AITHM | AUSTRALIAN INSTITUTE
OF TROPICAL HEALTH & MEDICINE

ANNUAL REPORT 2017

Health security in the Indo-Pacific region

JAMES COOK UNIVERSITY
AUSTRALIA

Cairns
Singapore
Townsville

CONTENTS

AITHM gratefully acknowledges the funds received from the Queensland Government, the Commonwealth Government through the Australian Research Council Special Research Initiative (ARC SRI), and the Division of Tropical Health and Medicine (DTHM) at James Cook University (JCU). This funding enables AITHM to build essential research capacity in tropical health and medicine for Australia and the region. We acknowledge the traditional custodians of the land on which AITHM facilities operate – the Bindal and Wulgurukaba (Townsville), Yirrganydji (Cairns), Kaurareg (Thursday Island) and Yuibera (Mackay) peoples - and pay our respects to all Elders, past, present and future.

Australian Government

Queensland Government

JAMES COOK UNIVERSITY AUSTRALIA

ABOUT AITHM

The Australian Institute of Tropical Health and Medicine (AITHM) is a multi-disciplinary health and tropical medicine research institute located in the Tropics.

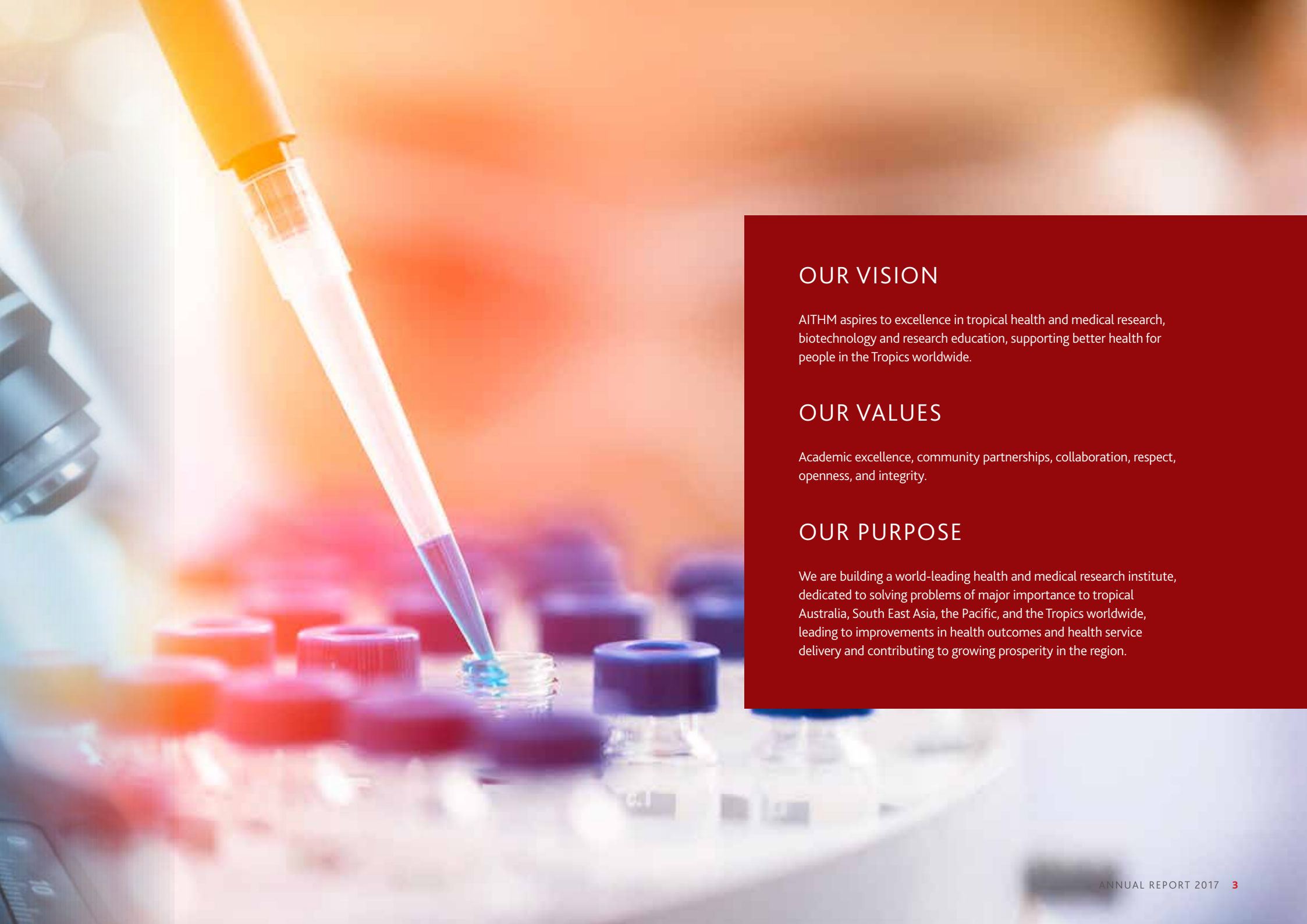
Based at James Cook University in northern Queensland, AITHM has key nodes in Townsville, Cairns and the Torres Strait.

AITHM's research programs confront northern Australia's major health security risks, tackle its worst health outcomes, develop better ways to deliver health services to remote communities and contribute to the development of northern Australia through research, knowledge, infrastructure and commercialisation of research findings.

Our research spans public health, biomolecular, clinical, translational, and health systems research and is strongly focussed on the health issues of most importance to tropical Australia and our nearest neighbours, delivering significant public health benefit locally, regionally and globally.

AITHM and its regional impact on health security

Our research teams are building capacity for improved health outputs and stronger health systems in the Indo-Pacific region. With advanced research capacity and significant infrastructure throughout northern Australia, AITHM is well placed to support planning and respond to health challenges presented by emerging and re-emerging infectious diseases, and the growing chronic disease burden within the Indo-Pacific region.



OUR VISION

AITHM aspires to excellence in tropical health and medical research, biotechnology and research education, supporting better health for people in the Tropics worldwide.

OUR VALUES

Academic excellence, community partnerships, collaboration, respect, openness, and integrity.

OUR PURPOSE

We are building a world-leading health and medical research institute, dedicated to solving problems of major importance to tropical Australia, South East Asia, the Pacific, and the Tropics worldwide, leading to improvements in health outcomes and health service delivery and contributing to growing prosperity in the region.

Distinguished Professor Louis Schofield
Director, AITHM

MESSAGE FROM THE DIRECTOR

Looking back over 2017, it is gratifying to see the extent to which AITHM activities and aspirations are congruent with major initiatives of government, industry and society at large. AITHM aspires to excellence in tropical health and medical research, biotechnology and research education, supporting better health for people in the Tropics, both within our region and worldwide. These themes are mirrored in a range of important initiatives from State and Commonwealth Governments, the health sector, philanthropy and industry, including the decision by the Commonwealth Government to launch on 8 October 2017 the $300M, five-year Indo-Pacific Health Security Initiative.

Increased air travel, ecological disruption and mobilisation of populations increase health security risks to Australia and its neighbours. Deforestation transfers new diseases from wild animals into livestock and humans, and this can be amplified by agricultural practices. The warnings are clear from the World Health Organization (WHO):

> "We cannot become complacent. As our world continues to change, with enormous growth in international trade and travel, more densely populated cities, and an increasingly volatile climate, so too does the way in which emerging diseases threaten our health, as well as social and economic security. We cannot guard against these threats without both strong national systems for surveillance and response and international cooperation[1]."

1. Securing our region's health – World Health Organisation: http://www.wpro.who.int/emerging_diseases/documents/docs/SecuringsRegHealth15.pdf

The WHO believes a new world pandemic is inevitable and that a mass infectious disease outbreak is likely to emerge from the Indo-Pacific region. Thus, the new Indo-Pacific Health Security Initiative from the Commonwealth Government is particularly timely and welcome.

AITHM at JCU is ideally located and poised to contribute to national and international health security with leading tropical health and disease researchers working across our multi-site northern Queensland facilities.

AITHM has established world-class laboratory facilities in Townsville to deal with both low-risk organisms (PC2-physical containment level 2) and high-risk infectious diseases (PC3-physical containment level 3). AITHM's northern Australia PC3 laboratory is the only one of its kind between Brisbane and Singapore.

2017 has seen the construction of outstanding new laboratory capacity in Cairns, with a dedicated Quarantine Containment Level 2 (QC2) facility for the containment and safe study of mosquito vectors of disease. This builds on the already impressive mosquito biology research infrastructure developed at JCU during earlier proof-of-principle trials. During those trials, JCU researchers contributed significantly to the successful *Wolbachia* program, which underpinned the subsequent development of the Eliminate Dengue/World Mosquito Program.

AITHM has also constructed a research laboratory on Thursday Island (TI), Australia's front line of defence from infectious diseases such as tuberculosis (TB), dengue and Zika virus.

From these facilities, AITHM researchers are conducting major programs of work targeting infectious and chronic disease risk, population health and the development of new therapeutics and diagnostics.

In the Indo-Pacific region, AITHM leads a consortium of institutions in strengthening partnerships and health workforces with our neighbours. We are actively building early warning and risk reduction capacity in the region to help manage national and global health risks. This includes providing research mentorship, workforce development and mutual learning, as well as innovative tools for policy evaluation and decision-making support. Stronger international health system surveillance and response capacity of this type aims to support timely, effective responses to emerging and existing infectious disease threats such as tuberculosis and Zika. Thus, AITHM is on the front-line of the health security agenda at home and abroad.

We are also delighted with the ongoing development of our research support for Queensland health services. Together with JCU, the Northern Queensland Primary Health Care Network, and the Mackay, North-West, Townsville, Cairns and Hinterland, and Torres and Cape Health and Hospital Services, AITHM has been instrumental in the establishment of the Tropical Australia Academic Health Centre (TAAHC).

TAAHC is developing a unique and highly-integrated research governance structure that will improve health outcomes for our local communities and regional prosperity through collective health research capability. The partnership also ensures domestic relevance and a clear translational pathway for the research undertaken by AITHM.

AITHM plans the launch of several start-ups and spin-out ventures in the coming years. To this end, we have reviewed and updated our innovation and commercialisation policies and entered into detailed negotiations with venture capitalists, pharmaceutical industry partners and other stakeholders across a number of projects.

Since 2013, AITHM has grown to a membership of almost 300 people. Through AITHM, more than 100 new jobs have been created, including jobs in highly skilled areas such as epidemiology, mathematics, immunology, bioinformatics and biomedicine. In addition, AITHM supports 128 students enrolled in the AITHM Cohort Doctoral Studies Program. Through the efforts of AITHM and JCU, a significant scientific workforce is developing in northern Queensland, creating new jobs, and nurturing future talent. We look forward to AITHM further contributing to growth in the local knowledge economy and improving the health of Queenslanders and tropical populations worldwide.

Distinguished Professor Louis Schofield
Director, AITHM

KEY RESEARCH

HEALTH SECURITY AND INFECTIOUS DISEASES

Health security in the Indo-Pacific is an increasingly important part of AITHM's work. A number of our research teams are dedicated to developing interventions for some of the most serious health issues in our region; specifically, the treatment and control of vector-borne diseases such as malaria and dengue fever, and infectious diseases like tuberculosis. Such communicable diseases are a significant health burden for people in the Tropics, causing many millions of deaths each year and posing a threat to Australia's health security. AITHM engages in both clinical and translational research with teams working in laboratories and local communities. Our researchers are seeking to understand and record the epidemiology of outbreaks in the region, as well as training and working with health professionals to better diagnose, treat, manage, and contain the spread of disease. Importantly, AITHM's infectious disease research projects protect Australia's borders, preserving national health security and enhancing health outcomes for our tropical neighbours.

Tropical Partners

The Tropical Partners project, led by Professor Emma McBryde, in collaboration with researchers from JCU and other partnering institutes, aims to strengthen health system responses to infectious disease in the Indo-Pacific region by building professional relationships and networks, pooling resources, and sharing knowledge. Tropical Partners is funded by the Australian Government's newly-created Indo-Pacific Centre for Health Security. The Tropical Partners project focusses on capacity strengthening and implementation research around surveillance and response. Another component of Tropical Partners is health systems mapping and risk evaluation.

Capacity strengthening in implementation research around surveillance and response

Tropical Partners team members have delivered tailored implementation research training in the Indo-Pacific region to health professionals from Papua New Guinea (PNG), Fiji, the Solomon Islands, Timor-Leste, and eastern Indonesia. In 2017, the team met representatives from health ministries, development agencies, non-government organisations, universities, and health services in the Indo-Pacific region to identify and train people with a desire to learn and do more to prevent and curb the spread of infectious disease in their countries. Presently, 50 participants across five countries (Fiji, the Solomon Islands, PNG, Timor-Leste, and Indonesia) are undergoing training in implementation research over a 12-month period, and these trainees will go on to perform the roles of research fellows and mentors in their home countries. The training is based on the Structured Operational Research and Training Initiative (SORT-IT) model; a program for research and training in tropical diseases supported by the WHO, the World Bank and the United Nations Children's Fund (UNICEF). The training model has been customised by Tropical Partners to support advocacy, policy and practice translation, and is delivered during workshops in-country.

Risk evaluation and health systems mapping

An evidence-based assessment tool for health system preparedness is undergoing development within selected countries in the Indo-Pacific region alongside a comprehensive gap analysis of health system preparedness for emerging infectious diseases. The investigators work with in-country partners to ensure the preparedness indicators that are developed are context-appropriate and adaptable. These indicators can be used to assess national preparedness, and to identify strengths and weaknesses of both national and regional systems.

CASE STUDY

HEALTH RESEARCH CAPACITY BUILDING IN THE SOLOMON ISLANDS

AITHM's Dr David MacLaren continued to support the work of Tropical Partner research fellows when he co-facilitated the Solomon Islands Health Research Symposium in Honiara in late 2017.

The Tropical Partners project delivers research workshops based on the WHO SORT-IT training model to health and biosecurity workers in Fiji, the Solomon Islands, PNG, Timor-Leste and eastern Indonesia. The sessions provide research training to local health professionals who are also research fellows conducting implementation research projects on local priority topics. SORT-IT workshops have been carried out by Dr Karen Carlisle, Dr David MacLaren, Mr Humpress Harrington, Professor Sarah Larkins and Professor Maxine Whittaker in collaboration with regional co-facilitators.

Dr MacLaren was engaged as a panel member for a special session discussing the *Future of Health Research in the Solomon Islands*. Another special session provided an opportunity for six of the current Tropical Partner fellows from the Solomon Islands to present their research projects to a national audience.

In addition to the special sessions, five Tropical Partner SORT-IT fellows presented their projects as part of the main program of the symposium.

JCU was the co-host of the Health Research Symposium. On the final day, Tropical Partners team members, in partnership with colleagues from the Atoifi Health Research Group, facilitated a practical workshop on health research design and methodology for frontline health workers attending the Symposium.

Participating in this support network allowed participants and presenters to learn more about new research practices in this region, as well as sharing experiences and lessons about the contextual challenges and enablers of working in the Indo-Pacific region.

Tuberculosis and health security

AITHM's Tuberculosis and Tropical Partnerships research team, led by Professor Emma McBryde, focusses on three broad streams of work related to tuberculosis (TB) and health security:

- Understanding TB
- Diagnosing TB
- Preventing TB.

Importantly, the research team works collaboratively with global partners in the region to protect Australia's borders, preserve national health security, and enhance access to new and effective tools for northern Australia and the Indo-Pacific region.

Understanding and diagnosing TB in remote Papua New Guinea

Using the tools of genomics, immunology, and epidemiology, AITHM and JCU researchers are working closely with people in the Western Province of PNG to:

- Describe the current burden of TB in the region
- Improve the diagnosis of TB in the region
- Identify local risk factors for the disease
- Ensure a sustainable research approach is used in this remote region.

This work is establishing techniques to identify the type, and burden of, drug resistant TB. Researchers are working with local collaborators in this neglected region to support the TB control program. Their work has a particular focus on the social and cultural determinants of health seeking behaviours and adherence to treatment. Immunological-based techniques are also being used to support the clinical diagnosis of TB.

Immunophenotyping, for example, is helping researchers to understand the immune response of people infected with TB. This research examines the T-cells (a type of white blood cell), and their activation level in patients proven to be infected with TB. Analysis of the immunological system at this cellular level will prove useful in earlier identification of latent TB and will provide insight into how the immune system responds to TB. With this new knowledge about TB markers, researchers can identify and improve diagnostics to target those people most likely to develop active TB. Current blood tests for TB are not perfect. New diagnostics could distinguish between latent and active TB at the cellular level, thereby providing a more thorough understanding of the level of activation of T-cells in people with TB.

Protecting Australia's northern borders through TB intervention

AITHM researchers, in collaboration with the Torres and Cape Hospital and Health Service, have a key role in examining the impact of TB incursions from PNG into northern Australia. For example, researchers are analysing transmissions to Australia, and costs and outcomes of TB cases. The purpose of this research is to help prevent TB outbreaks in Cape York and the Torres Strait, thereby enhancing Australia's health security. Researchers are assessing surveillance methodologies, risk factors, health management and outcomes for Australian and PNG nationals who have signs and symptoms of TB and seek help at health facilities in the Torres Strait Protected Zone. Local health services provide rapid response and close treatment supervision for TB cases diagnosed in the Torres Strait and Cape York regions, which has helped build community confidence in the health system and contributed to research with AITHM on the impact of health system changes on TB management.

The risks of drug-resistant TB

Multi-drug resistant TB (MDR-TB) is a threat to TB control because treatment of this virulent strain requires very difficult, lengthy and toxic drug regimens. It has become essential to understand the extent to which MDR-TB could replace drug-susceptible TB (DS-TB) as the dominant strain within a population. AITHM researchers have gathered information from studies in genomics, pharmacokinetics, and epidemiology, and have used this information to develop a mathematical model. The prevalence of MDR-TB is likely to overtake DS-TB, but the mathematical modelling indicates that strain replacement may take decades to occur. Acquired drug resistance (while a patient is on therapy) is the initial cause of MDR-TB, but this will rapidly give way to person-to-person transmission.

CAREER PROFILE

MICHAEL MEEHAN

Dr Michael Meehan is an AITHM Research Fellow based in Townsville, working with Professor Emma McBryde in infectious diseases modelling and epidemiology.

Born in Townsville, Michael attended high school at Ignatius Park College before undertaking an undergraduate degree at JCU. After commencing study in engineering and science, majoring in mathematics, Michael decided engineering was not the career he wanted, and changed focus to a science degree majoring in physics and maths.

"I was keen to pursue a career in something I enjoyed. I liked maths in school, so I continued studying it at university. I started with engineering because I thought it would give me a better chance at getting a job, but I didn't enjoy it apart from the maths aspect, so I dropped it.

"University physics was different to high school physics. The delivery differs and the rigour is greater and it was closer to maths, so a lot more enjoyable," Michael said.

After completing his undergraduate degree, Michael went on to complete his PhD in theoretical astrophysics and cosmology at JCU in 2015.

Michael was keen to stay in Townsville, and as luck would have it, there was a vacancy for a postdoctoral fellow position in AITHM's infectious diseases modelling and epidemiology department. Michael submitted his application, progressed to interview and was the successful candidate. He commenced in this role in January 2016.

"I was looking for a research job when I pursued this position, and it turned into a great opportunity. Emma is a great leader, with an alignment of the value of quantitative skills and capacity to let me develop."

"It's one of those jobs that, if I won the lotto – I would still come to work. There aren't too many opportunities like this in northern Queensland, let alone Townsville. I feel very lucky," Michael said.

Michael's current research is focussed on multi-drug-resistant tuberculosis, gauging the threat of emerging drug-resistance by modelling strain replacement. The research focusses on secondary questions such as: if there is an endemic disease in a population, what are the chances and what conditions are required for an emerging drug resistant strain to become more prevalent than an existing drug-susceptible strain.

"This discovery will allow us to inform policy and provide education about the use and effects of antibiotics," explained Michael.

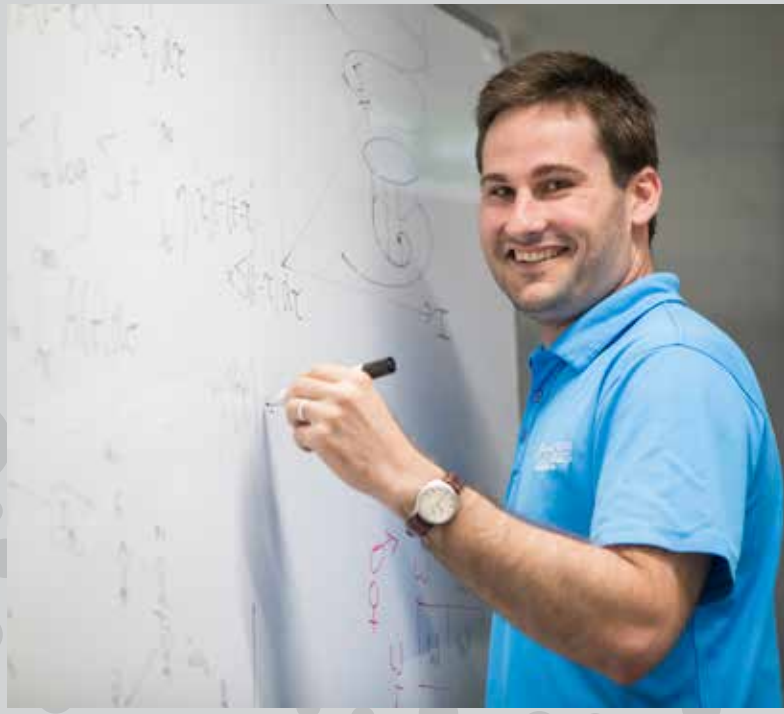
"Drug resistant tuberculosis is more severe, as the treatment regimens are lengthier and more toxic to the population.

"The numbers and equations are there to be solved, and translating these recommendations for health policy is the end goal," Michael said.

Michael would like to continue working in Townsville for as long as he can.

"I work in an unbelievable team; I'll be here as long as I can. I am aiming towards obtaining my own funding and establishing my skills and knowledge so I can stay in Townsville. My family is here, so I want to stay and forge my career here.

"It's because I wanted to stay in the north that I chased this opportunity. I didn't realise at the time what this opportunity meant, but now I see myself as incredibly fortunate to have this chance," Michael said.



Vector-borne diseases

Vector-borne diseases continue to pose a very real threat to tropical populations around the region and, as such, remain a threat to Australia's biosecurity. Two AITHM research teams with combined expertise in entomology, ecology, and biology are dedicated to the elimination and control of vector-borne diseases such as malaria, dengue fever and Zika virus. The research teams aim to understand the biology and behaviour of the vector (the mosquito), in their efforts to eradicate mosquito-borne diseases.

Vector surveillance and malaria control

The ability to eliminate malaria requires a full and comprehensive understanding of the vectors that transmit the disease, along with identification of the shortfalls in the surveillance and delivery of mosquito elimination programs. The vector ecology and biology team focusses on improving the monitoring and control of insect vectors of human diseases, particularly malaria. The team, led by Professor Tom Burkot, conducts basic and applied research on the ecology and biology of the malaria vectors, in addition to the development of new technologies that support vector control. In a project funded by the Bill & Melinda Gates Foundation, Professor Burkot is analysing current vector surveillance practices and comparing these with best practice to identify gaps and constraints that impede implementation in priority countries. Once these gaps are known, the research team will identify new technologies to address shortfalls in the surveillance needed to monitor the vectors to ensure continued effective control.

Zika virus enhanced surveillance and response in the Solomon Islands

Researchers are also investigating the prevalence of malaria and arboviruses (including dengue and Zika) in four study locations in the Solomon Islands to provide a deeper understanding of its epidemiology and transmission. As part of the broader Tropical Partners project, this investigation aims to identify risk factors for exposure to viruses, and to develop vector maps for the species that transmit dengue and Zika. Many types of data are collated to identify risk factors and develop the vector maps, including:

- Larval habitats
- Demographic and exposure risk information, such as the travel history
- Healthcare or treatments administered
- Housing characteristics
- Mosquito prevention habits, such as nets or coils.

The findings will lead to improved, rapid diagnostics for malaria, as well as an improved understanding of the transmission of dengue and Zika viruses in each of the study locations.

Mosquito evolution and optimising interventions

The widespread use of insecticide-treated nets and indoor residual house spraying has delivered 80 per cent of the total reduction that has been achieved to date in malaria transmission across the globe. Researchers at AITHM are investigating mosquito behaviour and examining the ways that changes in biting behaviours might be reducing the effects of insecticides. In a notable shift, mosquito species are changing their human biting pattern from indoors at night to early evening outdoors, thus circumventing exposure to insecticides. To stay one step ahead, the research team is suggesting that multi-pronged approaches are needed for effective and sustainable malaria control using a combination of current approaches, such as bed nets, and new interventions. Other control tools include treatments targeting mosquito larvae, improvements to housing, and insecticides that target the species at different phases of the lifecycle to interrupt evolution.

Using *Wolbachia* bacteria to control dengue

The public health entomology team, led by Professor Scott Ritchie, has been pivotal in the successful Eliminate Dengue program (now known as the World Mosquito Program) in northern Queensland. Funded by the Bill & Melinda Gates Foundation, this novel project introduces the natural bacteria, *Wolbachia*, into the mosquito *Aedes aegypti*, the mosquito species responsible for the transmission of dengue and Zika. The *Wolbachia* bacteria are spread when *Wolbachia*-infected females mate with uninfected wild mosquitoes. Once established in the wild population, the bacteria act like a vaccine to prevent the mosquitoes from transmitting dengue and other viruses such as Zika. The first open field releases occurred in Cairns in 2011, where AITHM's Mosquito Research Facility (MRF) was responsible for rearing the *Wolbachia*-infected mosquitoes. The last releases in Cairns occurred in 2017. This dengue-fighting microbe is now established in dengue mosquitoes in almost all urban areas of Queensland from Townsville north, where dengue activity is now at its lowest level in 30 years.

In another application of *Wolbachia*, releases of *Wolbachia*-infected male mosquitoes can be used to sterilise wild females and slowly crash the natural mosquito population. In project Debug, funded by Verily Life Sciences, and in partnership with Commonwealth Scientific and Industrial Research Organisation (CSIRO), the MRF team has been producing millions of *Wolbachia*-infected male *Aedes aegypti* mosquitoes, which have been released in the Innisfail area. Verily is Alphabet Inc.'s Life Sciences division and brings engineering expertise to the team. The mosquito rearing team at the MRF and CSIRO have been fortunate to use the latest technology in mosquito rearing, including sex sorters and counters, and a mosquito van that automatically releases live male mosquitoes while providing a detailed map of the results.

Future-proofing *Wolbachia*

The use of *Wolbachia* bacteria to control populations of *Aedes aegypti* mosquitoes and reduce infectious disease transmission continues to grow. In 2017, the use of *Wolbachia* to block virus transmission was utlised in more than 10 countries through the World Mosquito Project. As these programs are scaled up into large urban populations, there has been a move from small university and government-based programs into large industry-based programs. While successful to date, 'after release' strategies now need to be developed to sustain *Wolbachia* effectiveness. AITHM researchers, in collaboration with The University of Melbourne and Queensland Health, have identified the need for ongoing monitoring of the long-term stability of *Wolbachia* bacteria and its ability to continue blocking transmission into the future. Researchers highlight the Pan American Sanitary Organization *Aedes aegypti* Program, which, despite appearing successful, failed due to flagging political support. The futureproofing team is calling for preparedness and caution, whilst urging governments to continue with well-supported and robust scientific programs to ensure *Wolbachia*-based programs are successful today and into the future.

Building a better mozzie trap

Disease surveillance for mosquito-borne pathogens in remote tropical locations can be challenging. AITHM researchers have been investigating the use of mosquito faeces to monitor mosquito-carried viruses such as Ross River virus and Murray Valley Encephalitis virus. Current virus surveillance systems rely upon the processing of thousands of trapped mosquitoes for target viruses; a procedure that is laborious and costly. Recently, AITHM researchers, together with colleagues at Queensland Health Forensic and Scientific Services, have coaxed trapped mosquitoes to feed on honey-soaked nucleic acid preservative cards. The mosquito saliva on the cards is analysed by polymerase chain reaction (PCR) for target viruses. The amount of virus present in mosquito saliva, however, is very small and hard to detect. Ana Ramirez, an AITHM PhD student, has found that larger amounts of virus are shed when a mosquito excretes, and the virus is shed earlier than it is in saliva. Concurrently, Dr Dagmar Meyer, recipient of two Hot North research fellowships, and based at AITHM, is modifying existing mosquito traps for collection of excreta. We hope that these 'mozzie toilets' can increase our ability to detect these dangerous viruses carried by mosquitoes, and thus improve public health responses.

IMMUNOLOGY AND VACCINE DEVELOPMENT

AITHM researchers are dedicated to the development of new vaccines and the study of immunology. New vaccines are being tested and developed at AITHM to treat malaria and tuberculosis. Our scientists are also engaged in molecular-level discovery, which is a precursor for vaccine development; they are building a bank of knowledge about selected pathogens, genomes, antigens and interactions, which will form the building blocks for development of new vaccines. Researchers are also developing synthetic vaccine platforms that do not require refrigeration or administration by injection.

Generating new synthetic oral vaccines that do not require refrigeration

Associate Professor John Miles and his team

Vaccines are of limited use if they cannot be transported and administered in areas where they are needed. In many parts of the world, access to refrigerated transport and storage is limited, as is the number of skilled people who can administer injections. Associate Professor John Miles and his team are working to develop new synthetic vaccines that will overcome these two problems. The WHO estimates that 50 per cent of current vaccines approved for human use go to waste because of breakages in the cold chain required to deliver the vaccine from origin to patient. Significant financial resources are wasted because 'fresh' vaccines are not reaching their intended location. A second problem is that many people do not like injections. Special expertise and training is required to administer a vaccine by needle. Removing the need for needles makes vaccinations easier to administer. In order to solve these two problems, AITHM researchers are developing hyper-stable synthetic oral vaccines that are resilient to physical and enzymatic degradation. The current prototype is based on influenza, and the study is featured on the cover of the April 2018 edition of *The Journal of Clinical Investigation*.

Identifying individuals at risk of lung infections

The human immunology team, led by Associate Professor John Miles, looks for immune correlates of disease protection or susceptibility in infectious disease and chronic conditions. Using immune engineering, the team then attempts to correct these dysfunctions. The increasing global incidence and prevalence of non-tuberculous mycobacterial (NTM) infection, and new evidence of person-to-person transmission of multidrug-resistant NTM is of global concern. The reason why certain individuals are at risk of NTM infections is unknown. Using high definition immunoprofiling, the team has identified individuals at-risk of NTM infection by profiling patterns in T-cell function. T-cells are key immune cells needed to fight NTM infection. Thus, from a simple blood draw, these new immune signatures could be of significant diagnostic and prognostic value for patient management and could be used to identify new therapeutic pathways and new targets to correct immune dysfunction.

TB vaccine development

TB is generally contracted via inhalation through the lungs. But, unlike the cells in other organs, the vaccine-induced specialised immune cells in the lung often fail to elicit a long-lasting and effective immune response. By designing and administering a vaccine that replicates the natural infection process, researchers aim to provide better protection against the disease. One aspect of this research is focussing on understanding particular aspects of the immune response to TB in order to generate new and improved vaccines. Another area focusses on the design of a recombinant vaccine strain that evokes superior immune responses using genetically manipulated live bacteria; *Bacille Calmette-Guerin* (BCG). Preclinical studies of this vaccine are underway in the new AITHM PC3 laboratory, assessing the effectiveness of this method in preventing reactivation of latent TB infection. The research interrogates the ability of these vaccines to prevent TB-causing bacteria from reactivating and spreading to various organs, and ultimately to prevent infection and disease. The team will also investigate methods of administration.

Developing TB vaccines for patients with diabetes

The link between diabetes and TB is well recognised; both conditions often present in the body well before any symptoms are displayed. While TB rates are in decline in high-income countries, the incidence of TB remains high in the Indo-Pacific region. The prevalence of diabetes in parallel

is soaring globally, and this includes the Indo-Pacific region. Growing evidence suggests that diabetes is a risk factor for patients with TB. Treatment, interventions, and immune response can be complicated by the presence of both diabetes and TB. AITHM researchers are developing a TB vaccine that is effective in diabetic patients to help address the convergence of both conditions. This trial is in its early stages. The purpose of the trial is to produce a vaccine that can overcome impaired immune response by directly targeting the tissue resident memory cells in the lungs.

Malaria vaccine development

Malaria is a major public health threat throughout the Tropics. Significant mortality, morbidity, and socioeconomic costs are associated with malaria despite extensive worldwide efforts to develop an effective intervention. AITHM is home to leading malarial research groups in Australia, and is a significant global player in malarial research. At the AITHM laboratories in Cairns, researchers are tackling the complex challenges posed by the disease, focussing on the mosquitoes that transmit malaria, and the five species of the Plasmodium parasite that can infect humans. AITHM is also working on three vaccines at various stages of development: fundamental proof-of-concept, preclinical development, and clinical trial testing.

Saccharide-conjugate vaccine for malaria

Professor Louis Schofield's research team is working on the development of a saccharide-conjugate vaccine which utilises a synthetic saccharide target conjugated to a universally-approved carrier. The vaccine is designed to attack a universally conserved target that is present on the surface of most stages and all species of malaria. In preclinical testing undertaken in collaboration with the Walter and Eliza Hall Institute, the vaccine has proven to be efficacious against the invasive sporozoite stage, replicating blood-stage, and transmissible sexual stage of malaria. The work is funded by the Bill & Melinda Gates Foundation, the Australian Government Department of Industry, Innovation and Science, and the National Health and Medical Research Council (NHMRC). The next critical stage for this investigation will be to move into a formal manufacturing process and regulatory filing in preparation for Phase I clinical trial testing.

Genetically attenuated blood-stage malaria vaccine

AITHM's second malaria vaccine candidate, also led by Professor Louis Schofield, is in the clinical trial stage in Queensland. In collaboration with Professor James McCarthy from QIMR Berghofer, and the Walter and Eliza Hall Institute, Professor Schofield is also evaluating a genetically attenuated live blood-stage malaria vaccine in which pathogen virulence factors have been removed. Phase I clinical trials were completed in January 2018.

Rationally designed genome-based malaria vaccine

AITHM's Professor Denise Doolan is pursuing a third approach to developing a malaria vaccine. This approach explores the whole genome (or genetic blueprint) of the parasite. The researchers are undertaking a full analysis of the parasite's genomic blueprint to provide a comprehensive picture of the interactions between the Plasmodium parasite and its human host at the molecular level. This will help researchers to understand the most important targets of protection. This knowledge can guide the design of vaccines that incorporate multiple important proteins, and thus generate a strong and sustained immune response that the parasite cannot evade. To progress this work towards clinical testing, Professor Doolan is involved in an innovative collaborative program of antigen discovery science with the OptiMalVax consortium, which is linked to rapid clinical development of new vaccine candidates. The OptiMalVax consortium addresses tough problems in malaria vaccine design, such as antigen choice and polymorphism, as well as vaccine immunogenicity, efficacy, and durability. It employs stringent infectious challenges and functional assays to ensure biologically relevant outcomes. It is funded by the European Union and comprises key malariologists, vaccine researchers, and product developers in Europe, the US, Australia, and Africa.

Malaria challenge model

In collaboration with the QIMR Berghofer Medical Research Institute, the infectious diseases immunology team led by Professor Denise Doolan and the human immunology team led by Associate Professor John Miles are investigating the human immune response to live malaria infection. Using a controlled model of malaria infection in healthy people, researchers are working to understand the immune mechanisms induced in a human host when they first encounter a malaria parasite, and the cells and molecules that contribute

to protective immunity to malaria. They are also tracking the way T-cells deal with an infectious disease in real time to identify what T-cell features are required for optimal malaria defence. This information can then be mimicked in future designer vaccines and immunotherapies. Professor Schofield is also collaborating in the immunological analysis of live malaria vaccines with the QIMR Berghofer Medical Research Institute.

Systems-level approach to understanding immunity to disease

The infectious diseases immunology research team led by Professor Denise Doolan is investigating the immune mechanisms underlying protective immunity to malaria. The team takes a holistic approach, examining the human immune response to the malaria parasite as a whole, and using cutting-edge system-level technology. The premise of this work is that an integrated and unbiased network-based approach is needed to develop a comprehensive understanding of immune responses to complex pathogens. The researchers aim to identify key molecules and pathways and develop a pipeline of immunomodulatory molecules that can be transitioned towards clinical development. This research takes advantage of unique human experimental infection models and field studies.

Understanding mechanisms of immunity to malaria from human field studies

Complementing the systems-level approach, Professor Schofield is collaborating with the Papua New Guinea Institute of Medical Research and the Walter and Eliza Hall Institute to define a wider range of human immune responses associated with naturally acquired and innate immunity to malaria in human populations. These studies use functional cellular and antibody assays to define protective immune responses to malaria toxins, virulence factors and surface antigens in different species and life-stages of malaria. Such insights have direct relevance to the design and development of vaccines.

Professor Denise Doolan, tackling the complex challenges posed by malaria.

DEVELOPMENT OF MOLECULAR THERAPEUTICS

Viruses, bacteria, fungi and worms cause multiple diseases, but can also be a source of bioactive products with enormous therapeutic potential. AITHM scientists have discovered new classes of potential drugs by exploring pharmacologically active molecules produced by worms and other organisms. The reef and rainforest of tropical northern Queensland are rich in biodiversity, including unique and sometimes deadly creatures, and AITHM scientists are examining these tropical flora and fauna not only as potential threats, but also for their therapeutic potential.

Engineering peptides to reduce inflammation

The structural biology team, led by Professor Norelle Daly, uses molecules to solve real world problems across a broad range of disciplines. The team focusses on the synthesis and characterisation of peptides/proteins at a molecular level and applies expertise in nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry, and analysis of peptides from plants and animals to consider and develop new treatments for conditions such as inflammatory bowel disease and wound healing.

Inflammatory bowel diseases (IBDs) are a set of complex and debilitating diseases for which there is currently no satisfactory treatment. Recent studies by the structural biology team, in collaboration with the therapeutic development and biodiscovery team, have shown that small peptides show promise for reducing inflammation in models of IBD. These small peptides, however, are likely to be unstable and rapidly cleared from the circulation of the patient. To enhance the viability of the peptides, researchers have undertaken work to improve their stability by grafting them into a stable cyclic peptide scaffold to enhance their therapeutic potential. The engineered cyclic peptide has been shown to be more effective at reducing inflammation in mice models and delivered enhanced stability in human serum. These important findings suggest that the use of cyclic peptides as structural backbones offers a promising approach for the treatment of IBD and, potentially, other chronic inflammatory conditions.

Identifying wound healing potential

A minimal fragment of liver fluke granulin growth factor might offer solutions for non-healing wounds; a serious problem for diabetics, smokers and the elderly. AITHM researchers have produced granulin peptides that drive proliferation of human cells *in vitro*, demonstrating potent wound healing in mice. The team is now seeking a development partner to progress the work into preclinical development and, eventually, clinical trials. With a greater understanding of the granulin peptide structure, the ultimate goal is to develop a topical ointment for treating non-healing wounds. Having already attracted investment of $150,000 from the Merchant Foundation, the team is actively seeking investment for preclinical development of this healthcare solution.

New paradigm in anti-inflammatory therapeutics

Led by Dr Phurpa Wangchuk and Distinguished Professor Alex Loukas, AITHM is working to discover and develop hookworm-derived small molecules as an entirely new generation of anti-inflammatory therapeutics. The goal is to develop small molecules derived from hookworm secretions that suppress inflammation by promoting regulatory responses, notably the expansion and mucosal homing of regulatory T-cells. The market for inflammatory disease therapeutics is enormous and growing at an unprecedented rate. Inflammatory diseases include a wide range of disorders and conditions, and potential returns are high. Obvious disease target areas, where the current standard of treatment is insufficient, include autoimmune diseases such as Intestinal Bowel Disorder, rheumatoid arthritis, transplant diseases, psoriasis, multiple sclerosis, and coeliac disease, and allergic inflammation such as asthma, food allergies and allergic dermatitis. AITHM has already identified individual molecules that confer protection against inflammatory diseases in animal models and is working towards developing preclinical portfolios to accelerate these discoveries towards clinical trials in partnership with biotechnology or pharmaceutical companies.

CAREER PROFILE

MS STEPHANIE RYAN – AITHM PHD STUDENT

Ms Stephanie Ryan is an AITHM PhD student based in Cairns, working with Professor Alex Loukas's team developing new therapeutics.

Originally from Edinburgh in Scotland, Stephanie was torn between a career in medicine and a career in research. With this in mind, Stephanie obtained her Master in Biomedical Science at the Edinburgh Napier University, where she discovered her skill in the laboratory.

"I really found that I enjoyed working in the laboratory. The skills and techniques are interesting, so I chose the path of research over the career of medicine," Stephanie said.

Following graduation in 2011, Stephanie worked as a Research Assistant in the Maizels Parasitology and Immunology Laboratory at the University of Edinburgh focussing on the connection between allergies and parasite infections. This happened to be the same laboratory where her now-supervisor, Professor Alex Loukas, completed a post doctoral Fellowship in in the 1990s.

Seeing her potential, Stephanie's manager in Scotland put her in contact with Professor Loukas and assisted in creating a PhD opportunity for her in Professor Loukas's team in Cairns.

When Stephanie moved to Cairns in 2014 to work as part of Professor Loukas's team, her research focus changed from allergies into developing new therapeutics to treat different autoimmune diseases. Stephanie now uses her knowledge and background experience to create new therapeutics.

"I really enjoy working in the lab as part of a much broader team. There are so many great mentors and skilled researchers within AITHM, and I get to really develop my lab skills.

"I see my research becoming more focussed on the immunological mechanisms of how specific proteins can protect against inflammatory bowel disease. I am also keen to collaborate with other scientists and I am interested to see if my protein drugs candidates are protective in other models of inflammatory disorders such as allergy and asthma. It's wonderful working on new therapeutics for autoimmune diseases.

"I hope the discoveries we are making can make a difference for those living with these aforementioned conditions", Stephanie said.

Stephanie aims to submit her PhD thesis in mid-2018 and is interested in pursuing an academic career and becoming a postdoctoral fellow. She aims to expand and develop her knowledge in as many areas as possible and continue working in the laboratory.

Exploring tropical reef biomes for novel therapies

The toxinology team, led by Associate Professor Jamie Seymour, aims to understand the ecology and biology of venomous Australian organisms, predominantly marine species. With a focus on irukandji and box jellyfish, the team is seeking to develop new treatments and improve current treatment methods for patients. The researchers are also investigating new compounds from venoms for the use in therapeutics and anti-venoms.

Deadly irukandji moving south

The irukandji jellyfish exists in the northern waters of Australia. Data indicate that since 2007 the jellyfish have been moving gradually south to more populated beaches, including the Sunshine Coast. The length of the irukandji season has also increased from one-to-two months to almost six months, aligning with a temperature rise in the water off the coast of one to two degrees. Many more stings are being recorded in Australian waters each year, and two deaths have been attributed to irukandji. Researchers have shown that mice models exposed to irukandji venom demonstrate heart complications and cardiac failure. Researchers are seeking to build further understanding of the biology of irukandji, their habitat, and their breeding.

First aid treatments for stonefish stings

The stonefish is one of the most venomous fish in the world and is in abundance in the Tropics. Stonefish deliver toxins via spines on their dorsal fin when they are threatened or disturbed. In a new study by the toxinology group, findings show that immersion in hot water can be an effective treatment for stonefish stings; the protein-based venom breaks down when heated. The study showed that, on average, a stonefish spine must penetrate flesh to a depth of 18mm before the venom gland is compressed and venom expelled. Stonefish venom was exposed to a variety of temperatures prior to being added to human cells. Those cells exposed to the heat-treated venom required higher temperatures to neutralise 99 per cent of the venom. The study also suggested that, due to the depth of the puncture wound, longer incubation times should be sought to allow heat to penetrate the deeper portions of the dermis and effectively begin venom deactivation.

Supplying stonefish venoms for antivenom

Stonefish antivenom is often required for people who become ill after being envenomed by a stonefish where first aid measures are ineffective. For these patients, the antivenom counteracts the venom and can reduce pain and swelling caused by the sting. The toxinology team is Australia's only supplier of stonefish venom used in the production of antivenoms.

Insights for antivenoms
In the first study of its kind, the toxinology team, in collaboration with the therapeutic development and biomolecular discovery teams, have shown scorpions can fine-tune their venom to suit different predators and prey. Scorpions exposed to simulated predators exhibited significantly different venom chemistry compared with those that were not exposed to predators. The findings are specifically relevant to potential improvements in antivenom design, and understanding venom ecology.

Allergy research

Immunotherapeutics for food allergy
Food allergy is a major public health problem, affecting 8 per cent of children and 10 per cent of infants. It is estimated that 500 million people are affected worldwide. Some food allergies, including peanut, fish and shellfish are not outgrown in adulthood and can cause life-threatening reactions. There are no currently approved medical therapies to cure food allergies or prevent the effects of allergy. In particular, for fish and shellfish allergy, there are no therapies in development. The molecular allergy research laboratory team, led by Professor Andreas Lopata, is developing hypoallergenic proteins and immunopeptides using bio-molecular and immunological techniques that reduce the severity of allergic reactions. Use of such hypoallergenic proteins or peptides as immunotherapeutics allows those allergic individuals to slowly become tolerant to fish or shellfish over time. AITHM is working towards developing hypoallergenic variants of these proteins for preclinical trials and is looking to partner with biopharmaceutical companies to progress the development of hypoallergenic proteins and immunopeptides.

Understanding allergy caused by fish in the Tropics
In an effort better to understand allergies in the Tropics, the team has begun collecting clinical data to obtain an objective measurement of fish allergy in the Townsville region. Current allergy testing can help identify potential causes for allergic reactions but often does not provide a reliable guide on the severity of the reaction, as diagnostics are based mainly on European fish species. In an Australian first, a small cohort of volunteers has submitted blood samples for researchers to observe interactions of the antibodies when exposed to fish allergens. The next steps in this study are to extend the cohort in 2018. More volunteers are being sought to establish links between clinical symptoms in seafood-allergic subjects and their immune responses.

Can algae reduce allergies?
In a new (2017) cross-disciplinary collaboration with industry partner, MDB Industries, the research team aims to investigate therapeutic properties within natural products derived from algae.
In preclinical studies, soluble and purified extracts from a particular sea lettuce, Ulva, showed effective anti-allergic properties in a mouse model of peanut allergy. With these successful results, clinical trials are planned for 2019. The team aims to develop commercially available algal-based treatments to improve general gut health. This preclinical research has been made possible by an Innovation Connections grant with MBD Industries.

Predicting allergy in infants
The research team has identified specific allergens derived from dust mites and insects that may predict the onset of shellfish allergy as children grow older. This becomes important as shellfish allergy, which is very similar to peanut allergy, is lifelong and cannot be outgrown. Further studies aim to identify allergy markers, which may help clinicians to predict onset of allergies to fish. A key aim is to identify therapies that can be developed into vaccines to prevent the emergence of the allergic sensitization as well as therapies such as micro-dosing to desensitise allergic patients.

CASE STUDY

REVISITING THE VILIFICATION OF WORMS

Inviting people to play host to parasitic worms in the interest of medical research may seem like a tough sell. But a number of northern Queensland women at risk of developing type 2 diabetes have volunteered to take part in a project investigating a link between hookworm and type 2 diabetes.

Parasitic worms, once considered something to be banished from human bodies, are now being studied for their positive health and healing potential. Parasitic worms might be protective against type 2 diabetes and metabolic syndrome. AITHM researchers began a recruiting drive in late 2017, appealing to women aged 18-44, with a waist circumference greater than 90cm, to take part in Phase 1 trials.

The research team includes Professor Robyn McDermott, who said the Phase 1 trials would examine the safety and tolerability of participants to low doses of human hookworms.

"We now know that most societies that still have high levels of worm infestation do not have type 2 diabetes, while communities and cities where worms have been mostly eradicated are experiencing a dramatic rise in metabolic diseases. I think we have to revisit the vilification of worms," Professor McDermott said.

The research group includes Dr Paul Giacomin, who is also involved in human trials for parasitic worms that show promise in treating inflammation in patients with coeliac disease.

"Parasitic worms are masters of controlling inflammation and experiments in mice have shown that worm infections are strongly protective against diabetes, a condition that currently affects over a million Australians," Dr Giacomin said.

"We now have the opportunity to conduct a world-first trial into the safety and potential benefits that infections with parasitic worms have in humans who are at risk of metabolic diseases." This clinical trial has received a grant from the Far North Queensland Hospital Foundation. The human trial commenced in November 2017 in Cairns.

CHRONIC DISEASES

Chronic diseases are the leading cause of deaths worldwide and yet, in many cases, can be prevented. Often long in duration and generally slow to progress, chronic diseases can be influenced by genetics, lifestyle, socio-economic factors, and environment, and are expected to become more common as populations age. The impact of these diseases is particularly significant in developing countries, such as those around the Tropics, and among Indigenous communities in northern Australia. AITHM research teams are tackling chronic diseases from a number of angles, including the investigation of the potential of worms and worm-derived products as therapeutics for a range of chronic diseases.

Worm-based therapies

New treatments for autoimmune diseases and asthma

Professor Alex Loukas's and Dr Paul Giacomin's research teams have demonstrated that experimental hookworm infection of human subjects with coeliac disease can restore oral gluten tolerance. The worms promote a regulatory immune response which suppresses inflammation systemically. The teams then showed that the immunoregulatory effects of hookworm infection can be mimicked using just the secreted proteins that the parasites inject into the host tissues. The teams have identified individual proteins that, in recombinant form, suppress inflammatory responses in animal models of asthma and inflammatory bowel disease. These inflammatory conditions affect countless patients worldwide, and new treatments will improve the lives of millions of sufferers.

Hookworm therapy for coeliac disease

Following a successful clinical trial, researchers have sought to understand more about the anti-inflammatory properties of hookworms with a second trial in collaboration with the Prince Charles Hospital. During 2017, the team recruited a cohort of 60 participants in a double-blinded, placebo-controlled clinical trial to confirm the efficacy and feasibility of translating worm-based therapies. The results, anticipated mid-2018, will provide insight into the development of medications that mimic the immunoregulatory response of the worm. Specifically, the trial will allow the researchers to address whether hookworm infection will allow people to gradually reintroduce gluten-containing foods into their diet, thereby permitting tolerance to further accidental or deliberate exposure to gluten. Hookworm therapies offer good prospects for people with coeliac disease who currently rely on adherence to a strict gluten free diet but are always at

Distinguished Professor Loukas's team is developing new treaments for autoimmune diseases and asthma.

risk of inadvertent gluten exposure. With further funding, the development of a pill-based therapy would assist people with coeliac disease.

Preventing type 2 diabetes with parasitic worms

A collaboration between the Centre for Chronic Disease Prevention (CCDP), led by Professor Robyn McDermott, and the research teams headed by Professor Alex Loukas and Dr Paul Giacomin, has begun Phase 1 trials in which young overweight women at risk of metabolic disease, a precursor for diabetes, will be infected with hookworm. The project commenced recruitment in 2017 for the world-first trial based in Cairns. The work builds on an earlier study; mice models infected with parasites were protected against diabetes with evidence of anti-inflammatory molecules within their bodies. This new study, continuing in 2018, will assist in determining whether the same active molecules that worms release into the body to control metabolism, could be produced and used as a drug for preventing type 2 diabetes in humans.

Pharmacological treatments for chronic Strongyloides infection

Infection with the worm *Strongyloides steracoralis* is common in the developing world and in Aboriginal communities in northern Australia. The worm is transmitted through contact with contaminated soil and the prevailing treatment methodology is with ivermectin. A study undertaken by CCDP/AITHM researchers assesses whether the treatment methods should be combined with an environmental intervention in communities where infection is endemic. The study suggests that treatment of *Strongyloides* infection appears feasible using pharmacological treatments alone. The cohort of patients show ivermectin treatments to be highly effective and resulted in a sustained fall in infection rates independent of environmental and public health interventions. The outcomes indicate control of infection could be achieved through case-finding and treatment alone in these communities.

Nutrition in the north - the good and the bad news

The explosion of preventable obesity, diabetes, renal, and heart disease in northern Queensland is due mainly to poor diet; an excess of energy-dense food with too little healthy food, especially fresh fruit and vegetables. Folate is an essential vitamin, mainly found in fruit, vegetables, nuts, liver, and lentils, which is important for neurodevelopment. Folate deficiency in pregnancy can lead to neural tube defects in the offspring, including spina bifida.

Community surveys in remote northern Queensland, conducted by Professor Robyn McDermott and the CCDP team since 2000, show extremely high levels of folate deficiency, especially among Aboriginal and Torres Strait Islander women of childbearing age. Efforts to improve folate intake with voluntary measures (supplementation in pregnancy, nutrition education since the 1990s) have had little impact on these most vulnerable groups. In 2009 mandatory folate fortification of bread flour was introduced nationally. The CCDP team has analysed folate data on 292,000 Queenslanders, tested between 2004 and 2015. Mandatory folate fortification appears to have reduced folate deficiency by 94 per cent among Indigenous adults, and 84 per cent among non-Indigenous adults. Indigenous and non-Indigenous women of childbearing age now have equally low levels of folate deficiency and this has been sustained through 2015. This effect appears to have lowered the incidence of spina bifida in babies nationally, and especially among Indigenous babies. While this is very good news, the overall quality and affordability of healthy food remains low in remote communities, and a recent report from the team shows high rates of iron deficiency anaemia in children at six months to two-years-old across remote northern Australian communities, reflecting continuing poor nutrition. The CCDP is working with community-controlled Aboriginal health services and the Queensland Government to improve food security and quality in remote communities.

Smoking in pregnancy

Tropical populations, particularly Aboriginal and Torres Strait Islander communities, face particular health challenges. AITHM's Professor Alan Clough, in collaboration with researchers from the University of Newcastle (led by Associate Professor Gillian Gould), are working on programs to reduce the instance of smoking among pregnant women in Indigenous communities. Smoking remains a scourge in Indigenous communities throughout Australia, poses significant health risks to both mother and baby during pregnancy, and places a heavy burden on local health systems. The $2.3M NHMRC Global Alliance for Chronic Diseases 'Indigenous Counselling and Nicotine (ICAN) QUIT in Pregnancy' (re-named SISTAQUIT – Supporting Indigenous Smokers To Assist Quitting) project includes a cluster of randomised trials to implement culturally competent evidence-based smoking cessation for pregnant Aboriginal and Torres Strait Islander smokers. Most of the 30 sites (Aboriginal Medical Services) have been recruited across five States and Territories (QLD, NT, NSW, SA and WA). The trial is scheduled to commence in mid-2018 with webinar training being delivered to health professionals in the intervention arm. Control sites will offer usual care. Sites will recruit pregnant Aboriginal or Torres Strait Islander smokers, and follow them to post-partum. Their babies will be monitored until six months of age.

Cardiovascular disease (CVD) prevention in Aboriginal and Torres Strait Islander people

Aboriginal and Torres Strait Islander adults are known to be at much higher risk of heart disease and early death than many other demographic groups in Australia. The CCDP has applied the currently used Australian CVD risk guidelines to Indigenous cohort data linked to CVD events over a 15-year period, for the purpose of testing the reliability of the guidelines in Aboriginal and Torres Strait Islander communities. The team found that the currently used algorithms underestimated actual CVD risk by around 30 per cent in this large cohort. This has implications for screening and early detection of common risk factors and behaviours. A more active approach to prevention is needed. This study is now included in the updated guidelines for primary health services.

Vascular disease

The Vascular Biology laboratory, led by Distinguished Professor Jonathan Golledge, focusses on identification, testing and delivery of new methods to improve the care and wellbeing of patients with peripheral vascular disease (PVD).

Clinical trials investigating AAA therapeutic interventions

A commonly-used cholesterol-lowering drug is being trialled as a potential medical treatment for Abdominal Aortic Aneurysm. Abdominal Aortic Aneurysm (AAA) is a progressive ballooning in a weakened section of the body's main artery, which increases the risk of arterial rupture and fatal bleeding. It kills approximately 1000 Australians per year, often without warning. Experimental studies suggest that the fibrate class of drugs exert beneficial effects on AAAs by favourably altering important biological pathways involved in the disease. Two clinical trials have commenced into the use of Fenofibrate in the management of AbdoMinal aortic anEurism (FAME). The first double-blind control study (FAME) has commenced recruitment. Researchers are seeking to determine whether molecular changes detected in the aneurysm tissue of rodents models exposed to fenofibrate are replicated in human patients. The second trial (FAME2) will examine the short-term effect of fenofibrate on AAA growth and biomarkers of AAA.

Walking to reduce pain and decrease cost of healthcare

Peripheral artery disease (PAD) is the narrowing or blockage of the arteries in the leg. It is a common chronic condition and symptoms can include leg pain when walking, which is relieved by rest. People with PAD also have a high risk of stroke, heart attack and other major medical problems. Researchers at AITHM's Translational Research Facility in Townsville are undertaking a Phase 3 clinical trial with the aim of helping people with PAD to improve their walking capacity, quality of life, reduce leg pain, and the requirement for surgery, and reduce cardiovascular events. This trial tests a brief behavioural intervention aimed at improving physical activity in these patients.

New biomarkers to rapidly diagnose stroke

Each year approximately 50,000 Australians will suffer a stroke. Recent advances in medical techniques that restore blood supply to the brain have significantly reduced the risk of death or significant disability following a stroke. These treatments are only effective if given rapidly after the stroke commences. Currently, there are no blood tests for stroke, and patients must undergo specialist assessment and brain imaging, which can lead to significant delays in treatment. As a result, fewer than 10 per cent of eligible patients receive treatment within the effective time window. Current research data from laboratory models and patient groups have identified a group of blood-borne molecules that change rapidly following stroke onset. Researchers believe these molecules have the potential to act as biomarkers that can be measured easily and quickly to determine whether a patient has or has not suffered a stroke. With a clinical study due to commence in 2018, the team will assess blood samples from patients presenting with a suspected stroke at Townsville Hospital. The study aims to test the blood markers to rapidly diagnose and predict recovery for stroke patients, along with identifying potential improvements to delivery of medical care.

HEALTH SYSTEMS

AITHM's health systems research brings together collaborations between researchers and health professionals to focus on improving models of health service delivery and increasing the health workforce capacity in tropical Australia and beyond. In conjunction with rural, remote, Indigenous and Pacific communities, AITHM is developing targeted research to improve access to healthcare and improve health care delivery in these geographically remote communities.

Tropical Australian Academic Health Centre

AITHM is a founding partner of the Tropical Australian Academic Health Centre (TAAHC). TAAHC is a research collaboration between four hospital and health services in northern Queensland, the Northern Queensland Primary Health Network, and JCU, including AITHM. The purpose of TAAHC is to improve the health of the northern Queensland population and grow prosperity in the tropical region through a partnership that enhances collective capability in health care, health and medical research, and workforce development. TAAHC is seeking to transform the current partnership (established under a Memorandum of Understanding) into a Company Limited by Guarantee.

Occupational health and safety

Led by Associate Professor Gunther Paul, AITHM has established a research program in Mackay into occupational health and safety. Mackay is a major hub for tropical agriculture, an engineering centre for the Bowen basin's mining industry, and a residential base for the mining industry's fly-in-fly-out workforce. The program is housed at the Mackay Base Hospital, co-located with other Mackay-based JCU staff, and its researchers collaborate with the Mackay Hospital and Health Service's Mackay Institute of Research and Innovation (MIRI). In rural and remote areas one of the major causes of morbidity and mortality is workplace accidents. The focus of this research seeks to reduce this morbidity and mortality through a program of occupational health and safety research and translation, which focusses on accident and injury associated with key industries in northern Queensland.

Underground mining training and research simulator

Associate Professor Gunther Paul has jointly received, with industry partner MyneSight, a $400,000 project grant from the Mining Equipment, Technology and Services (METS) Ignited Bowen Basin Cluster Program to develop and establish an underground mining training and research facility in Mackay. This unique research environment is expected to provide industry with an exclusive capability to study the risk emanating from realistic and hazardous exposures in an underground miner's work system.

Telemedicine for better health care

AITHM researchers joined state-wide rural and cancer networks to lead the development of the Queensland Remote Chemotherapy Services model and guide. As a result, health services and cancer centres within Queensland now provide chemotherapy services closer to home for many rural patients. This model has been adopted in the Northern Territory, New South Wales and Western Australia. Another issue for rural people with cancer is access to the latest clinical trials. JCU/AITHM researchers, in collaboration with Monash academics, have convinced the Clinical Oncology Society of Australia to establish the Australian Teletrial Consortium, a joint venture of clinical oncology groups, government, the private sector and NGOs. JCU, through AITHM, is a paying partner in the consortium, which aims to implement the teletrials model nationally and enhance rural access to clinical trials. Other major funding was granted by MTP Connect, an industry growth centre of the Commonwealth Government. Currently, the teletrials approach has been adopted by Queensland Health's Health Innovation, Investment and Research Office, the Victorian Comprehensive Cancer Centre, Medicine Australia, and industry members, as well as many cancer centres across Victoria, NSW, Queensland, and South Australia.

Partnerships for strengthening quality in Aboriginal and Torres Strait Islander primary health care

AITHM researchers have strengthened long-standing alliances, including joint appointments and collaborative research projects with Indigenous organisations to strengthen Aboriginal and Torres Strait Islander health and wellbeing. Commencing in 2017, JCU/AITHM researchers led two major research projects funded by the NHMRC. The Leveraging Effective Ambulatory Practice (LEAP) project aims to strengthen responses to quality improvement activities in Indigenous primary health care. LEAP is a partnership with eight Indigenous primary health care services across northern Australia, Aboriginal Medical Services Alliance Northern Territory, Queensland Aboriginal and Islander Health Centre, the Northern Territory Top End Health Service, and four northern Primary Health Networks. A second project is the Women's Action for Mums and Bubs (WOMB) project. This involves working with ten Indigenous communities across five jurisdictions to test the effectiveness of community women's groups in engaging with maternal and child health care, strengthening and improving real health outcomes for mothers and their babies. Both of these projects feature Aboriginal co-leadership and extremely collaborative ways of working.

Implementation research capacity strengthening with Pacific partners

AITHM researchers have built a network of high-level partnerships with the Pacific Ministries of Health. JCU's strength in this area is recognised in the DFAT-funded Tropical Partners project. The project, described in more detail in the Health Security section of this report, aims to strengthen implementation and health system research capacity among ministry staff and other influential stakeholders in Fiji, the Solomon Islands, eastern Indonesia, Timor-Leste and PNG. The key role that grassroots stakeholders play in Pacific political and cultural life is recognised, and an important feature of this project is building trusting relationships with local organisations and communities to ensure our research is responding to locally identified priorities. Notable examples of this 'bottom-up' approach to engagement include ongoing work with the Atoifi Adventist Hospital and surrounding communities in the Solomon Islands to explore beliefs about, and care-seeking behaviour related to, soil transmitted helminth infections and yaws; and participatory research to investigate malaria, dengue and Zika infections; all translated into real local health care improvements.

ENABLING DISCIPLINES

AITHM has continued to build and strengthen its capacity to support cutting-edge research in line with its dedicated aim of solving major health problems in northern Australia, South-East Asia, the Pacific, and the Tropics worldwide. Leaders in enabling disciplines support research teams. The state-of-the-art facilities at AITHM have continued to bolster the Institute's research teams to further develop their scope. The use of Big Data to streamline projects, and support from leading genetic and genomic research scientists is fundamental to the Institute's research into infectious and chronic diseases across the Tropics. Specifically, AITHM has focussed on providing genotyping, transcriptional profiling deep sequencing, health economics, and bioinformatics knowledge and expertise to researchers.

Health economics

The AITHM health economics team aims to improve delivery of value and maximise outcomes for patients while minimising costs to healthcare systems. When introducing new treatments or changes in health systems, the health economics team assists in demonstrating efficiency or cost-effectiveness, along with positive patient, hospital, individual or health system outcomes. While such value is important, the AITHM health economics team prioritises work to ensure outcomes are delivered equally for all population groups. Led by Associate Professor Emily Callander, the team makes significant contributions to public debate and service delivery in the healthcare sector.

Increasing costs of maternal healthcare

The out-of-pocket costs of maternal healthcare were evaluated in a study undertaken by the AITHM health economics team during 2017. Data obtained from the Medicare Benefits Schedule (MBS) indicated the largest increase in any MBS service was for out-of-hospital obstetrics. An increase of 1035 per cent was noted, while out-of-pocket costs for in-hospital services rose by 77 per cent. The data showed that charges in metropolitan areas were consistently above the national average, while those living in outer regional areas had the lowest out-of-pocket expenses. While pregnant women can choose to access care within the public hospital free of charge at the time of delivery, they might find themselves paying out-of-pocket charges for additional services during the pregnancy; women are often unaware of the out-of-pocket fees for private services and their eligibility for rebates.

Indigenous women's maternal health groups

In a collaborative study, the AITHM health economics team, in conjunction with chief investigator Professor Sarah Larkins, will be assessing the impact of participatory women's groups to improve Indigenous maternal care. In an NHMRC-funded project, the research team will be actively involving the community in addressing challenges in the health of women and babies; the goal is to empower women through participation. Based on an overseas model, the team is applying the model in an Indigenous community setting. The AITHM heath economics team will be involved in assessing the cost effectiveness of the women's groups.

Clinical trials to reduce stillbirth

The AITHM health economics team is providing analysis of a series of interventions in an effort to reduce stillbirth. Unfortunately, stillbirth rates remain steady in Australia and New Zealand, with approximately 3000 babies dying each year. In a clinical trial across Australia and New Zealand, the health economics team will be assessing the cost-effectiveness of a mobile phone app designed to potentially reduce stillbirths by increasing maternal awareness of the importance of monitoring baby movements. In conjunction with the Mater Research Institute, the clinical trial enables pregnant mothers to monitor their foetus by recording kicks, and monitoring movements. The app tracks any reduction in movement, a sign that something might be wrong. The goal of the app is to alert the mother when a healthcare intervention may be required to prevent a potential stillbirth. The trial was underway during 2017 across 27 sites, with analysis to be conducted in 2018 and publications anticipated in 2019.

The real costs of cancer care

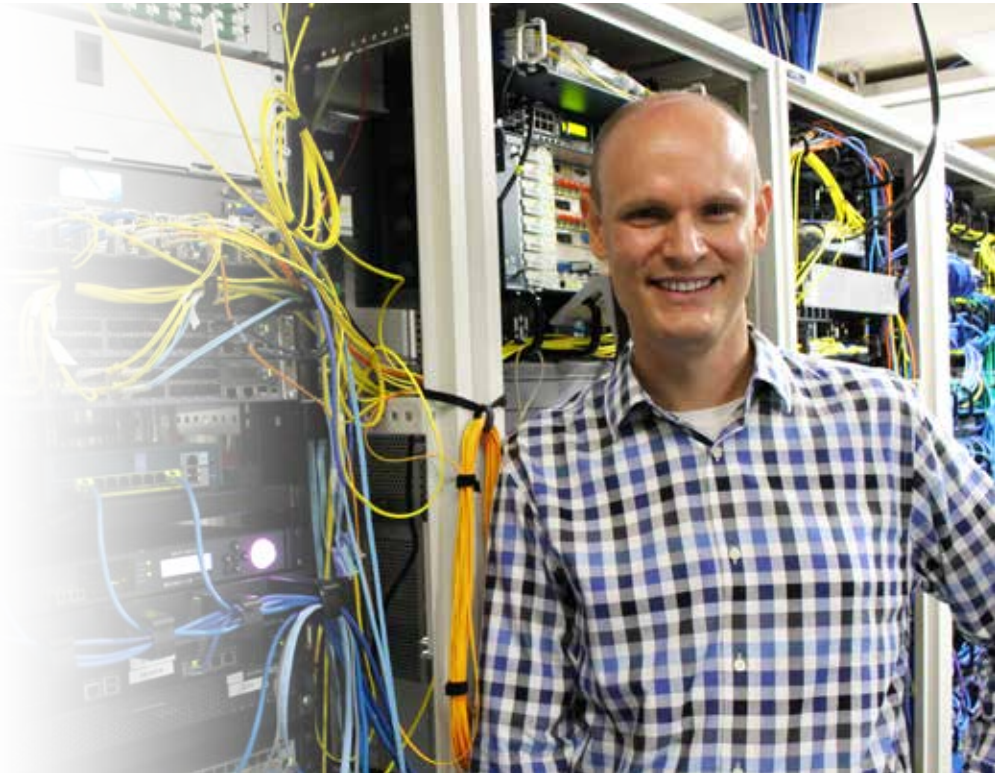
The AITHM health economics team is creating a whole-of-population dataset, a first-of-its-kind, which allows analysis of out-of-pocket costs for Indigenous and non-Indigenous cancer patients. Previous studies indicate a high variation in costs that are paid by patients, possibly as much as $20,000 per patient. The dataset developed by the team will enable researchers to compare costs and outcomes of cancer patients across Australia, along with any inequalities experienced by vulnerable populations undergoing cancer treatments. Work undertaken by the team during 2017 included obtaining the data set and ethics approvals; data analysis will be undertaken in 2018 and publications with policy recommendations will follow.

Bioinformatics

Led by Dr Matt Field, the AITHM bioinformatics team develops sophisticated algorithms to help researchers understand and analyse large and complex biological data sets. The bioinformatics team engages in extensive domestic and international collaborations aimed at developing computational methods for analysing genomic and molecular sequences to further our understanding of human biology and disease, leading to the development of better treatment options for patients.

Bioinformatics to personalise lung cancer treatments

In a new collaboration, AITHM researchers have partnered with the Queensland University of Technology to develop a personalised medicine program for lung cancer patients within the Australian health system. In a new pilot project funded by a Queensland Genomics Health Alliance grant, the team will analyse genetic sequences to determine whether a particular treatment method or therapy will be effective for each patient. This project, based in the Townsville Hospital and Health Service (THHS), aims to develop a personalised medicine program for lung cancer patients in Townsville Hospital. Each patient's genetic information will be collected and analysed to ensure they receive precisely the right drug for their tumour's mutation profile, thus realising some of the promise of personalised medicine. Personalised medicine represents the next generation of medicine and healthcare research by providing both significant benefits to patients and transforming the way healthcare is delivered in the clinic. The project follows on from a study, the largest of its kind, in which researchers developed the first blueprint of the genetic landscape of each melanoma sub-type by sequencing the whole genome from hundreds of patients. The study looked at all major sub-types of melanoma for the first time. Distinct mutational signatures were found to underlie each melanoma sub-type responsible for driving tumour growth. During this study, researchers discovered many mutations that had not previously been linked to melanoma.



GRANTS, FELLOWSHIPS AND AWARDS

AITHM continues to secure competitive grants at rates above the national average in many categories. During 2017, AITHM achieved a 50 percent success rate for career development fellowships awarded by the National Health and Medical Research Council (NHMRC) compared with the sector average of 15.7 per cent.

Fellowships

Fellowships that commenced in 2017 included:

- **Distinguished Professor Alex Loukas** received a NHMRC Senior Principal Research Fellowship for $0.95M. This grant underpins a great deal of early bio-discovery work that can be leveraged to attract commercial partners for downstream therapeutic development.
- **Professor Emma McBryde** received an Advance Queensland mid-career fellowship with funding of $0.3M to support her research on using a health system approach to combat antibiotic resistant infections, in partnership with the Townsville Hospital and Health Service.
- **Dr Joseph Moxon** received an Advance Queensland mid-career fellowship with funding of $0.3M to support his clinical and economic evaluation of blood tests for stroke, in partnership with the Townsville Hospital and Health Service.
- **Associate Professor John Miles** received a NHMRC Career Development Fellowship of $0.48M to support his research on modulating the human immune system.
- **Dr Sandip Kamath** received a NHMRC Early Career Fellowship of $0.32M for research into novel candidates for food allergy.
- **Dr Severine Navarro** was awarded an Early Career Fellowship from the Children's Hospital Foundation, with funding of $0.15M to support the research project: Preclinical development of a hookworm recombinant protein for the prevention of allergic asthma.

Major grants

Major grants that commenced in 2017 included:

- **Professor Emma McBryde** received a project grant from the Department of Foreign Affairs and Trade, Australian Government, with funding of $1.8M to develop tropical partnerships and strengthen health system responses to infectious disease in the Indo-Pacific.
- **Professor Denise Doolan** received a NHMRC Australia/European Union Collaborative Research Grant with funding of $0.49M to support OptiMalVax: Optimising a deployable high efficacy malaria vaccine.
- **Dr Andreas Kupz** received a NHMRC Project Grant for $0.75M to support new strategies for improved TB vaccines.
- **Professor Tom Burkot** received a Bill & Melinda Gates Foundation Grant for $0.62M in support of Technology Identification to Optimize Malaria Vector Surveillance.
- **Associate Professor John Miles** received a NHMRC Project Grant with funding of $0.41M to support his research on the risk of autoimmune disease.

Fellowships awarded in 2017, for commencement in 2018, included:

Professor Denise Doolan was awarded a NHMRC Research Fellowship with funding of $0.86M to support system-based approaches to inform the design of immunotherapies and immunodiagnostics against chronic pathogens.

Dr Andreas Kupz was awarded a NHMRC Career Development Fellowship with funding of $0.44M to support new strategies for improved TB vaccines.

Professor Stephan Karl was awarded a NHMRC Career Development Fellowship with funding of $0.43M to support the research project: Unravelling Plasmodium vivax transmission to mosquitoes.

Dr Matt Field was awarded a NHMRC Early Career Fellowship with funding of $0.33M to support developing core bioinformatics capacity at AITHM.

Awards

The talent and enthusiasm of emerging scientists is building a strong platform for future investment in AITHM. Their contributions to world-leading research is translating to improved healthcare for populations in the Tropics.

Queensland's inaugural emerging science leader
Dr Paul Giacomin was selected as Queensland Science's Emerging Science Leader for 2017. This inaugural annual award identifies a current Queensland scientist who is creating breakthroughs in research, leading collaboration, advocating for science, and inspiring others to build a career in STEM (science, technology, engineering and mathematics).

Queensland Science, Tall Poppy Awardees
Associate Professor Emily Callander and **Dr Sandip Kamath** were announced as 2017 Tall Poppy award winners. The awards recognise and celebrate Australian intellectual and scientific excellence and encourage younger Australians to follow in the footsteps of outstanding achievers in the field of science.

EDUCATION AND TRAINING

AITHM's Cohort Doctoral Studies Program assists and nurtures HDR students using a cohort model. The cohort program provides doctoral students with academic mentors, writing workshops and seminars, a peer support network, and two one-week on-campus intensive research training courses each year. The program was established in 2011 with the aim of supporting health professionals working full or part time to further their research goals. Students learn about, and conduct research in, areas of medicine and health, including health promotion, nursing, rehabilitation, and sports and exercise sciences. The program also includes students working in the fields of chemical, biomedical, molecular and veterinary sciences.

In 2017, there were 128 students in the program across 13 cohorts, including eight students supported by an AITHM PhD Scholarship.

To date, there have been 15 Higher Degree by Research (HDR) students enrolled in the cohort program who have completed their degrees. In addition, one Master of Public Health student and 17 students of the Graduate Certificate and Diploma of Research Methods have transitioned, are transitioning, or have applied to undertake a PhD program. Retention in the program is high at 86.4 per cent, and student outputs total more than 217 peer-reviewed publications since the commencement of the program.

AITHM has also facilitated mentoring programs and professional development training courses for new staff, students and external stakeholders. AITHM researchers have undertaken media training, industry engagement and commercialisation masterclass and statistics training sessions during 2017. A session specifically for early career researchers, titled *Engaging with your audience,* was presented to staff and students at JCU's Festival of Life Sciences.

RESEARCH TRANSLATION AND COMMERCIALISATION

AITHM has a particularly strong focus on research translation, commercialisation and impact. AITHM's governance structures incorporate representation from senior health and hospital service staff and individuals with extensive experience in research commercialisation. This assists in setting priorities and translating AITHM research findings into beneficial outcomes. Close alignment and cooperation is also developing among the various parties to the Tropical Australia Academic Health Centre (TAAHC) governance structure. Through JCU, AITHM is a member of the Medical Research Commercialisation Fund. This investment collaboration supports early-stage development and commercialisation opportunities from Australian medical research institutes and allied research hospitals.

JCU's Research Services team supports AITHM's executive and Advisory Board, and business development and commercialisation activities. Working jointly across a range of engagement and consulting activities, JCU's Research Services and AITHM executive and staff have procured consultancy support, commercialisation initiatives, market assessments for funding bids, detailed contract negotiations, negotiations with external partners around material transfer agreements/ potential projects and numerous non-disclosure agreements.

Through JCU, AITHM holds 12 Intellectual Property (IP) positions. Several of these inventions are also being marketed under confidentiality to potential industry partners with a view to further collaboration, investment and progression to market. Significant progress was made along these lines in 2017. Some examples of AITHM's research translation and commercialisation activities are listed as follows.

Novel therapeutic agents derived from hookworms

Ulcerative Colitis (UC) is an inflammatory disease affecting the colonic mucosa leading to bouts of bloody diarrhoea, abdominal cramps, and fever. AITHM researchers have developed an anti-inflammatory biologic derived from the hookworm secretome to treat UC as well as other inflammatory diseases. This 'first-in-class' biologic targets the underlying disease condition and has the potential to be disease modifying, unlike most current therapies which address only the symptoms of the disease. Led by Professor Alex Loukas, AITHM researchers are seeking investment to enhance the preclinical data package and conduct further toxicology and safety trials in mice before progressing to clinical trials.

Immunotherapeutics for food allergy

AITHM researchers, led by Professor Andreas Lopata, are developing hypoallergenic proteins and immunopeptides using bio-molecular and immunological techniques that reduce the severity of allergic reactions. Use of such hypoallergenic proteins or peptides as immunotherapeutics allow those allergic individuals to slowly become tolerant to fish or shellfish over time. AITHM is working towards developing hypoallergenic variants of these proteins for preclinical trials and is looking to partner with biopharmaceutical companies to progress the development of hypoallergenic proteins and immunopeptides.

Progression of malaria vaccine development

After tuberculosis and HIV, malaria is the third most serious infectious disease worldwide, and is a particular scourge in the Tropics. A vaccine is urgently required. Malaria parasites are complex and hard to target with 11 distinct life stages, each with multiple redundant strategies for survival in the host. Following a $0.8M NHMRC Development Grant and $2.8M grant from the Bill & Melinda Gates Foundation to pursue the preclinical development of a broad-spectrum vaccine, AITHM Director, Professor Louis Schofield received a further investment of $1.1M from the Australian Tropical Medicines Commercialisation Fund (Commonwealth Department of Industry). These funds are to take the vaccine through process development and formal toxicology testing.

Using peptides to accelerate wound healing

Chronic wounds, such as diabetic ulcers, contribute to high mortality rates and are a significant expense to the health system. Novel growth factor-based active peptides developed by AITHM show promise in accelerating wound healing in animal experiments. These therapeutic peptides show significant acceleration of wound healing when compared with products currently available.

Schistosomiasis

The blood fluke, *Schistosoma haematobium*, infects more than 100 million people throughout Sub-Saharan Africa. Chronic schistosomiasis is characterised by deposition of parasite eggs in various organs, such as the liver and the urinary tract, and subsequent formation of immune granulomas around trapped eggs. Currently, the only treatment available is the drug praziquantel, usually given through mass control programs. To achieve elimination of the disease, new tools are urgently needed such as vaccines and diagnostics. The Loukas/Pearson groups were awarded an Australian Tropical Medicine Commercialisation grant funded by Austrade and the global pharmaceutical company, Merck. The researchers are using an innovative high-throughput approach to generate blood fluke proteome arrays that will be probed with sera and urine from people living in endemic areas with the goal of identifying *S. haematobium* proteins that will form the basis of next generation vaccines and diagnostics for schistosomiasis. The work involves international collaborations with US partners at the University of California, Irvine and Baylor College of Medicine, and UK partners at the University of Edinburgh.

AITHM was pleased to host the visit to JCU of Dr Alex Zelinsky AO, Defence Chief Scientist, who briefed us on the Defence White Paper of 2016 with emphasis on Innovation and Next Generation technologies, and new pathways for collaboration between defence, academia and industry. In return, AITHM and JCU scientists were able to brief Dr Zelinsky on research developments of potential interest to the Department of Defence. The discussions resulted in several follow-up initiatives.

Pictured are (from right) Dr Andrew Johnson, Distinguished Professor Louis Schofield, Dr Alex Zelinsky, Professor Emma McBryde, Dr Xiang Wei, Mr Tony Tucker.

COMMUNICATION AND ENGAGEMENT

Special Events

Australasian Tropical Health Conference 2017

10-11 September 2017, Cairns Hilton Hotel

The fifth annual Australasian Tropical Health Conference was held in Cairns in September 2017 and focussed on the theme, *Asia Pacific Collaborations in Tropical Disease*. The conference brought together researchers from across Australia and around the world to discuss the specific and unique challenges associated with tropical health and medicine. This event comprised 30 speakers, including leading international and national researchers, with presentations delivered under the following themes:

- Chronic Disease
- Infectious Diseases
- Vectors
- Health Economics
- Epidemiology
- Bioinformatics
- Infectious Disease Modelling
- Big Data

Seminars

AITHM hosted 16 seminars in 2017, 10 of which featured international speakers. The AITHM seminar series supports researcher collaboration and exchange of information in the field of tropical health and medicine. The series aims to build and disseminate further knowledge in innovative medical research, development and translation, and to foster new collaborations with researchers, business and industry.

DATE	PRESENTER	AFFILIATION
12 Jan	Dr Peter Nejsum	Aarhus University, Denmark
1 Feb	Professor Laura Harrington	Cornell University, United States of America
20 and 21 Feb	Professor Lars Lindholm	National Research School, Sweden
24 Apr	Associate Professor Sammy Bedoui	University of Bonn, Germany
14 Jun	Associate Professor Giles Duffield	University of Notre Dame, United States of America
16 Jun	Dr Alex Trollope	James Cook University
20 Jun	Mr Claude Oeuvray	Merck Pharmaceuticals, Switzerland
29 Aug	Professor Roman R. Ganta	Kansas State University, United States of America
29 Aug	Dr Matthew Moyle	AnaptysBio, Inc
22 Sep	Professor Gueladio Cisse	Swiss Tropical and Public Health Institute, Switzerland
11 Oct	Dr Jessica Bolden and Dr Kirsten Fairfax	The Walter and Eliza Hall Institute of Medical Research, Melbourne
20 Oct	Dr Matt Field and Dr Jonathan Ellis	AITHM and Queensland University of Technology
3 Nov	Dr Kevin Francis	UCLA, United States of America
9 Nov	Professor Peter White	Imperial College, United Kingdom
30 Nov	Associate Professor Scott Cummins	University of the Sunshine Coast, Queensland

Professional development, workshops and training

AITHM researchers coordinated and delivered a number of professional development workshops and training events during 2017. Highlights included a health economics workshop titled *Cost effectiveness analysis in healthcare,* delivered by Associate Professor Emily Callander. The one-day introductory session provided participants with an understanding of how cost-effectiveness can be used to evaluate health programs and aid decision-making. Following the success of this session, a second workshop was delivered by Associate Professor Emily Callander titled, *Use of economic evidence for decision making* at the Townsville health research showcase. The health research showcase also included a research education program in which sessions were delivered by Professor Melanie Birks (*Grounded theory),* Associate Professor Kerrianne Watt (*Statistics for research*) and Dr Liz Tynan *(Writing for publication*).

Media training workshops were delivered to AITHM researchers in both Cairns and Townsville. These sessions were tailored to health and medical research communications. The senior and early career researcher workshops focussed on the importance of engaging with the media and included a practice session for speaking with journalists.

An introductory session, titled *Engaging with your audience,* was delivered to early career researchers, including Honours and Higher Degree by Research students, at JCU's Festival of Life Sciences. Also aimed at early career researchers, Dr Joe Moxon coordinated the delivery of a workshop titled *Building knowledge for research applications* to equip young researchers with the skills needed to apply for research grants.

Professor Adrian Esterman delivered a statistics workshop titled *Effect sizes: What they are and why you should report them* for established researchers. This session included an introduction to effect sizes and the importance for researchers to include their calculations into reports of clinical significance.

AITHM also delivered an *Industry Engagement, Collaboration and Commercialisation* masterclass aimed at all researchers across all stages of their career. This all-day session provided collaboration skills, pitching practise, marketing and development of research findings, along with the importance of intellectual property. AITHM was delighted to welcome keynote speakers: Mr Matthew Moyle, an expert in biologic drug discovery and development; Professor Zee Upton, a research director at A*Star Research; Kathy Connell from Johnson & Johnson; Dr Stuart Hazell from the Department of Industry, Innovation and Science, and Dr Jenny Petering from Patent and Trade Mark Attorneys, FB Rice.

Community engagement

During 2017, AITHM researchers shared their groundbreaking outcomes and findings through a number of engagement activities at JCU, throughout wider Australia, and on the international stage. Locally, researchers were invited to participate in the TEDx JCUCairns program. TEDx aims to help communities, organisations and individuals spark conversation and connection. AITHM presenters were Dr Michael Smout and Dr Andreas Kupz. Dr Smout's presentation was titled, *Could worm spit help prevent amputation from chronic wounds?* and Dr Kupz delivered *The importance of eradicating Tuberculosis, the biggest killer amongst all infectious diseases*.

As part of National Science Week celebrations in August, Dr Paul Giacomin presented a talk titled *Worms, germs and immune diseases* at a PechaKucha night and Professor Norelle Daly spoke on *Magnets and Miracles* at the Café Scientifique event.

On the national stage, Associate Professor Jamie Seymour presented at the *Festival of Failure* in Victoria on the importance of learning to bounce back in research, while Dr Michael Smout presented a session titled *Aliens Within* at the science tent during the Splendour in the Grass music festival. Internationally, Professor Scott Ritchie delivered community presentations on vector borne diseases in India and Sri Lanka. These sessions were sponsored by the Public Diplomacy program at the Australian High Commission in New Delhi and the Australian Department of Foreign Affairs and Trade.

The aquarium facility opened its doors for tours and talks during JCU's Open Day. The toxinology research team treated visitors to marine talks, as well as being given a rare opportunity to observe stonefish, polyp-stage irukandji jellyfish, cone shells, a baby crocodile, and giant IMAX equipment used for filming commercial natural history documentaries. The aquarium also hosted small tour groups, school visits and international institutes by private booking, providing an up-close insight to the health and medical research undertaken by the toxinology research team.

A number of research teams provided school talks, presentations and tours during 2017. Science Engineering, Technology and Maths (STEM) talks were provided to students in Year 10 and 11 at Trinity Anglican School, Cairns; Associate Professor Jamie Seymour spoke to students during their annual science week. In the Townsville region, a number of schools participated in the Maths Explains Our World (MEOW) program for Year 8 students.

AITHM and the Queensland Centre for Peripheral Vascular Disease hosted donors from the Heart Foundation to strengthen the relationship between philanthropy and medical research. Donors were given an insight into a working research laboratory, and shown the location for the team's current clinical trials.

AITHM continued its strong engagement on Thursday Island to further its remit for research in the Tropics and rural and remote communities. Following the completion of the research facility in the Torres Strait, AITHM participated in the NHMRC Roadmap Workshop to investigate the areas of research that will improve health and wellbeing for the local communities of Far North Queensland.

Media and communications

AITHM researchers play a lead role in delivering media activities locally, nationally and internationally to promote awareness of their work and of the importance of tropical health and medicine research more generally.

As part of a broader strategic communications plan, AITHM's traditional media outputs were supported by social media, an engaging website, a quarterly newsletter, and direct community engagement activities.

AITHM released 16 media releases through the JCU media team and, as a result of direct media engagement, more than 1100 commentaries were made during 2017.

A key highlight included Radio National's coverage of Professor Robyn McDermott's clinical trial investigating whether an experimental hookworm infection might help to prevent the onset of type 2 diabetes. Another media success was led by Professor Scott Ritchie with news of the achievements of the Eliminate Dengue program (now called World Mosquito Program) in Cairns.

More than 90 per cent of the mosquitoes in the *Wolbachia* release areas are now unable to spread dengue, which was widely reported in the media.

Findings that made the biggest impact in international media outlets were led by Dr Michael Smout and Professor Alex Loukas with their release titled: *Healing wounds with parasites*; more than 180 international platforms shared this news content. Following these successes, Dr Michael Smout was invited to feature on the Dr Karl podcast about the *Return of the worm in medicine*.

To help build awareness of food allergy, AITHM led a social media campaign in conjunction with the Molecular Allergy Research Laboratory team. The digital campaign encouraged people to paint one fingernail to demonstrate being allergy aware; an important reminder with an estimated 40 per cent of the population having some type of allergic response, according to the World Health Organization.

In other social media activities, AITHM delivered a digital campaign for International Women's Day, featuring leading female researchers encouraging women in science with the campaign tag line #BeBoldForChange.

The toxinology research team supports the *Nature of Science* YouTube channel and associated Facebook page, providing video content. Content includes research and discoveries with time-lapse and high-speed footage of scientific discoveries of Australia's tropical marine species, and their therapeutic potential as treatments and antivenoms. In addition to these activities, Associate Professor Jamie Seymour also has a regular radio segment on local breakfast radio called: "Ask Jamie", and is a fortnightly guest expert on ABC National.

Publications

Researchers in the Division of Tropical Health and Medicine and AITHM published more than 480 refereed articles, books, book chapters and conference papers in 2017.

The full details of these publications can be viewed via the AITHM website.

FACILITIES

Townsville

Completed in 2016, the Townsville facility includes both PC2 and PC3 certified laboratories, animal holding spaces, a Biobank for clinical and epidemiological samples, a translational research facility, and meeting rooms. This construction was enabled by the Queensland State Government ($21.5M), the Federal Government via the Australian Research Council Special Research Initiative ($8M), and JCU. This facility accommodates both laboratory-based and clinical researchers, as well as staff and students in key supporting disciplines including, epidemiology, biostatistics, and health economics. The PC3 laboratory is specially designed to meet safety requirements for work on highly infectious and pathogenic organisms such as TB. Lower-risk pathogens are studied in PC2 labs. Townsville's Translational Research Facility (TRF) is fitted with five clinic rooms used for clinical trials. The TRF is a space where clinicians and researchers can collaborate to meet the needs of patients, thus ensuring North Queensland trials can be conducted locally, and feed into local health care delivery.

Cairns

AITHM's research facilities in Cairns comprise the mosquito research facility, aquarium, PC2 laboratory and meeting rooms. The AITHM facilities include an advanced protein analysis facility with electrospray ionization (ESI) and matrix-assisted laser desorption ionization (MALDI) mass spectrometry and nuclear magnetic resonance (NMR) spectroscopy, as well as immunology and cell biology suites with multi-colour flow cytometry, and electron/fluorescence microscopy facilities. The completion in early 2018 of an additional AITHM Tropical Health Research and Training facility on the Cairns campus at a total construction cost of $25M will significantly increase capacity to expand research programs. Funded by the Federal Government via the Australian Research Council Special Research Initiative ($18M), the Queensland State Government ($6.5M), and JCU, the new state-of-the-art facility includes office spaces, laboratory and cryogenic storage capacity, and an additional PC2 laboratory that will be used to focus on bio-discovery and the therapeutic potential of tropical flora and fauna.

Thursday Island

The AITHM Clinical Research and Training Facility on Thursday Island is adjacent to the Torres Strait Hospital and enables research, training and community engagement. The facility, funded by the Queensland State Government ($6.33M) and JCU ($0.3M), was completed in 2017. Research in this facility will focus on:

- infectious disease, such as tuberculosis
- chronic disease, such as diabetes and obesity
- parasites
- mosquitoes that transmit dengue and Zika
- projects of local importance identified by local clinicians.

The community space also provides an ideal platform for engagement and collaboration with the Torres Strait community and the hospital service to ensure translation of findings.

Mackay

AITHM has established a research hub based in Mackay, which is housed within the Mackay Health and Hospital Service, co-located with other Mackay-based JCU staff. The research team's focus is on occupational health and safety.

RESEARCH CENTRES

Anton Breinl Research Centre for Health Systems Strengthening

Director: Professor Sarah Larkins

The Anton Breinl Research Centre for Health Systems Strengthening brings together a multidisciplinary team of medical, nursing, public health and allied health researchers to build on JCU's strong record of rural, remote, Indigenous, and tropical health research. The Centre aims to progress health equity in partnership with Australian Aboriginal and Torres Strait Islander peoples, rural and remote populations, tropical populations in neighbouring countries, and other underserved groups.

Major themes of work
Health systems strengthening and workforce development, Aboriginal and Torres Strait Islander health, responding to priority health challenges in our region.

research.jcu.edu.au/abrc

Centre for Biodiscovery & Molecular Development of Therapeutics (BMDT)

Director: Professor Denise Doolan

The BMDT provides an innovative approach to the development of compounds of therapeutic potential under its five key programs, with each program comprising its own project leader/s and team consisting of project researchers and early career researchers.

Major themes of work
Biodiscovery, molecular characterisation and design, molecular immunology, clinical translation.

research.jcu.edu.au/bmdt

Centre for Biosecurity and Tropical Infectious Diseases (CBTID)

Director: Professor Denise Doolan

The goals of the CBTID are twofold:

- Expand knowledge and understanding of tropical infectious diseases and translate this into new tools to manage diseases and control their transmission, at both individual animal and population levels.
- Harness the latest technologies in cell and molecular biology, proteomics, structural biology, and immunology to better understand the interactions that occur between pathogens and their hosts, and to translate that understanding into the development of new vaccines and therapies.

Major themes of work
Epidemiology, transmission and surveillance programme, host-pathogen interactions.

research.jcu.edu.au/btid

Centre for Chronic Disease Prevention (CCDP)

Director: Professor Robyn McDermott

The CCDP is committed to working with health services and communities in Far North Queensland to improve the management of chronic disease, particularly diabetes, heart and renal disease.

The Centre receives funding from the Queensland Department of Health, and undertakes research related to the prevention of chronic diseases in the community and improving primary health care practice and care pathways for chronic disease.

Major themes of work
Reduce disease progression, reduce risk factors for chronic disease, understanding health trends in remote populations, developing research capacity.

ccdp.jcu.edu.au

Centre for Nursing and Midwifery Research

Director: Professor Cate Nagle

The Centre for Nursing and Midwifery Research works collaboratively across disciplines to transform health outcomes for people in the Tropics by generating evidence that translates to quality healthcare, nursing and midwifery education and health policy.

Major themes of work
Improving clinical outcomes, health professional education, Indigenous futures, workforce and practice development.

research.jcu.edu.au/cnmr

Comparative Genomics Centre

Director: Professor Alan Baxter

The Comparative Genomics Centre studies the molecular basis of health and disease in a wide range of model organisms. It uses cutting-edge technologies to dissect interactions between complex microbial flora and the genomes of host animals to develop detailed models of disease initiation and progression. The goal is to improve our understanding of cancers, metabolic diseases, endocrine diseases, as well as immunological and psychiatric disorders.

Major themes of work
Bioinformatics and biotechnology, cancer metabolisim, immunogenomics, medical epigenetics and genomics, microbial pathogens and molecular immunology.

research.jcu.edu.au/cgc

Queensland Research Centre for Peripheral Vascular Disease

Chief Investigator: Distinguished Professor Jonathan Golledge

The Queensland Research Centre for Peripheral Vascular Disease was established in 2010. The centre amalgamated the previously established JCU Vascular Biology Unit formed in 2002 and clinical research undertaken on peripheral vascular disease at The Townsville Hospital.

The centre focusses on research designed to improve understanding and ultimately improve management of peripheral vascular diseases. Current research undertaken in the centre includes preclinical work designed to identify treatment targets and risk predictors for peripheral vascular disease patients; studies aimed at better understanding mechanisms involved in peripheral vascular disease development and progression, and clinical studies and trials designed to identify or test therapies for peripheral vascular disease.

Major themes of work
Arterial occlusive, aneurysmal, venous disease, myocardial infarction, stroke, renal impairment.

research.jcu.edu.au/qrcpvd

LEADERSHIP AND GOVERNANCE

AITHM Advisory Board

AITHM is governed by the AITHM Advisory Board, the key strategic body that drives the Institute's globally oriented research agenda. The Advisory Board provides independent and strategic advice on all aspects of the Institute, including high-level business management, research and commercialisation, and linkages with government, industry and philanthropic institutes.

The Board meets three times a year and is comprised of up to 12 members from a diverse range of external organisations as well as senior staff from JCU. AITHM would like to thank Dr Jim Thompson, Dr Peter Bristow and Dr Mark Wenitong for their contributions to the Advisory Board during their tenure.

Chair
The Honorable Doctor Michael Wooldridge
Independent Chair, Wooldridge Consulting

Advisory Board members
Distinguished Professor Louis Schofield
Director, AITHM

Professor Chris Cocklin
Senior Deputy Vice Chancellor, JCU

Professor Ian Wronski
Deputy Vice Chancellor, JCU

Doctor Jim Thompson**
Replaced by Ms Lea Diffey*
Executive Director, Department of Science, Information Technology and Innovation

Dr Peter Bristow**
Replaced by Mr Kieran Keyes*
Acting Chief Executive, Townsville Hospital and Health Service

Ms Clare Douglas (delegated to Ms Nicki Murdoch*)
Chief Executive, Cairns and Hinterland Hospital and Health Service

The Honorable Jan McLucas
Independent

Professor Zee Upton
Research Director, Institute of Medical Biology Agency for Science, Technology and Research

Mr Tony Wood
Program Director, The Grattan Institute

Dr Mark Wenitong**
Public Health Medical Advisor, Apunipima Cape York Health Council

* Joined the AITHM Board in 2017
** Stepped down from the AITHM Board in 2017

Management Advisory Committee

The Management Advisory Committee provides advice to the management of AITHM and associated researchers regarding key issues pertaining to AITHM's activities, including its operations, income, engagement and collaboration, management, and research program direction.

A review of the Terms of Reference and Membership of the Management Advisory Committee was undertaken during 2017, as it was recognised that the committee had grown too large to operate efficiently and effectively. The composition of the Committee was amended to reduce membership and focus more strongly on AITHM's engagement with the JCU Division of Tropical Health and Medicine's leadership group.

The Committee will be reconvened in 2018 with revised Terms of Reference and Membership.

FINANCIAL STATEMENT

The following general information is extracted from the 2017 Annual Report for James Cook University, published in 2017[2]. The principal accounting policies adopted in the preparation of these financial statements reflect the accounting policies used in the audited financial statement for James Cook University for the year ending 31 December 2017. The accounts are prepared on an accrual basis and comply with Australian Accounting Standards. It also requires management to exercise its judgement in the process of applying the University's accounting policies. The estimates and underlying assumptions are reviewed on an ongoing basis.

Audit Committee

The Audit Committee is responsible for all audit and related matters, and for monitoring the assigned performance measures on behalf of James Cook University (JCU) Council – thereby assisting the University to fulfil its responsibilities under the *Financial Accountability Act 2009*. The Act requires the mandatory appointment of the Auditor-General of Queensland as the University's external auditor. The Audit Committee also reviews the Queensland Audit Office's (QAO) approved audit strategy, observes the terms of the committee charter, and has due regard to Queensland Treasury's Audit Committee Guidelines.

Internal Audit

Internal Audit is an independent, objective assurance and consulting activity designed to add value and improve the University's operations. It assists the University accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes. Internal Audit activity encompasses the review of all financial and non-financial policies and operations of the University, excluding controlled entities.

2 James Cook University Annual Report 2017, ISSN 0158-7730. Produced by, and available from Quality, Planning and Analytics, James Cook University. This Annual Report is also publicly available on the JCU website at jcu.edu.au/about-jcu/annual-report.

Australian Institute of Tropical Health and Medicine

Statement of Operating Income and Expenses for the year ended 31 December 2017

Notes	INCOME	2016 $	2017 $
	Commonwealth Government Funding (ARC Special Research Initiative)	3,105,644	0
	State Government Funding (DSITI)	1,700,000	400,000
	Host Institution Funding (James Cook University)	5,019,474	4,038,891
	External Research Grants & Consultancies	3,703,617	6,587,189
	Other Income	565,998	785,859
	Total Income	**14,094,734**	**11,811,938**
	EXPENDITURE	**2016 $**	**2017 $**
	Operational		
	Salaries	5,064,687	6,000,398
	Equipment & Maintenance	1,232,932	1,233,746
1	Other Expenditure	1,125,334	1,570,281
	Capacity Building Grants (DSITI)		
	Salaries	459,932	410,603
	Equipment & Maintenance	109,196	19,570
	Other Expenditure	277,389	513,121
	External Research Grants		
	Salaries	2,317,746	3,078,662
	Equipment & Maintenance	188,762	108,012
	Other Expenditure	2,130,016	2,603,667
	Total Expenditure	**12,905,992**	**15,538,060**
	Surplus/(Deficit)	**1,188,741**	**-3,726,122**
	CASH FLOW SUMMARY	**2016 $**	**2017 $**
	Balance Brought Forward	18,178,407	19,367,148
	Surplus/(Deficit)	1,188,741	-3,726,122
	Closing Balance	**19,367,148**	**15,641,027**

Notes to the AITHM 2017 Financial Statement

1 Governance expenditure is included in the Financial Statement under Operational – Other Expenditure for 2016 and 2017. In the 2016 Annual Report, Governance expenditure is listed as a separate expense item.

2018 ACTIVITIES

Governance

- Appoint new Deputy Director AITHM
- Reconstitute AITHM's Management Advisory Committee under reviewed Terms of Reference, function and membership.

Research

- Review research themes to ensure they remain applicable to the current and anticipated program of research, and to enhance opportunities for cross-team collaboration.
- Promote access by researchers to diverse funding opportunities
- Build on occupational health and safety research, including black lung
- Extend collaborative engagement with Department of Defence and Department of Foreign Affairs and Trade
- Extend collaborations in the Asia-Pacific region, including Singapore
- Develop a research agenda for Thursday Island in consultation with Cape and Torres HHS and Torres community groups;
- Operationalise the newly built QC2 insectary capacity at AITHM Cairns.

Research training and professional development

- Improve training opportunities for HDR students and Early Career Researchers in areas such as: media, entrepreneurship, grant and fellowship applications
- Continue to support and enhance the Doctoral Studies Cohort Program
- Identify opportunities for Doctoral Studies Cohort Program graduates to continue to engage in AITHM/JCU research projects.

Business development, commercialisation and translation

- Increase activity and resourcing of business development
- Seek increased contracted research opportunities
- Actively engage with Research Services' business development teams in pursuing and leveraging commercialisation opportunities
- Contribute to JCU-wide review of innovation policy
- Contribute to design and intent of Cairns Innovation Centre
- Revise AITHM's business plan for the next five years, including financial modelling
- Continue to build on the commercialisation projects of drug and vaccine discovery and service provision in health economics, bioinformatics, statistics, and enabling disciplines
- Promote and support entrepreneurship training opportunities
- Build clinical trials capacity and experience.

Communications and engagement

- Conduct AITHM Seminar Series events to foster research collaboration and networking
- Continue regional cooperation and engagement with tropical populations, community groups, research institutions, governments, non-government organisations and industry partners
- Officially open AITHM Cairns
- Officially open AITHM Torres Strait
- Continue to promote AITHM researchers' strengths in tropical health research.

National and international linkages

- Continue to build collaborative opportunities afforded by the Tropical Australian Academic Health Centre (TAAHC), including research collaboration between the northern Queensland Hospital and Health Services, the Northern Queensland Primary Health Network, AITHM and JCU, and local community organisations
- Link with Singaporean institutions to promote research into health security and commercialisation of research outcomes
- Link with Pacific Island institutions to promote research and build capacity in areas including health security, tuberculosis, malaria and implementation research.

ACRONYMS

AAA	Abdominal Aortic Aneurysm
ABRC	Anton Breinl Research Centre for Health System Strengthening
AIDS	Acquired immune deficiency syndrome
AIP	Anti-inflammatory protein
AITHM	Australian Institute of Tropical Health and Medicine
ALPA	Arnhem Land Progress Association
APEC	Asia-Pacific Economic Cooperation
ARC	Australian Research Council
ARDS	Aboriginal Resource and Development Services
AuTuMN	Australian Tuberculosis Modelling Network
BCG	Bacille Calmette–Guérin
BMDT	Biodiscovery & Molecular Development of Therapeutics
CBTID	Centre for Biosecurity and Tropical Infectious Diseases
CCDP	Centre for Chronic Disease Prevention
CDC	Centre for Disease Control
CSIRO	Commonwealth Scientific and Industrial Research Organisation
COPD	Chronic obstructive pulmonary disease
CTP	Collapsible Passive Trap
CRE	Centre of Research Excellence
CVD	Cardiovascular disease
Dr	Doctor
DSITI	Department of Science, Information Technology and Innovation
DSITIA	Department of Science, Information Technology, Innovation and the Arts
DS-TB	Drug susceptible tuberculosis
DTHM	Division of Tropical Health and Medicine
EBV	Epstein Barr Virus
EID	Emerging infectious diseases
ESI	Electrospray ionization
FAME	Fenofibrate in the management of AbdoniMinal aortic anEurysm
HDR	Higher Degree by Research
Hon	Honourable
HIV	Human Immunodeficiency virus
IBD	Inflammatory Bowel Disease
ICAN	Indigenous Counselling and Nicotine
IHR	International Health Regulation
IMR	Institute of Medical Research
JCU	James Cook University
LEAP	Leveraging Effective Ambulatory Practice
LIEF	Linkage Infrastructure, Equipment and Facilities
M	Million
MALDI	Matrix Assisted Laser Desorption Ionization
MBS	Medicare Benefits Scheme
MIRI	Mackay Institute of Research and Innovation
MDR-TB	Multi-drug resistant tuberculosis
METS	Mining Equipment and Technology Services
MRF	Mosquito Research Facility
MRR	Mark, release, recapture
NCIG	National Centre for Indigenous Genomics
NGO	Non Government Organisation
NHMRC	National Health and Medical Research Council
NMR	Nuclear magnetic resonance
NPC	Nasopharyngeal carcinoma
NQHF	North Queensland Health Foundation
NTM	Non-tuberculous mycobacterial
OHS	Occupational Health and Safety
PAD	Peripheral Artery Disease
PC	Physical containment
PCR	Polymerase chain reaction
PhD	Doctor of Philosophy
PNG	Papua New Guinea
PVD	Peripheral vascular disease
QAO	Queensland Audit Office
RIBG	Research Infrastructure Block Grant
ROV	Remote operated vehicle
QC	Quarantine containment
QRCPVD	Queensland Research Centre for Peripheral Vascular Disease
SAHMRI	South Australian Health and Medical Research Institute
SIT	Sterile Insect Technology
SORT-IT	Structured Operational Research and Training Initiative
SRI	Special Research Initiative
SSA	Site Specific Approval
STEM	Science, Technology, Engineering and Mathematics
T2DM	Type 2 Diabetes Mellitus
TAAHC	Tropical Australia Academic Health Centre
TB	Tuberculosis
TI	Thursday Island
TRF	Translational Research Facility
UC	Ulcerative Colitis
UNICEF	United Nations Children's Fund
USA	United States of America
WEHI	Walter and Eliza Hall Institute of Medical Research
WHO	World Health Organization
WOMB	Women's Action for Mums and Bubs

AITHM | AUSTRALIAN INSTITUTE
OF TROPICAL HEALTH & MEDICINE

Australian Institute of Tropical Health and Medicine
Division of Tropical Health and Medicine
James Cook University
Townsville QLD 4811 AUSTRALIA

07 4781 3122
aithm@jcu.edu.au
aithm.jcu.edu.au

TOWNSVILLE // CAIRNS // MACKAY // THURSDAY ISLAND

JAMES COOK UNIVERSITY
AUSTRALIA

Cairns
Singapore
Townsville