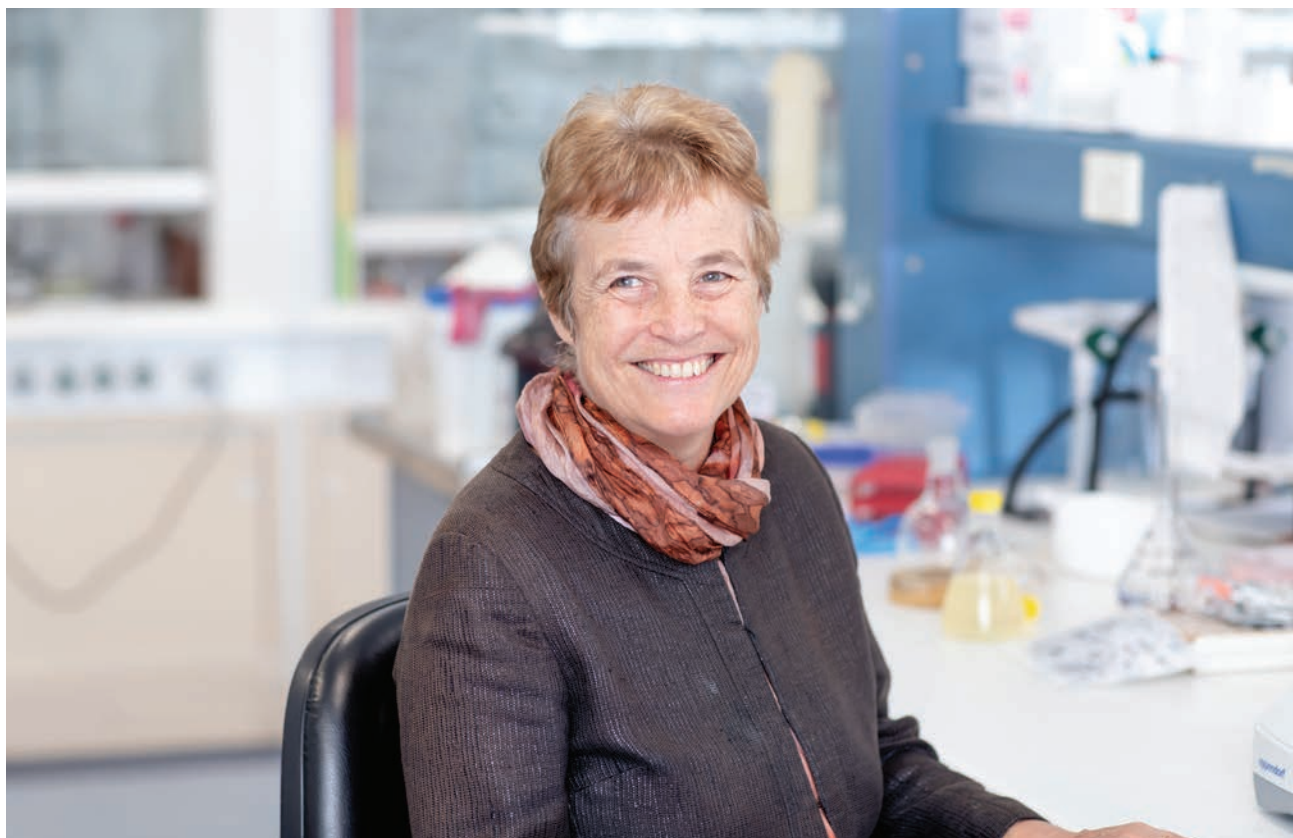
Highlights for 2020 include a study published in the leading journal *Angew Chemie* that showed that a polynuclear platinum complex, TriplatinNC, inhibits metastasis, and this may be attributable to a modulation of the geometry of a sugar component of heparan sulfate, an important component of the extracellular matrix. (Gorle *et al.*, (2021), Conformational Modulation of Iduronic Acid-Containing Sulfated Glycosaminoglycans by a Polynuclear Platinum Compound and Implications for Development of Antimetastatic Platinum Drugs. *Angew. Chem. Int. Ed.*).

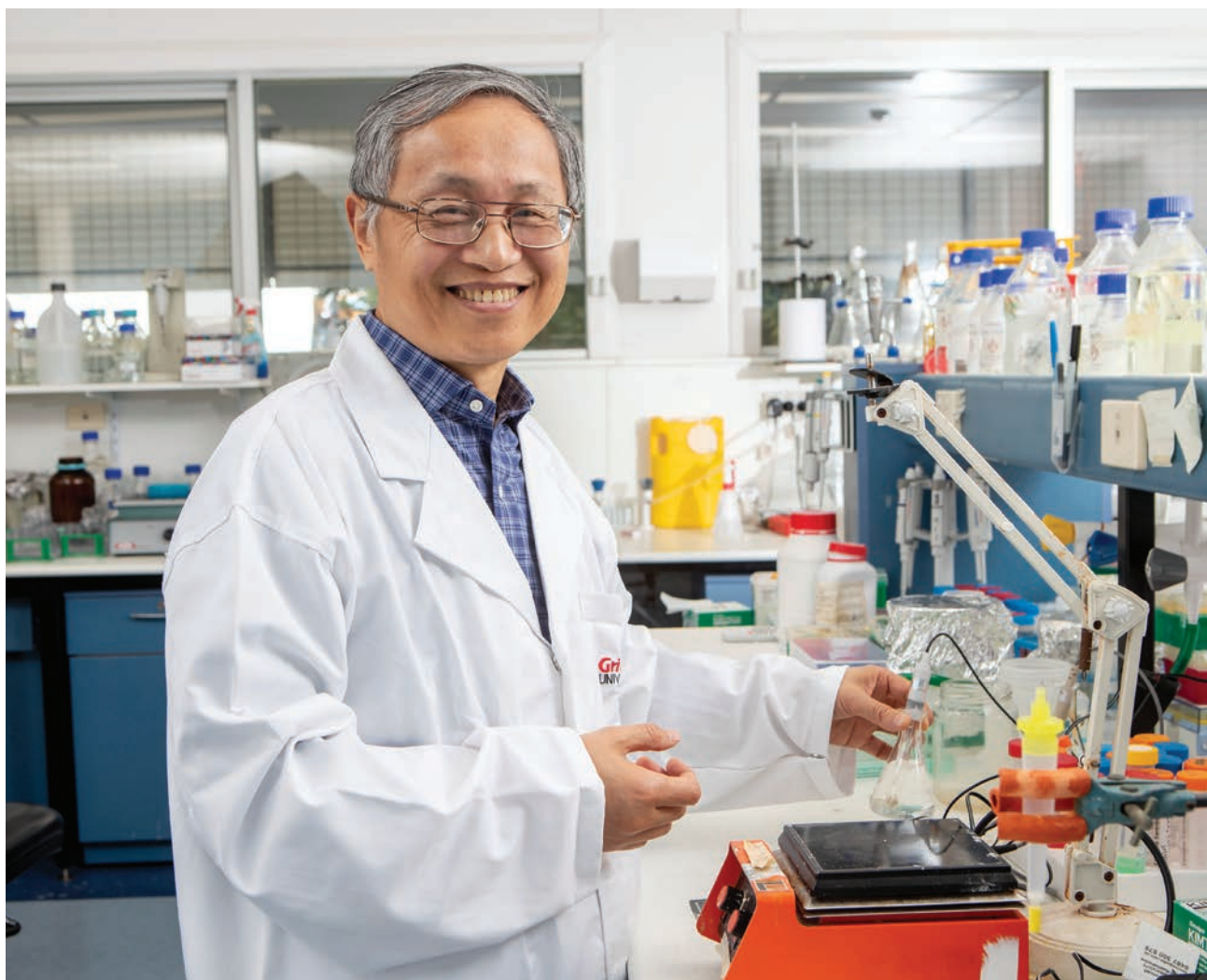
In order to shed light on the interaction of heparan sulfate with TriplatinNC, the research team in the Institute led by Research Fellow Dr Anil K. Gorle and in collaboration with Professor Nicholas Farrell (Virginia Commonwealth University and Massey Cancer Center Richmond, Virginia, USA), used the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

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

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

Professor Sue Berners-Price was the 2020 winner of the Griffith University Vice Chancellor's Research Excellence Awards for 'Excellence in Research Leadership' and has just completed a 2-year term as the President of the Society of Biological Inorganic Chemistry.





Professor Yaoqi Zhou

Principal Research Leader

The highlight of Professor Zhou's 2020 research is the publication of a powerful new method called SPOT-MoRF for predicting functional regions in intrinsically disordered proteins (Bioinformatics, 36, 1107, 2020).

Protein intrinsic disorder describes the tendency of a protein or a region of a protein that does not fold into a rigid three-dimensional shape by itself. However, some of these disordered regions can change from disorder to order when interacting with another molecule in segments known as molecular recognition features (MoRFs). Identifying MoRFs is an essential step for understanding the functions of these intrinsically disordered proteins. By transfer learning from their successful disorder predictor SPOT-Disorder2, SPOT-MoRF makes a 30% improvement over existing techniques in their correlation coefficient for a large independent test set of 850 proteins. SPOT-Disorder2 was ranked #1 in the international competition of the Critical Assessment of Intrinsic Disorder prediction (CAID special session, the ISMB/ECCB conference, Basel, Switzerland, July 25, 2019).

In 2020, Professor Zhou was also successful in securing a new grant from the Australian Research Council in collaboration with Professor Kuldip Paliwal on RNA structure prediction by deep learning and evolution-derived restraints. This grant resulted from a series of pioneering work on RNA structure prediction (*Nature Communications* 10, 5407, 2019; *Nucleic Acids Research* 48, 1451–1465, 2020; *Bioinformatics*, <https://doi.org/10.1093/bioinformatics/btaa652>, 2020).

2020 also marks the year that Professor Zhou's annual citation count passed 1,400, according to Google Scholar. This is a continuation of double-digit year on year growth since 2017. This fast-paced increase of citations reflects the growing impact of Professor Zhou's work in his field of structural bioinformatics and structural biology.

Professor Nicolle Packer

Principal Research Leader

In 2020, the COVID-19 pandemic affected Professor Packer's travel to the Institute for Glycomics from Sydney; however, her activities together with Associate Professor Daniel Kolarich and his team have still been productive.

The impact of the now well-established Advanced Mass Spectrometry Facility at the Institute has increased with glycomics and glycoproteomics analysis, enabling new collaborations to be formed nationally and internationally.

The establishment of a node of the ARC Centre of Excellence in Nanoscale Biophotonics (CNBP) at the Institute has resulted in many publications this year, across participating institutions, on the role of glycosylation sensing (*ACS Sensors*, *Molecular Omics*, *Nature Comms*) in diverse biologies such as pain (*Mol Neurobiol.*, *ACS Chem NeuroSci.*, *Nano Letters*), cancer (*Anal. Bioanal. Chem*) and immunology (*Front Immun.*).

A pilot project that will form part of future work, post CNBP, was carried out in collaboration with Dr Mark Hutchinson on the plasma proteomics and glycomics changes associated with exercise. In addition, the CNBP collaboration with Dr Chris Bursill has resulted in the

award of a grant from the National Heart Foundation of Australia to investigate atherosclerosis and the glycome.

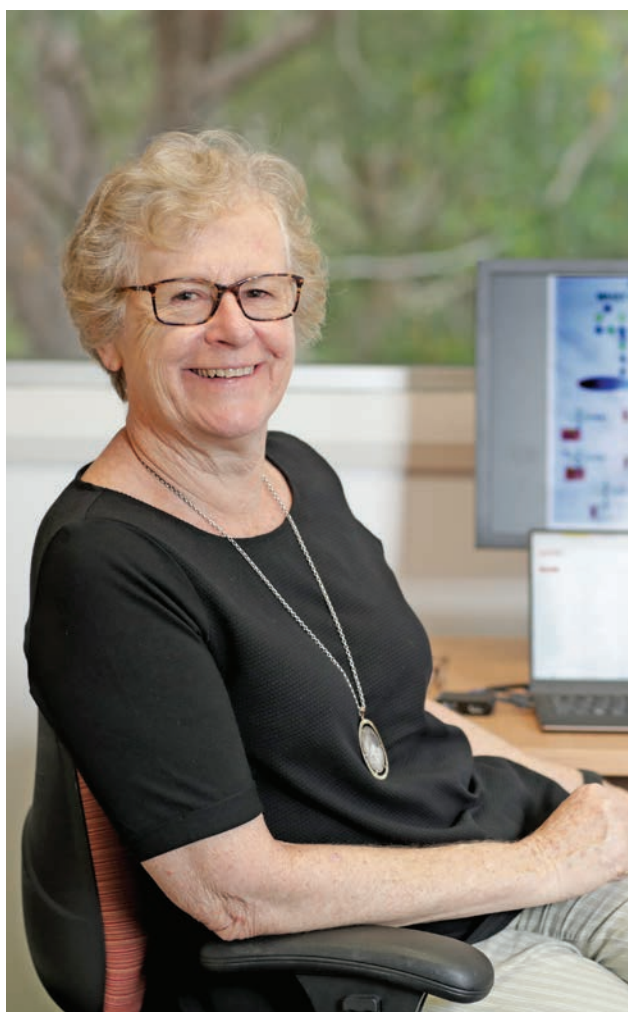
Professor Packer and Dr Everest-Dass are in the third year of their NHMRC Project grant at the Institute, in collaboration with the University of Wollongong, investigating the effect of host glycosylation on susceptibility and treatment of Group A Streptococcal infection and have published the second article from this work (*Antibiotics*).

As part of her aim of increasing the focus of glycomics in the research community, Professor Packer is working on the revision of the 3rd edition of the textbook, *Essentials of Glycobiology*, and has co-edited a Special Issue on *Glycomics & Glycoproteomics: From Analytics to Function*, in the new RSC journal, *Molecular Omics*.

To help standardise the mass spectrometric data interpretation for glycoproteomics, the HUPO Human Glycoproteomics Initiative (HGI) interlaboratory comparison of the protocols used to obtain mass spectrometric data from complex glycoproteomics experiments, that she initiated, has been prepared for publication.

Her group was also part of the De Leoz *et al.*, Interlaboratory Study on Glycosylation Analysis of Monoclonal Antibodies (*Mol Cell Proteomics*). She was elected to the HUPO Executive Council and became co-chair of the Biology/Disease Human Proteomics Project. In addition, she is continuing her involvement in the standardisation of glycomics data through her membership of the Minimum Information Required for A Glycomics Experiment (MIRAGE) Commission.

In recognition of the need to further develop glycoinformatics tools for the glycobiology field, Professor Packer is an Advocate of the NIH funded Glygen project (Glycobiology) and is Data Advisor to the Swiss GlyConnect database development at ExPASy and of the integrated Japanese GlyCosmos project, as well as founding member of the GlySpace Alliance (*Glycobiology*). She is co-editing a volume on Glycoinformatics for the Beilstein Journal of Organic Chemistry (BJOC).



Professor Johnson Mak

Research Leader

2020 was a year of trials and tribulations for many across the globe due to COVID-19. As a research laboratory that works on virology, the Mak lab has quickly consolidated its research activity to support SARS-CoV-2 related research activities.

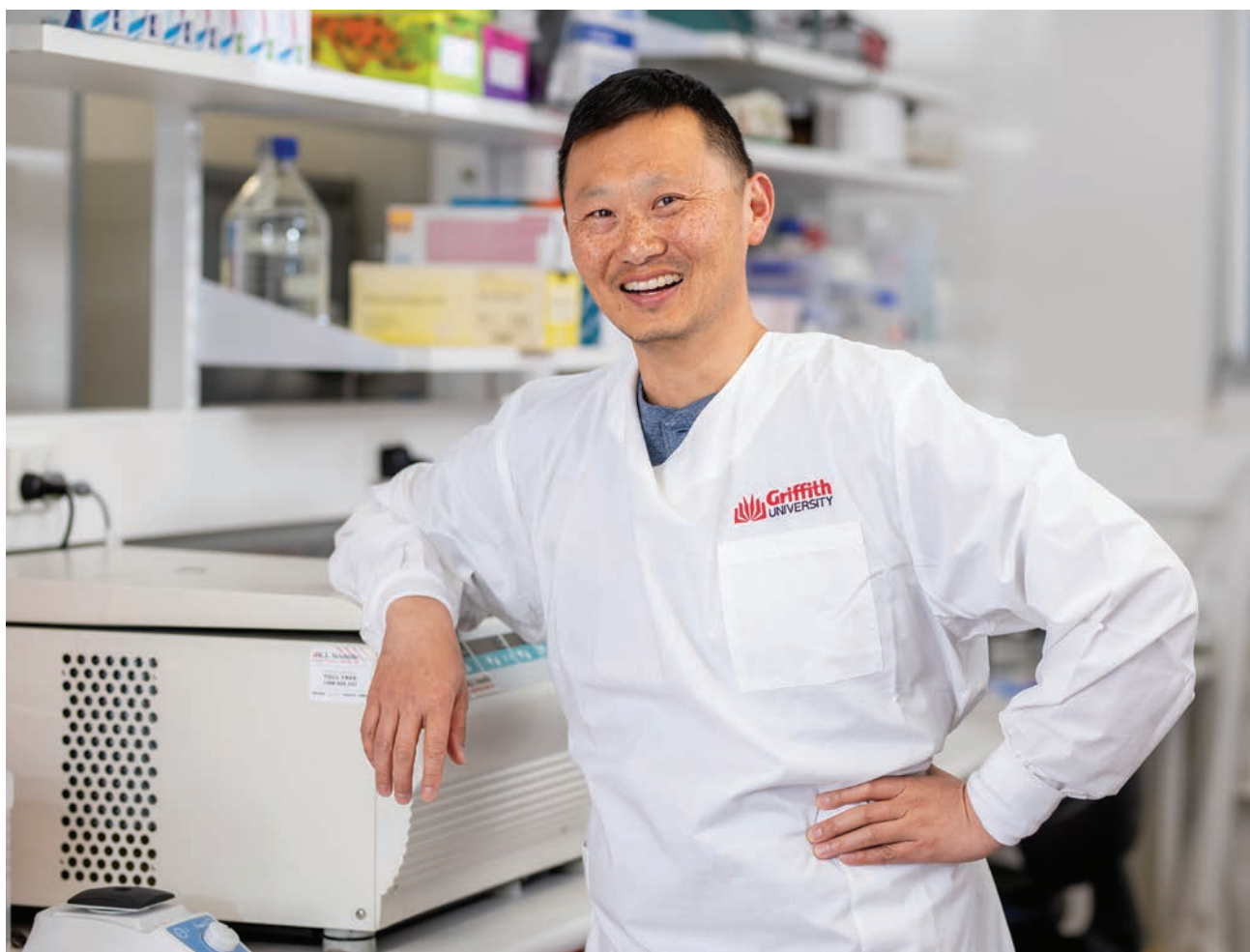
Using a pseudotyped virus-like-particles system (VLPs) to mimic the early steps of SARS-CoV-2 virus entry events, the Mak lab has played a supportive role to reveal immune responses in COVID-19 patients (led by Dr Manisha Pandey and Professor Michael Good AO) and to identify antiviral candidates against SARS-CoV-2 (led by Dr Christopher Day, Associate Professor Thomas Haselhorst and Professor Michael Jennings).

As part of our efforts in SARS-CoV-2 related work, we have established a new collaboration with the von Itzstein lab to investigate aspects of glycobiology in SARS-CoV replication, which included a six-month secondment of Dr Chi-Hung Lin to join the Mak lab to undertake COVID-19 research activities. New Research Assistant Ms Johana Luhur (recent honours graduate from UTS) also joined the Mak lab in April 2020 to be part of this research team.

As part of the funding support to develop the SARS-CoV-2 spike protein pseudotyped VLPs, the group is grateful for the support of Advance Queensland for their Advance Queensland Industry Research Fellowship to Dr Belinda de Villiers to establish this system.

Other research activities on HIV and retroviruses were also carried out in the backdrop of their COVID-19 research activities, including: (i) dissecting the role of glycan biology in HIV replication; (ii) defining the contribution of sugar-protein interaction that support HIV transmission; and (iii) delineating some of the regulatory process that mediate virus formation.

In collaboration with external partners, Dr Belinda de Villiers and Professor Johnson Mak have also been awarded a grant by the Australian Centre for HIV and Hepatitis Virology Research to develop diagnostic tools against Human T-cell Leukemia Virus type 1 (HTLV-1) that is more appropriate for remote setting. HTLV-1 is an infectious disease affecting up to 40% of indigenous population in remote areas in central Australia.



Professor Victoria Korolik

Research Leader, Associate Director (Education & Engagement)

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

The Korolik group is currently focused on studying the role of bacterial chemotaxis in pathogenicity and bacteria-host interactions, specifically, on deciphering ligand binding specificities of transmembrane chemosensory proteins of *Campylobacter jejuni*, *Campylobacter fetus* and *Helicobacter pylori*. Recent breakthroughs of the Korolik group are highlighted by the discovery of a novel class of bacterial chemosensors with broad ligand specificities that may be related to sensing of the host molecules, and thus, may play a role in host-bacterial interactions.

The group is currently developing a new research area focused on biofilm formation and its role in disease transmission for campylobacters and a new collaboration involving glycan-binding proteins of *Vibrio cholerae* is

being established. The group published five refereed papers in 2020 highlighted by articles in scientific reports, *Antibiotics and Microorganisms*.



Associate Professor Kate Seib

Research Leader, Associate Director (Research)

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

Highlights of 2020 include Associate Professor Seib's ongoing consultation with the World Health Organization to guide future development of a much-needed gonococcal vaccine to combat the high levels of antibiotic resistant *N. gonorrhoeae* strains that are emerging worldwide. She participated in virtual meetings in January 2020 and is a co-author of the report published outlining the public health value and preferred product characteristics of a gonococcal vaccine.

Her research group published several articles characterising vaccine candidates for *N. gonorrhoeae*, as well as the mechanism of bacterial epigenetic regulation. The group was also successful in gaining funding from a

philanthropic group for drug development for gonorrhoea and has a new NHMRC Ideas Grant for vaccine development for gonorrhoea. Dr Evgeny Semchenko was awarded an NIH Mentored Developmental Research Project (DRP). These projects, and other work during 2020 within the Seib lab, performed by highly talented postdoctoral researchers Dr Semchenko, Dr Taha, Dr Ruiz, and students Sarah Dunn and Xiaofan Chen will significantly contribute to disease prevention.





Associate Professor Daniel Kolarich Research Leader

The year of 2020 was a productive one despite the many unexpected turns it has thrown at this world. The Advanced Mass Spectrometry Facility at the Institute is now well established, and its unique analytical capacities have resulted in several new and consolidated existing national and international collaborations in the Kolarich group's core interests of cancer glycobiology (such as leukaemia, head and neck cancer, ovarian cancer or breast cancer), disease glycobiology (e.g. cardiovascular diseases) and vertebrate evolutionary glycobiology.

In their function as the Griffith University node of the ARC Centre of Excellence in Nanoscale Biophotonics (CNBP), they have delivered a number of exciting outcomes in understanding the role glycosylation plays in cell-signalling. A pilot project spun out of this initiative was completed in collaboration with Professor Mark Hutchinson, University of Adelaide, on plasma glycan changes associated with exercise. In addition, the CNBP collaboration with Dr Chris Bursill has resulted in the award of a grant from the National Heart Foundation of Australia to investigate atherosclerosis and the glycome.

The group has published several articles, such as the first major review article on the role of glycosylation in head and neck cancer (*Biochim Biophys Acta Rev Cancer*), book chapters (*Adv Biochem Eng Biotechnol*), with numerous exciting outcomes being currently prepared for publication. Together with Professor Packer and Dr Thaysen-Andersen, Associate Professor Kolarich has co-edited a Special Issue on Glycomics & Glycoproteomics:

From Analytics to Function, in the new RSC journal, *Molecular Omics*. In addition, he has been editing a Special Issue on "Mass Spectrometry Glycomics" for *Glycoconjugate Journal*, due to appear in the first half of 2021.

Associate Professor Kolarich was also successful in securing philanthropic funding for the group's work in understanding the role of glycosylation in leukaemia therapy resistance and established a new collaboration with colleagues from CSIRO to exploit the potential of glycosylation for vaccination strategies to protect Australian livestock from parasitic diseases.

While 2020 was not the year for attending international conferences in person, Associate Professor Kolarich still had the ability to present the group's work at the 19th Fraunhofer Seminar "Models of Lung Disease" in Hannover, Germany, in early February before the world was hit with the pandemic. The team had also several opportunities to present their latest work at a number of virtual conferences such as "HUPO2020" or the annual meeting of the Society for Glycobiology. In his function as a member of the MIRAGE committee, Associate Professor Kolarich participated in a two-day online committee workshop to further support the development of glycomics experiment reporting standardisation guidelines that will help making published outcomes comparable between laboratories, provide opportunities for bioinformatic data mining and database generation, which will further enhance new research opportunities in glycobiology.

Associate Professor Thomas Haselhorst

Research Leader

In 2020, the Haselhorst group continued its work on determining the structure and dynamic of glycans and their binding receptors, in the context of immunity and host-pathogen interactions.

On the basis of a joint ARC Discovery grant together with Professor Michael Jennings and Dr Chris Day, the Haselhorst group was able to resolve the first structure of a glycan-glycan complex in solution by a combination of NMR spectroscopy and molecular modelling methods. This exciting result underlines the fact that glycan-glycan interactions play a much greater role in biomolecular interactions than previously thought and that we can no longer ignore this emerging class of important biomolecular interactions. Two follow-up ARC Discovery grants jointly with Professor Michael Jennings and Dr Chris Day will be submitted in 2021 to further investigate these interactions.

The COVID-19 pandemic also had a strong impact on the Haselhorst group's research focus. In collaboration with Professor Michael Jennings and Dr Chris Day, the team has jointly identified a number of compounds that block SARS-CoV-2 from interacting with Angiotensin-Converting-Enzyme 2 (ACE2) by using a combined *in-silico* screening (Haselhorst) and an SPR repurposing drug screening (Jennings/Day) approach that were validated in SARS-CoV-2 viral assays in collaboration with Professor Mark von Itzstein's laboratory. This research has resulted in a recent publication accepted by *mBio* with Associate Professor Haselhorst as joint-senior author. The Jennings/Day/Haselhorst joint team has also made progress in structure-guided vaccine design and with a number of candidates being tested in various *in-vitro* and *in-vivo* models. Overall, COVID-19 research has resulted in 3 patents.

Ms Danielle Lee is in the 2nd year of her HDR studies in the Haselhorst group, with a focus on developing novel antifungal treatment options to combat invasive Aspergillosis together with Associate Professor Joe Tiralongo's research group. This project is part of the international research alliance *iCAIR*[®] (Fraunhofer International Consortium for Anti-Infective Research), with a focus on bringing early-stage compounds into regulatory development for market approval. In 2020, the Haselhorst/Tiralongo groups have identified 4 novel compounds with high antifungal activity. Associate Professor Haselhorst was an invited speaker at the 19th Fraunhofer Seminar "Models of Lung Disease" in Hannover, Germany, on February 6 and 7 2020, presenting a lecture entitled "*The role of glycans in viral and fungal infections studied by NMR spectroscopy*".

In 2020, the Haselhorst group continued its engagement with Germany 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 Professor Sørge Kelm at the University of Bremen, Germany, the Haselhorst group will continue 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. Dr Santosh Rudrawar from the School of Pharmacy and Pharmacology, Griffith University has joined this collaboration to oversee the lipid chemistry. Due to COVID-19 travel restrictions, student and staff exchange with the University of Bremen in Germany was not possible but Associate Professor Haselhorst delivered a number of online lectures to the advanced Bioscience students at the University of Bremen. A joint review article (under review) and two joint grant applications were submitted in 2020.

Overall, the Haselhorst group has authored and co-authored seven journal articles and three patents in 2020. Associate Professor Haselhorst welcomed Mr Shane Prenzler to his research group, who has started his PhD studies and is jointly supervised by Dr Santosh Rudrawar. Shane's PhD literature review has been submitted to a top tier journal for publication. Associate Professor Haselhorst was also delighted that Hadieh Eslampanah Seyedi submitted her PhD thesis in 2020. Due to an increasing teaching load in 2020, Associate Professor Haselhorst has declined to act as NHMRC grant panel member again, but maintains his role in the organising committee of the Australian-German Science and Innovation Day, QLD representative of the Australian Association of Alexander von Humboldt Fellows, Research Ambassador of the German Academic Exchange Service (DAAD), editorial board member of Scientific Reports (Nature Publishing Group) and the Magazine of the Australian and New Zealand Society for Magnetic Resonance (ANZMAGazine).

Associate Professor Joe Tiralongo

Research Leader

The current research focus of the Tiralongo group is studying the function and biosynthesis of carbohydrates in the context of stem cell biology, cancer progression and fungal biology, as well as the use of nanotechnology to study complex glycobiology important in human health and disease.

In 2020, highlights from the Tiralongo group included the continuation of a significant collaboration with Integra Healthcare, funded through both Griffith University and Integra Healthcare, which has generated a US patent, and generated new important data that will form the basis for a major Australian Research Council grant application in 2021. In addition, we welcomed two new master's students who will be working on related aspects of this project.

The Tiralongo research group's growing reputation in the emerging field of glyco-nanotechnology was highlighted by the publication of two excellent papers in *ACS Applied Nano Materials* and *Langmuir* in 2020, as well as book chapter in *Comprehensive Glycoscience 2nd Ed.* This work highlights the potential of our glyco-nano approaches for the development of innovative drug delivery and biosensing technologies.

The Tiralongo research group's work in the stem cell field in collaboration with Professor Justin Cooper-White

at the University of Queensland, has made significant progress that has further highlighted the significance and potential of carbohydrates in stem cell biology and regenerative medicine. This work is currently being funded through an Australian Research Council grant.

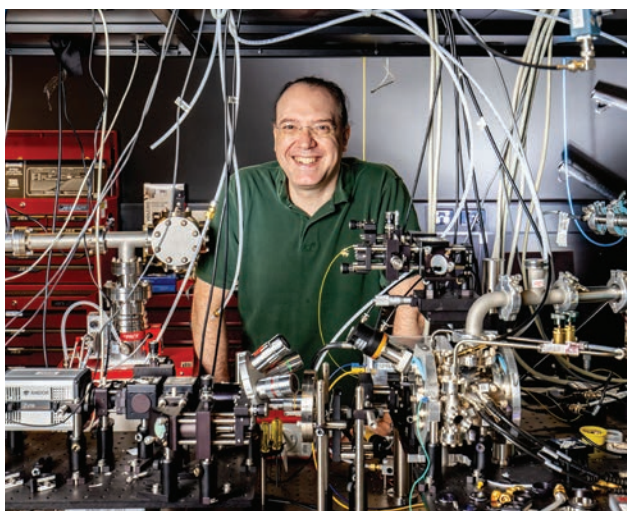
Additional highlights in 2020 include the completion of a master's graduate, the completion of a commercial research project with Boundary Blend Wellness, and the commencement of two honours students in the group.



Associate Professor Erik Streed

Research Leader

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.



With the public health situation complicating in-person undergraduate and Honours projects, much of our student driven efforts shifted to the virtual realm. This included undergraduate projects in machine learning for computer vision/image classification related to our ion trapping of yeast cells effort and a theoretical study of advanced diffractive optics techniques to enhance spectrometer sensitivity, the latter of which garnered Ryan Camilleri the ESC Best Capstone Poster for 2020.

Rose Manakil completed her Honours thesis "*Levitating Ionised Yeast Cells in a Linear ion Trap*" and has subsequently commenced a PhD in CQD.

The biophysics lab has also hosted materials science work on photonically enhanced silicon carbide on silicon sensors, remote quantum networking through our intra-campus fibre optic link, and preparatory work for investigating potential neutrino induced variations of time at the ANSTO Lucas Heights nuclear reactor.

Associate Professor Todd Houston

Research Leader

In spite of the difficulties of coping with the most significant pandemic in a century, the Houston research group has made significant progress in a number of areas in 2020.

Dylan Farr completed his PhD thesis and was able to submit it for examination two days before Christmas. He has made a number of exciting discoveries, including the development of a method for creating liposomal formulations of aminoglycoside prodrugs for targeting macrophages to treat intracellular infections including MRSA and TB. They are currently exploring an IP position on this technology. In addition, the group has gleaned valuable insight into potential mycobacterial targets of a family of antitubercular compounds.

PhD Candidate Taylor Garget has developed fluorescent receptors for carbohydrates that possess a unique divergent response that will aid in the detection of sugars involved in various disease states. He has also developed novel chemistry to facilitate construction of these sugar sensors. In addition, he completed an invited book chapter on boron compounds for the significant series *Comprehensive Heterocyclic Chemistry* (Elsevier). The group is currently working to apply his discoveries to a wider variety of sugar targets.

In collaboration with Professor Helen Blanchard, PhD candidate Peter Sunde-Brown has developed an elegant stereocontrolled synthetic route to thio-linked disaccharides. These hydrolytically stable linkages will be important in the development of bioactive ligands for Galectins, an important class of carbohydrate-binding proteins involved in a number of diseases, most notably cancer. The Houston group is planning to present these results at a Medicinal Chemistry conference in Australia in November 2021.



Dr Milton Kiefel

Research Leader

The Kiefel research group focuses on developing new chemistry methodology and chemical entities that facilitates the synthesis of molecules with potential applications in medicine and sustainability.



In 2020, the Kiefel group continued their efforts towards developing new efficient methods for the synthesis of higher order sugars found in pathogenic bacteria. This research is a key component of a broader research

program investigating potential new antibacterial agents, and in 2020 the research group developed new methods that facilitate large scale synthesis of key building blocks. A key achievement in 2020, in collaboration with microbiologist Dr Freda Jen, was the award of an NHMRC grant to explore the development of antibacterial vaccines.

The Kiefel group has also expanded its study into the synthesis of a new class of natural product with anticancer activity, and preliminary cell-based assays show some highly promising data. A new area of research within the Kiefel group relates to developing molecules that can “switch” between two physical states depending on the conditions (e.g. changing physical form when a certain wavelength of light is used), and this fundamental research may provide a novel approach towards delivering pro-drugs to specific sites prior to them becoming the active drug.

Research in collaboration with colleagues at Griffith University has resulted in the development of new synthesis of natural product analogues with biological activity, as well as the development of new materials that can be used as components of next-generation batteries.

Dr Lara Herrero

Research Leader

2020 was a busy year for the Herrero group, driven largely by ongoing industry and research commitments within the COVID-19 pandemic year.

With scientific, clinical and public health training, Dr Herrero spent a lot of time with media helping to explain aspects of SARS-CoV-2 and the implications of COVID-19 throughout 2020. This included interviews on national news and writing for newspapers/online media. Key examples of this media engagement can be seen in Dr Herrero's science articles published in *The Conversation* which have been read over 350,000 times in a three month period. Dr Herrero was also named the conference convenor for the Australasian Virology Society meeting in 2021, the 20th anniversary meeting to be held in QLD.

In further research output, PhD students continued their strong research drive producing excellent publications in high-ranking journals including the *Journal of Virology*, *mBio* and *Vector-Borne and Zoonotic Diseases*. Research gains were also achieved in the field of viral-arthritis and translational medicine. This included finalisation of the Advance QLD Fellowship and positive outputs to

further support industry-driven clinical investigation into treatments for viral-arthritis.

As testament to her strong research and translational output, Dr Herrero was also recognised as a 2020 Gold Coast Women in Business Awards winner for the category of Creating Change. This rounded off a very positive year for the Herrero group in 2020.



Dr Darren Grice

Research Leader

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



(i) In 2020 work continued in collaboration with Associate Professor Jenny Wilson and Dr Ian Peak on isolating and structurally characterising antigenic surface

carbohydrate structures from the Moraxellaceae family of Gram-negative bacteria. These are known to be involved in diseases affecting humans and cattle. Connected to this work, they received Year 1 Philanthropic funding and engaged an outstanding PhD student (master's degree, University of Wisconsin, USA 'development of a nanoparticle vaccine disease treatment ... in cattle') for further development of their human middle-ear vaccine candidate. Due to COVID-19 restrictions on international entry into Australia, this work is currently on hold. Work also continued in collaboration with Associate Professor Joe Tiralongo and Integria Healthcare P/L on isolating and identifying carbohydrate structures in medicinal mushrooms (fungi) with immunostimulatory activity. (ii) Ongoing research in collaboration with Professor Mark von Itzstein on designing and synthetically assembling novel PROTACS which are singularly capable of binding to cancer associated proteins and harnessing one of the body's natural destruction processes and was further progressed during the year. A small library of a section of these complex molecules having varying linker-lengths was advanced, allowing for future synthetic attachment to the cancer protein 'warhead' component, previously synthesised.

Dr John Atack

Associate Research Leader

The Atack lab continued its success of 2019 into 2020, with the completion of multiple projects and the commencement of new areas of research.

Dr Greg Tram, a post-doctoral researcher, finalised work concerning characterisation of the pig pathogen *Streptococcus suis*; specifically, he demonstrated that this organism is able to randomly switch expression of multiple proteins via systems called phasevarions. This will have important implications for development of vaccines against this important veterinary pathogen, and will be published early in 2021.

PhD students Zak Phillips and Nusrat Nahar continued their excellent progress in the lab, investigating gene regulation in the human pathogens non-typeable *Haemophilus influenzae* and *Streptococcus pneumoniae* (Zak) and pig pathogen *Actinobacillus pleuropneumoniae* (Nusrat). Zak made the finals of the ASM Queensland Nancy Millis student awards, where he will describe the findings of his PhD, with the finals to be held in early 2021.

We also welcomed back Ashley Fraser, who had completed her third-year project in the lab previously, this time joining as an honour's student. Ashley has made great progress investigating vaccine design in non-typeable *Haemophilus influenzae*, and we expect Ashley's first publication out soon. Dr Atack was invited to present work from the lab at leading national and international

conferences, including a keynote at the European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) in Paris, and talks at the Australian Society for Microbiology Annual meeting in Melbourne, and at the International Veterinary Vaccinology Network AGM, in Hanoi, Vietnam, but all were cancelled due to the COVID-19 pandemic.

More positively, Dr Atack was elected as the vice-chairperson of ASM Queensland, which will see him step into the role of chairperson at the end of the current tenure. This is an important position, allowing him to promote microbiology, and push its importance in health and education. Dr Atack also published three new papers in 2020, finalising his post-doctoral work with Professor Michael Jennings. Two of these papers demonstrated the prevalence of phasevarions in bacteria, and were published in the leading journals *mSystems* and the *FASEB Journal*. The third paper characterised how a major non-typeable *Haemophilus influenzae* virulence factor interacts with the human host, providing important information for us to develop ways to block this factor and treat infections.



Dr Chris Day

Associate Research Leader

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

In 2020, the Day group was a part of the publication of 18 research outputs including papers in *Science Advances*, *Gastroenterology*, *Langmuir* and *mBio*.

Bacterial toxins and their carbohydrate targets were a large focus of the Day group's work in 2020 with a third of the research outputs incorporating the analysis of bacterial toxins. A highlight of these were the publication of two *Science Advances* papers; one on the human adaptation of an MRSA toxin in collaboration with Professor Torres in New York University and another on the carbohydrate targets of cholesterol dependent cytolysins (CDCs) together with the Jennings group. Publication of these studies helped leverage an NHMRC Ideas Grant that was awarded to the Day and Jennings groups in collaboration with Professor Torres from New

York University to study novel methods of producing bacterial toxoids for use in vaccines.

The Day group also had great success in 2020 with the award of multiple grants to the collaborative team of the Jennings, Day and Kolarich groups to further the study 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 Manisha Pandey

Associate Research Leader

In 2020, Dr Manisha Pandey continued to lead streptococcal research and during the pandemic, along with Professor Michael Good, also joined the global efforts for COVID-19 vaccine research.



Their peptide-based vaccine approach encompassing minimal B cell epitopes from the RBD region of SARS-CoV-2 led to some exciting findings. A multi-institutional (national and international) collaboration led to a peer-reviewed publication. Drs Victoria Ozberk and Sharareh Eskandari both had major input in these studies. The funding support from Olymvax Pharmaceuticals to perform this research was gratefully received. In addition, a team effort involving Monash University and La Trobe University saw the successful selection of their COVID-19 vaccine approach to the

pre-clinical development program offered by VAANZ (a New Zealand government initiative). This program will enable them to further assess safety and efficacy, and their vaccine candidate(s) in transgenic mice with a possibility to move forward to clinical trials. A significant milestone in the Strep A vaccine development program has been the successful completion of toxicology study with MucoVax, the vaccine that utilises prime-pull immunisation regimen with intramuscular and intranasal administration. Dr Simone Reynolds along with Drs Victoria Ozberk, Ainslie Calcutt and Jessica Dooley have been highly instrumental in achieving this milestone.

The Strep research program was also joined by Dr Ailin Lepletier, a postdoctoral researcher who is undertaking studies involving immunological assessment of immunity following Strep A vaccination and/or experimental infection in humans, in addition to investigating immunity to COVID-19. She will be utilising her immunological expertise across a range of ongoing projects within the team.

The team published their research work in several peer reviewed high impact factor journals as well as two book chapters. Jamie-Lee Mills, working on a novel vaccine delivery system as part of her PhD project, published her first-author research paper in *npj Vaccines*. Dr Manisha Pandey, in recognition of her scientific/research achievements was awarded the Glycomics Research Excellence Award 2020.



Dr Danielle Staniscic

Associate Research Leader

The major highlight for the Malaria Team in 2020 was the completion of the Institute's world-first clinical trial to evaluate the effectiveness of the novel chemically attenuated whole parasite malaria vaccine in collaboration with Dr John Gerrard and clinicians from the Gold Coast University Hospital.

This trial was made possible through financial support provided by Rotary and the National Foundation for Medical Research and Innovation. Despite significant COVID-19-related delays, it is anticipated that the immunology-related studies will be completed this year with final results available in late 2021.

In 2019, Dr Staniscic and Professor Good were the grateful recipients of a Medical Research Future Fund (MRFF) "Accelerated Research" grant (\$500,000) which is allowing further development of this whole parasite malaria vaccine into a field-deployable vaccine formulation that will be suitable for use in malaria endemic areas. Pre-clinical work to further optimise this vaccine formulation was continued in 2020 by Ms Mei-Fong Ho, Dr Reshma Nevagi and Ms Emily Cooper and this will be completed in 2021. The Malaria Team, including Ms Heidi Plater, are currently establishing a GMP-compliant manufacturing process for this vaccine formulation to enable clinical evaluation, with a Phase I trial planned for the first half of 2022.

Dr Reshma Nevagi was awarded a prestigious Griffith University Postdoctoral Research Fellowship for 2021-2022 which she will use to further develop the novel controlled infection immunisation vaccine approach which involves co-administering live malaria parasites and an effective anti-malarial drug. This work is being undertaken in collaboration with Professor Istvan Toth at the University of Queensland.

In 2020, the team bid a sad farewell to Ms Emily Cooper, a Research Assistant who played a key role in the Malaria Vaccine clinical trials. We are happy to welcome Ms Maddie Walton, a recent Griffith University graduate to our team in 2021 to continue this important work.

The two students in the Malaria Team, Ms Winter Okoth (PhD student) and Mr Taymin Du Toit Thompson (Masters student) had a successful 2020 with Winter continuing to work on her field-deployable vaccine formulation and Taymin finishing up his laboratory work developing a whole parasite transmission-blocking malaria vaccine. This is the first evaluation of a whole parasite transmission-blocking malaria vaccine in pre-clinical models.

Dr Hanan Al-Nazal graduated in mid-2020, with her PhD thesis "*Immunity to Babesiosis and Discovery of Next Generation Vaccines*". The Babesia parasite is related to the malaria parasite, causes cattle tick fever and is a major issue for Australia's livestock industry as well as also infecting and causing disease in humans, particularly in the US and Europe. We wish her well for her future research activities.

With the COVID-19 pandemic presenting unique challenges for continuing research in 2020, the Malaria Team diversified their research interests, joining with members of the Strep team and the Gold Coast University Hospital to collect and analyse convalescent samples from patients recovering from COVID-19. This culminated in Dr Staniscic travelling to the Walter and Eliza Hall Institute of Medical Research at the end of 2020 for a collaborative research project with Associate Professor Diana Hansen to undertake immunologic profiling of these samples.

Dr Thomas Ve

Early Career Research Leader

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

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

molecular tools. This research is also complemented by work on proteins involved in innate immunity signalling pathways, and viral host-cell entry and inhibition.

In 2020 Dr Ve was awarded a NHRMC Investigator grant (5-year; \$1.5 million) entitled *Structural Biology and Inhibition of Axon Degeneration*. He was also awarded an ARC Future Fellowship (4-year; >\$800K) entitled *Molecular basis of nucleotide signalling by TIR domain containing proteins*. These grants will enable Dr Ve to continue his structural biology based research on SARM1 and bacterial members of this novel class of glycohydrolases.

In 2020 Dr Ve's group established international collaborations with neuroscientists Jeffrey Milbrandt and Aaron DiAntonio (Washington University, St Louis, USA), solved the cryo-EM structure of the entire SARM1 protein in its inactive state, and showed that SARM1 is activated by an increase in the ratio of NMN to NAD⁺. This work (*Neuron*, 2021) expands our understanding of SARM1 as a druggable target, with implications for a wide-range of neurodegenerative diseases.





OUR FACILITIES



OUR FACILITIES

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

Physical Containment Level 3 (PC3) Facility

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

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

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

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

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

Glycobioanalytical Facility

Our Glycobioanalytical Facility includes the Glycomics Array Facility and a Bioanalytical Suite:

- **Glycomics Array Facility** – established in 2006, this facility comprises a microarray manufacturing suite. The Array Facility has experience, expertise and instruments for the manufacture of contact printed microarray slides. Routinely printed slides include glycan, lectin (carbohydrate-binding protein), as well as custom arrays including amino acid, DNA, oligonucleotide, peptide and antibody arrays.
- **Bioanalytical Suite** – this Suite has the instrumentation to enable researchers a one-stop shop for identification of a binding profile and the further characterisation of these interactions through the implementation of surface plasmon resonance or isothermal titration calorimetry, and whole-cell-based assays through flow cytometry.



Advanced Mass Spectrometry Facility

A multi-million dollar investment by Griffith University allowed the establishment of a new glycomics and glycoproteomics focussed Advanced Mass Spectrometry Laboratory, embedded at the Institute for Glycomics.

As part of the Australian Centre for Cancer Glycomics (A2CG) a major focus of this Mass Spectrometry laboratory is to push the boundaries in biomedical research and working towards the discovery of new cancer diagnostics, drugs and vaccines, which will have global impact.

This purpose-built laboratory currently hosts three state-of-the-art high-end mass spectrometers catering for different challenges in cancer and disease glycomics:

1. rapifleX™ tissue imager
2. Orbitrap™ Fusion™ mass spectrometer
3. amaZon speed ion trap mass spectrometer

We are using these modern technologies to understand and translate the glycome changes occurring in cancer to identify new therapeutic targets, develop novel diagnostics for precision medicine and gain a better general understanding of cancer biology.

We are also offering one-stop services and solutions for industrial glycomics and glycoproteomics challenges and questions, with the team having over 60 combined years of experience in analytical glycobiology, glycomics and glycoproteomics.

In 2020, a successful Ian Potter grant provided funding for a **Leica Laser Microdissection System**. This state-of-the-art system allows contact- and contamination-free dissection and specimen collection simply by gravity.



Separations Science Facility

The Separations Science Facility provides an analytical service to internal and external clients.

It houses four HPLC systems ranging from UHPLC single quad MS-ESI to a semi-preparative HPLC system along with various detectors: diode array, refractive index, evaporative light scattering and fluorescence.

HPLC is a separation technique based on a solid stationary phase and a liquid mobile phase. It is a useful

technique for separating ions or molecules that are dissolved in a solvent, loaded onto a column and then separated and analysed by applying more solvent and using various detection methods.

We specialise in HPLC purifications and method development for products, which have never been analysed before, or a problematic HPLC method that requires optimisation or troubleshooting.

ZymeBank Facility

Provides enzymes that support both internal and external research projects. By cloning into various mammalian or bacterial expression vectors, ZymeBank is able to produce enzymes essential for glycan synthesis in high quality and purity.

ZymeBank offers:

- ready to use enzymes
- expression plasmids (in-house cloned)
- molecular cloning
- protein expression and purification
- assay development

Other Facilities

Other specialist resources within the Institute include computational chemistry and visualisation, nuclear magnetic resonance (NMR) spectroscopy, protein X-ray crystallography, advanced microscopy and imaging, PC2 and GMP-compliant laboratories, and an irradiation facility.

The Institute's cutting-edge drug and vaccine discovery and development resources are available to external research groups and industry.

Adapting operations to meet COVID-19 requirements

The rapid evolution of the COVID-19 pandemic in 2020 presented unique and ever-changing challenges to maintain the operational status of the Institute's facilities and equipment.

The Institute's Operations team, in consultation with the Institute's Executive, were responsible for the implementation of State Government health directives, and University guidelines in response to the pandemic. This involved closing, and then staged re-opening, areas of the Institute, developing and deploying safe work practices (e.g. social distancing) across the Institute, including certified laboratory spaces.

During the year, the Institute also implemented a significant number of new research projects focused on SARS-CoV-2, including projects focused on diagnostics, drug evaluation and vaccine development.

The Operations team were tasked with onboarding these projects in a safe but timely manner, including the development of training packages for the safe handling of this virus, access to scientific instruments and provision of personal protective equipment (PPE).

Due to the pandemic, the Institute's Business Continuity Plan was enacted and additional PPE was sourced to ensure research continuity and ability of staff to work in a safe manner (including COVID-19 associated research projects). Significant resources were utilised in securing PPE and other scientific reagents as national and international supply chains were affected.

Border closures (state and national) impacted on the Institute's ability to service and maintain specialised equipment and facilities with many technicians based overseas or interstate.

Through a process of careful planning and a risk assessment-based approach, equipment and facilities

were able to be maintained at a high level of operational capability with little downtime during 2020.

Various strategies were implemented, including increased remote support, remote auditing, changes in service dates to coincide with technician availability, and staggering of maintenance intervals to ensure baseline capacity.

Similarly, significant resources were committed to ensure technicians could access equipment and facilities in a safe manner; this included providing PPE, isolating and cleaning areas/equipment during or after maintenance, and completing documentation in support of travel exemptions.

The Operations team continue to review and plan for the various challenges posed by the on-going pandemic.

Pictured: The Institute's Senior Operations Managers, Dr Carie-Anne Logue and Dr Michael Batzloff





**2020
PUBLICATIONS
AND GRANTS**

2020 PUBLICATIONS

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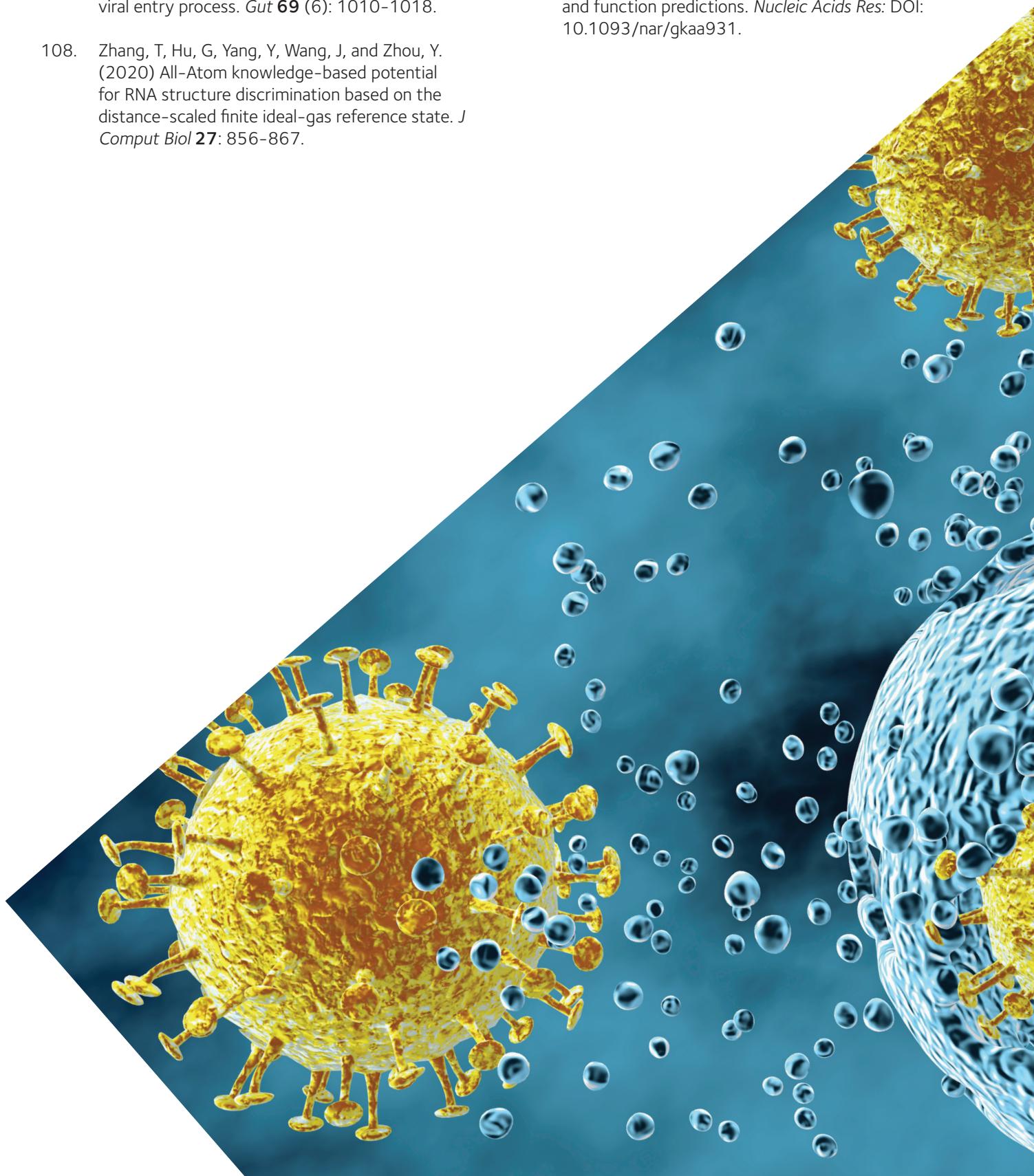
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NEW GRANTS AWARDED*/COMMENCING IN 2020

Grant Name	Project Name	Investigator(s)	Total Grant
NHMRC - Clinical Trials and Cohort Studies Grant	<i>A multicentre randomised controlled trial evaluating the efficacy of the meningococcal B vaccine, 4CMenB (Bexsero), against Neisseria gonorrhoeae infection in gay and bisexual men</i>	Associate Professor Kate Seib	\$2,774,292
NHMRC - Investigator Grant*	<i>An interdisciplinary approach towards antiviral therapy discovery</i>	Professor Mark von Itzstein AO	\$2,000,000
NHMRC - Investigator Grant	<i>Novel vaccine technology to translate knowledge of immunopathogenesis into vaccines and therapeutics</i>	Professor Michael Good AO	\$1,522,615
NHMRC Development Grant	<i>Breaking antibiotic resistance in high priority Gram-negative sepsis pathogens</i>	Professor Mark von Itzstein AO	\$1,067,778
NHMRC - Investigator Grant*	<i>Structural biology and therapeutic targeting of axon degeneration</i>	Dr Thomas Ve	\$1,062,450
NHMRC - Ideas Grant*	<i>A gonococcal vaccine on the horizon: Using human data from a cross-protective meningococcal vaccine to guide gonococcal vaccine development</i>	Associate Professor Kate Seib	\$826,488
ARC Future Fellowship*	<i>Molecular basis of nucleotide signalling by TIR domain containing proteins</i>	Dr Thomas Ve	\$826,420
NHMRC - Ideas Grant*	<i>Vaccine to prevent influenza virus and bacterial super-infection</i>	Dr Mehruz Zaman	\$707,716
US Department of Defense - Breast Cancer Research Program	<i>Detection of aberrantly glycosylated biomarkers as a novel approach to diagnose and monitor breast cancer</i>	Professor Michael Jennings; Dr Christopher Day; Dr Lucy Shewell; Dr Jodie Abrahams	\$695,018

NEW GRANTS AWARDED*/COMMENCING IN 2020

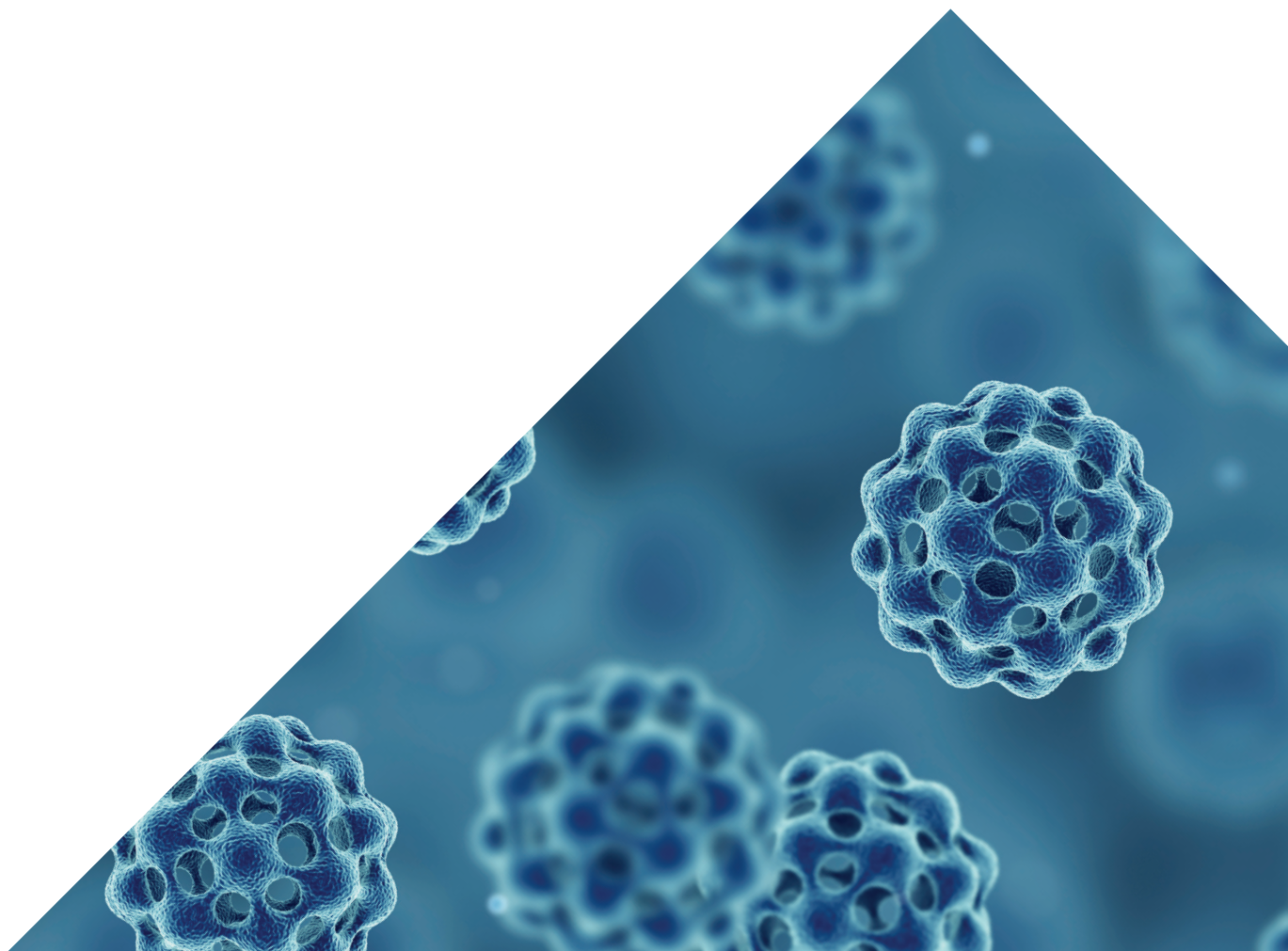
Grant Name	Project Name	Investigator(s)	Total Grant
NHMRC - Ideas Grant*	<i>Structure and biophysical analysis aided design of novel toxoid vaccines for a major class of bacterial toxins</i>	Professor Michael Jennings; Dr Christopher Day	\$608,423
ARC Discovery Project*	<i>RNA structure prediction by deep learning and evolution-derived restraints</i>	Professor Yaoqi Zhou; Professor Kuldip Paliwal	\$570,000
NHMRC - Ideas Grant*	<i>Targeting a bacterial glyco-Achilles heel to make new vaccines for Haemophilus influenzae and Neisseria gonorrhoeae</i>	Dr Freda Jen; Dr Milton Kiefel	\$526,949
ARC Discovery Project	<i>Genetic basis of variable expression of glycan xeno-autoantigens by cattle</i>	Professor Michael Jennings	\$495,838
Biomedical Translation Bridge Program (BTB) Grant	<i>Development and commercialisation of high-throughput liquid biopsy assays for the detection of breast cancer and monitoring of recurrence based on a unique, proprietary cancer-specific probe</i>	Professor Michael Jennings; Dr Christopher Day; Dr Lucy Shewell; Professor Allan Cripps	\$301,308
iCAIR® Initiative	<i>COVID-19 funding - iCAIR® initiative</i>	Professor Mark von Itzstein AO	\$200,000
Australian Department of Defence Grant via University of Adelaide	<i>Human biotechnologies: Performance patch and technology trajectory</i>	Associate Professor Daniel Kolarich; Dr Andreia Almeida	\$104,650
Advance Queensland Industry Research Fellowship	<i>Evaluation of COVID-19 antiviral and vaccine candidates, using a non-infectious virus-like-particle platform</i>	Dr Belinda de Villiers	\$90,000

NEW GRANTS AWARDED*/COMMENCING IN 2020

Grant Name	Project Name	Investigator(s)	Total Grant
Australian Centre for HIV and Hepatitis Virology Research Grant	Rapid diagnostic and prognostic assay for HTLV-1 and lymphocytosis, for patients in the Australian outback	Dr Belinda de Villiers; Professor Johnson Mak	\$88,000
STI CRC Developmental Research Project Award	High throughput analysis of serum samples to aid development of a gonococcal vaccine	Dr Evgeny Semchenko	\$70,340
Australian Centre for HIV and Hepatitis Virology Research Grant	Repurposing widely prescribed and safe drugs to block the establishment of HIV latent macrophages reservoir	Professor Johnson Mak; Professor Michael Jennings; Dr Christopher Day	\$50,000
Research, Development and Innovation Grant	Vaccine for control of Flystrike	Associate Professor Daniel Kolarich; Dr Kathirvel Alagesan	\$35,000
National Institute of Health (NIH) - USA	Vibrio cholerae biofilms: structure, function, regulation and role in infection	Professor Victoria Korolik	\$30,262
ANZGOG New Research Grant	Targeting metabolism to improve efficacy of ovarian clear cell carcinoma therapeutic agents	Dr Arun Everest-Dass	\$25,000
Australia-Germany Joint Research Cooperation Scheme	Dual functional drug delivery system for the treatment of Non-Hodgkin's Lymphoma	Associate Professor Thomas Haselhorst	\$24,800
Advance Queensland Women's Research Assistance Program (WRAP) Grant	Advance Queensland - Women's Research Assistance Program	Dr Larissa Dirr	\$11,700

NEW PHILANTHROPIC GRANTS IN 2020

Grant Name	Project Name	Investigator(s)	Total Grant
The Bourne Foundation Donation	<i>Characterising a newly discovered blood biomarker with potential use in the diagnosis and monitoring of ovarian cancer</i>	Professor Michael Jennings; Dr Lucy Shewell; Associate Professor Daniel Kolarich; Dr Christopher Day	\$300,000
Thyne Reid Foundation Grant	<i>Developing new drugs and a vaccine to protect against antibiotic resistant gonorrhoea</i>	Associate Professor Kate Seib; Dr Evgeny Semchenko	\$122,550
Civic Solutions Inc Grant	<i>Understanding the mechanisms of chemotherapy resistance in Leukaemia</i>	Associate Professor Daniel Kolarich	\$49,998
Tour de Cure Research, Support and Prevention Senior Research Grant	<i>Characterising a newly discovered blood biomarker with potential use in the diagnosis and monitoring of ovarian cancer</i>	Professor Michael Jennings; Dr Lucy Shewell; Associate Professor Daniel Kolarich	\$25,000

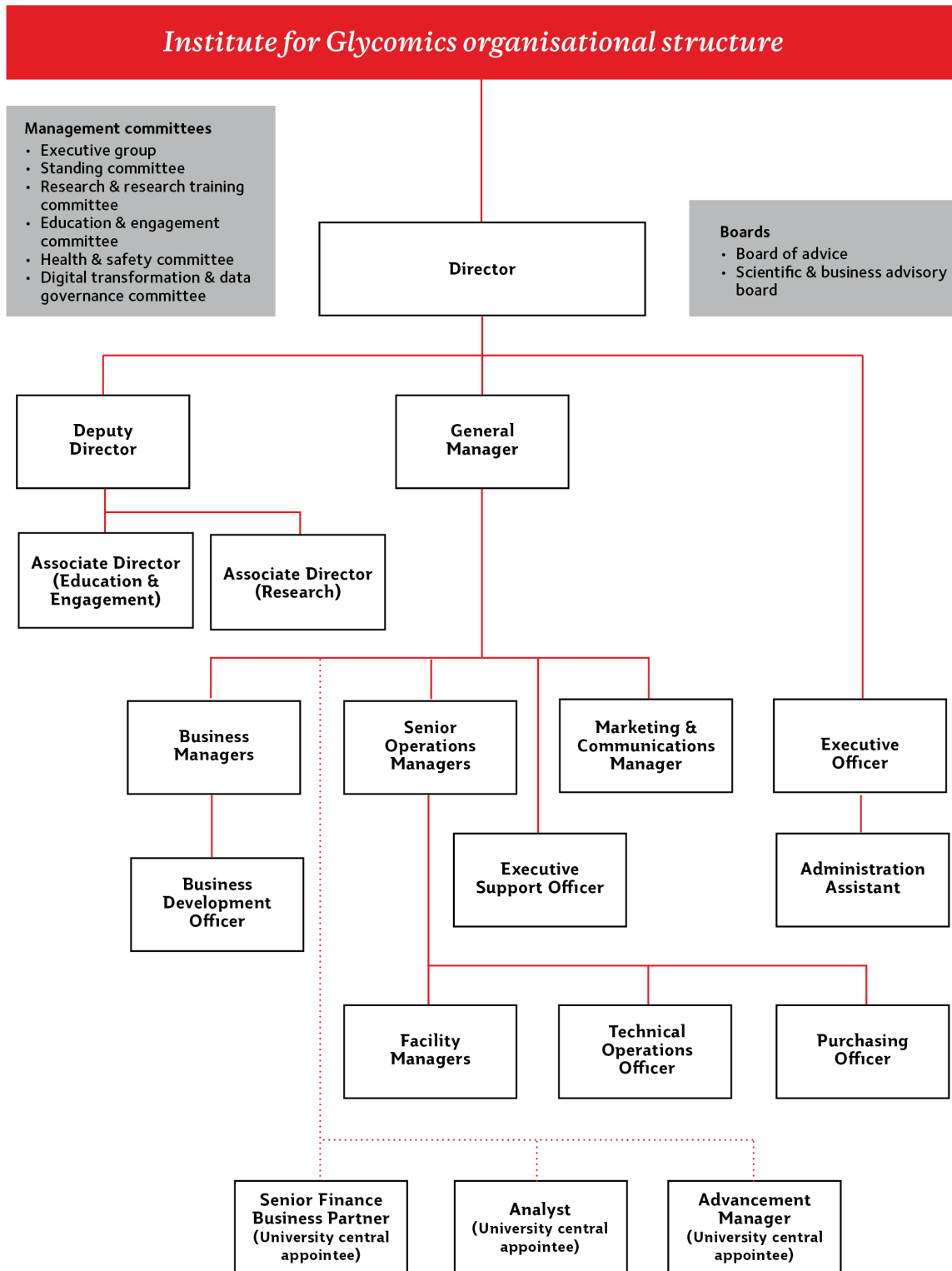


REMARKABLE PEOPLE



REMARKABLE PEOPLE

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





MEMBERSHIP IN 2020

Leadership team

Director: Professor Mark von Itzstein AO
Deputy Director: Professor Michael Jennings
General Manager: Dr Chris Davis

Administration, business and operations teams

Jenni Dyason
Dr Lauren Hartley-Tassell
Harshani Jayasinghe
Eloise Keeffe
Dr Philip Ellery
Nina Kristensen

Fiona Crone
Erica Luan
Phillip Hodgson
Dr Jelena Vider
Sarah Lukic
Sonia McKay

Steph Chaousis
Nancy Callaghan
Scott Feely
Dr Carie-Anne Logue
Dr Michael Batzloff
Dr Catherine Tindal

Research group leaders

Professor Michael Jennings
Associate Professor Thomas
Haselhorst
Professor Mark von Itzstein AO
Professor Nicolle Packer
Professor Carolyn Mountford
Professor Johnson Mak
Dr Christopher Day

Dr John Atack
Professor Victoria Korolik
Dr Ian Peak
Professor Sue Berners-Price
Professor Michael Good AO
Associate Professor Kate Seib
Professor Yaoqi Zhou
Associate Professor Todd Houston

Dr Milton Kiefel
Dr Darren Grice
Dr Manisha Pandey
Dr Danielle Stanisic
Associate Professor Joe Tiralongo
Associate Professor Daniel Kolarich
Dr Lara Herrero

Adjunct and visiting appointments

Dr James Fink	Professor Subhash Vasudevan	Dr John Lancashire	Dr Kai Zhou
Professor Nicholas Farrell	Professor Xing Yu	Professor John Gerrard	Dr Jessica Browne
Professor Peter Seeberger	Professor Helen Blanchard	Dr Grant Hansman	Emeritus Professor Ifor Beacham
Professor Yuedong Yang		Professor Sørge Kelm	

Research scientists

Dr Tamim Mosaib	Dr Yun Shi	Dr Ailin Lepletier de Oliveira	Dr Mehfuz Zaman
Heidi Plater	Dr Anil Gorle	Dr Yaramah Zalucki	Dr Alpesh Malde
Dr James Carter	Dr Larissa Dirr	Dr Patrice Guillon	Dr Penny Rudd
Eduardo Vasquez	Dr Rajaratnam Premraj	Dr Freda Jen	Stephanie Holt
Dr Andreia Almeida	Dr Bassam Elgamoudi	Dr Andrea Maggioni	Jessica Dooley
Dr Carolina Ruiz	Dr Sharareh Eskandari	Dr Ibrahim El-Deeb	Ainslie Calcutt
Heath Dean	Dr Jodie Abrahams	Dr Chih-Wei Chang	Mei Fong Ho
Dr Md. Farhadul Islam	Dr Kathirvel Alagesan	Dr Lucy Shewell	Helen Mostafavi
Veronika Masic	Dr Belinda de Villiers	Dr Mauro Pascolutti	Dr Chi-Hung Lin
Emily Cooper	Dr Victoria Ozberk	Dr Thomas Ve	Dr Robin Thomson
Johana Luhur	Dr Peng Xiong	Dr Matthew Campbell	
Jill Wallus	Dr Jessica Poole	Dr Arun Everest-Dass	
Dr Evgeny Semchenko	Dr Reshma Nevagi	Dr Taha	
Dr Benjamin Bailly	Dr Crystall Swarbrick	Dr Jian Zhan	
Dr Husen (Ari) Jia	Dr Greg Tram	Dr Simone Reynolds	

Research students

Brijesh Jakasaniya Aka Patel	Olivia Tan Hui	Arjuna Abitbol	Yasin Mojtahedinyazdi
Zhe Zhang	Joanna Musik	Kisshanpyar Anand	Ropafadzo Muchabaiwa
Greg Tram	Elina Panahi	d'Artagnan Barnard	Shrey Patel
Daniel Earley	Elizabeth O'Hara	Neeraj Bhatnagar	Jasmine Peachey
Brody Mallard	Annelies Van Den Bergh	Akarsha Bhola	Francis Pulik
Oren Cooper	Jing Wang	Allysha Bishop	Jenny Rose Quiatchon
Callum Bennett	Yuan Zhang	Peter Blakeley	Tahlia Ralph
Ammar Al-Kass	Abarna Mohana Murugan	Elise Browne	Tarran Roles
Rob-Marc Go	Nusrat Nahar	Jamie-lee Brundyn	Forrester Savell
Tongchuan Zhang	Winter Okoth	Ryan Camilleri	Valentin Slesarenko
Dylan Farr	Danielle Lee	Thalia Cannon	Emily Smith
Tiago Oliveira	Xiaofan (Amber) Chen	Riccardo Cecchin	Jennifer Smith
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Md Solayman	Ashley Fraser	Alasta Firkins	Alyce Topping
Taylor Garget	Jason Lee	Alex Fulton	Isabelle Watson
Peter Sunde-Brown	Taymin du Toit-Thompson	Emma Groucutt	Georgina Wilson
Gael Martin	Sandeep Balaganessh	Michael Hadjistyllis	(Annie) Huaying Xu
Sam Nozuhur	Jack Rowlatt	Lily Howell	Angie Zhou
Chengpeng Li	Xavier De Bisscop	Stephen Jiang	
Hanan Ahmed Najem	Sarah Dunn	Alex Johnston	
Al-Nazal	Ashleigh Ross	Andre Jones-Dorr	
Hadih Eslampanah Seyedi	Caity Thomas	Mina Khalil	
Linghui Li	Tiana Hippolite	Mercedes Lazarou	
Elisa Lim	Thangira Usavamaytee	Jarrold McCarthy	
Vimbaishe Chibanga	Yongbao Huo	Liam McClelland	
Jamie-lee Mills	Cecile Cumin	Jordan McKeown	

OUR BOARD OF ADVICE



The Honourable Robert Borbidge AO (Chair)

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

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



Mr Pat Crotty (Deputy Chair)

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

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



Mr Luke O'Dwyer

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

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



Mr Paul Sanders

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

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



Ms Christine Lohman MBA, FAICD, FPRIA

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



Mr William Matthews

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



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.



Ms Lucy Cole

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



Mr Sam O'Connor MP

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

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



Ms Rachel Hancock

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



Mr Nathan Blair

Nathan is a Responsible Executive of Ord Minnett Private Wealth and manages the Gold Coast office. He has been providing stockbroking and investment advice for over 20 years and has over \$600m of funds under his advice.

Nathan has a Bachelor of International Finance from Griffith University and has held numerous board, advisory and charity positions including Griffith University, Rotary International, Sailing and Surf Lifesaving.



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 not-for-profit.

She is also a professional speaker and trainer having worked with some of the world's leading brands, heads of state and national companies. Karen is a passionate advocate and contributor to both Queensland and the Gold Coast.

Over the past two decades she has served on a selection of key community boards. In 2018 Karen was awarded Gold Coast Citizen of the Year for distinguished service to the Gold Coast community.

She is Executive Director of both Queensland Women in Business & the Women in Business Awards of Australia.

A Special Tribute from Honorary Fellow, Mr Robert (Bob) Gordon

In 2020, Robert (Bob) Gordon retired from the Institute for Glycomics's Board of Advice. Bob served a remarkable 8+ years as a member of the Board of Advice, promoting community engagement while demonstrating his passionate support of our research. In this special tribute, Bob reflects on his long and remarkable journey alongside the Institute for Glycomics.

With more than 50 years' experience in journalism, including 13 years as editor in chief of Gold Coast Publications Pty Ltd (publishers of The Gold Coast Bulletin), Bob's lifework has been championing the Gold Coast; showcasing the capabilities that this vibrant city has to offer.

"My introduction to the Institute for Glycomics in 2002 is thanks to the late Terry Robertson. I couldn't believe I had uncovered such a hidden gem right here on my doorstep! The Institute for Glycomics was one of the most remarkable research institutes in the world, housing so much promise, not just for the Gold Coast but for global health. From humble beginnings, it was evident that the Institute's future was bright. Professor Emeritus Ian O'Connor AC, the Honourable Robert Borbidge AO and the late Terry Robertson invited me to join the Institute's Board of Advice.

"The story of the Institute for Glycomics was better than any front-page news headline, and it was this introduction so many years ago that fuelled my fire to advocate for the vital research projects being undertaken at the Institute. They had a story to tell; they just needed help to fill the chapters and realise their potential through

expansion. I was honoured to be invited to hold a Board of Advice membership, which I eagerly accepted.

"It was my experiences growing up that set the foundation for my desire to champion, advocate and build community support for medical research.

"I reflect on the major events of times gone past that have created a devastating mark on history, shaping the way in which we view diseases like cancers and infectious diseases; bringing puzzle pieces of the unknown, to the known, developing our understanding of diseases and translating that into ways that we can combat the devastation they can cause, and in some cases eradicate the illness altogether.

"In 1848, the great Polish composer Chopin gave a concert in Edinburgh. He was dying of Tuberculosis (TB) but played magnificently for two hours. Someone of such stature, brilliance and talent - dead just a year later. It's hard to fathom.

"TB spread across Scotland, so my ancestors, the Gordons of time past, decided their youngest son, a law student in Edinburgh should be sent Down Under. There

was land aplenty and the climate was thought to be drier and safer. I am pleased to say he lived on at Taio, well into old age.

“Back in Europe, hundreds of thousands died in the TB epidemic...not unlike what COVID has done in 2020. I grew up aware of epidemics, but the great fear of war babies like me, was not of the Germans or the Japanese, but of Polio.

“In the 1950s, while I was in boarding school, Brisbane was hit by a polio epidemic, with another a year or two later and no vaccine existed. We had to stay at school; no sport, no lessons, not even an opportunity to attend chapel for endless rosary prayers.

“Having lost our holidays and a good part of one term in quarantine, we were ordered to our beds for an injection. Salk hadn't yet been invented. Laying face down on our bellies, we awaited our fate in the form of a horse-sized injection needle, delivered by the nurse. I vividly remember looking across at the boy beside me who was much larger than I. The nurse administered the dose, unscrewed the top, poured more Gamma Globulin and proceeded to inject a second dose. Apparently, the dose was decided on weight and it was then that I was thanking my lucky stars that I was small.

“One of my classmates had died of polio, another spent a few years in an iron lung before he too died, and a third, curiously, recovered and had a growth spurt, making him large enough to play in the first fifteen. He, like my brother, did medicine and became a head surgeon at the Mater Hospital. A year or so later, along came Jonas Salk and Albert Sabin and their vaccines just about wiped out polio across the planet.

“Back in World War II, my great uncle Professor Doug Gordon (later Dean of Medicine in Queensland) served in the army team led by Raphael Cilento who tried to protect our soldiers from the real scourge of tropical diseases up there in Papua New Guinea and Asia. Brazil declared conscription after the surrender of Malaysia, but men could choose between going into the jungle to extract rubber for ships, airplanes and machine

guns or joining the Brazilian regiment to fight beside the Americans in Italy. Brazil lost 30,000 men, not by the hand of combat but by the contraction of diseases like yellow fever from the jungle.

“History astounds me. It tells a story - important news stories - which is why my career led me into journalism and news publication. This history and the experiences of growing up amidst pandemics and illnesses, seeing the devastation first-hand, has entrenched a burning desire to alleviate future generations from having to experience what I did, and what our ancestors have.

“Scientific discoveries and progress take dedication, passion, focus, collaboration and time, not only by researchers but also a community. A community who will stand up, dedicated to promoting the unique approach to these diseases, passionate about driving support, focused on a future no longer strangled by devastation, collaborating with networks to create a bigger community village and time spent educating the world on why these researchers need us, so that we can give time back to those who follow in our footsteps.

“I felt thrilled to be asked to stand alongside Professor Mark von Itzstein AO and his research teams to tell their story, champion the Institute and help create opportunity to be the change the world so desperately needs as they tirelessly work to create collateral damage against diseases of global impact. Their successes and progress to date reiterate that potential I saw nearly twenty years ago. The research being carried out right here on the Gold Coast is vital to the future of our health and civilisation.

“The team at the Institute for Glycomics are the real heroes, I just get to tell their story. I will continue to tell their story as I close the chapter on being a Board of Advice member and turn the page to an Honorary Fellow of the Institute for Glycomics.

This next chapter will be their best yet.”



REMARKABLE SUPPORT

Thank you to the supporters who make our discoveries possible!

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

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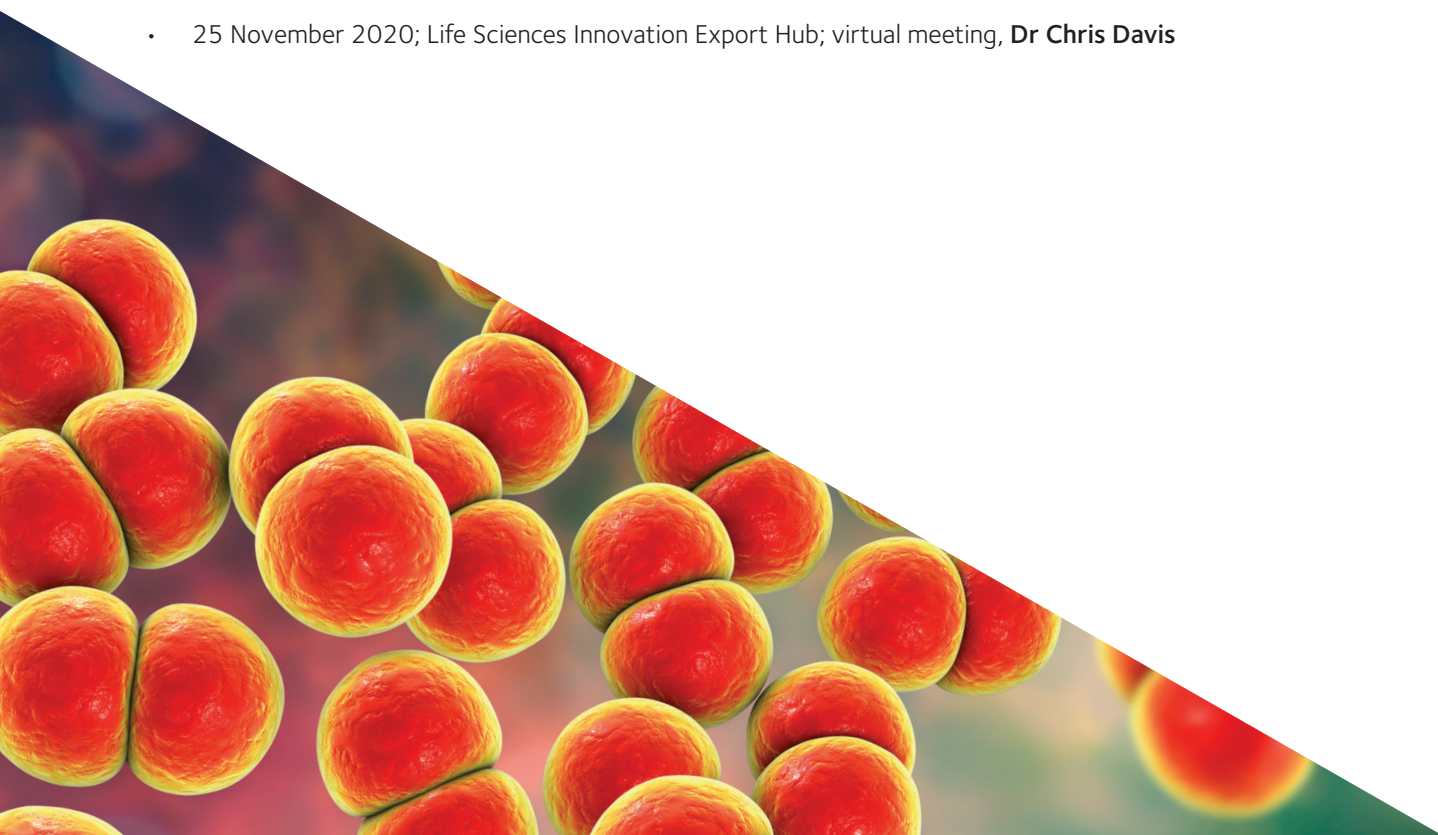
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The Hon Leneen Forde AC
Baslyn Beel
Jennifer Bartels
Harry Triguboff AO DUniv and Rhonda Triguboff
Robert Gordon

PLENARY, KEYNOTE, AND INVITED LECTURES IN 2020

- 6-7 February 2020; 19th Fraunhofer Seminar “Models of Lung Disease”; Hannover, Germany; **Associate Professor Thomas Haselhorst and Associate Professor Daniel Kolarich**
- 30 March – 3 April 2020; International Conference on Antiviral Research 2020 (ICAR 2020); Seattle, Washington, USA; **Professor Mark von Itzstein AO**
- 13-14 May 2020; WHO Gonococcal vaccine preferred product characteristics; virtual multidisciplinary follow-up consultation, **Associate Professor Kate Seib**
- 22 June 2020; MIE-2020: Malaria Immunology and Elimination; virtual short symposium; **Dr Danielle Stanisic**
- 20 August 2020; Deep Dive: Opportunities in Biomedical R&D with China; Australia China Business Council Webinar; **Dr Chris Davis**
- 12-13 September 2020; Rotarians Against Malaria; Virtual Conference; **Dr Danielle Stanisic**
- 14 October 2020; Trade and Investment Queensland Interviews; TIQ Brisbane; **Dr Chris Davis**
- 21-24 October 2020; *Neisseria gonorrhoeae* Research Society (NgoRS) inaugural conference; virtual conference; **Associate Professor Kate Seib**
- 30-31 October 2020; International Virtual Conference on Computer-Aided Drug Design; **Dr Alpesh Malde**
- 16-20 November 2020; Joint Australasian HIV & AIDS and Sexual Health Conferences; virtual conference; **Associate Professor Kate Seib**
- 16-20 November 2020; International Union of Microbiological Societies Congress (IUMS 2020 Virtual Conference); virtual seminar; **Professor Mark von Itzstein AO**
- 17 November 2020; 33rd International Conference on Antiviral Research; virtual webinar; **Professor Mark von Itzstein AO**
- 21 November 2020; 10th Annual Meeting of the Academic Committee of SKL of Chemical Biology & Drug Discovery; virtual meeting; **Professor Mark von Itzstein AO**
- 25 November 2020; Life Sciences Innovation Export Hub; virtual meeting, **Dr Chris Davis**



Our vision for the future

After closing the book on our 20th Anniversary with many exciting research and funding outcomes, we now enter into a new and exciting chapter: our 21st Birthday year, our coming of age.

The Institute is well-positioned to achieve great things in the fight against diseases of global impact. Our resolve to tackle those complicated diseases that have no solution remains our mission, and we endeavour to make significant breakthroughs in the year ahead that will deliver our translational research vision.





Institute for Glycomics

Queensland, Australia

Contact us

Institute for Glycomics
Griffith University Gold Coast
Queensland, Australia 4222

Phone: (07) 5552 8051
Fax: (07) 5552 8098
E-mail: glycomics@griffith.edu.au

griffith.edu.au/glycomics



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