

The Peter Doherty Institute
for Infection and Immunity



Introduction

Finding solutions to prevent, treat and cure infectious diseases and understanding the complexities of microbes and the immune system requires innovative approaches and concentrated effort.

This is why The University of Melbourne – a world leader in education, teaching and research excellence – and The Royal Melbourne Hospital – an internationally renowned institution providing outstanding care, research and learning – have partnered to create the Peter Doherty Institute for Infection and Immunity (Doherty Institute); a centre of excellence where leading scientists and clinicians collaborate to improve human health globally.

Located in the heart of Melbourne's Biomedical Precinct, the Doherty Institute is named in honour of Patron,

Laureate Professor Peter Doherty, winner of the 1996 Nobel Prize in Physiology or Medicine for discovering how the immune system recognises virus-infected cells. Under the expert guidance of Director, University of Melbourne Professor Sharon Lewin, the Doherty Institute has more than 700 staff who work on infection and immunity through a broad spectrum of activities. This includes discovery research; diagnosis, surveillance and investigation of infectious disease outbreaks; and the development of ways to prevent, treat and eliminate infectious diseases.



Professor Sharon Lewin

Leading infectious diseases expert, Professor Sharon Lewin, is the inaugural Director of the Doherty Institute. She is also a Professor of Medicine at The University of Melbourne and a National Health and Medical Research Council (NHMRC) Practitioner Fellow. As an infectious diseases physician and basic scientist, her laboratory focuses on basic, translational and clinical research aimed at finding a cure for HIV and understanding the interaction between HIV and hepatitis B virus. Her laboratory is funded by the NHMRC, the National Institutes of Health, The Wellcome Trust, the American Foundation for AIDS Research and multiple commercial partnerships. She has authored over 230 publications and given over 100 major international invited talks on HIV cure. She co-chairs the International AIDS Society's *Towards an HIV Cure* initiative, and in 2014, was the local co-chair for the 20th International AIDS Conference in Melbourne, the largest health conference ever held in Australia. She is chair of the Ministerial Advisory Committee for Blood Borne Viruses and Sexually Transmitted Infections, the peak advisory committee to the Federal Minister for Health; a member of the NHMRC Council; an elected member of the Governing Council of the International AIDS Society representing the Asia-Pacific region; and was a foundation council member of the Australian Academy for Health and Medical Research. She was named Melburnian of the Year in 2014, and in 2015, was awarded the Peter Wills Medal by Research Australia.

Our vision

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To improve health globally through discovery research and the prevention, treatment and cure of infectious diseases.

Our mission

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The Doherty Institute will be an inspiring, innovative and enabling environment. We are dedicated to identifying and addressing fundamental challenges in all aspects of infection and immunity. Through our leadership, advocacy and education we will shape policy, practice and research both nationally and internationally.

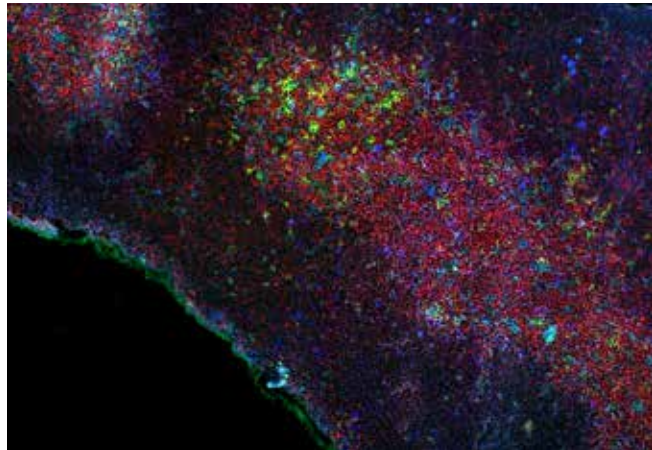
Our values

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- Discover**
We break new ground and innovate.
 - Deliver**
We work to improve health practice and outcomes.
 - Inspire**
We develop the highest calibre people to achieve excellence.
 - Connect**
We engage locally and globally with our partners, stakeholders, colleagues and community.

Our Work

Work undertaken at the Doherty Institute is centred around the following themes and cross-cutting disciplines.

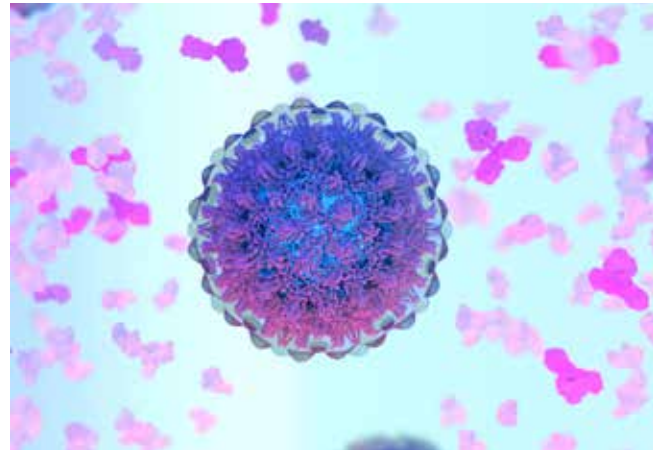
Themes



Immunology

Our outstanding scientists are working to understand how the human immune system recognises and responds to infectious agents, and develops immunological memory, which is vital for the discovery and development of new vaccines and therapeutics.

University of Melbourne Professor Dale Godfrey's laboratory discovered that mucosal-associated invariant T cells (MAIT cells), making up a large portion of immune cells in the body, go through three distinct developmental stages – similar to primary school, high school and university – before commencing their role in protecting the body against disease. This developmental map has laid the foundations for researchers globally to understand what controls the production, numbers and function of MAIT cells, and how to manipulate numbers to improve immunity to infections and other diseases.



Viral infectious diseases

The Doherty Institute specialises in research, diagnosis and treatment of viral infectious diseases, with a particular focus on HIV, viral hepatitis, influenza, dengue and emerging infections such as Zika.

The Doherty Institute, along with the French National Agency for Research on AIDS and Hepatitis and the International HBV Meeting, created the International Coalition to Eliminate Hepatitis B (ICE-HBV) in 2016. Led by Associate Professor Peter Revill, a Royal Melbourne Hospital researcher, ICE-HBV was inspired by the International AIDS Society's *Towards an HIV Cure* initiative, and seeks to accelerate scientific progress in finding a cure for HBV. The Coalition supports the discovery of a safe, affordable, scalable and effective cure, available to everyone living with HBV.



Antimicrobial resistance and healthcare associated infections

Through ongoing surveillance, analysis, and clinical and outbreak management, our experts are concentrating their efforts to address the increasing threat of antimicrobial-resistant pathogens and acquisition of healthcare associated infections.

The Doherty Institute is home to the Centre of Research Excellence – National Centre for Antimicrobial Stewardship (NCAS), funded by the National Health and Medical Research Council (NHMRC), which studies and aims to improve antibiotic prescribing and usage practices in humans and animals across Australia. In addition, staff from the Victorian Healthcare Associated Infection Surveillance System (VICNISS) at the Doherty Institute aim to reduce the number of infections acquired in acute care public and private Victorian hospitals and develop new interventions by monitoring and reporting infection rates.

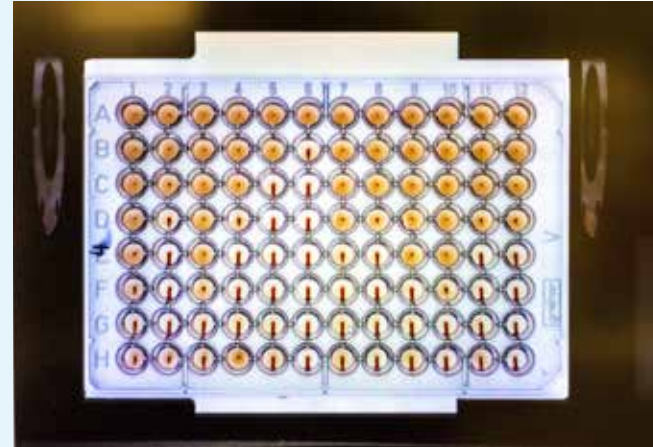


Host-pathogen interactions

The Doherty Institute focuses on the research, diagnosis and treatment of a range of host-pathogen related diseases, with a particular emphasis on malaria, enteric infections, arboviruses and tuberculosis.

University of Melbourne Professor Bill Heath's laboratory in collaboration with the Biomedicine Discovery Institute at Monash University and the Centenary Institute developed a new vaccine strategy for malaria called 'prime and trap'. The first 'priming' injection boosts the army of malaria-specific immune cells in the body and helps to attract them to the liver, while the second 'trapping' injection pulls them into the liver and converts them into liver-resident immune cells to permanently guard the organ from malaria infection. When tested in mice, it gave complete protection.

Cross-cutting disciplines



Public health

The Doherty Institute is strongly engaged in improving public health within Victoria, Australia and internationally, and houses both of Victoria's specialist infectious diseases reference laboratories: Victorian Infectious Diseases Reference Laboratory, and Microbiological Diagnostic Unit Public Health Laboratory.

Australia's only biosafety level four laboratory for diagnostic work and research on easily transmissible, fatal diseases in humans such as Ebola is located at the Doherty Institute. In addition, the Doherty Institute leads a National Health and Medical Research Council-funded Centre of Research Excellence, the Australian Partnership for Preparedness Research on Infectious Diseases Emergencies (APPRISE). APPRISE brings together Australia's leading experts in clinical, laboratory and public health research to address the key components required for a rapid and effective emergency response to infectious diseases from over 20 institutions. A multidisciplinary response to emerging viral diseases will be a major focus of the new national network.



Discovery research

Through the use of cutting edge technologies and innovative approaches, our researchers aim to elucidate fundamental biological principles to gain a detailed understanding of how humans respond to infection and how microbes adapt.

The Doherty Institute hosts two multimillion dollar NHMRC Program Grants. *Limiting the impact of Influenza* aims to understand immune system responses to influenza and develop novel influenza vaccine strategies. *Antigen presentation, recognition and the immune response*, led by University of Melbourne Professor Jim McCluskey, aims to improve understanding of immunity during infection of inflammatory diseases, enhancing our ability to design new generation vaccines for combating infectious diseases. In late 2016, the Doherty Institute was awarded 19 NHMRC Project Grants valued at close to \$15 million, a near 50 per cent success rate compared to the national rate of approximately 17 per cent.



Epidemiology

Epidemiological research and surveillance is central to the Doherty Institute's role in understanding and reducing the burden of infectious diseases in Australia and globally.

The Victorian Infectious Diseases Reference Laboratory's Epidemiology Unit hosts the VicSPIN General Practice Influenza Sentinel Surveillance Scheme, a partnership with the Victorian Department of Health and Human Services and the World Health Organization Collaborating Centre for Reference and Research on Influenza. The data collected provide essential year-on-year context to aid interpretation of influenza notifications and hospitalisations, and allow estimation of vaccine effectiveness. These resources are synthesised with basic virological and immunological insights relevant to understanding influenza infection and spread using epidemiological models. In partnership with the Australian Government Office of Health Protection, these models have been used to inform global influenza pandemic preparedness policy.



Translational and clinical research

The Doherty Institute aims to improve health outcomes globally through the translation of basic scientific discoveries into clinical practice by leading large, multisite international clinical trials to investigate new approaches to the treatment of infectious diseases.

The HIV clinical research program is led by Professor Sharon Lewin and has a strong focus on HIV cure. She leads many international, national and local clinical trials and has developed multiple specialised tests to detect low levels of HIV that persist on treatment, the major barrier to eradicating HIV infection. Recent studies include examining the role of antiretroviral therapy (ART) intensification on HIV persistence and the effects of new cancer drugs that can activate HIV that hides on treatment, or modulate immune function in HIV persistence on ART. These studies will provide important insight into which residual HIV populations remain and how they can be eliminated.

Cross-cutting disciplines



International health

Our internationally recognised research leaders specialise in dengue, malaria, HIV, tuberculosis, antimicrobial resistance and zoonotic diseases, amongst others, and have formed many international partnerships to address these health issues affecting communities globally.

University of Melbourne Professor Cameron Simmons' research group works closely with hospitals and institutes in Vietnam to improve the outcome for patients with dengue through clinical trials of new drugs and vaccines. His group is also engaged in an international effort to prevent the spread of dengue and Zika viruses by deploying mosquitoes that carry the naturally occurring bacteria, *Wolbachia*, which has been shown to prevent the viruses growing in mosquitoes and being transmitted to people. Communities and governments in Vietnam, Indonesia, Colombia and Brazil have embraced this new and potentially self-sustaining approach to controlling mosquito-borne viruses.



Education and professional development

The Doherty Institute provides a wealth of education and professional development opportunities through its facilities and experts in infection and immunity, and is home to The University of Melbourne's Department of Microbiology and Immunology, which delivers specialised courses in bacteriology, virology and immunology.

More than 100 Honours, Masters and PhD students are obtaining high-level training in microbiology, immunology, epidemiology and clinical infectious diseases research at the Doherty Institute. A Doherty Institute PhD Program was launched in 2016 to provide our students with a unique, multidisciplinary experience and industry opportunities beyond their immediate research topic across epidemiology, clinical and translational research, infectious diseases surveillance, outbreak investigations, and more. This powerful combination of training experiences will give graduates a competitive advantage to allow them to establish fulfilling and influential careers across academia and beyond.



Indigenous health

Indigenous Australians are affected by a disproportionate health burden from infectious diseases, and many of our researchers are collaborating with other Australian organisations to address this major issue.

Associate Professor Steven Tong, a Royal Melbourne Hospital clinician researcher, draws together several collaborative groups at the Doherty Institute to reduce the impact of infections in Indigenous Australians, such as influenza and HBV. Indigenous Australians in the Northern Territory with HBV infections have been found to be uniquely and exclusively infected with a novel genotype of the virus. Efforts are underway to understand the impact of this on the natural history of disease and vaccine efficacy. In addition, groups are leading research to reduce the unacceptably high burden of skin sores – one-in-two Aboriginal children in remote communities suffer from skin sores at any one time.



Genomics

The Doherty Institute is actively engaged in the field of genomics nationally and internationally through its primary research activities and public health laboratory-led initiatives. The Institute is using Genomics to support and enhance ongoing public health activities such as antibiotic resistance tracking, disease surveillance and outbreak response.

The Microbiological Diagnostic Unit Public Health Laboratory is home to Doherty Applied Microbial Genomics, which facilitates research relevant to understanding the role of microbial genomics in public health and clinical microbiology practice in Australia, and to provide leadership and training in this field. In 2014, a dramatic increase in *Klebsiella pneumoniae* carbapenemase (KPC) harbouring bacteria was observed in patients from multiple Victorian healthcare facilities. Combining whole genome sequencing data with a traditional epidemiological investigation revealed that KPC transmission in Victoria was driven by discrete outbreaks in a small number of healthcare facilities, allowing targeted interventions.

Joint venture partners



THE UNIVERSITY OF
MELBOURNE

The University of Melbourne

The University of Melbourne was established in 1853 and makes distinctive contributions to society in research, learning, teaching and engagement.

The University is ranked number one in Australia in the Times Higher Education (THE) World University Rankings and is consistently ranked among the leading universities in the world.

Units of the Doherty Institute from The University of Melbourne:

Department of Microbiology and Immunology

The Department of Microbiology and Immunology is part of the Faculty of Medicine, Dentistry and Health Sciences - Australia's premier biomedical research faculty. The Department has attracted more national peer-reviewed medical research funding than any other medical and health sciences departments in Australia. Research in the Department focuses on mechanisms of infection and immunity and the development of new ways to control and treat infectious diseases. Current research programs include the molecular analysis of bacterial and viral infections, as well as understanding the development and function of the immune system.

Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL)

The role of the MDU PHL is to collaborate with health professionals to provide vital analytic services and technical advice in public health microbiology to inform public health policy and practice. Serving the community since 1897, the MDU PHL is the longest continuously serving public health laboratory in Australia with its primary responsibility to elicit any public health implications from microorganisms such as bacteria from humans, animals, food, water and the environment. MDU PHL is also the World Health Organization Regional Reference Laboratory for Invasive Bacterial-Vaccine Preventable Diseases.



The Royal Melbourne Hospital

The Royal Melbourne Hospital

The Royal Melbourne Hospital is a world-renowned institution, providing outstanding care and treatment and improving health outcomes through a

comprehensive medical research program and training of future health professionals.

Units of the Doherty Institute from The Royal Melbourne Hospital:

Victorian Infectious Diseases Reference Laboratory (VIDRL)

VIDRL is Australia's leading infectious diseases reference laboratory. Formally designated as a Victorian public health laboratory in 1992, VIDRL provides the Victorian Department of Health with virology and mycobacteria public health reference laboratory services including surveillance, outbreak investigations, reference testing and research, and also performs diagnostic testing for hospitals. In addition, VIDRL has national reference laboratory designations to the Commonwealth Department of Health for polio and enteroviruses, measles, viral haemorrhagic fevers and smallpox. VIDRL is also the designated base for the World Health Organization (WHO) Polio Regional Reference Laboratory for the Western Pacific Region, WHO Measles Regional Reference Laboratory for the Western Pacific Region, WHO Hepatitis B Regional Reference Laboratory for the Western Pacific Region, WHO National Influenza Centre, WHO Collaborating Centre for Reference and Research on Influenza (see below), WHO Collaborating Centre for Mycobacterium Ulcerans and WHO Collaborating Centre for Viral Hepatitis.

World Health Organisation (WHO) Collaborating Centre for Reference and Research on Influenza

The WHO Collaborating Centre for Reference and Research on Influenza is part of the WHO Global Influenza Surveillance and Response System. The network was established in 1952 to monitor the frequent changes in influenza and reduce the impact of its viruses. Together with the WHO Collaborating

Centres in Atlanta, Beijing, London and Tokyo, the Centre is responsible for analysing influenza viruses currently circulating in the human population across the globe. This information is used by the WHO to make recommendations on appropriate viruses to be included in annual seasonal influenza vaccines for the northern and southern hemispheres. The Centre also undertakes research, training and regional capacity building activities related to influenza.

Victorian Infectious Diseases Service (VIDS)

VIDS provides a full range of inpatient and outpatient infectious diseases services, with a special focus on travel-related and tropical infections, HIV, hepatitis, tuberculosis and hospital-acquired infections. Established in 1996 at The Royal Melbourne Hospital following the closure of the Fairfield Infectious Diseases Hospital, today the VIDS team includes infectious disease physicians, nurses, pharmacists, epidemiologists, information technology staff and allied health professionals with an established record of clinical research, strong links to public health and a commitment to evidence-based practice. VIDS also houses the Victorian Tuberculosis Program - a multidisciplinary team providing statewide public health services relating to tuberculosis. Some members of The University of Melbourne's Department of Medicine also sit within VIDS at the Doherty Institute with a focus on malaria and international and immigrant health.

Victorian Healthcare Associated Infection Surveillance System (VICNISS)

Established in 2002, the aim of VICNISS is to reduce the number of infections acquired in acute care public and private Victorian hospitals by monitoring and reporting infection rates. Staff also monitor trends in resistance developing in pathogens causing these hospital acquired infections and work with MDU PHL to collect data on carbapenemase-producing Enterobacteriaceae. VICNISS also contributes to guideline development for control of multiresistant organisms, and to state and national control efforts. The team comprises infection control consultants, infectious disease physicians, and others with epidemiological and biostatistical skills who collect, analyse and report data on healthcare associated infections.



A joint venture between The University of Melbourne and The Royal Melbourne Hospital

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