



WORLD-CLASS PHARMACY AND PHARMACEUTICAL SCIENCE RESEARCH

Monash Institute of Pharmaceutical Sciences (MIPS) can trace its roots to 1881. Today, MIPS is a dynamic, innovative and ambitious centre of research and learning, with a growing emphasis on cutting edge global projects.

More than 450 MIPS scientists research drug discovery, design, delivery and use. Our therapeutic strengths lie in neuroscience and mental health, cardiovascular and metabolic health, and global health.

We are committed to research translation and have made major contributions to collaborative drug discovery programs that have progressed more than 35 novel drug candidates into clinical development.

MIPS is housed at the Monash University Parkville campus, the university's most researchintensive campus. Close to Melbourne's CBD and part of Australia's top health and biomedical precinct, our neighbours include major hospitals, the University of Melbourne, WEHI, the Florey, the Doherty Institute and CSL Limited.

In addition to our research scientists and graduate students, the Parkville campus is also home to approximately 2000 undergraduate students. Our major undergraduate programs are the combined Bachelor and Master of Pharmacy, and the Bachelor of Pharmaceutical Science.

MIPS HISTORY



1881

The Victorian College of Pharmacy (VCP) opens.

1958

Monash University is established.

1992

VCP merges with Monash University 2008

VCP becomes the Faculty of Pharmacy and Pharmaceutical Sciences

2008

Research restructured and incorporated into the Monash Institute of Pharmaceutical Sciences (MIPS) and the Centre for Medication Use and Safety.

2019

Centre for Medicine Use and Safety ioins MIPS.

2022

2022 QS World University Rankings by Subject ranks Monash #1 in the world for Pharmacy and Pharmacology

MIPS BY THE **NUMBERS**

#1

in Asia Pacific for Pharmacy and Pharmacology (QS 2016-2023)

globally for Pharmacy and Pharmacology (QS 2017-2023)

Top 3 \$40M+

external research income

400+ publications per year

Ž20 PhD candidates

282

MONASH UNIVERSITY BY THE NUMBERS



Australia's largest university with the broadest international profile and footprint

85,000+

\$672M

total research income (HERDC – Categories 1–4 in 2022)

#42

in the 2023 QS WUR by Subject

#57

in the 2023 QS World Rankings

Located in

global students

MELBOURNE / VICTORIA

consistently ranked in the top 10 of world's most liveable cities





AREAS OF EXPERTISE

RESEARCH SPECIALISATION

Our research programs focus on:

- drug discovery biology
- medicinal chemistry
- drug candidate optimisation
- drug delivery, disposition and dynamics
- medicine use and safety.

Within these broad areas we have particular skills in:

- the pharmacology of G protein-coupled receptors and the role of allostery and biased signalling in receptor pharmacology
- structure-based drug design and the use of fragment-based screening and DNA encoded libraries (DEL)
- optimisation of physicochemical, metabolism and pharmacokinetic properties during hit-to-lead and lead optimisation through to candidate selection
- oral and pulmonary drug delivery and the use of nanomedicines including lipid nanoparticles in optimised drug therapy
- pharmacoepidemiology, pharmacoeconomics and pharmacometrics.

THERAPEUTIC PROGRAM AREAS

Much of our collaborative work in drug discovery biology, medicinal chemistry, drug delivery, lead optimisation and medicine use is disease agnostic, however, we have an internal focus in three main therapeutic areas:

- neuroscience and mental health
- cardiovascular and metabolic health
- global health.

Within these areas we have major programs in neuropsychiatric disorders, metabolic disease, heart failure, fibrosis, chronic pain, addiction and malaria.

INFRASTRUCTURE

We operate a range of research facilities directed towards translational drug discovery. These include drug target identification using proteomics and metabolomics; fragment-based drug screening (NMR, SPR); medicinal chemistry design and synthesis and physicochemical, metabolism and pharmacokinetic profiling.

We also house state-of-the-art imaging covering optical (confocal, super-resolution, CARS) and electron microscopy (single particle cryo-EM); MALDI mass spectrometry imaging and in vivo imaging (2-photon, tomographic fluorescence, CT); chemical profiling and bioanalysis (NMR, mass spectrometry) and pharmacometrics/QP capabilities.



OUR RESEARCH THEMES

DRUG DISCOVERY BIOLOGY

Our work in pharmacology and drug discovery has a sustained impact on the understanding and treatment of major global health burdens.

Our research is based on four major multidisciplinary and complementary areas of expertise:

- Pharmacology
- Structural biology
- Target identification and
- Translational science.

Our principal therapeutic focus areas are neurological disease, cardiovascular disease and metabolic disease. We also have interests in pain, inflammatory disease and cancer. We serve as the headquarters of the ARC Industrial Transformation Training Centre for Cryo-Electron Microscopy of Membrane Proteins for Drug Discovery, a national training centre with collaborators from the University of Melbourne, WEHI and the University of Wollongong and research partners including AstraZeneca, Servier and Thermo Fisher Scientific.

We have specific interests in the structure and function of G protein-coupled receptors, the role of allostery and bias in receptor signalling. Our expertise is applied particularly to neuroscience, the genes, proteins and pathways that are important in metabolic disease and the development of new treatments for heart failure resulting from interruptions in coronary blood supply (such as in heart attack) or as a result of diabetes.

MEDICINAL CHEMISTRY

Our major areas of research focus are in synthetic medicinal chemistry, structure-based drug design, fragment screening and academic drug discovery. Our research strengths also include peptide science, chemical-biology and computational chemistry.

We headquarter the MRFF-funded initiative MedChem Australia, which, in partnership with WEHI and the University of Sydney, is a national medicinal chemistry capability to support drug discovery. The ARC Industrial Transformation Training Centre for Fragment Based Design (CFBD) is also headquartered at MIPS. CFBD is a national training centre with collaborators from Griffith University and the University of Sydney and research partners including CSIRO, Takeda, and Vernalis. We are home to the Australian Translational Medicinal Chemistry Facility.

Historically, our achievements include Zanamivir (Relenza®), a first in-class antiviral drug developed to treat and prevent influenza. More recently we have spun out start-ups including Cincera, Ankere and Inosi Therapeutics to develop novel agents to treat metabolic disease and fibrosis.

DRUG DELIVERY, DISPOSITION AND **DYNAMICS**

We are focused on the design and development of drug delivery systems that efficiently target drugs to the right place at the right time, be that via oral administration, inhalation or injection.

We are leaders in drug delivery and nanomedicine and have particular strengths in lipid based drug delivery and lymphatic transport.

Our major programs address the challenges of:

- delivering drugs that have very low solubility
- switching the need to administer drug by injection to using other routes such as inhalation
- better understanding the subcellular trafficking of drug molecules
- targeting anticancer medicines to tumours
- understanding drug transport into the brain
- profiling the relationship between delivery system structure and function using field-leading analytical capabilities such as the Australian Synchrotron
- targeting drugs to the lymphatic system to better treat immune and metabolic disease.

CENTRE FOR DRUG CANDIDATE OPTIMISATION

We foster drug discovery innovation through large multidisciplinary collaborative programs with commercial partners, not-for-profit organisations and academic research institutes.

We specialise in identifying the optimal physicochemical, biopharmaceutical and pharmacokinetic properties of drugs and translating drug candidates from discovery into clinical development.

We run all major in vitro and in vivo ADME and pharmacokinetic platforms to fulfil candidate selection and progression criteria.

These include in vitro screens for solubility, drug metabolism, permeability, transporters, CYP inhibition, and protein binding, and in vivo assessment of drug absorption, disposition and hepatic, renal and biliary clearance.

We have extensive experience in drug discovery for tropical infectious diseases but work in other therapeutic areas including cancer, CNS disorders, cardiovascular and metabolic disease.

CENTRE FOR MEDICINE USE AND SAFETY

We make medicine use safer in Australia and globally.

We run major collaborative multidisciplinary projects to investigate medicine use issues and problems, propose interventions and evaluate implementation strategies.

We use pharmacoepidemiology and pharmacometric techniques to investigate profiles of medicine use and to probe interventions that enhance patient treatment and safety.

We are Australasia's leading practice-based research group, and work closely with clinicians and medical researchers from within and outside the pharmacy profession to address major issues of medicine use and safety.



THERAPEUTIC PROGRAM AREAS

Our Therapeutic Program Areas (TPAs) unite researchers from across different themes and research groups around a common disease focus. These TPAs represent major research strengths across MIPS, however we also undertake research in areas such as cancer, pain, and inflammatory and infectious disease.

Cardiovascular and Metabolic Health

The expertise in the Cardiovascular and Metabolic Health TPA encompasses medicinal chemistry, structural biology, analytical pharmacology, drug disposition, drug delivery, translational models of disease and medicines use and safety.

We focus on understanding how excess nutrient consumption and nonfunctioning metabolic organs contribute to obesity, diabetes and metabolic associated cancers, thus enabling the development of improved treatments for metabolic associated diseases.

We have broad expertise in delineating the underpinning mechanisms of cardiovascular disease and in developing new treatments for heart failure resulting from interruptions

in coronary blood supply (such as in heart attack), diabetic cardiomyopathy and cardiopulmonary disease.

Neuroscience and Mental Health

The Neuroscience and Mental Health TPA encompasses multidisciplinary approaches to unmet medical needs in psychiatry, neurodegeneration, pain, and other mental health conditions.

Major programs of work include innovative approaches to small molecule drug discovery to tackle schizophrenia and cognitive disorders; novel drug targets, interventions and agents in the design of more effective and safer pain medications; evaluation of the underlying pathology of neurodegenerative disorders and exploration



of innovative therapeutic strategies to treat disease progression and cognitive symptoms.

Working with clinicians and colleagues in medicines use and safety, our collaborative drug discovery teams combine medicinal chemistry, structural biology, analytical pharmacology, drug disposition, and translational models of disease to improve patient outcomes.

Global Health

The Global Health TPA works to improve health and achieve equity in health for all people worldwide.

Our major activities focus on infectious diseases and maternal, child and reproductive health, along with capacity-building programs for pharmacy globally.

Our research ranges from the discovery of new drugs, vaccines and diagnostics, to improving medicines and treatment regimens to suit specific populations.

Existing collaborations operate in the Pacific, South and Southeast Asia and sub-Saharan Africa and we look to expand our reach further, aligning our activities with local, national and international frameworks to make a positive impact on global health.



Talos L120

OUR RESEARCH INFRASTRUCTURE

AUSTRALIAN TRANSLATIONAL MEDICINAL CHEMISTRY FACILITY (ATMCF)

ATMCF is a purpose-designed, outward-facing, collaborative facility that supports early stage medicinal chemistry-led drug discovery. ATMCF provides medicinal chemistry insight and expertise and a translational bridge between early-stage biology and translational lead optimisation and pre-clinical development.

CENTRE FOR DRUG CANDIDATE OPTIMISATION (CDCO)

In addition to its role as a research theme at MIPS, CDCO also constitutes a major university research platform providing expertise and infrastructure in ADME lead optimisation to multidisciplinary drug discovery teams for improved compound design, selection and progression through to drug candidate selection.

COMPUTATIONAL CHEMISTRY FACILITY

Our well-equipped computational chemistry facility has an open access laboratory with more than 30 Linux workstations available to all Faculty researchers. It also has a wide range of academic and commercial software to support research programs in computational chemistry, X-ray crystallography, NMR spectroscopy and bioinformatics.

CRYO-EM STRUCTURAL BIOLOGY PLATFORM

We have a major research collaboration with Thermo Fisher Scientific to develop and streamline workflows in elucidating the structure of membrane proteins (in particular G proteincoupled receptors) by cryo-EM and utilising this information in structure-based drug design. We have a Thermo Fisher Scientific Talos L120C G2 on site, a Thermo Fisher Scientific Glacios 200kV microscope hosted at the Bio21 Institute (University of Melbourne), and access to Thermo Scientific Krios 300kV microscopes through the Monash Ramaciotti Cryo-EM Centre and via the Bio21 Institute.

FRAGMENT BASED DRUG DISCOVERY -MONASH FRAGMENT PLATFORM (MFP)

The MFP employs biophysical binding assays such as NMR, SPR and ITC to identify ligands that bind to therapeutic targets. Hits are either identified using DNA encoded libraries (DEL) or fragment-based screening (FBS), FBS uses a high-quality, in-house fragment library designed to maximise chemical space coverage and enable rapid hit optimisation. Bespoke medicinal chemistry support subsequently facilitates Rapid Elaboration of Fragments into Leads, to power translation.

HMSTrust ANALYTICAL LABORATORY

This open-access analytical facility uses sophisticated physical and chemical characterisation techniques to overcome challenges faced in modern drug development. Academic and industry researchers can access a comprehensive suite of advanced chemical characterisation instruments.

IMAGING, FACS AND ANALYSIS CORE (IFAC)

IFAC uses the latest imaging, flow cytometry and analysis platforms for samples ranging from single molecules to whole animals. Our extensive range of ultra-precision microscopes include widefield, high throughput, holographic, hyperspectral, electron, superresolution, confocal, multiphoton, lifetime imaging and label free confocal. We also provide analytical and sorting flow cytometry capabilities.

MEDICINES MANUFACTURING INNOVATION CENTRE (MMIC)

MMIC is an initiative established with the Victorian State Government to bring academic and industrial scientists together to optimise manufacturing processes, enhance current and new product development and build a highly skilled, industryready, workforce. MMIC provides specialist analytical and formulation development services via a team of experienced industrial scientists.

MELBOURNE CENTRE FOR **NANOFABRICATION (MCN)**

MCN provides MIPS researchers with streamlined access to MCN and the broader Australian National Fabrication Facility (ANFF). ANFF is a network organisation with eight nodes offering service capabilities such as micro and nano fabrication, characterisation, device fabrication, packaging and testing. MCN is the Victorian node of ANFF and the Southern Hemisphere's largest open-access fabrication facility.

MONASH BIOMEDICAL IMAGING (MBI)

The MIPS node of MBI includes three pre-clinical imaging systems for imaging and tracking disease in vivo. Instrumentation based at MIPS allows for in vivo tomographic fluorescence imaging. bioluminescence imaging and CT imaging. The broader MBI platform provides access to 3T MRI, MR-PET and CT clinical imaging capabilities.

DRUG TARGET IDENTIFICATION PLATFORM (INCORPORATING THE PARKVILLE NODE OF THE MONASH PROTEOMICS AND **METABOLOMICS FACILITY)**

The Drug Target Identification Platform uses a range of cutting edge metabolomics, lipidomics and proteomics capabilities to identify and deconvolute new drug targets, to elucidate mechanisms of drug action and to discover novel biomarkers of drug action. Our analytical methods are suitable for samples arising from cell culture, animal studies or clinical trials, and our workflows are ideally suited to untargeted comparative analyses.

MURINE DISEASE MODEL FACILITY

Our full barrier animal house and holding facilities for mice and rats provide a range of rooms and systems to maximise research capabilities and minimise animal stress. They include microisolator housing and facilities for open and closed cages, surgical suites and a range of behaviour rooms containing assessment capabilities including prepulse inhibition chambers and water mazes.

PEPTIDE SYNTHESIS FACILITY

This facility features three Protein Technologies Automated Peptide Synthesizers, which allow the routine solid phase synthesis of peptides of up to 30 amino acids in length. They provide the base capacity to develop larger or modified peptides, cyclic peptides, peptidomimetics or small molecules.

SPECTROSCOPY FACILITY

Housing NMR spectroscopy and chromatography instrumentation, this facility supports a broad range of research, most notably synthetic medicinal chemistry and fragment-based drug discovery. Equipment includes four LC-MS spectrometers, analytical and preparative HPLC systems and two 400 MHz NMR spectrometers for routine chemical characterisation. In addition. 500 MHz and 600 MHz NMR spectrometers equipped with cryogenic probes and high capacity sample changers support screening applications and biomolecular structure determination. The 500 MHz system is optimised for ¹⁹F-NMR applications.

THE AUSTRALIAN SYNCHROTRON

MIPS researchers use X-ray crystallography beamlines at the Australian Synchrotron to solve protein structures and evaluate drug-protein interactions rapidly and with high definition atomic resolution. We also use the SAXS/WAXS beamline at the Australian Synchrotron to investigate nanostructure in drug delivery systems.

mRNA THERAPEUTICS

MIPS scientists have been active in the field of nucleic acid delivery and the design and evaluation of nanomedicines for many years. The COVID-19 pandemic served to accelerate our activities in the development of mRNA therapeutics using lipid nanoparticle-based delivery systems as a new frontier in medicine. MIPS researchers were the architects of Australia's first mRNA COVID-19 vaccine to enter clinical trials.

Subsequently, MIPS has launched the Victorian mRNA Innovation Hub (VMIH) after receiving \$5.4 million in funding from the mRNA Victoria Activation Program and has initiated mRNA Core via receipt of \$5 million in funding from the MRFF mRNA Clinical Trials enabling program.

Headquartered at MIPS, VMIH is made up of a collaborative team of researchers from Monash, The University of Melbourne and The Doherty Institute and aims to advance new technologies that will underpin the development of mRNA therapeutics and vaccines that are more effective, cheaper and faster to produce. mRNA Core at MIPS works collaboratively with researchers across Australia to accelerate the development of novel mRNA products towards clinical trials.

In 2023, MIPS announced the establishment of the Monash-Moderna Quantitative Pharmacology Accelerator, a five-year program which aims to drive advancements in mRNA medicines through a \$3 million investment by Moderna and substantial in-kind contributions by the two institutions.



TERRACOTTA

IMPROVING COPD MANAGEMENT IN PRIMARY CARE

Chronic obstructive pulmonary disease (COPD) is a common, preventable and treatable lung condition. Yet it is the third leading cause of death worldwide, with over 80 percent of deaths occurring in low and middle-income countries.

A Cochrane systematic review suggests current models of educational intervention are not working, and new approaches are needed.

Researchers from the Centre for Medicine Use and Safety are conducting a cluster randomised controlled trial to address deficiencies in Australia's primary care relating to COPD management.

The trial, Targeting Treatable Traits in COPD to Prevent Hospitalisations (TERRACOTTA), is the first of its kind to offer tailored interventions, including assessments and treatment programs, for at-risk individuals.

The aim? To improve quality of life and avoid hospitalisations in moderate-to-severe COPD.





HEPARIN NASAL SPRAY

Researchers at Monash University's Medicines Manufacturing Innovation Centre (MMIC) hope a heparin nasal spray may hold the answer to reducing transmission of COVID-19 in high-risk settings such as aged care facilities and hospitals.

Heparin is usually prescribed as an anticoagulant and is used during open-heart surgery, blood transfusions, kidney dialysis and bypass surgery. However, mounting evidence shows that heparin can also block the proliferation of influenza in laboratory cultures. This project seeks to determine whether administering heparin via a nasal spray could similarly block or reduce the risk of acquiring and transmitting COVID-19.

Researchers from Northern Health, Murdoch Children's Research Institute, the University of Melbourne, the Doherty Institute, St Vincent's Hospital and the CSIRO are taking part in this multidisciplinary project. Researchers at MMIC have been responsible for the formulation and nasal device, as well as the performance and stability testing of the nasal spray.

The spray may provide a treatment option for people who are unable to be vaccinated, and the study investigators see its greatest potential use in protecting vulnerable workers in high-exposure settings, such as health care and education settings and crowded public environments.



AUSTRALIA'S FIRST DRUG TARGET IDENTIFICATION PLATFORM

There is an urgent unmet need for target identification capabilities to support Australia's drug discovery pipeline. Many promising biomedical discoveries fail to progress to clinical therapeutics due to poor efficacy, which is often underpinned by a lack of understanding about their mechanism of action.

To fill this gap, MIPS has established the first dedicated Drug Target Identification Platform (DTIP) in Australia to provide an efficient and unbiased avenue to identify drug targets and biomarkers for the Australian drug discovery community. DTIP provides state-of-the-art proteomics, metabolomics and lipidomic analyses to identify and deconvolute new drug targets, to elucidate mechanisms of drug action and to discover novel biomarkers of drug action. The platform has been made possible by the Commonwealth Government's Medical Research Future Fund National Critical Research Infrastructure Grant, which has invested \$3 million into the program.

The project is being led by MIPS in collaboration with Monash's Faculty of Medicine Nursing and Health Sciences, Griffith University, Australian National University, WEHI, Centre for Cancer Biology (University of South Australia), BioCurate, Canthera, BioIVT and the Children's Cancer Institute (University of New South Wales).

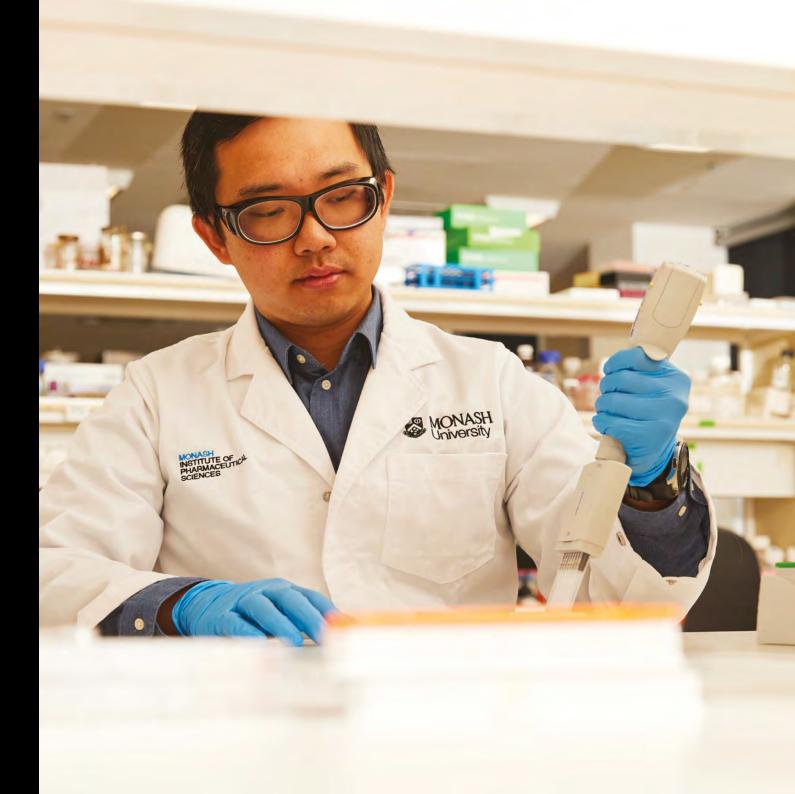
NEUROMEDICINES DISCOVERY CENTRE

NEW TREATMENTS FOR MENTAL HEALTH CONDITIONS

Over the past five decades there have been extraordinary breakthroughs in the treatment of a wide range of diseases, from heart disease and cancer to diabetes and dementia. Yet, despite the fact that almost half of Australians will experience a mental health condition during their lifetime, there hasn't been anything like the same innovation in mental health.

The Neuromedicines Discovery Centre (NDC) is working to stimulate medical research into mental health conditions to bring hope to those for whom current treatments are ineffective. Neuromedicines are drugs that act on the brain, and include psychedelics such as psilocybin, ketamine and MDMA. NDC focuses on conditions including depression, post-traumatic stress disorder, eating disorders, schizophrenia and substance-use disorders. The ultimate goal is to find 'antibiotics for the mind' that require minimal dosing with a quick onset of action, have fewer side-effects, and are effective for longer periods.

The NDC is a collaborative venture with the University of Melbourne and The Florey Institute of Neuroscience and Mental Health. From mechanism-driven drug discovery to clinical trials, world-leading researchers are taking an evidence-based approach to patient care.



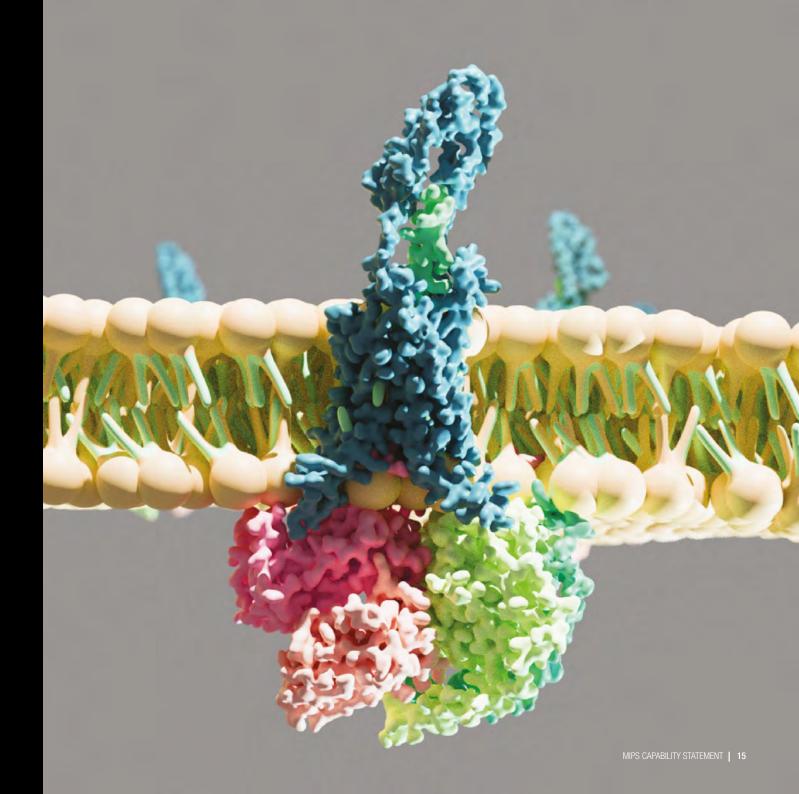
SEPTERNA

Understanding the structure and function of Gprotein-coupled receptors (GPCRs), the largest drug target class, and unravelling novel modes of GPCR drug action, such as allosteric modulation and biased signalling, has been a key strength of MIPS for more than a decade.

On the back of this world leading expertise, researchers from MIPS and Duke University are the co-founders of Septerna, an exciting new biotechnology company dedicated to discovering and advancing novel small molecule medicines targeting GPCRs.

Septerna applies latest generation structural biology approaches, such as cryo-electron microscopy, and cutting edge molecular pharmacology to enable industrial-scale drug discovery using novel screening technologies to guide structure-based drug design. This approach promises to facilitate a new era of GPCR drug discovery, bringing together years of innovation in translating unprecedented therapeutic modalities of GPCR drug action.

The company has attracted US\$100m in Series A funding, and an additional US\$150m in Series B financing, led by Third Rock Ventures with significant support by Samsara BioCapital, BVF Partners, Invus, Catalio Capital Management, Casdin Capital and Logos Capital.





MEDCHEM AUSTRALIA

A NATIONAL APPROACH TO DRUG DISCOVERY

Australia has an enviable reputation in fundamental biology but a poor record in translating discoveries into commercially attractive drug candidates. MedChem Australia (MCA) brings together leading medicinal chemistry and drug metabolism and pharmacokinetic (DMPK) groups to guide early-stage projects through the critical value creation steps where 'hits' are optimised to drug candidates with enhanced commercial value.

MCA is headquartered at MIPS and integrates three of Australia's leading Medicinal Chemistry groups (MIPS, WEHI and the University of Sydney) with DMPK expertise at the Centre for Drug Candidate Optimisation at MIPS. These experienced academic groups are backed in this initiative by Therapeutics Innovation Australia.

MRFF funding provides a significant subsidy to this initiative, lowering the barrier to access class leading discovery capabilities. Project entry into MCA is open to all Australian drug discovery groups and project selection is prioritised by an expert external assessment panel.

MCA fills a major gap in the drug discovery landscape in Australia and will facilitate the development of increasing numbers of innovative early stage Australian drug discovery projects towards clinical assessment and commercialisation.



CINCERA

TACKLING INFLAMMATORY AND FIBROTIC DISEASES

Cincera Therapeutics is focused on the discovery and development of new drugs to treat inflammatory and fibrotic diseases.

The MIPS spin-out company, which is a collaboration with the Centre for Cancer Biology at the University of South Australia, has developed a novel drug class that possesses a highly unique and orthogonal mechanism of action for the treatment of fibrotic diseases. This approach aligns with the underlying aetiology of several highly prevalent unmet medical needs associated with inflammatory and fibrotic conditions, such as heart failure, scleroderma, CKD, IPF, and NASH.

Cincera has generated highly encouraging single agent data for its lead development candidate and back up across disease models of lung, kidney and liver fibrosis. It is currently completing discovery stage development of its candidate compounds prior to initiation of CMC and clinical trials in a nominated indication.

DEMENTIA RISK REDUCTION

The Holistic Approach in Primary care for Preventing Memory Impairment aNd Dementia (HAPPI MIND) study, funded through a NHMRC Boosting Dementia Research Grant, is the first multi-domain dementia prevention intervention in primary care targeting middle-aged adults.

The interdisciplinary project led by Centre for Medicine Use and Safety researchers involves comprehensive dementia risk assessment, personalised risk-reduction interventions delivered through their primary healthcare professionals, and a self-management smart phone application.

The personalised interventions include a pharmacist medication review to optimise medicine use. Deakin University, University of Melbourne, University of Newcastle, University of New South Wales, North West Melbourne Primary Health Network and CSIRO are partners on this innovative model of care targeting a leading global health burden which can have significant impacts on our society, healthcare and the economy.



NEW TREATMENTS FOR TYPE 2 DIABETES

An international study, led by a team at MIPS, has uncovered that a compound called IC7Fc could improve glucose metabolism and prevent weight gain, enabling it to be an effective treatment for conditions including type 2 diabetes, obesity and loss of muscle mass.

With no current drug on the market with these multiple, positive benefits on overall health and metabolism, this is the first time that pharmacological evidence has presented a potential solution to treating a suite of metabolic diseases with a single drug.

The ability of IC7Fc to induce muscle hypertrophy – an increase in the size of skeletal muscle through a growth in size of component cells – is important since increased muscle mass reduces the risk of type 2 diabetes.





TARGETING THE LYMPHATICS TO ENHANCE DRUG DELIVERY

For most drugs, oral delivery is the preferred route of absorption. There are some medicines however, that despite being very effective, are broken down in the liver after oral administration and must be delivered via different routes, such as by injection. This increases cost and decreases convenience to the patient.

To address this issue, a team of researchers from MIPS have developed a lipid prodrug-based drug delivery platform that enables the trafficking of drugs directly into the lymphatic system following oral administration, avoiding liver breakdown. This technology has been licenced to PureTech Health and is in Phase 2 clinical trial with a prodrug of allopregnanolone in a model of anxiety.

Allopregnanolone is currently given as a long intravenous infusion. The MIPS technology aims to enable delivery as a simple oral capsule instead. This has the potential to dramatically increase utility and also has broad application to a range of neurological conditions including anxiety, mood disorders, Fragile X-associated Tremor/Ataxia Syndrome and related disorders.

The technology has also been applied to cannabidiol to promote oral bioavailability and reduce liver exposure with potential initial application in focal epilepsy.



INNOVATION. **COLLABORATION.** IMPACT.

The discovery, development and optimal use of medicines is a complex, international enterprise. To make significant change, our researchers partner with industry, government and philanthropic organisations across the world to improve global health.

These partnerships range from the discovery of new antimalarial drugs to better control of neuropsychiatric disease to international approaches to education innovation.

Our many successes are the result of our collaborative, multidisciplinary approach to research excellence, our "Better Medicines by Design" philosophy and a determination to make a real impact on the health of the broad community we serve.

A number of our collaborative programs are detailed on the next page.

INCREASING IMPACT THROUGH PARTNERSHIP

BIOMEDICAL TRANSLATION

BioCurate is an \$80 million partnership between Monash University and The University of Melbourne that aims to traverse the "valley of death" between early drug discovery and the clinical validation and development pipeline. BioCurate targets this critical phase of preclinical and early clinical development and provides the commercial focus, expertise and funding necessary to boost successful translation and commercialisation.







BREAST CANCER

Breast cancer is the most common cancer affecting Australian women. We are investigating how nerves affect growth of cancer that arise in the body, as well as their response to standard cancer treatments. This work is characterising new strategies to stop cancer.









DRUG DISCOVERY

Drug discovery is one of the most complex interdisciplinary challenges in science. MIPS scientists work with biologists, chemists, and delivery scientists within Australia and internationally to drive advances in drug discovery in devastating diseases including microbial and parasitic infection, cancer, CNS and metabolic disorders, and cardiovascular disease.















GLOBAL WOMEN'S HEALTH

Every year, up to 70,000 women die of blood loss after childbirth, an outcome that can be prevented by injection of the drug oxytocin. Together with philanthropic organisations and international pharma partners we are developing a novel aerosol system for oxytocin delivery that allows the drug to be inhaled from a simple, disposable device, making it accessible and affordable in resource poor communities.







INNOVATIVE MEDICINES MANUFACTURING

MIPS is home to the Medicines Manufacturing Innovation Centre (MMIC), an industry hub led by MIPS researchers with investment from the Victorian State Government. The Centre supports pharmaceutical manufacturers and allied industries by providing innovative formulation and analytical expertise to current and new product development programs.

In 2021 it was announced that the expansion of MMIC to Clayton has been funded through an \$8.58 million investment from the Victorian Higher Education State Investment Fund, allowing the scale-up of medicine manufacturing capability. and support for clinical trials and growth of exports and jobs. Construction is expected to finish towards the end of 2023.











IMPROVING HEALTH EQUITY

MIPS is home to the recently established Monash International Quality of Medicines Initiative (QoMI), which aims to help address health inequity in low-and middle-income countries (LMICs) by improving medicines quality.

Lack of access to safe and effective medicines is a considerable health issue in LMICs, where patients are at an unacceptably high risk of encountering poor-quality and falsified medicines.

The QoMI establishes a dedicated resource to bring world-leading pharmaceutical expertise to address issues of medicines quality and better understand the prevalence and causes of substandard medicines.



NANOMEDICINES

Nanomedicines and nanotechnologies are on the cusp of revolutionising diagnosis and therapy in many diseases.

Our multidisciplinary research teams aim to understand and control the interaction of nanomaterials with biological systems and in doing so progress the design of the drugs, delivery systems and biosensors of tomorrow.

We have close collaborations with nanomaterial scientists across the country and industrial collaborators such as Starpharma and Ulvac. More recently we have expanded our networks with a greater focus on the emerging technology of lipid nanoparticles and application to the delivery of mRNA.







UNSW







NEW DRUG TARGETS

G protein-coupled receptors are the targets for approximately 40% of modern medicines. MIPS is the headquarter of the Australian Research Council Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins, a leading training and research centre. producing world-class and industry-ready graduates in the application of cryo-EM to drug discovery and development.









NEW TECHNOLOGIES FOR DRUG DELIVERY

Even the most potent drugs fail in the clinic if they are not effectively delivered to the target tissue. MIPS scientists are working with pharma partners, including Starpharma, PolyActiva, PureTech Health and Halozyme to promote drug absorption after oral administration, target highly toxic cancer drugs specifically to tumour sites and to sustain and control drug delivery to reduce dosing frequency and avoid toxicity.









PARASITIC INFECTIOUS DISEASES

Parasitic infectious diseases are responsible for millions of deaths each year in the world's poorest countries. Together with major publicprivate partnerships such as the Medicines for Malaria Venture and Drugs for Neglected Diseases initiative we are discovering and developing lifesaving drugs to treat malaria, as well as neglected diseases such as human African trypanosomiasis, Leishmania and Chagas disease.





PHARMALLIANCE

PharmAlliance is an international partnership between three global leaders in pharmacy and pharmaceutical science: Monash University, the University of North Carolina at Chapel Hill and University College London. Together with our PharmAlliance partners we work collaboratively to address major international challenges in education, professional engagement and research and to inspire and train tomorrow's leaders.







TRAINING LEADERS IN SCIENCE AND HEALTH CARE

Our courses include:

- Australia's first integrated Bachelor and Master of Pharmacy
- The Bachelor of Pharmaceutical Science, providing highly skilled employees for Australia's biotech and pharma industries
- The Bachelor of Pharmaceutical Science (Advanced), a four-year variant of our Bachelor of Pharmaceutical Science degree that provides students with a guaranteed place in our honours program
- Honours degree in Pharmaceutical Science, a standalone 1-year program
- A Master of Pharmaceutical Science by coursework, developed to give students a breadth of experience across the drug discovery pipeline, as well as an advanced skill set
- Master of Philosophy
- Australia's premier pharmaceutical sciences PhD program, training tomorrow's research leaders.



MIPS AT A GLANCE



RESEARCH THEMES

Drug Discovery Biology

Medicinal Chemistry

Centre for Drug Candidate **Optimisation**

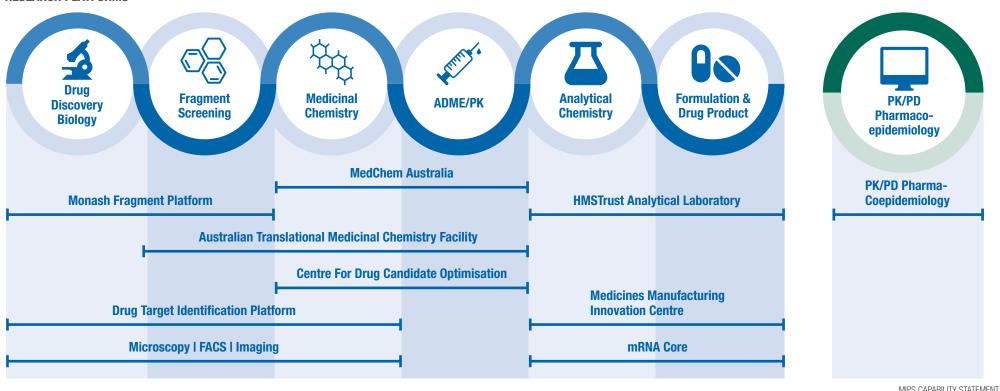
Drug Delivery, Disposition & Dynamics

Centre for Medicine Use and Safety

THERAPEUTIC PROGRAM AREAS

Neuroscience and Mental Health Global Health Cardiovascular and Metabolic Health

RESEARCH PLATFORMS







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