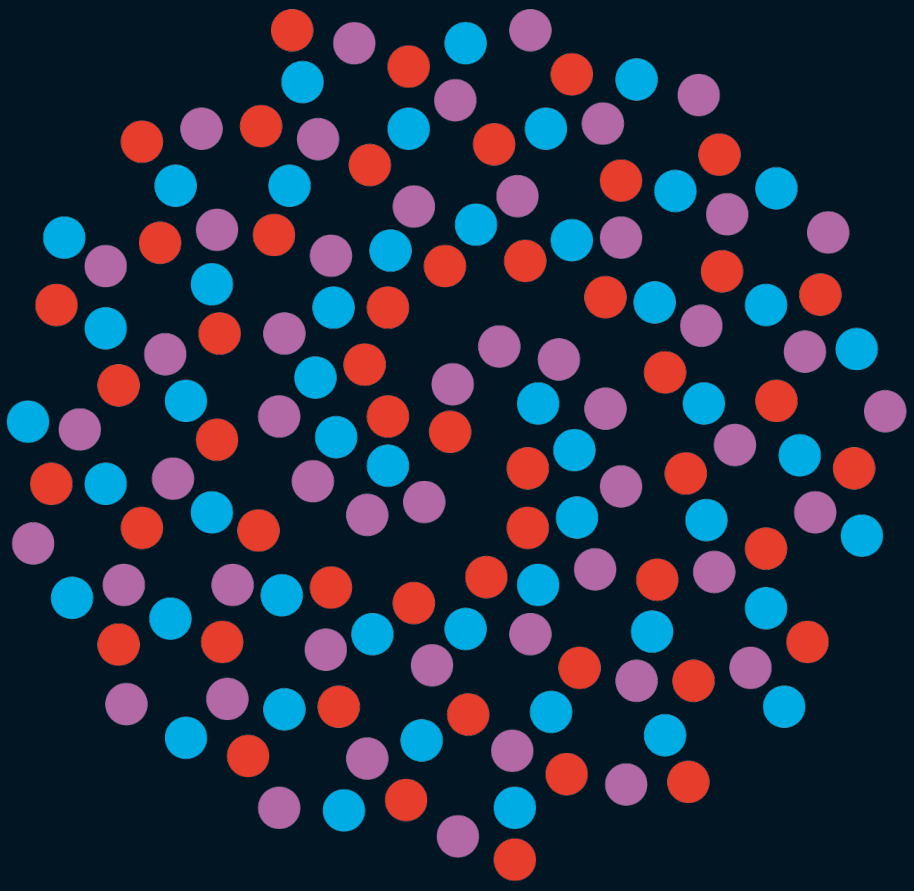

MAURICE WILKINS CENTRE

New Zealand's Centre of Research Excellence
targeting human disease

Annual Report 2022

Maurice Wilkins Centre

New Zealand has an outstanding reputation for biomedical research. The Centre aims to harness this expertise to develop drugs and vaccines, tools for early diagnosis and prevention, and new models of disease. In addition to translational research that directly targets human disease, the Maurice Wilkins Centre encourages innovative fundamental science that has the potential for high impact on human health.

The MWC completed 20 successful years at the end of 2022 – a remarkable achievement for a Centre of Research Excellence. Its early years were focussed on establishing relationships to promote collaborative research amongst its founding investigators and between their relevant institutions. Over later years this has expanded and the Centre is now New Zealand's largest network of medical researchers, comprising over 500 scientists and clinicians, including many of New Zealand's best biomedical and clinical researchers. The Centre is partnering with Māori and Pacific health organisations to improve the health outcomes of Māori and Pacific peoples.

As a national network for molecular biodiscovery the Centre provides a point of contact for a broad range of national scientific expertise, which is strengthened by collaborations with international researchers and research institutions as well as engagement with industry and the medical profession. It is committed to building scale in the New Zealand biomedical sector.

For more information see www.mauricewilkinscentre.org

For more information on New Zealand Centres of Research Excellence see www.acore.ac.nz

MAURICE WILKINS CENTRE
FOR MOLECULAR BIODISCOVERY

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Director's Report

Tēnā koutou katoa,

In 2022 much of our time has been devoted to planning meetings across the MWC to get us out of the starting blocks and running smoothly under some of the new structures in the Centre. Members of the research leadership forum have been instrumental in leading us through the first phase of MWC 4.0 and I thank them for their commitment and time. The 2023 MWC symposium demonstrated that we have started strongly, and the quality of the science presentations and energy was right back to where they were pre-covid-19. During 2022 we funded 39 projects from the flexible funding rounds and 20 projects in the three major research themes of the MWC. Thank you to all those people that served on the various assessing panels and to Rochelle and the MWC operations team for the many weeks of paperwork that followed. New rounds of flexible funding are currently ongoing in 2023.

There have been many highlights in 2022. We have produced our first Māori engagement strategy and the initial steps in the implementation pathway are underway (pages 10-11). Our investigators have been recognized for the outstanding contributions they have made to Biomedical research both on the national and international stage (pages 8-9). Our Māori and Pacific colleagues have featured strongly in new research partnerships, with major highlights being further studies on the CREBRF gene variant and type 2 diabetes, and new work on the implementation of real time pathogen genomics for diagnostics and surveillance in the Pacific Islands (pages 12-15).

Our early career researchers continue to produce world-leading publications in uncovering new avenues for combatting drug-resistant TB (pages 16-17). It has been great to see our young people travelling again to learn new skills driven by our Categories 3 and 4 funding and we read about some of the exciting adventures in pages 20-21.

Linkages with clinicians continue to be a strong focus and it is great to see these connections being used to provide insight on the evolution of cancers diagnostically by sequencing mutations that leak out of tumours into the blood, and how tumour heterogeneity can influence treatment strategies. MWC Cancer researchers continue to have a strong commercial focus and congratulations to the latest MWC-inspired cancer spin out company TamoRx focussed on developing immunotherapy medicines for novel treatments to combat advanced metastatic cancer.

The MWC welcomed a visit from Hon Dr Ayesha Verrall, Minister of Research, Science and Innovation to the Maurice Wilkins Centre in Auckland on the 18th of August. The Minister met with Dr Stephanie Dawes, Dr Alan Cameron and Dr Anna Brooks who outlined their infectious disease research and highlighted the value of being part of the MWC network for advancing their work. Professor Rod Dunbar and Mr Peter Lai also briefed the Minister on progress with the China-MWC collaborative research programme.

Outreach activities remain a strong focus of the MWC and a huge thank you for everyone that participated in the teacher professional development workshops. The team took the workshops on the road with a focus on topics across the broad field of Biology and all tailored to align with the NCEA Biology curriculum. In total, four school venues and two university locations were visited across New Zealand with over 210 teachers attending. A special shout out to the many people working behind the scenes including MWC Principal Investigator Professor Dave Grattan, Teacher Liaison Ms Rachel Heeney (Epsom Girls Grammar School) and MWC Research Operations Coordinator Dr Sindy Luu who manage the programme content and coordinate with schools across the country.

Thank you to Rochelle Ramsay and the hard-working operations team who have assembled this report, and to the MWC investigators who have contributed to the work reported. I want to acknowledge the support of my Deputy Directors, Professor Emily Parker, Distinguished Professor Dame Margaret Brimble and Professor Peter Shepherd in navigating and leading us successfully through the early stages of MWC 4.

MWC Director

Distinguished Professor Greg Cook

MAURICE WILKINS CENTRE
FOR MOLECULAR BIODISCOVERY

Impact Statement

MWC strategic impacts:

- Improved long term health outcomes and well-being of New Zealanders, particularly for Māori and Pacific Peoples
- Diverse range of young scientists with advanced capability and a greater awareness of cultural, economic, and community aspects of biomedical research
- Economic benefits for the country including growth in the investment and performance of the therapeutics industry in New Zealand
- Improved science education for school children, particularly in Māori and Pacific communities
- New Zealand scientists as good global citizens in contributing to global health outcomes

MWC outcomes:

- Development of better ways of treating disease using inter-disciplinary and inter-institutional collaborations, biomedical and translational research, and facilitating clinical trials supported by relevant diagnostic biomarkers
- Development of young scientists who have skills in a broader range of experience and mentorship than would traditionally have been available
- Development of a new generation of Māori and Pacific researchers in biomedical sciences to lead future activities with these communities who can collaborate safely with culturally aware tauiwi researchers
- Validation of new drug targets, development of new drugs or strategies for using drugs, development of diagnostics and vaccines and the development of clinical trials to test efficacy of such strategies
- Promotion of a greater understanding of biomedical science in the New Zealand community, particularly in schools and Māori and Pacific communities·
- Enhancement of the scientific partnership between New Zealand and other nations that leads to increased opportunities for New Zealand researchers

Dr Jemma Geoghegan with Hon Dr Megan Woods and Hon Dr Ayesha Verrall

Highlights

Prestigious awards recognise the work of MWC investigators

MWC Principal and Associate Investigators were awarded international and national recognition for their scientific research and engagement with the community.

In mid-2022, Dr Jemma Geoghegan, won the 2021 Te Puiaki Kaipūtaiao Maea Prime Minister's MacDiarmid Emerging Scientist Prize for work investigating how viruses jump to new hosts, then emerge, evolve, and spread in space and time. Dr Geoghegan is one of the scientists behind New Zealand's COVID-19 genome sequencing programme and her efforts to better understand this "evolutionary arms race" have impacted all New Zealanders.

Dr Geoghegan is part of the MWC-funded 'Real time pathogen genomics for diagnostics and surveillance in the Pacific Islands' research project.

The Rutherford Discovery Fellow at the University of Otago and ESR scientist is only the second woman to have won the Prize worth $200,000 which she hopes to use to inspire more women into science, build capability in the area of infectious disease, and explore viruses in nature and better understand their ecology and evolution.

Fellow University of Otago colleague, Professor Michael Baker received the 2022 Callaghan Medal, Royal Society of New Zealand Te Apārangi for his science-informed commentary on the Covid-19 pandemic and other major public health issues.

The 2022 Hector Medal, Royal Society of New Zealand Te Apārangi was awarded to Massey University's Professor Murray Cox for his major advances in population genetic theory together with new computational methods providing great insight into genome evolution.

Cancer immunology investigators from the North and South have been recognised for their longstanding contributions to the scientific community.

Professor Mark Hampton, from the University of Otago, won the NZ Society for Biochemistry and Molecular Biology Award for Research Excellence. His work investigates the intriguing way cells sense and respond to oxidants and how these pathways might be modulated to prevent and treat human disease. His present research looks at how oxidants regulate epigenetic and cell death pathways, how disrupting redox homeostasis can help kill cancer cells and pathogenic microbes, and how oxidative stress is associated with the biological processes underlying human ageing.

University of Auckland based Professor Cristin Print, has received the prestigious New Zealand Society for Oncology (NZSO) Translational Award for his work cultivating partnerships, connecting scientists with clinicians, and Māori and non-Māori across the cancer field.

Also in cancer immunology, Associate Professor Aniruddha Chatterjee was awarded The Roche Translational Cancer Research Fellowship Award (NZSO 2021), alongside Dr Rajiv Kumar, to upskill and translate his research on better understanding of the mechanism of disease in cancer into clinical practice. Chatterjee lab is using cutting edge next-generation sequencing, computational analysis, and experimental work to decipher the role of epigenetic modification, focusing on DNA methylation in disease, particularly in cancer.

Further afield, Distinguished Professor Dame Margaret Brimble, MWC Director, has received international acclaim with the 2022 Pedler Award by the Royal Society of Chemistry (RSC) recognising her lifetime work in organic chemistry and, announced in 2022, the 2023 Ernest Guenther Award in the Chemistry of Natural Products from the American Chemical Society recognises her outstanding achievements in the analysis, structure elucidation, and chemical synthesis of natural products.

Koru Unfolding

Wikicommons images: Jon Radoff

MWC celebrates future with first Māori Engagement Strategy

MWC's first Māori Engagement Strategy will enable and guide engagement between Māori people and communities and MWC for more impactful world-leading research.

Alongside leading Māori researchers and Alan Wilcox and Associates, and after rigorous review and discussion with Māori partners, across the MWC research themes and all levels of leadership, the MWC has drafted its first Māori Engagement Strategy.

The process has involved a broad review of strategy, processes, reports, and activities related to improving Māori health outcomes and led to a framework to support more effective engagement among MWC, researchers and Māori partners using the most appropriate approaches and at the most appropriate level.

Director Professor Greg Cook says he is excited for the future. "The Framework sets up an amazing opportunity and will be an incredible gift for all MWC researchers by identifying actions individual researchers or the centre as a whole can take to ensure the world-class science we do has maximum benefits for Māori."

An important part of the new strategy is the involvement of Māori in decision-making. During 2022, MWC welcomed Huti Puketapu-Watson (Ngati Porou, Tainui) and Peter-Lucas Jones (Te Aupōuri, Ngāti Kahu, Te Rārawa, Ngāi Takoto) onto the Board to add Māori voices in high-level decision making and leadership at the heart of MWC.

The other step forward has been creating the Kaiārahi role to ensure Māori are involved in the centre's running and to provide a structure to assist MWC researchers in engaging with Māori. Conor Watene O'Sullivan (Te Arawa, Te Rārawa, Ngāpuhi, Ngāti Maru) from The Moko Foundation joined MWC as Kaiārahi in 2022 and has begun a programme of work around the country to help increase a broader understanding of Te Ao Māori and aspirations of hauora Māori for MWC researchers.

Greg Cook says, "MWC research has a strong focus on major diseases relevant to Aotearoa/New Zealand, particularly those affecting Māori, with the aim to reduce health inequalities. When implemented, the strategy will enable people and communities most affected by particular conditions to be more involved in our research and the production of the solutions."

As a stepping-stone in this direction, the MWC has required investigators to articulate how their projects will benefit Māori in research proposals. The new process was co-developed by senior Māori researchers to ensure Māori health advancement was prioritised. The MWC Kaiārahi is now involved in this process and provides feedback and guidance to investigators.

Greg comments, "What has been really pleasing is seeing how much this strategy has been embraced, especially with younger members of the Centre leading the way."

Conor Watene O'Sullivan says that the strategy was developed on the basis that MWC is a crown-funded entity with a responsibility to advance Māori health outcomes and to uphold its commitment to the Treaty and Te Tiriti o Waitangi.

"The foundations of the strategy, Mana whakahaere, Mana motuhake, Mana tangata and Mana Māori, are derived from Te Tiriti to help guide MWC to achieve mana-enhancing outcomes for te iwi Māori. They are goals for Māori, whether individuals, whānau, hapū, iwi or Māori organisations that engage with MWC to achieve. This strategy helps guide the MWC to make this possible."

Sakiusa Baleivanualala working in the Department of Microbiology and Immunology.

Image courtesy of Antonella Gianfelice

Real time pathogen genomics in the Pacific

MWC is partnering with New Zealand-trained Pacific colleagues to develop diagnostics and tools for infection control and public health in the Pacific Islands.

MWC researchers from across the Infectious Diseases network are working through a large-scale four-year project exploring how to spot and stop the rise and travel of pathogens in and across the Pacific using next generation sequencing (NGS).

Pathogens rarely have respect for international borders. With significant bidirectional movement of people between New Zealand and the Pacific Islands, improved control of infection in the Pacific benefits the entire region.

The project, employing real time pathogen genomics for diagnostics and surveillance in the Pacific, is led by immunologist and clinical microbiologist Professor James Ussher, along with MWC early and mid-career researchers from across institutions. Lupeoletalalelei Isaia and Sakiusa Baleivanualala, two PhD candidates from the University of Otago, have expertise in NGS analysis of priority anti-microbial resistant (AMR) pathogens in the Pacific. They will be working in Samoa and Fiji during the project.

NGS technology grew in fame through its use of metagenomic sequencing to rapidly identify SARS-CoV-2 as the cause of an outbreak of severe pneumonia in Wuhan at the end of 2019. It continued to play a crucial role in identifying novel variants of SARS-CoV-2.

Until recently, genomic sequencing required expensive equipment and bioinformatics expertise, limiting its use to areas with access to specialist sequencing facilities. Now with advances in chemistry increasing accuracy and lower-cost disruptive technologies, pathogen genomics is in reach of diagnostic laboratories.

Lupeoletalalelei and Sakiusa are collaborating with the Communicable Diseases Research Centre at Fiji National University and Tupua Tamasese Mea'ole Hospital in Samoa where they will be using some of the latest sequencing technology, the Oxford Nanopore Technologies MinION. This small USB-sized device can be taken into the field. It plugs into a standard, well-powered computer and provides real-time sequencing data. James Ussher says the tool could be used to quickly identify outbreaks and help prevent transmission of hospital-acquired infection such as by multidrug-resistant organisms.

Another application of NGS that the team is exploring is its use for culture-independent genotypic resistance testing of *Mycobacterium tuberculosis* which is an important challenge due to its higher incidence in the Pacific and emerging drug resistance strains of this bacteria.

James says the bacterium is very slow growing and the strain can be resistant to front-line drugs. "If you start a person on a course of anti-TB agents, without knowing whether the strain is resistant, you might drive further resistance and transmission to other people." NGS does not rely on the slow process of growing bacteria in culture. After someone has been diagnosed via a PCR test, the MinION could be used to predict whether the bacteria are likely susceptible or resistant to the planned anti-TB therapy.

NGS could also detect novel and difficult to diagnose pathogens causing life-threatening diseases such as severe community-acquired pneumonia, meningitis, or encephalitis.

The MWC researchers will continue to work on the fundamental science in New Zealand and the Pacific, sequencing samples and developing protocols suited to the local situations to establish NGS capability across the region.

Dr Kate Lee

Unique genetic variant and mechanism drives powerful Type 2 diabetes protection

New light is shining on the role of genetics in the etiology and management of obesity and diabetes in New Zealand populations with MWC support through the Metabolic Health Flagship project.

The explosion of research on genetic factors driving health and disease is a key driver in the development of precision medicine strategies. Initially this research focussed on Europe and the US, but more recently large-scale studies have also been undertaken in Africa and Asia. However, Māori and Pacific peoples are not included in those studies so run the risk of missing out on advances in precision medicine and creating new health inequities as precision medicine becomes embedded in the future. Now, under MWC's Metabolic Health Flagship programme 'Phenotyping and gene functional studies' has made new discoveries of the impact of a genetic variant in the CREBRF gene that is only found in Māori and Pacific people. This provides the MWC's first major contribution to the development of personalised healthcare for these peoples.

The MWC has supported a study with New Zealand Māori and Pacific participants across multiple sites, including Māori research organisations, that matched genotypes with a wide range of metabolic phenotypes. The initial focus was on the CREBRF gene variant as this is found in 30 percent of Māori and Pacific people. In these studies the CREBRF gene variant was associated with a large increase in body mass index (BMI) which would normally suggest an increase in unhealthy levels of body fat.

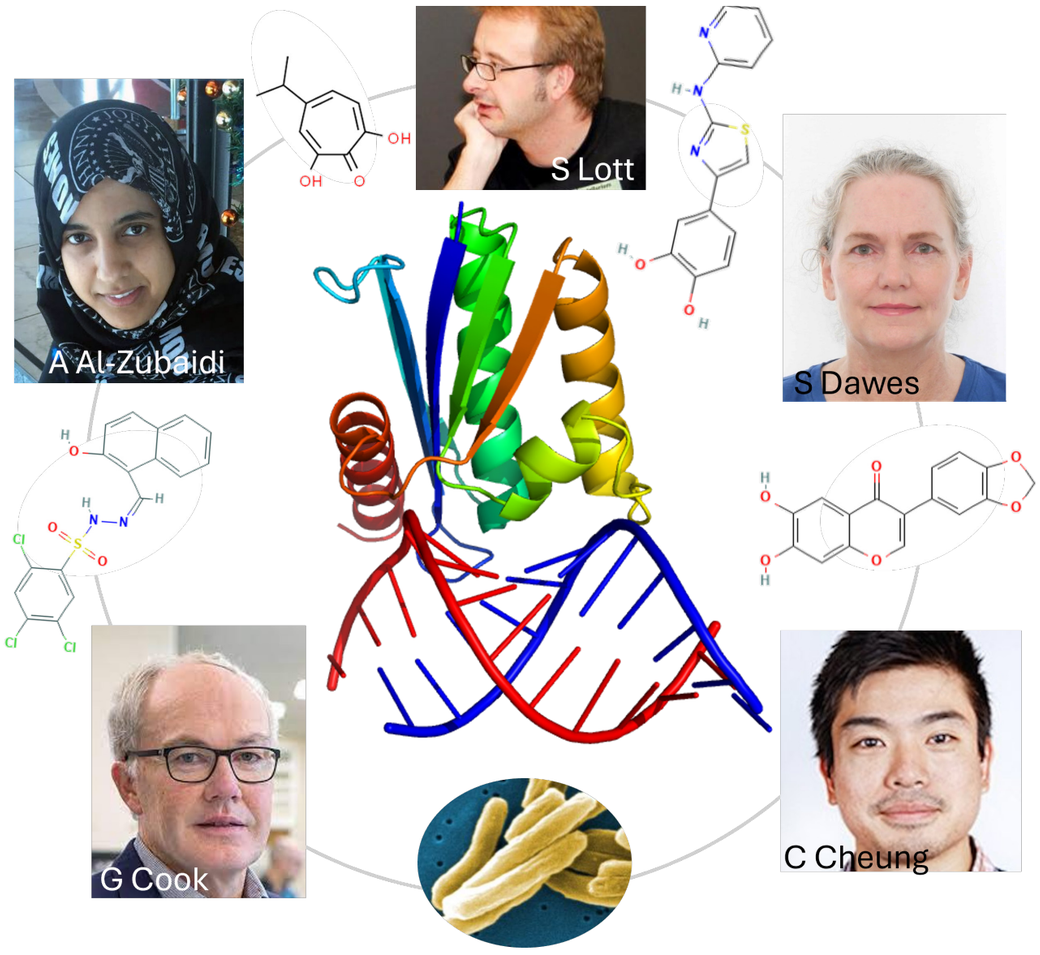
A large team of MWC researchers have been investigating this by combining a range of studies in mouse models with the phenotyping studies in humans. Results of the two studies have been published in the high impact journal Molecular Metabolism[1]. MWC Associate Investigator Dr Kate Lee, lead author of the paper, says despite having high BMI, men who are carriers of the CREBRF allele show better glucose metabolism and healthier body composition than those who do not carry the variant and these could be ways in which this variant gives some protection against diabetes.

Dr Lee says, "Surprisingly they have lower body fat and higher lean muscle compared with non-carriers, particularly as they age. This is a more metabolically healthy body composition. The study uncovered a potential mechanism for these effects "Uniquely, we found serum myostatin was lower in human male carriers." Myostatin regulates skeletal muscle growth and limits gain in muscle mass.

Dr Lee says "The MWC provides a unique way to support this work through its structures to enable this type of complex research by facilitating collaboration across a large, multidisciplinary team with expertise in different organ systems and experimental techniques, early career and mid-career researchers, Māori and Pacific scientists, community partners and clinical associates."

There are ongoing MWC supported studies into the CREBRF variant and how it might impact the actions of important medicines. The flagship is now moving on to study other genetic drivers of metabolic disease in Māori and Pacific with a focus on several shortlisted gene variants which have the potential to impact healthcare. Through this the MWC is making important initial steps to ensure that Māori and Pacific peoples benefit from the new wave of precision medicine.

1. https://doi.org/10.1016/j.molmet.2022.101464



MWC team members Dr Al-Zubaidi, Dr Dawes and A/P Lott (University of Auckland) and Prof Cook, Mr Cheung (University of Otago) validated RNase HI, an enzyme that destroys RNA:DNA hybrids, as a new vulnerable drug target in Mycobacterium tuberculosis *(image insert at the bottom). They discovered that inhibition of RNase HI makes rifampicin more potent, which might help redesign first-line therapy for tuberculosis, and limit antimicrobial resistance.*

Outer circle: Chemical structures of the four RNase HI inhibitor compounds that potentiate killing of M. tuberculosis *by rifampicin.*

Centre: Cartoon drawing of RNase HI (top) in complex with RNA:DNA hybrid (bottom).

Image courtesy of Stephanie Dawes

New avenues in fight against drug resistant TB

While rising drug resistance in Mycobacterium tuberculosis ***is eroding the power of almost all available antibiotics in the fight against this major pathogen, work completed by MWC-supported postgraduate students and emerging researchers is unveiling new promising and complementary areas of attack targeting tuberculosis (TB) and antibiotic resistance.***

Multidrug-resistant TB is defined by the resistance of *M. tuberculosis* to first-line antibiotics rifampicin and isoniazid. Mitigating or reversing resistance to these inexpensive first-line drugs offers a means of preserving and extending their use in TB treatment.

With support from the MWC, Dr Abeer Al-Zubaidi, alongside other MWC researchers led by Dr Stephanie Dawes and Associate Professor Shaun Lott, have discovered a new means of enhancing the potency of rifampicin and other anti-TB drugs. The University of Auckland team has also identified promising compounds providing a first step in the development of a new class of antimycobacterial drug.

Parallel work by University of Otago PhD candidate Natalie Waller and senior researcher Dr Matthew McNeil has uncovered weaknesses in drug resistant strains of *M. tuberculosis* that if exploited could lead to new unique drug combinations to greatly reduce treatment times from months to weeks and prevent the emergence of new drug resistance.

Work from both teams has been published in two high impact journals Antimicrobial Agents and Chemotherapy[1], and Nature Communications[2].

Stephanie and Shaun's team set their focus on R-loop metabolism. R loops can be lethal to the cell if not resolved. RNase HI is an enzyme that removes R-loops. By depleting the RNase HI enzyme in mycobacteria, sensitivity to Rifampicin increased by almost 100-fold.

Stephanie points to the potential of an RNase HI inhibitor which could be used in conjunction with Rifampicin. "Rifampicin has many side effects. An RNase HI inhibitor could enhance first-line antibiotic activity. Patients could receive the same benefits from a fraction of a dose, and in turn have fewer side effects and greater likelihood of completing the course of drugs. A good RNase HI inhibitor may also re-sensitise rifampicin-resistant bacteria, enabling the drug to be used again on resistant strains."

Researchers also identified four small molecules known to inhibit RNase HI from HIV which could be re-purposed to inhibit M. *tuberculosis*.

Looking at the entirely different phenomenon of collateral sensitivity, work done by MWC researchers Natalie Waller and Matthew McNeil found new ways to kill drug-resistant strains of M. tuberculosis and new ways to combine different drugs to stop drug resistance from occurring in the first place.

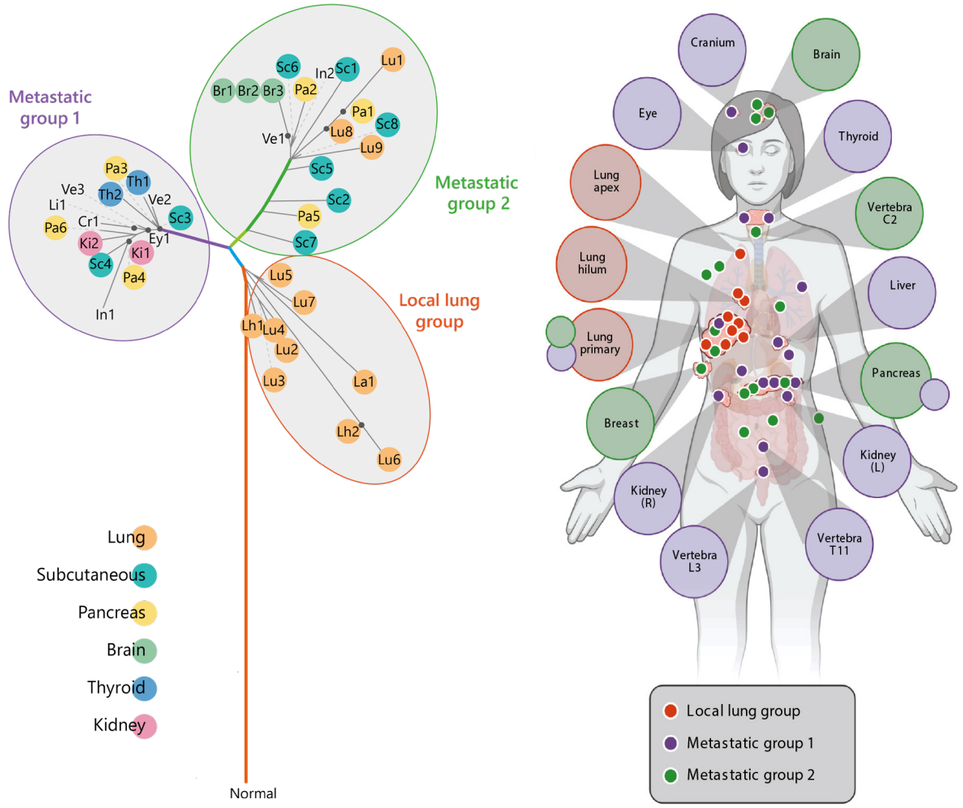
When a pathogen becomes resistant to a specific antibiotic, it can become vulnerable or sensitive to another unrelated antibiotic. By identifying this susceptibility by drug susceptibility profiling, genomics and evolutionary studies, the MWC researchers show drug resistance strains could be killed off rapidly.

McNeil says, "this work, in combination with the contributions of others, highlights how an improved understanding of the biology and consequences of drug-resistance can identify unique therapeutic strategies to revolutionize the fight against anti-microbial resistance."

The discovery has promising implications for other drug-resistant diseases.

1. https://doi.org/10.1128/aac.02091-21

2. https://doi.org/10.1038/s41467-023-37184-7



Left: DNA phylogram displaying the major anatomical locations. Coloured circles behind sample names indicate major anatomical locations according to the key (bottom left).

Right: Anatomic location of genomic groups. Colored circles overlaid on body represent tumor sampling sites colored according to the genomic group(s) present. Tumors are labeled and shaded according to dominant genomic group(s).

Images from Robb (2021) and Robb et al (2023), https://doi.org/10.1158/2767-9764.CRC-22-0101

Following the evolving genetics of cancer

Through a broad transdisciplinary project and extensive DNA sequencing analysis, MWC scientists have identified how different metastases evolve through a variety of genetic changes, including how they adapt to avoid the immune system.

The Rapid Autopsy study, led by MWC Associate Investigators oncologist Ben Lawrence and scientist Cherie Blenkiron, along with MWC Principal Investigator Cris Print, has given insight into how scientists and clinicians can follow evolving cancers by sequencing mutations that leak out of tumours into the blood, and how tumour heterogeneity can influence treatment strategies.

Tumour heterogeneity is the emerging idea that not all cells in a tumour, or even tumours around a body, have the same genetic profile.

MWC supported this research from its early beginnings by supporting development of the tissue science and molecular technologies required for this work and access to molecular databases required for data interpretation, as well as supporting MWC investigators and researchers across the project.

Professor Print says the study has been a true team journey with the tissue donor, her whānau , PhD candidates, oncologists, radiologists, pathologists, laboratory and bioinformatic scientists and even virtual reality visualisation experts from the University of Auckland's Centre for eResearch and School of Architecture.

The donor, a woman nearing the end of her battle with cancer, had the foresight and tenacity to recognise the value her tumours might offer others after her death. Her gift has provided an unparalleled opportunity to investigate many tumours at high resolution, something not possible during a patient's lifetime. Her whānau remain engaged with the research group and keep up to date with the scientific discoveries which their mother's gift continues to deliver in aiding the understanding of cancer.

Dr Tamsin Robb, now a postdoctoral fellow in Print and Lawrence Group has been a lynchpin across the project. While exploring the metastases from the patient within her PhD research, she uncovered a Darwinian-like evolution of cancer cells. By tracking a stepwise series of mutations for 44 tumours, Dr Robb discovered that it was not the mutations that drove the tumour growth initially.

"We saw base-pair mistakes in the ARID1A gene in every sample analysed at autopsy. We would expect this to be an early event in the tumours' evolutionary history – but paradoxically, the ARID1A variant was not present in the tumour when the patient was first diagnosed."

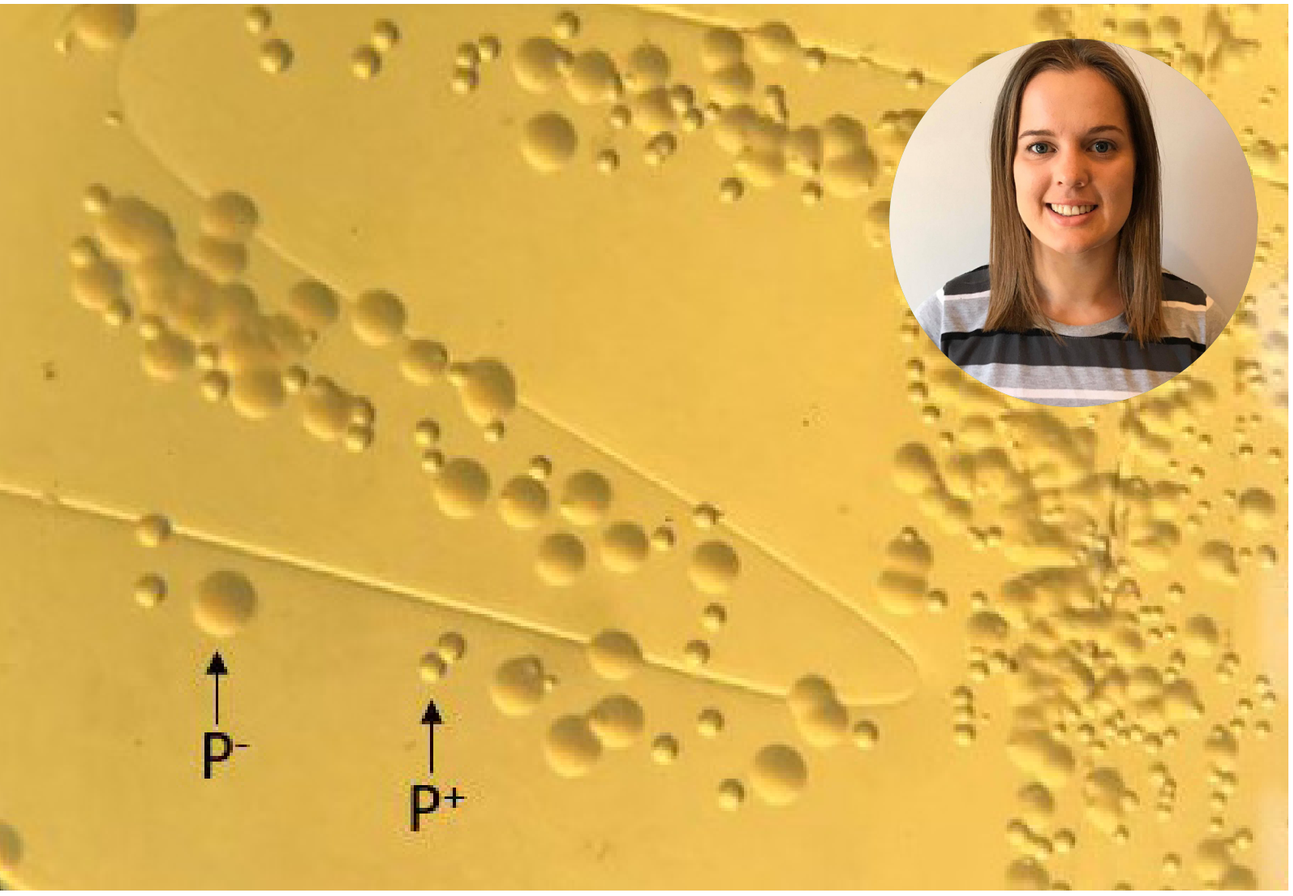
Instead, Dr Robb saw the loss and gain of copies of different chromosomes without any recognised mutation were driving the tumour initially – the mutations came later. Tamsin also saw that blood samples showed some mutations, but not all. The patient had tumours in many sites including the lung, pancreas, brain, and subcutaneous tissue, yet not all these anatomical sites were equally detected in the blood plasma. Some metastases hide!

Professor Print says this is a new and exciting understanding of how tumours grow.

"This has big implications in how we treat cancers and may be why cancers metastasize in the first place or why tumours evade a drug treatment."

The work was published in early 2023 in Cancer Research Communications[1] and amassed a generous repository of data available for future research.

1. https://doi.org/10.1158/2767-9764.CRC-22-0101



Neisseria gonorrhoeae *under the microscope, with labels of the two different morphological states: Non-piliated (P-) and Piliated (P+)*

Insert: Emma Walker

Images courtesy of Emma Walker

Early career researchers spread their wings

With relaxed travel regulations, MWC resumed support for ECR visits to international laboratories. These visits help progress research in new directions, extend networks, and bring new skills and knowledge back home.

Two early career researchers from the University of Waikato were the first in 2022 to take up this opportunity to access specialist facilities and training overseas.

Emma Walker, who is undertaking fundamental research in *Neisseria gonorrhoeae* with a dedicated team lead by Dr Jo Hicks in Hamilton, spent five weeks in Professor Maggie So's laboratory at the University of Arizona, Tucson, where she unlocked the 'trade secrets' of studying the fastidious human pathogen, *Neisseria gonorrhoeae*. Emma worked alongside laboratory manager Dr Maria Rendon and post-doctoral fellow Dr Kate Rhodes to learn how to genetically manipulate and efficiently grow the *Neisseria gonorrhoeae* organism in culture, and how to carry out host cell association assays including, adhesion, invasion, and intracellular survival.

Prior to Tucson, the New Zealand team had difficulty genetically manipulating *Neisseria gonorrhoeae* — a critical starting point before progressing to fundamental experiments to unravel how genetic manipulation affects the pathology of the pathogen. In the So Laboratory, Emma learnt the fundamentals of working with the organism and achieved her major goal of successfully complementing her laboratory's knock out strains. Success came down to the morphological status of the Neisseria colonies that were used for transformation.

"Under the microscope their *Neisseria gonorrhoeae* looked very different to what we were working with in New Zealand. We noticed a key difference in the piliation status."

''Beautifully piliated" strains have since been established in the Hamilton laboratory.

Annmaree Warrender's goal is to identify antibodies with potential for vaccine and therapeutic candidates. A three-month visit to Professor Sai Reddy's laboratory in ETH Zurich Basel, Switzerland advanced her work investigating human IgG antibody diversity and determining the effects of the genetic variation.

Difficulty in throughput was a factor limiting research progress in New Zealand. In the Reddy laboratory, Annmaree worked with post-doctorate fellow and Harvard graduate, Dr Eddie Irvine, to learn skills in synthetic immunology and develop methods to screen many modifications in high throughput. She trained in Deep Mutational Scanning of monoclonal antibodies and established a workflow for assessing the affinity profiles of the mutagenic libraries. She also gained access to an Octet Red system that uses Biolayer Interferometry (BLI) technology to evaluate antibody binding interactions in a massively parallel fashion.

"We can implement these techniques in New Zealand to accelerate our project and expand research opportunities to investigate mutations of different types of antibodies and proteins."

The visits spurred ongoing collaboration and a joint project with Dr Kelton's laboratory and the Sai Reddy laboratory has been established to advance research in genetic variation engineering.

Emma and Annmaree have shared their experiences and training with the MWC community online at the MWC Emerging Researcher Showcase in February 2023, as well as with the Hicks Laboratory Group and the Proteins and Microbes Group at Waikato University.

Speakers and attendees at the MWC Teacher Professional Development Day, Wakatipu High School (Queenstown).

Photo courtesy of Rachel Heeney.

Teacher workshops back on the road

The MWC teacher professional development scheme supports biology teachers by helping refresh their current scientific knowledge and share high quality content with their high school biology pupils.

In 2022, after two years of an adapted programme focussed around the COVID-19 pandemic, MWC resumed its original format for the outreach scheme. Six prominent and emerging scientists took workshops to six centres across the North and South Islands. Over 210 teachers attended, listening to topics across the broad field of Biology and all tailored to align with the NCEA Biology curriculum.

Dr Alana Alexander, a molecular ecologist and evolutionary biologist from the University of Otago spoke about her genetics and ecological research within a Te Ao Māori framework. She shared an example of how working alongside Dr Ramari Stewart, a mātauranga Māori practitioner showed her how vast and different mātauranga is to science, but also how science could stand in support of mātauranga.

Associate Professor Guy Warman, a world-leading expert in chronobiology presented the science of circadian rhythms. Immunology and biomedical scientists Associate Professor Nikki Moreland and Dr Reuben McGregor spoke on rheumatic fever and its significance in New Zealand. Professor Dave Grattan discussed thermoregulation during pregnancy, and Dr Anna Brooks a cellular immunologist presented research on Long Covid.

Workshops ran through November and were generously hosted at Nga Tawa Diocesan School, Marton, Karamu High School, Hastings, Wakatipu School, Queenstown, Southland Boys, Invercargill, Victoria University of Wellington, Wellington, and at the University of Otago, Dunedin.

Tony Cairns attended the Wellington workshop. He says the days are “essential” and teachers can use the information immediately in their classes, labs and in our NCEA assessments. “It is hands-on relevant and useful. It is vital to science education in New Zealand.”

Julie Waddell attended in Queenstown and left reminded why she is a biology teacher. “The event shows a vast array of areas that students might move into after secondary school, allows me to ask questions of experts, feel relevant to advances in scientific knowledge, and chat with scientists from different fields. It improves my knowledge and gives me stories I can share with my students.”

“I am reminded that Biology is such a huge field – not everyone works indoors, not everyone works with humans, I discover pathways that my current and future students might follow.”

MWC organises and funds this programme as part of our outreach activities. Through generous donations of time from MWC investigators and associated speakers, and space from local schools, the programme remains free to attend. The scheme’s success can be attributed to many people working behind the scenes including MWC Principal Investigator Prof Dave Grattan, Teacher Liaison Ms Rachel Heeney (Epsom Girls Grammar School) and MWC Research Operations Coordinator Dr Sindy Luu who manage the programme content and coordinate with schools across the country.

Rachel says “We were so privileged to hear from amazing scientists. It is a time of great change in education and for teachers to have the day to go, sit, learn, question is so uplifting and gives us knowledge and confidence in ourselves and in what we are teaching.”

TamoRx

Image courtesy of Dr Rod Dunbar

TamoRx – a greater hope for a fighting chance

A spin out company focussed on developing immunotherapy medicines based on MWC research and facilities is providing hope for novel treatments to combat advanced metastatic cancer.

Immunotherapy is the most promising therapy to achieve long-term survival from cancer in cases where it has spread through the body. Drug treatments targeting many different mechanisms within a person's own immune system, can amplify the body's own responses to improve life expectancy and cure some patients with even the most advanced cancer. However, current immunotherapy drugs still only work in a minority of cancer patients, so there is a large unmet need for new immunotherapy approaches.

MWC investigators Dr Joanna Mathy and Prof Rod Dunbar, working in the Cancer Immunotherapy Flagship, have founded TamoRx, a cancer drug research company focussed on novel drug development.

The team at TamoRx is hoping to exploit a novel discovery from research undertaken by Dr Mathy during her MWC PhD scholarship and work as a Research Fellow in Professor Rod Dunbar's laboratory at the University of Auckland. Dr Mathy's research uncovered a mechanism that restricts the immune system from fighting cancer. She says that targeting this new immune control pathway offers "new hope to help activate patients' own immune systems to attack and destroy cancer cells within tumours".

Dr Mathy says "Success would be new therapeutics that can target this immune control mechanism without affecting other cells in the body. We want to move quickly to bring new immunotherapy to patients as soon as possible."

Both Dr Mathy and Prof Dunbar acknowledge that MWC has played a big role in enabling the company to be founded, both in supporting Dr Mathy's PhD and in building the technical capabilities of the Dunbar Laboratory over many years. Collaborative links with the Auckland Cancer Society Research Centre (ACSRC) developed through the MWC network also enabled access to sophisticated computational drug screening technology established by Associate Professor Jack Flannagan and his team at the ACSRC.

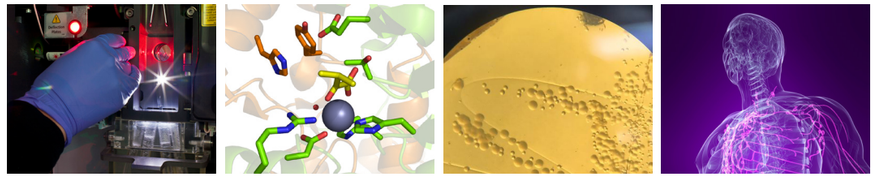
TamoRx's aim is to develop small molecule inhibitors that work either as a single agent or in combination with other treatments, increasing the number of patients who can benefit from immunotherapy. More than $15 million has been invested in the start-up by life science investor Brandon Capital along with the University of Auckland Inventors' Fund, managed by UniServices, the University's commercialisation and research impact company.

Prof Dunbar says the substantial funding injection is sufficient to take the lead drug through to early-stage clinical trials.

Duncan Mackintosh, head of Brandon BioCatalyst[1] in New Zealand says a world-class team is developing what could be a revolutionary therapy for cancer patients globally. "It is great to see this happen from New Zealand, really highlighting the capability of our research community."

TamoRx is one of many start-ups and technology licences sprung from the MWC network.

1 Formerly the Australian Medical Research Foundation



Research carried out by the Maurice Wilkins Centre

Vision Mātauranga

A significant focus in 2022 has been the development of a MWC Māori engagement strategy that aspires to enable and guide the Centre and its investigators in future engagement with Māori people and communities. The strategy is on track to be finalised in 2023 and more details of the progress is included in the highlight story on page 10.

During 2022 the MWC has also increased the proportion of Māori voices in decision making and leadership with the appointment of Huti Puketapu-Watson (Ngati Porou, Tainui) and Peter-Lucas Jones (Te Aupōuri, Ngāti Kahu, Te Rārawa, Ngāi Takoto) to the MWC Board and Conor Watene O'Sullivan (Te Arawa, Te Rārawa, Ngāpuhi, Ngāti Maru) as MWC Kaiārahi.

The MWC research programme focuses on addressing major health issues that are contributing to health disparities for Māori. From the start of 2022 the Centre introduced a requirement for the lead investigators of proposals for research MWC programmes and projects to articulate how the research aims to contribute to improved health outcomes for Māori and Pacific peoples, build Māori and Pacific researcher capacity and promote partnership with communities. This process was co-developed by senior Māori researchers and has taken an educative approach to assist and guide MWC investigators. Following completion of the Māori engagement strategy in 2023 this process will be further refined.

In general, MWC initiatives aimed at building Māori researcher capacity have been deferred until 2023 when they can be informed by the finalised MWC Māori engagement strategy. Two activities were supported in 2022: travel scholarships for three SING Aotearoa (Summer Internship for INdigenous peoples in Genomics Aotearoa) scholars to attend Queenstown Research Week and a 2022/23 summer internship for a health science student with The Moko Foundation. More details on these activities is included on pages 38 and 39.

Research programme

The MWC research programme has three disease focussed themes, metabolic health, infectious disease and cancer immunology, each of which support large scale nationally collaborative flagship research programmes. During 2022 significant progress was made with the initiation of research programmes across all three themes. While the ongoing effects of COVID associated delays are still evident in some of the research programmes, overall progress towards planned milestones has been pleasing over 2022 and is reported in the following sections.

The MWC also provides support for a pipeline of new research strands associated with the three themes through the Flexible Research Programme. Projects supported usually involve smaller-scale collaborations that are developing new research ideas and providing training opportunities for postgraduate students and early career researchers. This programme recommenced in 2022 with projects funded outlined on pages 31 to 34.

Theme 1 – Metabolic health

Flagship programme 1: Detailed phenotyping to understand genetic drivers of metabolic disease in Māori and Pacific women.

This programme of work seeks to collect detailed clinical, physiological and genetic information from a large cohort of Māori and Pacific men and women and determine whether specific genetic variants are associated with physiological changes that might predispose to an altered risk of disease. It also seeks to take specific variants that have been identified and develop comprehensive mechanistic studies to understand the biological pathways that might mediate effects on health outcomes.

Progress against the project milestones to undertake in-depth phenotyping studies is on track for completion. Recruitment for the study began but was impacted by the unexpected temporary closure of facilities in Wellington. Additional recruitment will continue in 2023.

Good progress is also underway to understand the impacts of genetic variants on metabolic disease. Several gene variant targets were selected for their prevalence in and relevance to Māori and Pacific communities in comparison to other populations: JAZF1, CALCRL, SLC22A3, CREBRF, G6PC2 and HK2, and CoQ6.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Role of JAZF1 SNP in diabetes risk; **Professor Julia Horsfield** and **Dr Megan Leask** (University of Otago)
- Studies of CALCRL variant; **Dr Hao-Han (George) Chang** and Professor Alan Davidson, (University of Auckland); Professor Debbie Hay (University of Otago)
- Studies of coding variants in the SLC22A3 gene; **Dr Qian (Claire) Wang**, Dr Kate Lee, Professor Peter Shepherd and Professor Rinki Murphy (University of Auckland)
- The effect of Māori and Pacific-specific gene variant in CREBRF (R457Q) on side effect profiles of commonly used drugs: pioglitazone and glucocorticoids; **Dr Kate Lee**, Professor Peter Shepherd, Professor Rinki Murphy and Dr Qian (Claire) Wang (University of Auckland); Dr Ryan Paul (Te Whatu Ora Health New Zealand Waikato); Professor Dave Grattan and Dr Sharon Ladyman (University of Otago)
- Investigating effects of Māori/Pacific specific variants in G6PC2 and HK2 in relation to type-2 diabetes; **Dr Waruni Dissanayake** and Professor Peter Shepherd (University of Auckland)
- Investigations of CoQ6 Mitochondrial Gene; **Dr Chris Hedges**, Dr Jagdish Jaiswal and Mr Tame Vailahi (University of Auckland)
- Understanding the molecular role of mitochondrial variants in metabolic health; **Dr Natalie Netzler**, Mr Robert Atiola and Professor Peter Shepherd (University of Auckland); Professor Tony Merriman and Dr Anna Gosling (University of Otago)
- Human Phenotyping study (Auckland); **Professor Peter Shepherd** and Professor Rinki Murphy (University of Auckland); Professor Jeremy Krebs and Dr Rosemary Hall (University of Otago)

Flagship programme 2: Developing customised genotyping for metabolic diseases in Māori and Pacific Peoples.

This programme will seek to address the question of how genetic variants specifically important to Māori and Pacific Peoples can be best identified in future research or clinical studies. This will involve a process to identify the best technology to use for such approaches and then developing this into a utilisable platform that can be applied. This will also involve partnering with Māori and

Pacific groups to ensure the appropriate methods for undertaking such studies and for storing participant information are in place.

Progress against project milestones for this programme, to develop a genotyping platform has been delayed. Extensive discussions with MWC members have taken place regarding best methods, data sovereignty and a governance mechanism which have contributed to the ongoing development of this work. Project funding will be recommended in the future based on a finalised proposal.

Flagship programme 3: Developing targeted pharmacogenetic approaches for Māori and Pacific Peoples.

This will utilise clinical studies and evaluation of clinical records and other relevant approaches to understand the clinical efficacy in Māori and Pacific Peoples of modern medicines used to treat metabolic disease, with a specific focus on understanding how genetic factors might modulate this efficacy.

The 2022 research milestone for this programme, to implement a pharmacogenomic study, was delayed. A detailed protocol has been developed with input from a network of leading clinicians for a pharmacogenomic study to assess whether genetic variants specific to or enriched within Māori and Pacific populations are likely to alter the response to treatments for type 2 diabetes. Hiring process for part time research assistant staff was initiated. The recruitment of study participants is anticipated to begin in 2023.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Developing targeted pharmacogenetic approaches for Māori and Pacific peoples; **Professor Rinki Murphy,** Professor Peter Shepherd and Dr Ofa Dewes (University of Auckland); Associate Professor Philip Wilcox (University of Otago)

New strands in metabolic health research

In 2022 the MWC provided support for one new project that addressed research objectives in metabolic health in addition to the flagship programmes.
The project was initiated in late 2022 and will evaluate the association of unique Māori and Pacific genetic variants with the cardiovascular disease risk factor, lipoprotein(a).

Theme 2 – Infectious diseases

Prevention

In this programme, MWC projects will exploit novel antigens, adjuvants and chemistry to develop new vaccines for viruses and bacteria to improve disease prevention.

This programme's milestones for 2022 focused on initiating work to characterise new and novel bacterial vaccine antigens, evaluate viral vaccine candidates, and initiate work towards a systems immunology platform to assess vaccine responses for priority pathogens. Progress against these milestones is principally on track, with one of which was delayed.

Priority pathogens were identified in 2021, focusing on pathogens that are associated with significant inequities for Māori and Pacific Peoples, including bacterial pathogens with extensive resistance to antimicrobial drugs. Initial work characterising novel bacterial antigens was started in mid-2022, and model systems are being optimised. However, the evaluation of viral vaccine candidates has been held back for redevelopment.

Work on a systems immunology platform to assess vaccine responses has progressed in 2022, with initial work focusing on the design of antigen luminex panels being completed.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Preventing Rheumatic Fever: Assessing novel vaccine formulations against Strep A infections; **Dr Jacelyn Loh**, Professor Thomas Proft and Associate Professor Nikki Moreland (University of Auckland); **Dr William Kelton** (University of Waikato)
- Generation of vaccines against gonococcus using the PilVax platform; **Professor Thomas Proft**, Dr Catherine Tsai and Mr Mejo Korah (University of Auckland); Dr Joanna Hicks (University of Waikato)

Detection

In this programme, projects will develop new diagnostic methods for priority bacterial and viral pathogens.

Detection has two main milestones in 2022: to identify potential targets for improved diagnosis of bacterial and viral disease, and to initiate an outreach programme to engage with communities about remote sampling for serosurveillance.

Priority antimicrobial resistant pathogens have been identified for genomic analysis, and initial work investigating the use of Nanopore sequencing for rapid diagnosis has begun with the development of a bioinformatic pipeline enabling analysis of pilot data.

The milestone around community engagement on the detection of infectious diseases was not been progressed by the MWC as it is now funded from another source.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Real time pathogen genomics for diagnostics and surveillance in the Pacific Islands. **Professor James Ussher**, Ms Lupeoletalalelei Isaia, Mr Sakiusa Baleivanualala, Dr Jemma Geoghegan and Dr Htin Lin Aung (University of Otago); Dr Joep de Ligt (ESR)

Treatment

Projects in this programme will harness novel small molecule and peptide chemistry as well as synthetic biology-driven natural product approaches to develop new drugs for prioritised viral and bacterial diseases.

The 2022 project milestones for this programme are on track for completion. Target (proteins that are important for infection) validation and characterisation for prioritised pathogens is making excellent progress, building on initial characterisation. Synthesis and evaluation of new antimicrobial treatments (small molecule inhibitors and antimicrobial peptide inhibitors) have been initiated for SARS-CoV-2, Neisseria gonorrhoeae, Mycobacterium tuberculosis, and other multidrug-resistant (MDR) pathogens. Work to mine microbiomes to identify new classes of antimicrobials was also initiated in late 2022.

Projects awarded funding in 2022 (project leader(s) are in bold):

- New anti-viral based therapies for Covid-19: Protease inhibitors; **Dr Ashley Campbell**, Professor Kurt Krause and Professor Vernon Ward (University of Otago) **Dr Louise Stubbing** and Professor Dame Margaret Brimble (University of Auckland)
- Advancing Antimicrobial Peptide (AMP) Scaffolds for Treatment of MDR Gram-negative and Grampositive Pathogens (Priority Pathogens); **Dr Alan Cameron**, **Dr Veronika Sander**, Professor Dame Margaret Brimble, Associate Professor Paul Harris, Professor Alan Davidson, Associate Professor Jane Allison, Professor Richard Douglas, and Dr Brett Wagner (University of Auckland); Dr Daniel Pletzer (University of Otago)
- Targeting essential bacterial pathways and processes as targets for new antibiotics with novel modes of action; **Dr Joanna Hicks** and Ms Jessica Usu (University of Waikato); **Dr Wanting Jiao** and Dr Gerd Mittelstadt (Victoria University of Wellington); **Dr Stephanie Dawes**, Dr Andrew Thompson and Associate Professor Shaun Lott (University of Auckland)

New strands in infectious diseases research

In 2022 the MWC provided support for five projects that addressed research objectives in infectious disease in addition to the flagship programmes.

The focus of these projects includes development of a chemoenzymatic platform to synthesise highly modified antimicrobial peptides, assessment of new a low-cost sequencing method for detection of antibiotic resistant bacteria, development of a method for detection of historic SARS-CoV2 viral infections and assessment of a potential new antiviral treatment for SARS-CoV2.

Theme 3 – Cancer immunology

Flagship programme 1: Precision immuno-oncology

This flagship is built around an in-depth analysis of immune responses in the cancers of patients across New Zealand. All projects supported by this flagship seek to better understand how tumour cell-immune cell battles are fought and won, in line with the flagship's milestones.

This flagship focuses on enabling early-mid career researchers, practising cancer clinicians, and Māori and Pacific researchers to initiate and grow their research programs. This approach complements the other two flagships of the Cancer Theme, which involve larger projects often led by mid-senior career principal investigators. Cancer Theme flagship 1 investigators have access to three expert technical mentors in bioinformatics, data science and advanced tissue analysis, alongside guidance from Māori research leaders. Many of the flagship 1 projects were linked to externally funded projects, allowing each patient's tumour to be analysed in multiple research projects.

In 2022, Clinical, Māori and Pacific leaders were identified for the tumour immuno-phenotyping programme. Ten of fifteen tumour immune-phenotyping research projects were identified and had support from three facilitator/technology mentors, where appropriate, who are experts in genomic and tissue immune analysis, including digital pathology analysis. The implementation trials of tumour immuno-phenotyping were progressed at the cellular, protein and genomic levels.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Research facilitator – molecular tissue imaging technologies. **Dr Saem Park** (University of Auckland)
- Research facilitator – genomics and bioinformatics. **Mr Greg Gimenez** (University of Otago)
- Research facilitator – cancer genomics. **Dr Peter Tsai** (University of Auckland)

Flagship programme 2: Targeted delivery of immune stimulants

This programme aims to stimulate tumour immune responses by delivering new small-molecule drugs directly to the tumour. This targeted delivery maximises the effects on the tumour and minimises side effects in other parts of the body.

The first milestone was to complete in vivo proof-of-principle experiments for targeted delivery of immune stimulants in models of cancers relevant to Māori and Pacific peoples, specifically cancers of the lung and colon. Progress against this milestone has been delayed due to supply chain issues but will be on track to be completed in 2023. A provisional patent was filed in 2022, with the current experiments expected to contribute to a full patent application.

The second milestone was to initiate research projects that use resources generated in the overall MWC immune-targeting programme, and this was achieved in 2022.

Projects awarded funding in 2022 (project leader(s) are in bold):

- Immunological analysis of tissue samples from in vivo models used to explore the utility of bacterial LPS as an immunotherapy adjuvant. **Dr Rachel Purcell** and Dr Arielle Sulit (University of Otago)
- Targeted immune stimulants to hypersensitize lung cancer to checkpoint blockade. **Associate Professor Jeff Smaill**, Associate Professor Adam Patterson, Professor Robert Anderson, Dr Amir Ashoorzadeh, Dr Victoria Jackson-Patel and Ms Emily Liu (University of Auckland); **Professor Ian Hermans**, Dr Regan Fu and Ms Kathryn Farrand (Malaghan Institute of Medical Research)

Flagship programme 3: Personalised therapeutic vaccines

This project builds on the MWC's expertise in the development of cancer treatment and focuses on a multidisciplinary team of bioinformaticians, immunologists, chemists, and clinicians. The team works on developing personalised vaccines, where synthetically made, tumour-specific antigens derived from each patient's tumour(s), stimulate the patient's immune system to recognise, attack, and eventually destroy the cancer cells, without causing damage to healthy cells. The project tackles the widespread challenge of rapidly, safely, and affordably producing sufficient numbers of personalised vaccines for use in clinical settings. A new technology—an automated flow peptide synthesis unit—has been developed to address the challenge. This approach allows near-real-time production of cancer vaccines and is complementary to recently derived RNA-based approaches.

This project was delayed while the project's design was refined and will be finalised and initiated in early 2023. It is expected that the 2022 milestones will be met during 2023.

New strands in cancer research

In 2022, the MWC provided support for ten projects that addressed research objectives in cancer, in addition to the major flagship programmes, with a priority for supporting new projects from early career researchers.

The majority of these projects focus on the biology of the immune system and the development of new methods and agents for stimulating and controlling immunotherapy in cancer treatment. Other projects are piloting a new multiplexed immunofluorescence imaging method to visualise anti-tumour immune responses within tumour tissue and investigating small molecule agents as potential cancer therapeutics.

Flexible research programme

The Maurice Wilkins Centre aims to build on the current network of researchers to foster new interdisciplinary collaborative research. One avenue to achieve this is through the contestable Flexible Research Programme.

Two rounds of this programme were held in 2022: July and December. Four categories of support were open for applications from MWC investigators

1. Inter-disciplinary postgraduate training (Category 1, round 2)
2. New research initiatives (Category 2, rounds 1 and 2)
3. Access to specialised facilities and equipment (Category 3, rounds 1 and 2)
4. Access to specialised international and national training and international facilities (Category 4, rounds 1 and 2)

Details of investigators awarded funding through round 1 of this programme are listed in the following sections. Round 2 funding was awarded in early 2023 and will be included in the 2023 report.

New research initiatives

The MWC provides funding for research expenses for innovative, interdisciplinary projects that will also promote progress in scientific areas of importance to the MWC. Fifteen projects were awarded funding for working expenses in 2022. Details of successful projects are listed below (project leader(s), student(s), and lead institution are in bold):

Metabolic Health

- The association of Unique Māori and Pacific genetic variants with the cardiovascular disease risk factor lipoprotein a; **Dr Qian (Claire) Wang**, Professor Sally McCormick, Professor Peter Shepherd, Associate Professor Troy Merry, Professor Rinki Murphy, **University of Auckland**.

- A novel 3D organoid model to study obesity-associated breast cancer; **Dr Emma Nolan**, **Dr Reena Ramsaroop, Dr Kate Lee, University of Auckland**. (Also relevant to Cancer Immunology)

Infectious Diseases

- The next generation of mRNA vaccines for Aotearoa; **Associate Professor Wayne Patrick, Dr Lisa Connor**, Dr Joanna Hicks, Dr Tifany Oulavallickal, Professor Gavin Painter, Associate Professor Davide Comoletti, **Miss Meghan Rousseau, Miss Kaitlin Buick, Miss Samara Maxwell, Victoria University of Wellington**.

- Using synthetic biology to access next-generation antiviral and antibiotic nucleoside analogue drug candidates; **Dr Alistair Brown**, Professor David Ackerley, Dr Lawrence Harris, Associate Professor Rob Keyzers, **Miss Bella Davies, Victoria University of Wellington**.

- Feasibility of using a novel TLR2 agonist to target Staphylococcus aureus; **Dr Fiona Radcliff,** Dr Iman Kavianinia, Distinguished Professor Dame Margaret Brimble, Professor Rod Dunbar, Professor John Fraser, **Miss Kelly Peterken, University of Auckland**.

- A chemoenzymatic platform to synthesise highly modified antimicrobial peptides; **Dr Aimee Horsfall**, Dr Scott Fergusson, Dr Stephen Ritchie, Dr Ghader Bashiri, Distinguished Professor Greg Cook, Associate Professor Paul Harris, Distinguished Professor Dame Margaret Brimble, Dr Yann Hermant, **University of Auckland.**

- Targeting F420 metabolism as a novel strategy against tuberculosis; **Dr Ghader Bashiri, Dr Wanting Jiao, Dr Matthew McNeil, University of Auckland, Victoria University of Wellington** and **University of Otago.**

- Evaluating RNase HI as a drug target in Neisseria gonorrhoeae; **Associate Professor Shaun Lott**, Dr Stephanie Dawes, Dr Joanna Hicks, Dr Andrew Thompson, **University of Auckland.**

Cancer Immunology

- Development of functionalised ligand-targeted liposomes for the targeted delivery of immune stimulants in ovarian tumours; **Dr Mak Sarwar, Dr Iman Kavianinia**, Associate Professor Peter Sykes, Distinguished Professor Dame Margaret Brimble, Associate Professor Paul Harris, Dr Sunali Mehta, **Ms Keziah Poggenpoel, University of Otago** and **University of Auckland**.

- Novel biological nanorod-based vaccine carriers for personalised cancer immunotherapy; **Associate Professor Jasna Rakonjac**, Professor Ian Hermans, Professor Gavin Painter, Ms Catherine Davenport, **Massey University**.

- CAF:T cell interactions in the tumour microenvironment; **Professor Roslyn Kemp**, Dr Kirsten Ward-Hartstonge, Dr Janet Rhodes, **Mr Rory Costello, University of Otago**.

- Developing a Prodrug to Enhance Immunostimulatory SVV Targeted Cancer Virotherapy; **Dr Mihnea Bostina, Dr Alan Cameron**, Dr Laura Burga, Dr Iman Kavianinia, Associate Professor Paul Harris, Distinguished Professor Dame Margaret Brimble, **Miss Polly Sun, Miss Lena Cassin, University of Otago** and **University of Auckland.**

- Identification of peripheral immune biomarkers to predict patient outcomes in gastric cancer; **Dr Kirsten Ward-Hartstonge**, Professor Roslyn Kemp, Dr Hillary (Billie) Sheppard, **Ms Jessica Harte, University of Otago**.

- Heating up' the pancreatic cancer stroma with immune stimulating nanobody conjugates; **Dr William Kelton, Dr Iman Kavianinia, Dr Jiwon Hong**, Associate Professor Paul Harris, Distinguished Professor Dame Margaret Brimble, **Mr Johanes Kevin Kasim, University of Waikato** and **University of Auckland**.

- Tunable control of immunotherapy using small molecules; **Dr Julie Spicer**, Associate Professor Jack Flanagan, Kimiora Henare, Professor Peter Shepherd, Professor Rod Dunbar, Dr Alicia Didsbury, Professor Alex McLellan, **Miss Samantha Rickard, University of Auckland**.

Access to specialised facilities and equipment

The Centre supports investigators in accessing specialised facilities and equipment across New Zealand. The scheme is intended to cover the costs of user charges attracted by these facilities or equipment and the travel and accommodation necessary to enable MWC investigators to work in facilities away from their host institution.

As part of the development of this scheme, a register of New Zealand facilities and equipment was set up within the members' section of the MWC website. Over 97 facilities and items of equipment were registered in 2022. It is intended that MWC investigators use this register as a resource to identify and compare facilities and equipment across New Zealand that they can use for their research.

Nineteen applications were awarded funding in 2022. Details of successful projects are listed below (project leader(s), student(s), and lead institution are in bold):

Metabolic Health

- Using Nanopore Sequencing to Unravel the Secrets of the LPA KIV-2 Complex Repeat Region in the Human Genome; **Miss Lamia Ismail, University of Otago**.

- Understanding the role of bone marrow adipocytes on skeletal health; **Dr Brya Matthews, Dr Emma Buckels, Dr Randall D'Souza, University of Auckland.**

Infectious Diseases

- Profiling sulfur metabolites in the pathogen Neisseria gonorrhoeae; **Dr Joanna Hicks, Miss Stacy van Niekerk, Mr Jack McGarvie, Mrs Jessicca Usu, University of Waikato.**

- Exploring the Potential of a Low-Cost Approach to Sequence Antimicrobial Resistant Bacteria with Oxford Nanopore Sequencing; **Professor James Ussher, Mr Sakiusa Baleivanualala, University of Otago.**

- Investing the effect of type I interferons on MAIT cells; **Professor James Ussher**, Mr Rajesh Lamichhane, **Miss Laura Wedlock, University of Otago**.

- From zebrafish to mice: drug screening of novel pretomanid derivatives showing superior efficacy in a zebrafish model of tuberculosis; **Dr Andrew Thompson, University of Auckland.**

- Development of flow cytometry assays to confirm historical SAS-CoV-2 infection and immune dysfunction associated with Long Covid; **Dr Anna Brooks**, Mr Terry Taylor, University of Auckland.

- Efficacy of HS mimetics as potential antivirals against SARS-CoV-2; **Dr Natalie Netzler**, Professor Miguel Quiñones-Mateu, Dr John Taylor, Professor Tony Merriman, Professor Peter Shepherd, **University of Auckland.**

- Investigating novel PI3K inhibitors as potential therapeutics for treating SARS-CoV-2 infection and subsequent cytokine storming; **Dr Claire Wang,** Dr Natalie Netzler, Professor Peter Shepherd, Professor Miguel Quiñones-Mateu, **University of Auckland**.

Cancer Immunology

- Understanding the impact of circulating suppressor cells during the manufacturing of T cell-based products for ovarian cancer; **Dr Alicia Didsbury,** Dr Shelly Lin, Dr Anna Brooks, Dr Michelle Wilson, Dr Joanna Mathy, **University of Auckland.**

- Bacterial drivers of colorectal neoplasia; **Dr Rachel Purcell,** Professor Tim Eglinton, Associate Professor John Pearson, **Miss Jessica Permain, University of Otago.**
- Determining Immune Mechanisms of Complete Response to Radiotherapy in Rectal Cancer; **Dr Arielle Kae L. Sulit**, Dr Rachel Purcell, Professor Frank Frizelle, Associate Professor John Pearson, **Miss Adèle Hegoburu, University of Otago**.
- Access to Chromium 10x single cell RNA-sequencing for analysis of NZM melanoma cell lines and melanoma patient circulating tumour cells; **Professor Michael Eccles**, Professor Cris Print, Dr Peter Tsai, Professor Chris Jackson, **Ms Sultana Mehbuba Hossain, University of Otago**.
- Understanding the Effect of Metal-based Anticancer Agents on Charge State Envelopes; **Professor Christian Hartinger**, Associate Professor David Goldstone, Dr Timothy Allison, **Mr Liam Eade, University of Auckland**.
- Spatial transcriptomic maps of hepatocellular carcinoma; **Dr Saem Park**, Dr Jennifer Eom, Associate Professor Klaus Lehnert, Dr Positha Santhakumar, Ms Jennifer Chen, Professor Rod Dunbar, **University of Auckland**.
- Study of novel drug effect on pancreatic cancer organoids by high-content imaging and/or confocal microscopy; **Dr Jiwon Hong, Mr Johanes Kevin Kasim, Dr Iman Kavianinia, University of Auckland.**
- Multiplexed immunofluorescence (mIF) imaging of entire murine tumours; **Dr Kimiora Henare, Dr Alexandra Mowday,** Dr Saem Park, Dr Inken Kelch, Ms Jennifer Chen, **University of Auckland.**
- AI-Guided Discovery of Novel Btk Inhibitors for Treatment of Cancer and Immunological Diseases; **Associate Professor Joanne Harvey**, Professor Paul Teesdale-Spittle, Dr Wanting Jiao, Dr Binh Nguyen, **Mr Goutham Rajendran, Victoria University of Wellington**.
- Multi-target kinase inhibitors by design; **Associate Professor Jack Flanagan,** Dr Julie Spicer, Dr Kimiora Henare, Professor Peter Shepherd, **University of Auckland**.

Access to specialised international and national training and international facilities

The MWC provides funding to enable MWC investigators to access specialised facilities and training internationally, either to work in leading laboratories overseas on collaborative projects involving advanced technology or to attend specialised technology practical workshops unavailable in New Zealand.
Five applications were awarded in 2022 for ECRs to visit laboratories and access specialised facilities in the USA, Canada, Japan, Switzerland, Auckland, and the United Kingdom (see map below).

- Dr Naomi Daniels (University of Otago), Laboratory visit to the Henao-Tamayo lab, Colorado State University (CSU)
- Ms Annmaree Warrender (University of Waikato), Visit to Department of Biosystems Science and Engineering, ETH Zurich, Basel, Switzerland
- Dr Catherine Tsai and Miss Risa Takahashi (University of Auckland), Laboratory visits to the Institute of Medical Science, University of Tokyo (IMSUT)
- Miss Emma Walker (University of Waikato), Laboratory visit to University of Arizona, Department of Immunobiology, BIO5 Institute
- Dr Waruni Dissanayake (University of Auckland), Visit to MacDonald islet biology laboratory within the Alberta Diabetes Institute

Further details of the technical training received by the ECRs who travelled in 2022 can be found on page 37.

Publications and Patents

Research outputs from Maurice Wilkins Centre investigators in 2022 included more than 640 peer-reviewed scientific papers and reviews aligned with the MWC research themes.

The majority of 2022 research outputs have resulted from projects that were supported by the Maurice Wilkins Centre prior to July 2021 using funds from the previous MWC CoRE 2015-2021 grant from the Tertiary Education Commission.

The MWC contributed support to 50 scientific papers and reviews, and 10 patents filed, published, or granted. See Appendix 1 for the lists of peer-reviewed publications and patents.




Maurice Wilkins Centre in the tertiary education system

Development of human capital, including contribution to the priorities of the Tertiary Education Strategy

Development of future leaders

The MWC encourages the involvement of emerging researchers in the Centres multi-disciplinary and multi-institutional research projects. During this reporting period many emerging researchers continued to be involved in the development of a portfolio of projects to be considered for allocation of research theme resources. Approximately 38% of research theme projects approved in 2022 are led by emerging researchers with the support of senior investigators as mentors.
One of the aims of the Flexible Research Programme is to enable emerging researchers to apply for funding and establish their ideas. In 2022, 50% of the projects approved for working expense support (Categories 2 and 3, see pages 31 and 33) are led by an emerging researcher.
The MWC supports an Early Career Steering Committee (ECSC) which provides an opportunity for emerging researchers to gain leadership experience. The ECSC raises issues of relevance to emerging researchers (including postgraduate students) across the Centre and organises activities to benefit these researchers. Details of the ECSC's activities can be found in sections below.

Early Career Steering Committee

The MWC Early Career Steering Committee (ECSC) continues to provide the opportunity for emerging researchers associated with the MWC to join the committee and develop their leadership capabilities. Members of the ECSC in 2022 were updated in June, and the two committees' memberships are outlined in 'Management' (page 42).
The ECSC's mission is to provide career development opportunities for early career researchers within the MWC through activities such as delivering workshops and events to support the MWC ECR community. The ECSC developed two workshop series for 2022:

- Mentoring scheme workshops A continuation from the last half of 2021, these webinars were designed to upskill mentors and mentees. See page 39 for further details.
- Minimum information and standards for reporting in peer-reviewed publicationsThe ECSC initiated a new workshop series in 2022 to spotlight the minimum required methods and standards for high-quality research publication. For further details, see page 52.

A significant piece of work by the ECSC in 2022 was implementing the MWC ECR Award Recognising Science Excellence and Community Engagement. The award recognises the extra work emerging scientists undertake to make a positive impact alongside their cutting-edge research and reframes perspectives of success and excellence in the scientific community.
The 2022 inaugural winners were Dr Natalie Netzler (University of Auckland), Dr Petr Tomek (University of Auckland), Dr Mak Sarwar (University of Otago, Christchurch), and Mr Christopher Puliuvea (University of Auckland). Natalie and Christopher have supported Māori and Pacific communities during the COVID-19 pandemic since early 2021. Petr shares a mutual passion for science and music and has held charity concerts to raise awareness and funds for cancer research.
Finally, Mak has initiated many scientific fora and outreach drives to connect communities with biomedical/clinical advancements in gynaecological cancer research.
The award winners were acknowledged and presented at the MWC Emerging Researchers' Showcase in February 2023. The winners received $2000 prize money to contribute towards their research or community outreach activities.

Postdoctoral research staff

Postdoctoral research staff are key personnel for the three MWC research themes. Following the initial allocation research theme resources to projects in early to mid-2022 support was provided across the remainder of the year for 17 staff (3.10 FTE) at various stages of their research careers. A number of these research staff are early or mid-career postdoctoral research fellows who are leading the projects that they are involved in under the mentorship of senior investigators.

Postgraduate research training

The MWC network includes a large cohort of postgraduate students who all have the opportunity to engage and benefit from membership of the national network, through initiatives like the mentoring programme for early career researchers (see page 39) and research or technical meetings. The MWC also supports postgraduate student training by providing financial support for stipends, research working expenses and travel for training opportunities.

Recruitment of postgraduate students supported through the research theme flagship programmes was started in 2022 with one PhD student and one MSc student appointed to scholarships in the Infectious disease research theme. Two further MSc student supported through this theme will start their scholarship in 2023 and five postgraduate students will benefit from research expenses provided through the three research themes.

A contestable process to allocate postgraduate student scholarships as part of the flexible research programme was started in the third quarter of 2022 resulting in the award of four PhD scholarships in early 2023 (two full and two partial scholarships) and one MSc scholarship. A further 22 postgraduate students will benefit from research and travel expenses awarded to research projects in the first round of the Flexible Research Programme held in mid-2022.

Forty-one postgraduate students who were supported by the MWC prior to July 2021 continued their study in 2022 with funding support from other sources. Of these students, seventeen completed their study in 2022.

Technical training opportunities

Through Category 4 of the contestable flexible research programme, the MWC provides funds for investigators to access specialised training, equipment, and facilities overseas that are not currently available in New Zealand. A key aspect of the programme is the investigator will share their developed expertise with the New Zealand science community on their return.
With the reopening of New Zealand borders in July 2022, after two years of COVID-related closures, the MWC supported the international travel of four emerging researchers in 2022:

- Ms Emma Walker's (University of Waikato) PhD project is focused on the prevention and treatment of Neisseria gonorrhoeae. The MWC supported her visit to Professor Magdalene Yh So's laboratory at the University of Arizona, which specialises in the pathogenesis of Neisseria species. Details of Emma's visit and successes are outlined in the highlight story, 'Early Career Researchers spread their wings' (page 20). Emma has shared her technical knowledge with her collaborators in New Zealand at the 2023 MWC Symposium and in an online video on the MWC website.
- Ms Annmaree Warrender (University of Waikato) travelled to further her PhD research into the

effects of antibody sequence diversity on Fc receptor binding and to learn the technical skills required for engineering antibody Fc sequence diversity. Annmaree spent three months with Professor Sai Reddy's lab in the Department of Biosystems Science and Engineering (D-BSSE) at ETH Zurich in Basel, Switzerland, to work alongside international collaborators and learn key skills in synthetic immunology. Details of her visit and successes are also outlined in the highlight story, '*Early Career Researchers spread their wings*' (page 20).

- Dr Catherine Tsai and PhD student Ms Risa Takahashi's (University of Auckland) research is focused on the pilus of the human pathogen Group A Streptococcus (GAS) and its potential as a novel vaccine delivery system for the influenza A virus. The MWC supported a six-week visit to the Institute of Medical Science, the University of Tokyo (IMSUT) and Chiba University, Japan. Learning from these experts in the field helped Catherine and Risa gain insights from assays that require resources not yet available in New Zealand and expand the range of experiments they could perform. They also took the time to observe and learn about the wide range of projects managed by the Japanese teams, which span from basic research to clinical trials, to give insight into how the direction of their project could be expanded.

For more information on these and previous overseas experiences for MWC ECRs see https://www.mauricewilkinscentre.org/sub-pages/education-careers/emerging-scientists/specialised-training-facilities-accessed-by-mwc-investigators/

Science education initiatives

The Maurice Wilkins Centre continues to support high quality science education in Aotearoa New Zealand schools, to encourage the next generation of scientists and promote greater understanding of biomedical sciences in the community. Activities include, but are not limited to, the following initiatives:

Maurice Wilkins Centre Biology Teacher Professional Development Programme

Since 2012, the MWC has supported free teacher professional development (PD) days for secondary school teachers. The PD programme draws upon the national network of scientists with specialist knowledge and expertise to give talks directly relevant to the NCEA curriculum. Feedback about the programme has reflected how very valuable these days are to teacher professional development, and that the materials from the days are often used directly in teaching.

The popular annual PD programme resumed in November 2022 after years of COVID restrictions. Over 210 teachers from across the country attended the workshops at Hastings (7 November 2022), Marton (8 November), Wellington (9 November), Queenstown (28 November), Invercargill (29 November), and Dunedin (30 November).

Whereas the 2020/21 MWC Teacher PD programme focused on the science of the COVID pandemic, this year saw a return to a broader range of subjects to support teachers to deliver the NCEA Biology program to their students. Topics included the science of Long Covid (Dr Anna Brooks, University of Auckland), rheumatic fever (Associate Professor Nikki Moreland and Dr Reuben McGregor, University of Auckland), circadian rhythms (Professor Guy Warman, University of Auckland), thermoregulation (Professor Dave Grattan, University of Otago), genetics, ecology, and te ao Māori (Dr Alana Alexander, University of Otago).
Read more about the 2022 teacher PD days on page 22.

Partnership with The Moko Foundation

The MWC partnered with The Moko Foundation to support a summer studentship in the Far North over late 2022/ early 2023. Mr Lennox Ashby was supported to conduct a research survey within their community on the impact of the Fructose in Schools Study, and to gather insights about their understanding of issues such as lactose intolerance and other metabolic health issues. Lennox's interest in science was first identified through the Fructose in Schools workshops run at Taipa Area School and he is currently enrolled in the Hikitia te Ora- Certificate of Health Science at University of Auckland.

Equity and wellbeing

MWC Mentoring Programme

The MWC mentoring scheme is managed by the Early Career Steering Committee. This well-received scheme continued in 2022 with 21 active mentor/mentee pairs, including seven new pairs established in October.

The programme contributes towards the development of young scientists in their career progression pathways, with mentors sharing their skills and experience in running research groups, gaining faculty positions and grants, industry and commercialisation experience, and work-life balance (with family). In 2022, 26 MWC investigators from across New Zealand, from both universities and Crown Research Institutes, volunteered to be mentors. Three postdoctoral fellows also joined the programme in 2022 as mentors to provide specific support to PhD students.

The ECSC continues to provide support to mentoring pairs through regular check-ins with both mentors and mentees, travel assistance for pairings based at different institutions, and by offering bespoke training to ensure that mentors are best able to support their mentees. Workshops designed to upskill mentors and mentees were also run in early 2022. Two speakers, Carol Scholes (New Zealand Coaching and Mentoring) and Dr Jane Allison (University of Auckland), were invited to present. The overall mix of speakers in this workshop series provided MWC-affiliated mentors and mentees with various viewpoints on effectively mentoring within the New Zealand landscape

Representation of students and emerging researchers

The MWC Early Career Steering Committee has continued to act as a representative body for emerging researchers associated with the MWC. The Chair of the ECSC is a member of the MWC Research Leadership Forum and acts as a strategic link between the two groups to ensure that emerging researchers are represented in the strategic decision-making processes of the MWC. In 2022 the MWC has also involved an emerging researcher representative in each flexible research programme review panel which has the dual benefit of providing a voice for emerging researchers in funding decisions as well as emerging researchers gaining skills in project review that they can apply in their future career.

Development of skills and education for Māori and Pacific Peoples

The MWC aims to improve outcomes for Māori and Pacific students in science and research from school level right through to university level.

In July 2022, the Early Career Steering Committee initiated a partnership with Mara Ki Ma'ala (MKM) to improve the accessibility and inclusivity for Māori and Pacific researchers. MKM is a holistic mentoring initiative based at the University of Auckland, developed to help Māori and Pacific mentees to grow academically, professionally, and culturally. It is a hauora-based model underpinned by cultural values of aroha, faka'apa'apa, tautua and fetokoni'aki and uses the tokoua vs tehina (tuākana vs teina) approach. The mentoring style is underpinned by the te whare tapa whā model, with four dimensions of wellbeing developed by Sir Mason Durie in 1984, and is reflected through other Pacific cultures, such as the Fonofale model in Samoan culture (Fuimaono Karl Pulotu-Endemann). Four Pacific students were enrolled in this pilot scheme and were actively engaged in regular meetings with their mentors. Support was provided to mentees in their thesis writing, teaching and research opportunities, and providing cultural support. Mentees were also invited to be part of a larger Pacific and Māori group for co-studying and indigenous workshops.

Also in 2022 the MWC provided support, in partnership with SING Aotearoa (Summer Internship for INdigenous peoples in Genomics Aotearoa) to enable a group of SING interns to attend the 2022 Queenstown Research Week. The three successful MWC supported interns were; Sommah Tauwhare, Jordon Lima and Lia Heremia.



CoRE collaboration and collaborative practices within the Maurice Wilkins Centre

MWC Board

In 2022 the MWC Board Members were Mr Bill Falconer (Chair, Independent), Professor David Harper (Victoria University of Wellington), Mr Peter-Lucas Jones (Te Aupōuri, Ngāti Kahu, Te Rārawa, Ngāi Takoto), Professor Jim Metson (University of Auckland), Professor Warren Tate (University of Otago) and Ms Huti Watson (Ngati Porou, Tainui).

The MWC Board met four times in 2022; March, June, September, and December. The Board reviewed and advised on the strategy of the MWC Māori Engagement Strategy, the China-MWC Programme, and the decision-making processes underlying the Flexible Research Programme.

They also reviewed and approved recommendations for resource allocations within each of the three research themes and from the July and December MWC Project Review Committees for the allocation of resources from the Flexible Research Programme. The Board monitored overall progress of the MWC throughout the year for compliance with the milestones set out in the MWC 2021-2024 plan, the funding mandate and the 2021-2024 budget.

The MWC Board received detailed briefings of the goals and strategies of each research theme at meetings across 2022. These sessions enabled the Board Members to develop a deeper understanding of the structure and scientific ambitions of each theme.

Scientific and Clinical Advisory Boards

During 2022 the MWC Directorate began a process of consideration of the membership of the MWC Scientific Advisory Board in consultation with the Research Leadership Forum. This process will be finalised in early 2023, with the first meeting planned for early 2024.

The Directorate also consulted with the Research Leadership Forum on the ongoing need for a Centre wide Clinical Advisory Board. Co-ordinators for each of the three research themes confirmed that clinical advisors and investigators with clinical experience are embedded within each theme and that this model was preferred to a Centre wide Clinical Advisory Board.

Management

Directorate

The Directorate comprises the Director, Distinguished Professor Greg Cook (University of Otago), and Deputy Directors, Distinguished Professor Dame Margaret Brimble (University of Auckland), Professor Emily Parker (Victoria University of Wellington) and Professor Peter Shepherd (University of Auckland). The Directorate met 3-4 times per month over the reporting period to coordinate the implementation of the 2021-2024 plan and oversee the routine management of the Centre. The Research Operations Manager, Ms Rochelle Ramsay, Research Operations Coordinator, Dr Sindy Luu, and interim MWC Kaiārahi Mr Conor Watene O'Sullivan also attended these meetings as required.

Research Leadership Forum

The Research Leadership Forum (RLF) was established in April 2021. Members of the forum in 2022 were:

- Distinguished Professor Greg Cook (Chair, MWC Director and Principal Investigator, University of Otago)
- Dr Abigail Bland (MWC Early Career Steering Committee Chair and Affiliate Investigator, University of Otago) (March – December 2022)
- Distinguished Professor Dame Margaret Brimble (MWC Deputy Director and Principal Investigator, University of Auckland)
- Professor Rebecca Campbell (MWC Principal Investigator, University of Otago)
- Dr Ofa Dewes (MWC Associate Investigator, University of Auckland)
- Professor Dave Grattan (MWC Principal Investigator, University of Otago)
- Dr Joanna Hicks (MWC Associate Investigator, University of Waikato)
- Professor Philip Hill (MWC Associate Investigator, University of Otago)
- Professor Roslyn Kemp (MWC Associate Investigator, University of Otago)
- Professor Kurt Krause (MWC Principal Investigator, University of Otago)
- Dr Kate Lee (MWC Early Career Steering Committee Chair and Associate Investigator, University of Auckland) (January – March 2022)
- Associate Professor Shaun Lott (MWC Principal Investigator, University of Auckland)
- Ms Tracy Macfarlane/ Mr Conor Watene O'Sullivan (MWC Māori Partner, The Moko Foundation)
- Associate Professor Nikki Moreland (MWC Principal Investigator, University of Auckland)
- Professor Rinki Murphy (MWC Principal Investigator, University of Auckland)
- Professor Emily Parker (MWC Deputy Director and Principal Investigator, Victoria University of Wellington)
- Professor Cris Print (MWC Principal Investigator, University of Auckland)
- Professor Peter Shepherd (MWC Deputy Director and Principal Investigator, University of Auckland)
- Dr Julie Spicer (MWC Associate Investigator, University of Auckland)
- Associate Professor Phil Wilcox (MWC Principal Investigator, University of Otago)

The RLF met four times during this reporting period in February, April, August and November. In 2022, the RLF reviewed and advised on the development of the Māori Strategic Framework and an MWC-led response to MBIE's Te Ara Paerangi Future Pathways Green Paper. They continued to contribute to the implementation of the MWC research plan including the allocation of resources to the three research themes. They also discussed in detail aspects of the Flexible Research Programme for 2022, including the incorporation and formative assessment of Māori and Pacific Health Advancement Statements by applicants, and advocated for a revised costing of student scholarship stipends. In 2022, the RLF also approved initiation of development of the Centre's Pacific engagement strategy.

Early Career Steering Committee

The Early Career Steering Committee's (ECSC) mission is to provide career development opportunities for emerging researchers within the MWC through activities such as the delivery of workshops and events. The ECSC also provide a voice for early career researchers (ECRs) within the MWC and the wider New Zealand scientific community.
According to their Charter, the committee reviewed their membership in June to foster the development of new ideas and allow a wide group to gain leadership experience. Members of the ECSC in 2022 were:

- Dr Kate Lee (University of Auckland, Chair to March 2022)
- Dr Abigail Bland (University of Otago, Chair from March 2022)
- Ms Theresa Alipia (University of Auckland, member to June 2022)
- Mr Rakesh Banerjee (University of Otago)
- Dr Sandra Fitzgerald (University of Auckland, member from June 2022)
- Dr Simon Jackson (University of Otago, member to June 2022)
- Dr Georgia Lenihan-Geels (Victoria University of Wellington, member from June 2022)
- Dr Natalie Netzler (University of Auckland)
- Mr Christopher Puliuvea (University of Auckland)
- Dr Debina Sarkar (University of Otago, member from June 2022)
- Dr Luke Stevenson (Victoria University of Wellington)
- Dr Catherine Tsai (University of Auckland, member to June 2022)
- Ms Annmaree Warrender (University of Waikato)

The ECSC met seven times over the reporting period; February, March, May, June, August, October, and December. Some key initiatives led by the ECSC included:

- Submission of an ECR-led response to the MBIE's Te Ara Paerangi Future Pathways Green Paper
- Development of their inaugural Early Career Researcher Award Recognising Science Excellence and Community Engagement
- Planning a new workshop series to develop professional development of ECRs in their research methods and reporting.

Project Review Committee

The funding of MWC projects is based on the recommendation of project review committees. These committees are comprised of researchers from across the centre. This has been a successful model for ensuring new funding is of an appropriately high scientific standard and also that there is transparency and fairness in the decision-making process.

The Project Review Committee was convened twice in July and December 2022 to review applications submitted in 2022 for inclusion in the Flexible Research Programme and make recommendations for project funding to the Directorate and MWC Board.

In July, the Project Review Committee comprised ten principal investigators and seven associate investigators from the University of Auckland, University of Otago, University of Waikato, and Victoria University of Wellington. Three ECSC members from the University of Otago, the University of Waikato, and the Victoria University of Wellington were also involved in the committee. They reviewed applications for Categories 2, 3, and 4 of the Flexible Research Programme.

In December, the Project Review Committee comprised six principal investigators, fifteen associate investigators, and three ECSC or ECR representatives from the University of Auckland, the University of Otago, the University of Waikato, and the Victoria University of Wellington.

The MWC Kaiārahi also attended all but one of the meetings to provide feedback on the Advancing Māori and Pacific Health statements within the applications. The committee reviewed applications for Categories 1, 2, 3, and 4 of the Flexible Research Programme.

Personnel

Principal Investigators

The MWC had a cohort of 20 Principal Investigators in 2022:

- University of Otago: Professors Antony Braithwaite, Rebecca Campbell, Greg Cook, Michael Eccles, Dave Grattan, Debbie Hay, Kurt Krause; Associate Professors James Ussher and Phillip Wilcox.
- University of Auckland: Professors Margaret Brimble, Rod Dunbar, Rinki Murphy, Cris Print, Peter Shepherd; Associate Professors Shaun Lott, Adam Patterson and Nikki Moreland
- Victoria University of Wellington: Professors Gary Evans and Emily Parker
- Malaghan Institute of Medical Research: Professor Ian Hermans

Professor Vicky Cameron stepped down as an MWC Principal Investigator at the end of 2021 alongside retirement from her role at the University of Otago.
The MWC also had two Emeritus Principal Investigators, Distinguished Professor Ted Baker and Distinguished Professor Sir Bill Denny.

Associate Investigators

During 2022, 14 new associate investigators were invited to join the Centre, bringing the total number of associate investigators to 261 on the 31st of December 2022. In line with the MWC strategy of supporting future leaders of these new associate investigators, two were previously MWC affiliate investigators and, on review in 2022, had developed their careers to the stage that they were approved for promotion to associate investigators.

New associate investigators appointed in 2022:

- Dr Alana Alexander, Department of Anatomy, University of Otago
- Mr Andrew Selwood, Bioactive Group, Cawthron Institute
- Dr Barry Hock, Haematology Research Group, Canterbury District Health Board & Department of Pathology and Biomedical Science, University of Otago (Christchurch)
- Dr Binh Nguyen, School of Mathematics and Statistics, Victoria University of Wellington
- Dr Gergley Toldi, Liggins Institute, University of Auckland
- Dr Helen Woolner, School of Biological Sciences, Victoria University of Wellington
- Dr Jaydee Cabral, Department of Microbiology and Immunology, University of Otago
- Dr Joep de Ligt, Institute of Environmental Science and Research
- Dr Julie Bennett, Department of Public Health, University of Otago (Wellington)
- Dr Louise Stubbing, School of Chemical Sciences, University of Auckland
- Dr Megan Leask, Department of Physiology, University of Otago
- Dr Peter Choi, Auckland Cancer Society Research Centre, University of Auckland
- Associate Professor Shyamal Das, School of Pharmacy, University of Otago
- Dr Yan Li, School of Science & School of Interprofessional Health Studies, Auckland University of Technology

Affiliate Investigators

Ninety-nine postdoctoral and postgraduate students were appointed as affiliate investigators in 2022, with the total cohort now numbering over 360.

Clinical Associate Investigators

The MWC investigator cohort includes practising clinicians with clinical challenges and ideas actively promulgated through the MWC's research programmes.
In 2018 the MWC launched the Clinical Associate membership category as part of a commitment to expand its clinical networks to include a wider group of practising clinicians who wish to be involved with the MWC. Four new clinical associates were appointed during 2022, bringing the total number of clinical associates to 32:

- Dr John Mathy, Counties Manukau District Health Board/University of Auckland
- Mr Jonathan Koea, Waitemata District Health Board/University of Auckland
- Dr Gavin Harris, Canterbury District Health Board
- Dr Jim Smith, Southern District Health Board

Community Associate Investigators

This investigator category was not initiated in 2022.

Research Operations Team

The team based at the University of Auckland included a Research Operations Manager, Ms Rochelle Ramsay and four Research Operations Coordinators: Dr Sindy Luu, Ms Wendy Li (part-time), Ms Lauren Watson (part-time) and Ms Uru-Manuka Williams (part-time).
A Kaiārahi, Mr Conor Watene O'Sullivan was contracted through The Moko Foundation in a part-time capacity in 2022. Appointment of additional specialist staff including a Pacific engagement role, a communications advisor and a school outreach role were also deferred to 2023 to allow further time for development of MWC strategy which will help to refine the roles of these staff.

Research Staff and Postgraduate Students

As set out on page 27 in 2022 the MWC supported 17 postdoctoral research staff (3.10 FTE) at various stages of their research careers. The MWC also provided support for one research technician (0.17 FTE).
As set out on page 27 the MWC recruited one PhD student and one MSc student to scholarships in 2022. This will increase in 2023 with the award of further PhD and MSc scholarships through the Flexible Research Programme.

Engagement by the Maurice Wilkins Centre with end-users and stakeholders

Industry engagement

The primary focus of the Maurice Wilkins Centre is on finding new ways to effectively target human disease. The Centre drives the translation of its research and expertise from the laboratory through a variety of partnerships with commercial and non-profit organisations, in New Zealand and overseas.

The creation of spin-out companies is an important pathway for the development of the Centre's research, and this often brings in international partners and funds. Maurice Wilkins Centre investigators maintain close links with such companies and further work is regularly contracted back to their research groups. They also support innovation in the biotechnology and drug development sector by providing companies with expertise and facilities.

In 2022, MWC investigators provided significant expertise and/or facilities to:

- **Allergan Pharmaceuticals**

  Allergan, now part of AbbVie, is a global pharmaceutical company with a focus on developing new medicines in critical therapeutic areas. Associate Investigator Professor Kerry Loomes from the University of Auckland is working with Allergan to publish their findings in metabolic disease.

- **Amaroq Therapeutics**

  Founded and led by Associate Investigator Dr Sarah Diermeier in 2021, Amaroq is a biotechnology startup company based at the University of Otago with a focus on developing more precise cancer therapeutic drugs that target long non-coding RNAs specifically expressed in cancer cells.

- **Avalia Immunotherapies Ltd.**

  Avalia Immunotherapies is developing immunotherapies that support the treatment of cancers and infectious diseases including chronic hepatitis B (cHB). The companies approach includes the use of licenced intellectual property discovered in MWC investigators laboratories (i.e. Professor Gavin Painter from the Ferrier Research Institute and Professor Ian Hermans from the Malaghan Institute of Medical Research). Both investigators are working with Avalia Immunotherapies to further advance the technology and progress it to clinical trials.

- **Comvita Ltd.**

  Comvita New Zealand is an international natural health products company with offices across Asia, the USA and the UK. Comvita are working with investigators Distinguished Professor Dame Margaret Brimble and Professor Kerry Loomes to identify the active components and biomarkers present in Manuka honey.

- **DDRx Pharmaceuticals**

  This life science pharmaceutical company was founded in 2022 by Auckland Cancer Society Research Centre investigators Associate Professor Michael Hay, Emeritus Professor Bill Wilson and Associate Professor Stephen Jamieson. Managed by COO Dr Lydia Liew, the company is developing inhibitors of DNA damage response pathways as potential radiosensitisers for use in cancer treatment

- **NZ Clinical Research Ltd.**

  This company (formed from a merger of Auckland Clinical Studies and Christchurch Clinical Studies Trust) provides Phase I and II clinical research to local and international pharmaceutical and biotechnology companies. Throughout 2022, Maurice Wilkins Centre investigator Professor Rod Dunbar, Dr Anna Brooks and their teams continued to collaborate with NZCR providing analytical services such as immune monitoring to support ongoing clinical trials sponsored by international pharmaceutical and biotechnology companies.

- **Optimal Clinical Trials Ltd**

  The Auckland-based company specialises in conducting commercial phase 1b to 3 trials across a wide range of therapeutic areas. In 2022 MWC investigator Professor Rod Dunbar's team began providing laboratory services to Optimal to support a clinical trial sponsored by a major international pharmaceutical company.

- **Rain Oncology**

  Rain Oncology is a NASDAQ-listed company based out of the United States which aims to develop targeted cancer therapies. It has conducted Phase II clinical trials of the hypoxia-activated pro-drug, Tarloxotinib, and is currently supporting two Investigator Initiated Trials of Tarloxotinib in combination with Sotorasib and Stereotactic Body Radiotherapy (SBRT), respectively, the latter being conducted at Auckland City Hospital. Tarloxotinib was invented by Associate Professors Adam Patterson and Jeff Smaill, MWC investigators who have served as consultants and members of the Scientific Advisory Board of Rain Oncology in support of this research.

- **SapVax LLC.**

  Sapvax LLC was founded in 2016 and is developing a pipeline of products for the treatment of different cancers, with an initial focus on tumours expressing NY-ESO-1. Professors Dame Margaret Brimble and Rod Dunbar are the academic founders of this company, which is headquartered in the USA, and in 2022 they continued to consult and carry out contract research for the company.

- **TAMORx Ltd**

  TAMORx was founded in 2022 by Dr Joanna Mathy and Professor Rod Dunbar, with investment from the University of Auckland's Inventor's Fund, managed by Auckland UniServices, and Brandon BioCatalyst (formerly the Australian Medical Research Commercialisation Fund). In 2022 Dr Mathy led the company's experimental work based at the University of Auckland, and coordinated contract research from several research institutions, including Callaghan Innovation's Biotechnologies group based at the University of Canterbury.

The knowledge and expertise developed by Maurice Wilkins Centre investigators in scientific fields vital to the biotechnology and pharmaceutical sectors are highly sought after. The Centre's investigators act as consultants for a number of national and international companies.

In 2022 the expertise of Maurice Wilkins Centre investigators was sought by:

- Abbott Diagnostics NZ Ltd
- AbbVie Inc (USA)
- Aeroqual Ltd
- AgriSea NZ Seaweed Ltd
- Aligos Therapeutics (USA)
- Allergan Pharmaceuticals (USA)
- Amaroq Therapeutics Ltd
- Amgen Inc (USA)
- Animal Breeding Services
- Aprea Therapeutics Inc (USA)
- Auckland Clinical Studies Ltd
- Auxilio Pharmaceuticals Ltd
- Avalia Immunotherapies Ltd
- Bayer HealthCare Animal Health Inc
- Bayer Leverkusen (Germany)
- Beyond Capital MedTech Management Ltd.
- BDG Synthesis Ltd
- Biogold
- BioOra
- Biotelliga Ltd
- Blis Technologies Ltd
- Bridgewest Ventures NZ
- Callaghan Innovation
- Cancer Research UK
- Canterbury Scientific Ltd
- Carr's Supplements NZ Ltd
- CoDA Therapeutics Inc
- Comvita Ltd
- Connovation Ltd
- Convert Pharmaceuticals SA (Belgium)
- CRV NZ Ltd
- Dairy Goat Cooperative Ltd
- Demuris Ltd (UK)
- Deosan NZ Ltd
- DockBio Holdings Ltd
- Elanco Animal Health Inc
- Eli Lilly and Company (USA)
- Evgen Pharma (UK)
- FIMECS Ltd (Japan)
- Fisher and Paykel Healthcare Ltd
- Gilead Sciences Ltd (USA)
- GlycoSyn Ltd
- GSK Vaccines Institute for Global Health (Italy)
- Hikurangi Bioactives Ltd
- ImmunoGenesis Inc (USA)
- InflammX Therapeutics Inc (USA)
- Janssen Pharmaceutical (Belgium)
- Jannsen Research & Development, LLC (USA)
- JunoFem Ltd
- Kea Therapeutics Ltd
- Kimer Med Ltd
- Manaaki Whenua – Landcare Research
- LifeArc (UK)
- Livestock Improvement Corporation
- Living Cell Technologies Ltd (Australia)
- Medical Kiwi Ltd
- Metavention Inc (USA)
- MitoQ Ltd
- Mote Research Ltd
- Nacuity Pharmaceuticals Inc (USA)
- Nanolayr
- New Zealand Clinical Research
- New Zealand Leather and Shoe Research Association
- New Zealand Pharmaceuticals Ltd
- Te Tāwharau o Ngāti Pūkenga
- OcuNexus Therapeutics Inc (USA)
- Ora Foods Ltd
- Orbis Diagnostics Ltd
- Organic Bioactives
- Otago Innovation Ltd
- Pacific Harvest NZ Ltd
- Pictor Ltd.
- Pfizer Inc.
- Port of Tauranga Ltd
- Premium Seas Ltd
- Procter & Gamble - Snowberry
- Quality Scientific Solutions LLC
- Rain Therapeutics Inc (USA)
- Rekover Therapeutics Ltd
- Roche Diagnostics NZ Ltd
- SapVax LLC (USA)

- SCY Consulting Ltd
- Souson Holdings Ltd
- South Pacific Sera Ltd
- Sphingotec GmBH Ltd (Germany)
- Suzhou Lixin Pharmaceutical Co. Ltd (China)
- Synthase Biotech Ltd
- Te Whānau-ā-Apanui
- Teva Pharmaceutical Industries Ltd
- Transfection Holdings Ltd.
- Upside Biotechnologies Ltd
- Upstream Medical Technologies Ltd
- Urigo Ltd
- Variant Bio (USA)
- Waste Management NZ Ltd
- Wellington Zhaotai Therapies Ltd
- Whiore Enterprises Ltd
- Zespri International Ltd
- Zoono Group Ltd

In addition to these examples above, Maurice Wilkins Centre investigators have established a variety of other relationships with companies and non-profit organisations that drive the translation of their research and expertise into new approaches to fight human disease. For example, Maurice Wilkins Centre investigators are involved with international organisations such as the Global Alliance for TB Drug Development.

Public engagement and outreach

Maurice Wilkins Centre investigators actively engage with the public by sharing news of their research successes and by providing commentary on topical scientific issues. In 2022, MWC investigators communicated with New Zealanders through the news media, public talks and wānanga, and school visits. MWC investigators also engaged with clinical and community groups around topics of cancer, metabolic health, Rheumatic Fever, and COVID-19.

The media often contact individuals from the MWC network to comment on current healthcare research or issues of public interest. MWC investigators spoke with media on topics including:

- Genomic medicine (Professor Cris Print, University of Auckland, and Associate Professor Phillip Wilcox, University of Otago)
- Gene editing (Dr Hillary Sheppard, University of Auckland)
- Genetic testing (Professor Andrew Shelling, University of Auckland)
- Mpox (monkey pox) outbreak (Professor Kurt Krause, University of Otago)

A number of MWC investigators continued their regular involvement and commentary of the COVID-19 responses in New Zealand: on testing, vaccine education, vaccination drives, and antiviral treatments, by Dr Ofa Dewes (University of Auckland), Professor James Ussher (University of Otago), Dr William Kelton (University of Waikato), Dr Natalie Netzler (University of Auckland), and Professor Kurt Krause (University of Otago). Professor Paul Atkinson (Victoria University of Wellington) also provided commentary on new important COVID-19 papers to an email list of over 120 recipients of science colleagues, lay people, and government departments.

MWC investigators are also fostering additional engagement with Māori and Pacific communities. In May 2022, Professor Ian Hermans (Malaghan Institute of Medical Research) was interviewed on Samoa Capital Radio (Siufofoga O Le Laumua), on their CCDHB (Health) programme about "*Vaccines prevent disease, can they be used to treat disease*?".

Focusing on inspiring the next generation, several MWC investigators coordinated and participated in outreach and community engagements throughout the year to encourage Māori and Pacific secondary students into science.

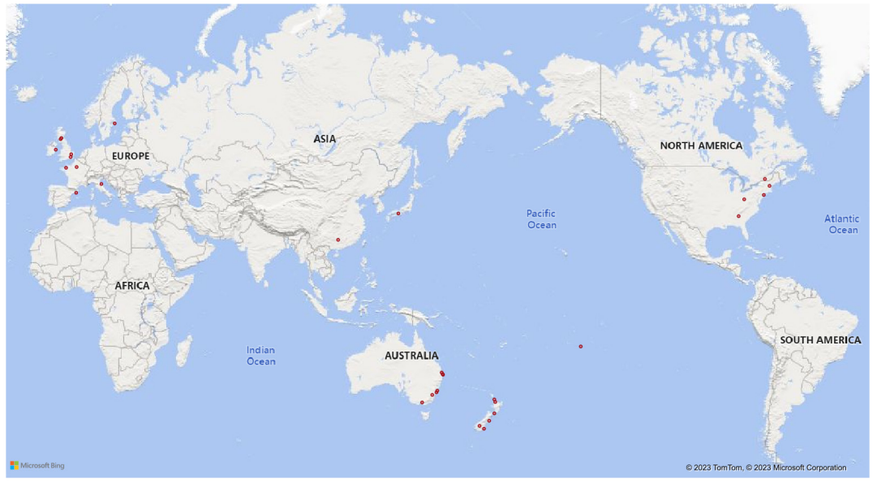
- Dr Natalie Netzler (University of Auckland) organised a laboratory visit by Year 10 Māori and Pacific students; and was an invited speaker for the University of Auckland UniBound Summer programme, a programme for Pacific school leavers.
- Dr Anna Pilbrow (University of Otago), participated in the 2022 Pūhoro STEM Academy outreach session at Ara Institute of Canterbury (Christchurch) for Māori high school students.
- Dr Farah Lamiable-Oulaidi (Victoria University of Wellington), with the Ferrier and Robinson Research Institutes, ran 'Tech Bootcamps' for Māori and Pasifika students to spend a week working alongside scientists.

MWC investigators were also involved in other school education outreach programmes from across the country, including Professor David Grattan (University of Otago), Professor Nikki Moreland (University of Auckland), Professor David Ackerley (Victoria University of Wellington), Professor Gavin Painter (Victoria University of Wellington), Associate Professor Troy Merry (University of Auckland), Dr Htin Aung (University of Otago), and Dr Kim Mellor (University of Auckland).

MWC investigators also contributed to regional events, like the annual Auckland-based MOTAT Museum of Transport and Technology STEM Fair (Associate Professor Jane Allison and Dr Hilary Sheppard, University of Auckland).

Presentations: Keynotes, Plenary, Invited talks

The significance of the research being done by Maurice Wilkins Centre investigators and their teams is demonstrated by more than 80 invitations to give international and national presentations in 2022. The presentations included invited lectures at conferences and seminars at academic institutions in Australia, Canada, China, France, French Polynesia, Italy, Japan, Spain, Sweden, the United Kingdom and the United States of America, as shown in the diagram below.



Presentation highlights

The highlights listed below include plenary and keynote lectures of note and are in addition to numerous invited presentations at New Zealand based events and international meetings.

- Distinguished Professor Dame Margaret Brimble (University of Auckland) delivered the Opening plenary lecture at the Journées de Chimie Organique of the Société Chimique de France JCO in November 2022. The lecture showcased Natural Product Synthesis: A Crucible for New Method Development and Drug Discovery. Additionally, Margaret gave the opening plenary lecture at the 48th IUPAC World Chemistry Congress and 104th Canadian Chemistry Conference and Exhibition in Montreal, Canada. Margaret has also given an invited talk at the 36th European Peptide Symposium & 12th International Peptide Symposium in Barcelona, Spain.

- Distinguished Professor Greg Cook (University of Otago) was a keynote speaker in Dublin, for the ASM/ESCMID Joint Conference on Drug Development to Meet the Challenge of Antimicrobial Resistance in October 2022. Greg presented his talk *'Identifying the network of bactericidal interactions between mycobacterial respiratory chain complexes to develop fast-acting drugs for tuberculosis*'. Greg has also given multiple invited talks to national and international audiences.
- Professor Dave Grattan (University of Otago) gave multiple plenary presentations in 2022, including '*Prolactin, pregnancy and the preparation for parenthood*' at the International Congress of Neuroendocrinology in Glasgow, Scotland (August 2022). Dave also talked to Prolactin-induced adaptations in the parental brain at The Parental Brain Meeting in St Malo, France (May 2022). Additionally, Dave gave the plenary presentation 'Pregnancy hormones act in the maternal brain to facilitate adaptive changes in maternal physiology' at the Genetic Society Focus Meeting: Genetics of Reproduction in London, UK (November 2022). Dave has also given three invited talks to international and national audiences.
- Professor Christian Hartinger (University of Auckland) gave several plenary presentations in 2022, including '*Biology-inspired Ligands and their Metal-based Anticancer Agents*' at the 2nd International Forum on Medicinal Chemistry of Natural Active Ligand Metal-Based Drugs in Guilin China, and '*Surprising Organometallic Chemistry in our Quest for Protein-Targeted Anticancer Agents*' at the 4th International Conference on Coordination Chemistry in Rimini, Italy in September 2022.
- Professor Ian Hermans (Malaghan Institute of Medical Research) gave a plenary presentation at the 50th Annual Scientific Meeting of the Australian and New Zealand Society for Immunology (November 2022), held in Melbourne. Ian's address was entitled '*Targeting hypoxia to improve immunotherapy of solid tumors*'. Ian also gave an invited talk entitled '*Using agonists for type I NKT cells as immune adjuvants*' at the Australasian Vaccines & Immunotherapeutics Development Meeting (AVID) in May 2022.
- Professor Lisa Matisoo-Smith (University of Otago) gave a keynote presentation '*Why does* understanding Pacific prehistory matter for human genetics?' at the Human Genetics Society of Australasia in Christchurch (September 2022). Lisa was also invited to present at the Oceanian Genomics Consortium in Tahiti in November 2022.
- Associate Professor Nikki Moreland (University of Auckland) presented the keynote talk '*Rapua te mea ngaro ka tau - Facilitating Strep A vaccine development for Aotearoa New Zealand*' at the 4th Melbourne Strep A Symposium in December 2022. Nikki was also invited to speak at the 21st Lancefield International Symposium on Streptococci, Stockholm, Sweden (June 2022).
- Professor Emily Parker (Victoria University of Wellington) gave two keynote presentations in 2022. One of which, '*Reconstructing pathways for indole diterpene production*' at the Organic and Medicinal Chemistry Conference in Wollongong in November 2022, and the other '*Twisting tales and interchangeable allostery in key biosynthetic enzymes*' at the Gordon Research Conference in June 2022 in New Hampshire. Emily has also given multiple plenary presentations to international audiences in 2022.
- Dr Daniel Pletzer (University of Otago) gave a plenary presentation '*Peptides and peptidomimetics to combat adaptive multidrug resistant high-density infections*' at Australasian Wound & Tissue Repair Society meeting held in Sydney (September 2022). Daniel has also given invited talks to national audiences.
- Professor Cris Print (University of Auckland) gave the virtual Translational award address entitled 'P*artnership in patient-focused genomic research*' at New Zealand Society for Oncology, 29 January 2022. Additionally, Cris gave the keynote presentation '*Heading Towards Routine Precision Genomics in New Zealand*' at the Empowering Precision Oncology through Genomics Meeting (Queenstown) in August 2022. Cris was invited to give plenary presentations four times in 2022 at multiple events. Firstly, Cris presented in February at the NZ eResearch conference on The Rakeiora program, then in March at the NEAC/HDEC ethics training Day, then at the Cancer Trials NZ annual meeting in Christchurch, and finally at the Te Aka Mātauranga Matepukupuku (UoA Centre for Cancer Research) inaugural symposium where Cris talked to '*The precision oncology research-practice continuum*' in November. Cris has also given three invited talks across New Zealand.
- Professor Jasna Rakonjac (Massey University) gave the keynote presentation at the Cold Spring Harbour Laboratory Course in Antibody Engineering and Phage Display in New York, USA (October 2022). Jasna's talk addressed filamentous bacteriophage biology and structure.
- Professor Peter Shepherd (University of Auckland) gave a plenary presentation at the Australasian Diabetes Congress in Brisbane in August 2022., where he presented *'Identification of New Genetic Drivers Regulating Body Composition and Risk of Type-2 Diabetes*'. Peter was also invited to give a talk at the Garvan International Signalling Symposium in Sydney in October 2022.
- Dr Robert Weinkove (Malaghan Institute of Medical Research) gave the keynote presentation '*Third-generation anti-CD19 CAR T-cells incorporating a TLR2 domain for relapsed or refractory B-cell lymphoma: A phase 1 clinical trial (ENABLE)*' at the annual scientific meeting of Haematology Society of Australia & New Zealand in Sydney, September 2022. Robert also gave several talks to both national and international audiences as an invited speaker.




The role of the Maurice Wilkins Centre at a national and international level

National networks

The MWC comprises a national network of over 500 researchers and clinicians, including many of New Zealand's best biomedical and clinical researchers from across the country. The network spans a wide range of disciplines and fosters the collaborative development of its members. The MWC supports and engages this network through workshops, sponsorships, and national events.

Workshop – Minimum information and standards for reporting in peer-reviewed publications

The Early Career Steering Committee's (ECSC) mission is to provide career development opportunities for emerging researchers within the MWC through activities such as the delivery of workshops and events. The ECSC initiated a new workshop series in 2022 to spotlight the minimum required methods and standards for high-quality research publication. The first workshop, by Dr Kate Lee (University of Auckland) and Dr Nicola Dryden (ThermoFisher Scientific), was on qPCR and the MIQE Guidelines (Minimum Information for Publication of Quantitative Real-Time PCR Experiments). Over 55 researchers attended in Auckland, Dunedin, and on Zoom. The workshop was recorded and made available online to the MWC community for future reference.

Queenstown Research Week

Queenstown Research Week (QRW), the largest annual molecular biology and biomedical science conference in New Zealand, returned as an in-person event in 2022 after two years of COVID-19 restrictions. QRW 2022 combined the 31st Annual Queenstown Molecular Biology meeting, the 16th New Zealand Medical Sciences Congress, and six 2-day satellite meetings on specialist topics; five of which directly align with MWC research themes. The conference provided an important opportunity for MWC scientists, early career researchers and students to interact with Australasian experts in their research areas.

The MWC is a premier academic sponsor for QRW and continued this support to enable a forum for Centre investigators to profile their own research to a national audience. The MWC also co-hosted a joint meeting with one of the new University of Auckland-based CoREs 'Healthy Hearts for Aotearoa New Zealand – Manaaki Manawa' to explore areas of common research interest and potential collaboration in future.

The MWC hosted a networking evening for its investigators at the start of the conference and also provided partial support for the QRW registration costs of 96 early career investigators.

ChemEd & BioLive 2022

The ChemEd & BioLive is a biennial conference for chemistry and biology educators. Organised by Secondary Chemistry Educators of NZ (SCENZ) and Biology Educators of Aotearoa New Zealand (BEANZ), the ChemEd & BioLive conference delivered pedagogical workshops with a senior Biology or Chemistry theme.

The conference featured three keynote speakers: Professor Allan Blackman (AUT), Professor Judith Bennett (University of York), and Professor James Renwick (Victoria University of Wellington). The MWC supported this event with a sponsorship towards the costs of speakers and general running costs of the conference.

New Zealand branch of Australasian Society of Immunology (NZASI), Annual Scientific Meeting 2022

The Australasian Society of Immunology is the professional society for immunologists across Australia and New Zealand. The New Zealand branch holds annual research meeting and is the premier meeting for immunologists in Aotearoa New Zealand. NZASI prioritises in providing an opportunity for early career researchers, especially PhD students, to present their work; an opportunity that was missed over the last two years of travel restrictions.

The meeting featured three keynote speakers: Dr Kylie Quinn (RMIT University, Australia), Dr Kate Schroeder (University of Queensland, Australia), and Professor David Murdoch (University of Otago, New Zealand).

New Zealand Institute of Chemistry's Maurice Wilkins Centre Prize for Excellence in Chemical Science

The New Zealand Institute of Chemistry's Maurice Wilkins Centre Prize for Excellence in Chemical Science is an annual premier prize of the New Zealand Institute of Chemistry (NZIC) and is awarded to a candidate based on the excellence and impact of their chemistry.

The 2022 prize was awarded to Professor David Larsen (University of Otago). David has been actively engaged in several areas of organic chemistry, from natural products synthesis, through medicinal and biological chemistry, and to drug development. His more recent work on carbon monoxide releasing molecules has had a significant impact on the field. His impact on the chemical sciences in teaching, mentoring and leadership is also noteworthy.

International networks

The Maurice Wilkins Centres's reputation as a research network is strengthened by its affiliations and collaboration with similar bodies worldwide. The Centre contributes to and benefits from this extensive network our investigators have built over many years. The research funded through the Centre has strengthened many of these existing links and helped to establish new collaborations. The international and national reach of these collaborations is shown in the diagram below.

See Appendix 2 for the list of new and continuing international collaborations.

International engagement

China-MWC Collaborative Programme

The China-Maurice Wilkins Centre Collaborative Research Programme (C-MWC) is funded by the MBIE Catalyst Strategic Fund and aims to develop collaborative biomedical research projects and broaden the engagement between the biomedical research communities in both countries.
In early 2021 the C-MWC awarded funding to six projects. At the end of 2022 all six funded projects are on track with some progressing beyond their current milestone status and already considering the next stages of commercialisation and translational. As 2022 draws to a close, plans are underway to visit major project partners in early 2023.
In late 2022 the C-MWC initiated a second project funding round for New Zealand-based biomedical researchers interested in collaborating with peers in China. The 2023 funding round was open to researchers not affiliated with the Maurice Wilkins Centre (MWC) as well as MWC investigators and called for proposals for new therapeutic agents or diagnostic techniques with potential health benefits for both countries. This process will be completed in early 2023.

International visitors

The MWC hosted one international visitor in 2022, Professor Haian Fu from the Department of Pharmacology and Chemical Biology at Emory University (USA). Professor Fu gave a seminar titled 'neo-Protein-Protein interactions in Cancer: discovery and targeting' at the University of Auckland in November 2022.
The number of international visitors is expected to increase in 2023.

Service roles by MWC Investigators

Maurice Wilkins Centre investigators support both the national and international science communities through service in leadership roles and on many advisory boards and panels.

National roles

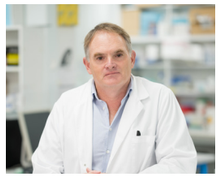
Between January and December 2022, Maurice Wilkins Centre investigators served in advisory and governance roles in many New Zealand organisations including;

- Auckland Medical Research Foundation
- Auckland Academic Health Alliance
- Auckland Regional Tissue Bank
- Australasia New Zealand Society for Extracellular Vesicles (ANZSEV)
- Australasian Cytometry Society
- Australasian Genomic Technologies Association (AGTA)
- Australasian Leukaemia and Lymphoma Group (ALLG)
- Australasian Society for Biophysics
- Australia and New Zealand Bone and Mineral Society
- Australian New Zealand Magnetic Resonance Society (ANZMAG)
- Australia New Zealand Marine Biotechnology Society
- Australia and New Zealand Society for Immunology
- Australasian Wound and Tissue Repair Society
- Cancer Society of New Zealand
- Cancer Research Trust
- He Taonga Tapu Cancer Society Tissue Bank Board
- Coeliac Society NZ
- Institute of Environmental Science and Research (ESR)
- Environmental Protection Authority
- Diabetes Auckland
- Diabetes Foundation Aotearoa
- Freemason Roskill Trust
- Genesis Oncology Trust/NZ Cancer Research Trust
- Gut Cancer Foundation
- Health Research Council of New Zealand
- Health Research Society of Canterbury (HRSC)
- Kea World Class NZ Awards Selection Panel
- Leukaemia & Blood Cancer New Zealand
- L'Oreal-UNESCO Women in Science Fellowships in Australia and New Zealand
- Melenoma Network of New Zealand (MelNet)
- Ministry of Business, Innovation and Employment
- Ministry of Health
- Ministry of Primary Industries
- Neurological Foundation of New Zealand
- New Zealand Breast Cancer Association
- New Zealand Association of Breast Cancer Research
- New Zealand eScience Infrastructure
- New Zealand Institute of Chemistry
- New Zealand Microbiology Network
- New Zealand Society for Oncology
- New Zealand Society for the Study of Medical Sciences
- New Zealand Society of Endocrinology
- Pharmaceutical Management Agency (PHARMAC)
- Physiological Society of New Zealand
- Queenstown Molecular Biology Society (Queenstown Research Week)
- Royal Society of New Zealand
- Te Aho O Te Kahu / Cancer Control Agency
- Te Manawa Museum of Art, Science and History
- The Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists
- Tongan Health Society

International roles

In 2022 members of the MWC served in more than 140 advisory, editorial and governance roles in international organisations based in Austria, Australia, Canada, China, France, Germany, India, Singapore, South Korea, Spain, Switzerland, The Netherlands, the United States of America and the United Kingdom.






Awards and Honours

MWC investigators, affiliates and students were acknowledges with a number of international and national honours in 2022:

- **The Royal Society of Chemistry, 2022 Pedler Award**

  Distinguished Professor Dame Margaret Brimble (MWC Directorate and Principal Investigator, University of Auckland) received the Pedler Award in recognition of her lifetime work in organic chemistry: natural product synthesis, peptide chemistry, and medicinal chemistry. As the recipient of the Pedler Award, Margaret will complete a UK lecture tour in 2023 and be formally presented the award (a medal and £3000).

- **Prime Minister's MacDiarmid Emerging Scientist Prize, Te Puiaki Kaipūtaiao Maea**

  Associate Professor Jemma Geoghegan (MWC associate investigator, University of Otago) was awarded the Te Puiaki Kaipūtaiao Maea. The award celebrates an outstanding emerging scientist undertaking leading edge research and has generated significant impact. For Jemma, the Te Puiaki Kaipūtaiao Maea recognises her strong research interest, extensive expertise, and global collaborative networks in the field of evolutionary virology. Her work contributed to the greater understanding of how viruses evolve and spread, such as during the Covid-19 pandemic in New Zealand.

- **Royal Society of New Zealand Te Apārangi, Hector Medal**

  Professor Murray Cox (MWC Associate Investigator, Massey University) received the Hector Medal for outstanding work in chemical, physical or mathematical and information sciences. The Hector Medal is awarded annually to an investigator in which the Academy Council recognised to have done most towards the advancement of a branch of science. Murray was nominated for major advances in population genetic theory and the innovative development of associated computational methods that have delivered deep insight into genome evolution.

- **Royal Society of New Zealand Te Apārangi, Callaghan Medal**

  Professor Michael Baker's (MWC Associate Investigator, University of Otago) received the Callaghan Medal for his continued dedication to science communication in New Zealand. The Callaghan Medal is awarded for an outstanding contribution to science communication and raising public awareness of the value of science to human progress, through his science-informed commentary on the Covid-19 pandemic and other major public health issues in New Zealand.

- **Royal Society of New Zealand Te Apārangi, Fellow of the Royal Society of New Zealand (FRSNZ)**

  A number of MWC investigators were elected to the Royal Society Academy in 2022 for their distinction in research or for advancing science, technology and the humanities. These were:

  - Prof Debbie Hay (MWC Principal Investigator, University of Otago)
  - Professor Murray Cox (MWC Associate Investigator, Massey University)
  - Prof Christian Hartinger (MWC Associate Investigator, University of Auckland)
  - Professor Nigel Perry (MWC Associate Investigator, University of Otago)
  - Professor Peter Fineran (MWC Associate Investigator, University of Otago).

  Peter was also awarded Siebold Collegium Institute of Advanced Studies (SCIAS) Fellow (Würzburg, Germany).

- **Health Research Council, Sir Charles Hercus Fellowship**

  The Sir Charles Hercus Fellowship is intended to build New Zealand's future capability to conduct world-class research. The prestigious award provides four years of full support for outstanding emerging New Zealand scientists in health research. Three MWC Investigators were awarded Sir Charles Hercus Fellowships

  - Dr Simon Jackson (MWC Associate, University of Otago), to study 'A genomics-led approach to bacteriophage therapies for infectious disease'
  - Dr Mark Calcott (MWC Affiliate, Victoria University of Wellington), to study 'Large-scale substitution approaches to engineer non-ribosomal peptides'
  - Dr Matthias Fellner (MWC Affiliate, University of Otago), to study 'Development of diagnostic fluorescence and ultrasound probes for *S. aureus*'

- **New Zealand Society for Oncology, Translational Research Award**

  Professor Cris Print (MWC Principal Investigator, University of Auckland) was awarded in recognition of his outstanding contributions to translational cancer research in New Zealand.

- **NZ Society for Biochemistry and Molecular Biology, Award for Research Excellence**

  Professor Mark Hampton's (MWC Associate Investigator, University of Otago) demonstrated excellence in New Zealand biochemistry and molecular biology was acknowledged by the New Zealand Society for Biochemistry and Molecular Biology. The Award for Research Excellence also recognised Mark's significant contributions to the scientific community.

- **Roche, Translational Cancer Research Fellowship**

  Research Associate Professor Aniruddha Chatterjee (MWC Associate Investigator, University of Otago) was announced the Roche Translational Cancer Research Fellowship at the 2021 New Zealand Society for Oncology conference. This award provided Aniruddha the opportunity to upskill and translate his research into clinical practice. His research is focused on better understanding of the mechanism of disease in cancer.

Alongside the awards listed above, MWC investigators were recognised by their home institutions and have gained other notable awards and honours for their contributions within the science community in 2022.

Appendix 1: Research outputs from projects supported by the Maurice Wilkins Centre

The majority of 2022 research outputs have resulted from projects that were supported by the Maurice Wilkins Centre prior to July 2021 using funds from the previous MWC CoRE 2015-2021 grant from the Tertiary Education Commission.
The MWC contributed support to 50 scientific papers and reviews, and 10 patents filed, published, or granted. See Appendix 1 for the lists of peer-reviewed publications and patents, listed below.

Papers and Reviews

1. Ahangarpour, M., Kavianinia, I., Hume, P. A., Harris, P. W. R. & Brimble, M. A. (2022). N-Vinyl Acrylamides: Versatile Heterobifunctional Electrophiles for Thiol-Thiol Bioconjugations. Journal of the American Chemical Society 144(30): 13652-13662.
2. Al-Zubaidi, A., Cheung, C. Y., Cook, G. M., Taiaroa, G., Mizrahi, V., Lott, J. S. & Dawes, S. S. (2022). RNase HI Depletion Strongly Potentiates Cell Killing by Rifampicin in Mycobacteria. Antimicrobial Agents and Chemotherapy 66(10).
3. Alexander, T. I., Tasma, Z., Siow, A., Rees, T. A., Brimble, M. A., Harris, P. W. R., Hay, D. L. & Walker, C. S. (2022). Novel Fluorescently Labeled PACAP and VIP Highlight Differences between Peptide Internalization and Receptor Pharmacology. ACS Pharmacology and Translational Science.
4. Banerjee, R., Smith, J., Eccles, M. R., Weeks, R. J. & Chatterjee, A. (2022). Epigenetic basis and targeting of cancer metastasis. Trends in Cancer 8(3): 226-241.
5. Brain, S. D., Russo, A. F. & Hay, D. L. (2022). Editorial: Calcitonin Gene-Related Peptide: Novel Biology and Treatments. Frontiers in Physiology 13.
6. Crystal Chan, S. H., Griffin, J. M., Clemett, C. A., Brimble, M. A., O'Carroll, S. J. & Harris, P. W. R. (2022). Synthesis and Biological Evaluation of Termini-Modified and Cyclic Variants of the Connexin43 Inhibitor Peptide5. Frontiers in Chemistry 10.
7. Denny, W. A. (2022). Inhibitors and Activators of the p38 Mitogen-Activated MAP Kinase (MAPK) Family as Drugs to Treat Cancer and Inflammation. Current Cancer Drug Targets 22(3): 209-220.
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9. Garelja, M. L., Bower, R. L., Brimble, M. A., Chand, S., Harris, P. W. R., Jamaluddin, M. A., Petersen, J., Siow, A., Walker, C. S. & Hay, D. L. (2022). Pharmacological characterisation of mouse calcitonin and calcitonin receptor-like receptors reveals differences compared with human receptors. British Journal of Pharmacology 179(3): 416-434.
10. Garelja, M. L. & Hay, D. L. (2022). A narrative review of the calcitonin peptide family and associated receptors as migraine targets: Calcitonin gene-related peptide and beyond. Headache 62(9): 1093-1104.
11. Garelja, M. L., Walker, C. S. & Hay, D. L. (2022). CGRP receptor antagonists for migraine. Are they also AMY1 receptor antagonists? British Journal of Pharmacology 179(3): 454-459.
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13. Harold, L. K., Jinich, A., Hards, K., Cordeiro, A., Keighley, L. M., Cross, A., McNeil, M. B., Rhee, K. & Cook, G. M. (2022). Deciphering functional redundancy and energetics of malate oxidation in mycobacteria. Journal of Biological Chemistry 298(5).
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15. Hashimi, F. N., Bennett, J., Baker, M. G., Moreland, N. J., Merry, T. L. & Loh, J. M. S. (2022). The effects of sugar in drinking water on Streptococcus pyogenes colonisation in a murine nasopharyngeal infection model. Scientific Reports 12(1).
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Patents

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1. Barzak, F.M.Y., Filichev, V.V., Harjes, E., Harjes, S., Jameson, G.B., Kurup, H.M., Kvach, M.V., Su, Y. Single stranded DNA enzyme inhibitors. World Intellectual Property Organization WO2022162536. 2022
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3. Filichev, V.V, Hale, T.K., Harjes, E., Harjes, S., Jameson, G.B., Kurup, H.M., Su, Y Hairpin DNA enzyme inhibitors. Australia AU2022902039. 2022

Appendix 2: International collaborations by Maurice Wilkins Centre investigators

The Maurice Wilkins Centre investigators were part of an extensive network of national and international collaborations in 2022, as listed below.

New academic collaborations

- Ahvaz Jundishapur University of Medical Sciences (Iran)
- Cambridge University (UK)
- Cardiff University School of Chemistry (Wales)
- Cardiff University School of Dentistry (Wales)
- Chengdu University of Traditional Chinese Medicine (China)
- Children's Cancer Institute (Australia)
- Chongqing Medical University (China)
- Drugs for Neglected Diseases initiative (Switzerland)
- Duke Kunshan University (China)
- Fiji National University (Fiji)
- Hacettepe University (Turkey)
- Heart Research Institute Australia (Australia)
- Heinrich Heine University Düsseldorf (Germany)
- Higher Colleges of Technology (United Arab Emirates)
- Institute of Molecular and Translational Medicine (Czech Republic)
- James Cook University (Australia)
- Kyungpook National University (South Korea)
- McMaster University (Canada)
- MD Anderson Cancer Center (USA)
- Nankai University (China)
- Ohio State University (USA)
- Shandong University (China)
- Simon Fraser University (Canada)
- Sun Yat-sen University (China)
- TB Alliance (South Africa)
- The Catholic University of America (USA)
- The Francis Crick Institute (UK)
- The Ohio State University (USA)
- Universidad de la República (Uruguay)
- University of California, San Francisco (USA)
- University of California, Berkeley (USA)
- University of Innsbruck (Austria)
- University of Rochester (USA)
- University of São Paulo (Brazil)
- University of Science & Technology of China (China)
- University of St Andrews (Scotland)
- University of Technology and Applied Sciences (Oman)
- University of Western Australia (Australia)
- Variant Bio (USA)
- Warwick University (UK)
- Wesleyan University (USA)
- Yantai Institute of Coastal Zone Research (China)

Continuing academic collaborations

Asia Pacific

- Australian National University (Australia)
- Baker Heart and Diabetes Institute (Australia)
- Children's Medical Research Institute (Australia)
- Edith Cowan University (Australia)
- Garvan Institute of Medical Research (Australia)
- Griffith University (Australia)
- La Trobe University (Australia)
- Macquarie University (Australia)
- Menzies Institute for Health Research (Australia)
- Monash University (Australia)
- Murdoch Children's Research Institute (Australia)
- National Health and Medical Research Council (Australia)
- Perth Children's Hospital (Australia)
- Peter MacCallum Cancer Centre (Australia)
- QIMR Berghofer Medical Research Institute (Australia)
- Queensland University of Technology (Australia)
- Telethon Kids Institute (Australia)
- The Peter Doherty Institute for Infection and Immunity (Australia)
- University of Adelaide (Australia)
- University of Melbourne (Australia)
- University of New South Wales (Australia)
- University of Newcastle (Australia)
- University of Queensland (Australia)
- University of Sydney (Australia)
- University of Wollongong (Australia)
- Walter and Eliza Hall Institute (Australia)
- Fudan University (China)
- Fujian University of Traditional Chinese Medicine (China)
- Guangzhou Institute of Biomedicine and Health (China)
- Jinan University (China)
- National Center for Protein Sciences (China)
- Peking University (China)
- Qingdao University (China)
- Shenzhen University (China)
- Shanghai Jiao Tong University (China)
- Sun Yat-sen University (China)
- Xinjiang University (China)
- Zhejiang University (China)
- University of Guam (Guam)
- University of Hong Kong (Hong Kong)
- Pondicherry University (India)
- Universitas Gadjah Mada (Indonesia)
- Universitas Padjadjaran (Indonesia)
- Kanazawa University (Japan)
- Keio University (Japan)
- Kindai University (Japan)
- Kyushu University (Japan)
- Nagasaki University (Japan)
- National Defence Medical College (Japan)
- Okinawa Institute for Science and Technology (Japan)
- Tokyo Institute of Technology (Japan)
- University of Tokyo (Japan)
- Yamaguchi University (Japan)
- Daegu Gyeongbuk Institute of Science and Technology (South Korea)
- National University of Malaysia (Universiti Kebangsaan Malaysia) (Malaysia)
- University of Malaya (Malaysia)
- Ministry of Health and Sports (Myanmar)
- University of Sarghoda (Pakistan)
- University of Papau New Guinea (Papau New Guinea)
- A*Star (Singapore)
- Institute of Medical Biology (Singapore)
- Nanyang Technological University (Singapore)
- National University of Singapore (Singapore)
- National Cheng Kung University (Taiwan)

UK and Europe

- Medical University of Innsbruck (Austria)
- Medical University of Vienna (Austria)
- Oroboros Instruments GmbH (Austria)
- University of Innsbruk (Austria)
- University of Vienna (Austria)
- Université Libre de Bruxelles (Belgium)
- University of Ghent (Belgium)
- University of Namur (Belgium)
- VIB-KU Leuven Center for Brain & Disease Research (Belgium)
- University of Copenhagen (Denmark)
- University of Eastern Finland (Finland)
- Claude Bernard University (France)
- Commissariat Ã l'Energie Atomique et aux Energies (France)
- Institut National de la Recherche Agronomique (France)
- Paris VI (France)
- University of Lille (France)
- University of Lyon (France)
- Université de Montpellier (France)
- Université Pierre et Marie Curie (France)
- University of Strasbourg (France)
- Braunschweig University of Technology (Germany)
- Free University of Berlin (Germany)
- Hamburg University of Applied Sciences (Germany)
- Max Planck Institute (Germany)
- The Helmholtz Association of German Research Centers (Germany)
- Universität Bremen (Germany)
- University Medical Center Hamburg-Eppendorf (UKE) (Germany)
- University of Freiburg (Germany)
- University of Hannover (Germany)
- Universität des Saarlandes (Germany)
- University of Würzburg (Germany)
- deCODE Genetics (Iceland)
- Fondatione Bruno Kessler (Italy)
- Universita' degli Studi G. d'Annunzio Di Chieti – Pescara (Italy)
- Vilnuis University (Lithuania)
- Delft University of Technology (Netherlands)
- University of Maastricht (Netherlands)
- University Medical Center Utrecht (Netherlands)
- Radbound University (Netherlands)
- Oslo University Hospital (Norway)
- Consejo Superior de Investigaciones Científicas (Spain)
- Karolinska Institute (Sweden)
- Lund University (Sweden)
- Research Institutes of Sweden (Sweden)
- Uppsala University (Sweden)
- University of Gothenburg (Sweden)
- École polytechnique fédérale de Lausanne (EPFL) (Switzerland)
- ETH Zurich (Switzerland)
- Eurogout (Switzerland)
- Paul Scherrer Institut (Switzerland)
- Roche Pharmaceuticals (Switzerland)
- Swiss Federal Institute of Technology (Switzerland)
- University of Zurich (Switzerland)
- Vaccine Formulation Institute (Switzerland)
- Defence Science and Technology Laboratory (UK)
- Durham University (UK)
- Imperial College London (UK)
- Keele University (UK)
- London School of Hygiene and Tropical Medicine (UK)
- Newcastle University (UK)
- University College Dublin (UK)
- University College London (UK)
- University of Aberdeen (UK)
- University of Bath (UK)
- University of Bristol (UK)
- University of Cambridge (UK)
- University of Dublin (UK)
- University of Dundee (UK)
- University of East Anglia (UK)
- University of Edinburgh (UK)
- University of Exeter (UK)
- University of Huddersfield (UK)
- University of Liverpool (UK)
- University of Manchester (UK)
- University of Oxford (UK)
- University of Southampton (UK)
- University of Warwick (UK)

North America

- British Columbia Cancer Agency (Canada)
- McGill University (Canada)
- Hospital for Sick Children (Canada)
- Montreal Neurological Institute and Hospital (Canada)
- University of British Columbia (Canada)
- University of Guelph (Canada)
- University of Lethbridge (Canada)
- University of Montreal (Canada)
- University of Ottawa (Canada)
- University of Saskatchewan (Canada)
- University of Vancouver (Canada)
- York University (Canada)
- AbbVie (USA)
- Arizona State University (USA)
- Albert Einstein College of Medicine (USA)
- Cedars-Sinai Hospital (USA)
- Cleveland Clinic (USA)
- Cold Spring Harbor Laboratory (USA)
- Colorado State University (USA)
- Columbia University (USA)
- Connecticut College (USA)
- Emory University (USA)
- Food and Drug Administration FDA (USA)
- Georgia Institute of Technology (USA)
- Global Alliance for TB Drug Development (USA)
- Hudson Institute (USA)
- Harvard University (USA)
- Icahn School of Medicine at Mount Sinai (USA)
- Johns Hopkins University (USA)
- Kent State University (USA)
- La Jolla Institute for Allergy and Immunology (USA)
- MD Anderson Cancer Center University of Texas (USA)
- Midwestern University (USA)
- Michigan State University (USA)
- Moffitt Cancer Center (USA)
- National Cancer Institute (USA)
- National Institutes of Health (USA)
- Office of Applied Research and Safety Assessment CFSAN (USA)
- Office of Regulatory Affairs OARSA (USA)
- Ohio State University (USA)
- Penn State University (USA)
- Phoenix Children's Hospital (USA)
- Rice University (USA)
- Rockefeller University (USA)
- Rochester Institute of Technology (USA)
- Rutgers University (USA)
- Sanford Burnham Institute of Medical Research (USA)
- Space Foundry Ltd (USA)
- Stanford University (USA)
- St Jude Children's research Hospital (USA)
- Stony Brook University (USA)
- Temple University (USA)
- Texas A&M University (USA)
- University of Alabama (USA)
- University of Arizona (USA)
- University of California, Irvine (USA)

- University of California, Los Angeles (USA)
- University of California, San Diego (USA)
- University of Chicago (USA)
- University of Colorado (USA)
- University of Connecticut (USA)
- University of Georgia (USA)
- University of Houston (USA)
- University of Iowa (USA)
- University of Maryland (USA)
- University of Miami (USA)
- University of Michigan (USA)
- University of Minnesota (USA)
- University of Missouri (USA)
- University of North Carolina (USA)
- University of Pittsburgh (USA)
- University of Southern California (USA)
- University of Texas South Western (USA)
- University of Texas (USA)
- University of Utah (USA)
- Vanderbilt University (USA)
- Wadsworth Centre (USA)
- Wake Forest University (USA)
- Washington University (USA)
- Weill Cornell Medical College (USA)
- Winona State University (USA)
- Yale University (USA)

South America

- Federal University of Minas Gergais (Brazil)
- Federal University of Sao Paulo (Brazil)

Africa

- University of KwaZulu-Natal (South Africa)

Additional regions

- Ben Gurion University of the Negev (Israel)

MAURICE WILKINS CENTRE
FOR MOLECULAR BIODISCOVERY

Summary

Broad category	Detailed Category	2021*	2022
FTEs by Category	Principal investigators	0.52	1.42
	Associate investigators	0.13	1.57
	Postdoctoral fellows	0	1.76
	Research technicians	0	0.17
	Administrative/support	0.49	1.87
	Research students	0	0.75
	Total	**1.14**	**7.54**
Headcounts by category	Principal investigators	24	22
	Associate investigators	224	240
	Postdoctoral fellows	0	10
	Research technicians	0	1
	Administrative/support	4	7
	Research students	51	71
	Total	**303**	**351**
Peer reviewed research outputs by type	Journal articles	31	49
	Book chapters	1	1
	Conference Proceedings	0	0
	Total	**32**	**50**
Commercial activities	Patent applications	2	3
	Patents granted	1	1
Students studying at CoRE by level	Doctoral degree	45	59
	Master's degree	5	9
	Other	1	3
	Total	**51**	**71**
No. of students completing qualification by level	Doctoral degree	8	16
	Master's degree	1	3
	Other	0	2
	Total	**9**	**21**
Immediate post-study graduate destinations	Further study in NZ	0	1
	Further study overseas	0	0
	Employed in NZ in Māori organisation	0	0
	Employed in NZ other	6	14
	Employed overseas	3	2
	Unknown	0	3
	Other	0	3
	Total	9	23

*for the period 1st July-31 December 2021

Summary Financial Statement 2020-21

Actuals	**2021***	**2022**
($000)		
Funding received		
Tertiary Education Commision grant	3100	6200
Surplus/(Deficit) carried forward	0	2789
Total funding received	3100	8989
Salaries and salary related costs	121	848
Overheads	170	937
Project costs	18	197
Travel	2	122
Postgraduate students	0	20
Total expenditure	**311**	**2124**
Net surplus/(Deficit)	**2789**	**6865**

*for the period 1st July-31 December 2021

Directory

Governing Board

Mr Bill Falconer (Chair)

Professor David Harper

Mr Peter-Lucas Jones (Te Aupouri, Ngati Kahu, Te Rarawa, Ngai Takoto)

Professor Jim Metson

Professor Warren Tate

Ms Huti Watson (Ngati Porou, Tainui)

Principal investigators (management)

Name	Department	Institution
Professor Antony Braithwaite	Department of Pathology	University of Otago
Distinguished Professor Dame Margaret Brimble	School of Chemical Sciences	University of Auckland
Professor Rebecca Campbell	Department of Physiology	University of Otago
Distinguished Professor Greg Cook	Department of Microbiology and Immunology	University of Otago
Professor Rod Dunbar	School of Biological Sciences	University of Auckland
Professor Mike Eccles	Department of Pathology	University of Otago
Professor Gary Evans	Ferrier Research Institute	Victoria University of Wellington
Professor Dave Grattan	Department of Anatomy and Structural Biology	University of Otago
Professor Debbie Hay	Department of Pharmacology and Toxicology	University of Otago
Professor Ian Hermans		Malaghan Institute of Medical Research
Professor Kurt Krause	Department of Biochemistry	University of Otago
Associate Professor Shaun Lott	School of Biological Sciences	University of Auckland
Associate Professor Nikki Moreland	Department of Molecular Medicine and Pathology	University of Auckland
Professor Rinki Murphy	Department of Medicine	University of Auckland
Professor Emily Parker	Ferrier Research Institute	Victoria University of Wellington
Associate Professor Adam Patterson	Auckland Cancer Society Research Centre	University of Auckland
Professor Cristin Print	Department of Molecular Medicine and Pathology	University of Auckland
Professor Peter Shepherd	Department of Molecular Medicine and Pathology	University of Auckland
Associate Professor James Ussher	Department of Molecular Medicine and Pathology	University of Otago
Associate Professor Phillip Wilcox	Department of Mathematics and Statistics	University of Otago

Principal investigators (emeritus)

Name	Department	Institution
Distinguished Professor Edward (Ted) Baker	School of Biological Sciences	University of Auckland
Professor Garth Cooper	School of Biological Sciences	University of Auckland
Professor Sir William (Bill) Denny	Auckland Cancer Society Research Centre	University of Auckland
Professor John Fraser	Department of Molecular Medicine and Pathology	University of Auckland
Distinguished Professor Peter Hunter	Auckland Bioengineering Institute	University of Auckland

Associate investigators

Name	Department	Institution
Prof David Ackerley	School of Biological Sciences	Victoria University of Wellington
Dr Alana Alexander	Department of Anatomy	University of Otago
Assoc Prof Jane Allison	School of Biological Sciences	University of Auckland
Dr Timothy Allison	School of Physical and Chemical Sciences	University of Canterbury
Prof Bob Anderson	Auckland Cancer Society Research Centre	University of Auckland
Prof Greg Anderson	Department of Anatomy	University of Otago
Dr Catherine Angel	School of Biological Sciences	University of Auckland
Prof Vic Arcus	School of Science	University of Waikato
Dr Amir Ashoorzadeh	Auckland Cancer Society Research Centre	University of Auckland
Dr Jonathan Astin	Department of Molecular Medicine and Pathology	University of Auckland
Prof Paul Atkinson	School of Biological Sciences	Victoria University of Wellington
Dr Htin Aung	Department of Microbiology and Immunology	University of Otago
Emeritus Prof Bruce Baguley	Auckland Cancer Society Research Centre	University of Auckland
Prof Michael Baker	Department of Public Health	University of Otago, Wellington
Dr Ghader Bashiri	School of Biological Sciences	University of Auckland
Prof Chris Battershill	School of Science	University of Waikato
Dr Julie Bennett	Department of Public Health	University of Otago, Wellington
Prof Mike Berridge		Malaghan Institute of Medical Research
Prof Mik Black	Department of Biochemistry	University of Otago
Dr Cherie Blenkiron	Department of Molecular Medicine and Pathology	University of Auckland

Prof Stefan Bohlander	Department of Molecular Medicine and Pathology	University of Auckland
Assoc Prof Mihnea Bostina	Department of Microbiology and Immunology	University of Otago
Prof Nicola Brasch	Department of Chemistry	Auckland University of Technology
Dr Anna Brooks	School of Biological Sciences	University of Auckland
Prof Peter Browett	Department of Molecular Medicine and Pathology	University of Auckland
Prof Colin Brown	Department of Physiology	University of Otago
Dr Rosie Brown	Department of Anatomy	University of Otago
Dr Christina Buchanan	School of Medicine	University of Auckland / Te Whatu Ora - Te Toka Tumai Auckland
Assoc Prof Jaydee Cabral	Department of Microbiology and Immunology	University of Otago
Dr Alan Cameron	School of Chemical Sciences	University of Auckland
Prof Rebecca Campbell	Department of Physiology	University of Otago
Prof Richard Cannon	Department of Oral Sciences	University of Otago
Dr Philip Carter		Environmental Science and Research
Research Associate Professor Aniruddha Chatterjee	Department of Pathology	University of Otago
Dr Peter Choi	Auckland Cancer Society Research Centre	University of Auckland
Assoc Prof Davide Comoletti	School of Biological Sciences	Victoria University of Wellington
Dr Lisa Connor	School of Biological Sciences	Victoria University of Wellington
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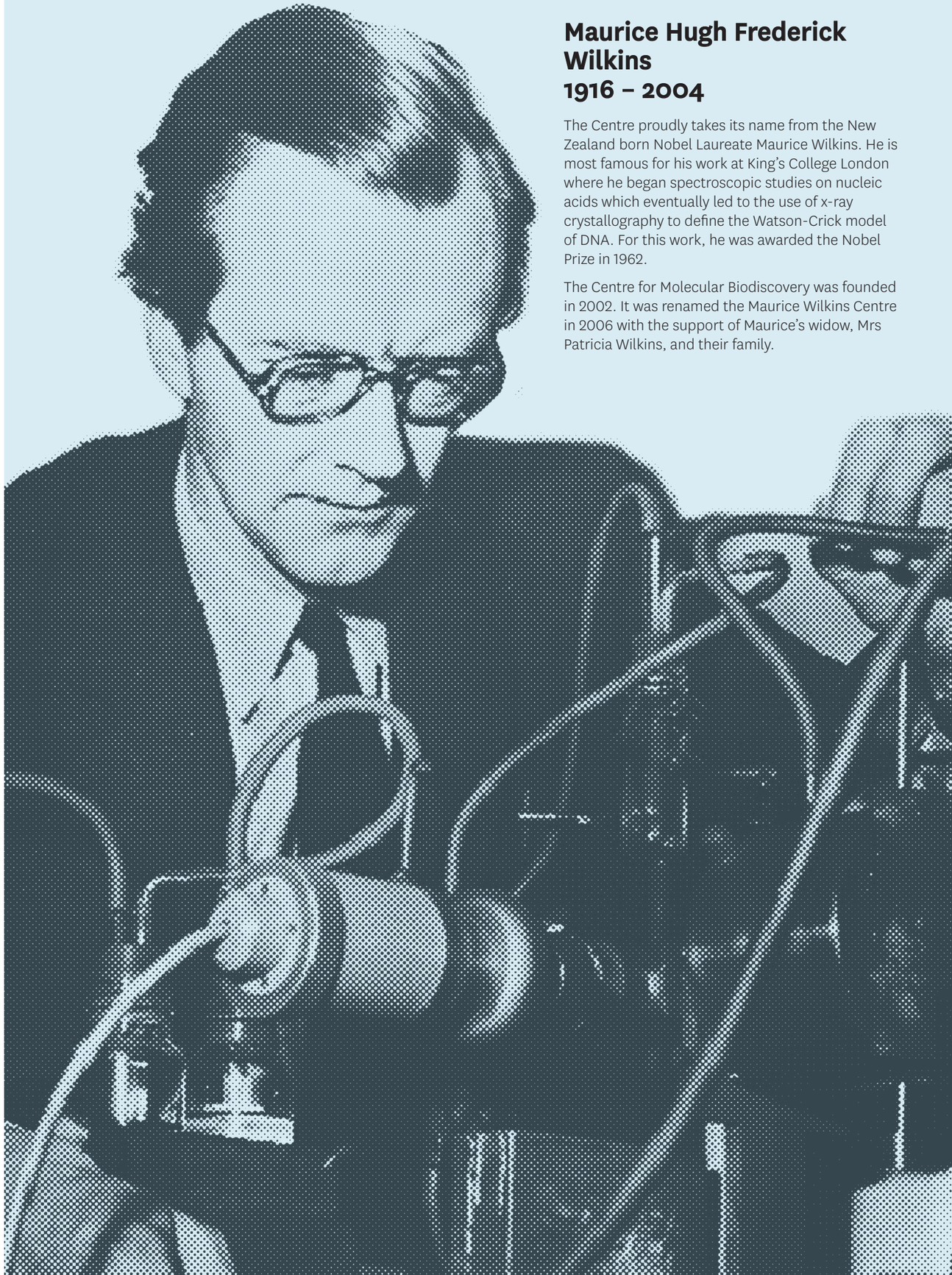

Maurice Hugh Frederick Wilkins
1916 – 2004

The Centre proudly takes its name from the New Zealand born Nobel Laureate Maurice Wilkins. He is most famous for his work at King's College London where he began spectroscopic studies on nucleic acids which eventually led to the use of x-ray crystallography to define the Watson-Crick model of DNA. For this work, he was awarded the Nobel Prize in 1962.

The Centre for Molecular Biodiscovery was founded in 2002. It was renamed the Maurice Wilkins Centre in 2006 with the support of Maurice's widow, Mrs Patricia Wilkins, and their family.