

ANU Medical School Research Report



2020



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A portrait of Professor Zsuzsoka Kecskes, a woman with short blonde hair, wearing a red cardigan over a black top and a stethoscope. She is smiling and has her arms crossed.

Foreword

I am very excited about this report and want to express my sincere thanks to all who have contributed to this collation of the highlights of research done at the ANU Medical School.

This is the first time that such a report has been collated and reflects the work of many over many years.

As you can see the researchers, whether they are scientists, clinicians, or clinician academics, employed by ANU or health organisations, come together to improve the life of people – across a large range of topics. The topics are wide ranging, and span fundamental research to applied studies, cover the ages of people from the start of their life to the end of their life, and tackle central health problems.

The Medical School started as a School strong in education to graduate future doctors, many of whom are now also involved in the research as faculty or collaborators of the Medical School. This report clearly highlights the high quality of the ANU Medical School, combining excellent research and education, all faculty working together to improve the life of people here in Australia and across the world.

Professor Zsuzsoka Kecskes - Acting director

Research Committee Chair Report

The year of 2020 with bushfires, hail and COVID19 has created real challenges for all involved in provision of health care, the training of health care professionals and health and medical research. ANU Medical School researchers in particular have stepped-up to the challenges and have been making remarkable direct contributions to the health and well-being of our communities. Unexpectedly through this year, the need to find new ways to communicate has brought Medical School researchers together more than ever which created a great opportunity for us to do a stock-take of our achievements and strengths and to plan our path forward.

This report gives visibility to the high quality of research undertaken by Medical School academics. While being known for graduating a high calibre of doctor, The Medical School should also be known for its excellence in research. The report highlights several areas of current and emerging strength within two broad research themes- “Future of Society and Health” and “Decoding Health and Disease.”

The contributions of Medical School researchers to leadership within several flagship research programs within the College of Health and Medicine (CHM) at ANU is clearly evident as is the engagement of its researchers in the development of evidence-based clinical guidelines and health policy.

The missions of The Medical School research going forward are to;

- (i) Advance Health through Knowledge
- (ii) Mobilise Great Science
- (iii) Attract, Strengthen and Thrive
- (iv) Engagement and Advocacy



Professor Christopher (Chris) Nolan - Chair of the research committee

ANU Medical School Mission Statement

Mobilise Great Science

Through our position at the interface of research and health care provision, Medical School acts both as a driver of our own cutting-edge research program and as a conduit of supporting translational research excellence across the university, nationally and internationally.

Attract, Strengthen and Thrive

The Medical School will build a reputation for excellence in health and medical research through rich and diverse collaborations which will strengthen our distinctiveness in research, to attract current and future health and medical research leaders and to create a robust research landscape to optimise discovery through translation to clinical practice and policy.

Advance Health Through Knowledge

The Medical School will create new knowledge through health and medical research, advancing our curriculum to ensure future health care professionals and leaders in medicine are knowledgeable, and to implement new knowledge from research into policy and practice so as to advance the health of nations.

The Medical School will proactively strive to include collaboration, be valued and supported by consumers, Indigenous people, vulnerable groups, the general public, health care providers and all levels of Government throughout its research pipeline and strategically aim to introduce best practice to the university sector in Australia and globally.

Engagement and Advocacy

Leading Disaster Response:

Stepping-up to help our community during the bushfires and COVID-19

Haze and Health

During the recent crisis, air quality across the country reached hazardous conditions and the ACT was one of the most affected areas. The ANU Medical School was actively involved in the health response and providing support, working tirelessly to support our staff and students directly impacted by the fires as well as providing medical expertise to fire affected communities.

The long-term effects of bushfire smoke and the resulting quality of air are currently unknown, and the Medical School is leading research in a number of areas to determine what supports and resources will be needed into the future to address the physical and mental damage of living in smoke haze. Some of the research areas and community resources include:

- Bushfires and COVID-19: the impact on mothers and babies (Mother and Child 2020-MC2020 study).
- Community Trauma Toolkit
- Bushfire smoke Storybook
- Effects of exposure to bushfire smoke on lung function in Canberra residents during the 2019/2020 bushfire season
- Novel smoke exposure questions in ACT Kindergarten Health Check
- Smoke, heat and fear of fire in the ACT

Many of our researchers have been drawn upon to provide frank and trusted advice to local and national media outlets. Of particular note are contributions by Professor Peter Collignon, Associate Professor Sanjaya Senanayake, Dr Nick Coatsworth, Professor Paul Kelly, Professor Michael Kidd and Dr Jason Agostino. Between January and August 2020, collectively they have contributed their expertise to over 10,800 media items. This includes leadership efforts of our Early Career Researchers like Dr Amita Bansal (featured in Canberra Times, Bega District News). and Amanda Wingett who, respectively, lead the Developmental Programming and Aboriginal Health teams of the MC2020 study, Dr Kathleen O'Brien who is part of the international Quick COVID-19 Clinician Survey, and Dr Lillian Smyth who leads the Medical Education and COVID-19 Hub.

Pandemic Response

Diverting staffing to the frontline of service provision and policy making in the territory, the Medical School is working to keep our community safe. They have been seconded, influenced conversations and entrusted to provide essential information to improve key decisions. At the national level, key staff are embedded in the Federal and Territory Governments, working directly with the Chief Medical Officer. Some of the research and policy areas include:

- COVID-19 General Practice Clinicians, Rapid, Rolling survey for Policy Impact
- Rapid Appraisal of ACT healthcare workers perceptions of care delivery in the context of the COVID-19 epidemic
- Lessons for distance education and e-learning, forged in the crucible of a pandemic
- Severe Acute Respiratory Distress Syndrome: Generating Evidence in Australia and New Zealand (SAGE-ANZ) during the COVID-19 pandemic
- Evaluating collaborative processes in the COVID-19 response
- Informing the mental health response for Aboriginal and Torres Strait Islander peoples during COVID-19

The ANU Medical School has provided clinical leadership and innovative research at the highest level during the disastrous bushfires of 2019-2020 and the ongoing COVID-19 pandemic.

Theme 1: Future of Society and Health

The Future of Society and Health team applies a translational and applied social research lens to medicine and education. The Future of Society and Health interdisciplinary research group brings together researchers from diverse fields, drawing upon expertise in psychology, social science, pedagogy, medical science, technology enhanced learning and teaching, and clinical training. Many of its members have been recognised by teaching and research awards. Their reputations acknowledged by invitations to lead national and interdisciplinary collaborations, in doing so driving changes in national health policy. This strong group, places the ANU Medical School in an excellent position to be a leader in applied and translational research in medicine. What follows are research highlights from members of the ANU Medical School Future of Society and Health theme.



HealthANSWERS Partnership



HealthANSWERS
Education | Research | Services

HealthANSWERS is a collaboration between three universities - ANU, University of Wollongong and University of Canberra - and regional health partners, including Canberra Health Services, ACT Health Directorate, Southern NSW Local Health District (LHD), Illawarra Shoalhaven LHD, Murrumbidgee LHD, and the primary health networks (Capital Health Network and Coordinare) in those regions, as well as Katungul Aboriginal Corporation Regional Health Care, Calvary Hospital, NSW Ambulance and the Health Care Consumers Association.

The key research priorities for the team are end-of-life care, mental health, chronic disease and cancer care. The communities within the HealthANSWERS footprint are still recuperating from the direct impact of the drought and the 'black summer' bushfires of 2019/2020. Now, with COVID-19, the compounding effects of two major crises, one after the other, has placed great stress upon health services in the region.

The simple but powerful goal of the partnership - to improve service delivery and health outcomes in the region through translational research, education and services - is creating positive change for the 1.2 million people it supports.

Professor Christine Phillips, lead ANU Medical School HealthANSWERS member explains how the research undertaken this year is helping vulnerable health services and populations. "We were able to provide an early rapid health assessment of the impact of bushfires on the people of Katungul. Since then, the World Wildlife Fund (WWF) has funded a project to examine the impact of the fires on land and water and social and emotional well-being for the Mogo Land Council. All the partners have collaborated to support Mother and Child 2020 exploring the impacts of COVID and bushfires on mothers and babies in the region. The partnership has received Medical Research Foundation Fund (MRFF) funding for a collaborative project led by University of Canberra on vulnerable children in Canberra."

Although the partnership is still young, they've already made impressive headway to innovate the health system and improve the lives of the communities they assist through evidence-based recommendations. They will continue to influence policy and practice in the future with their collaborative approach and vision to create universal access to optimal healthcare and health promotion for regional areas.



Improving End-of-life



The increasing number of people over 65 years of age is shining a spotlight on end of life care, now more than any other time in history. It turns out, the majority of Australians have difficulty communicating their end-of-life wishes to their loved ones and doctors. This can impact the quality of their final days and cause unnecessary anxiety.

Professor Imogen Mitchell

Leading research by Professor Imogen Mitchell and Dr Brett Scholz is shaping the narrative of end-of-life care by involving the voices of all the key players in palliative care – the doctor, the patient and their carers. Their work has already created communication protocols and resources that doctors can use during end-of-life discussions in the ICU. Current work will extend upon this to create a patient-centred end-of-life care consultation process, which can be applied across clinical disciplines nation wide.

Professor Mitchell and Dr Scholz have made remarkable strides with their research with multiple recent publications on the topic and success in attracting research funding to support ongoing projects about consumer leadership and communication in end-of-life care. Looking to the future, the team is building capacity in end-of-life care through supervision of PhD and medical student research projects.

Indigenous Health

Dr Stewart Sutherland is a proud Wiradjuri man from New South Wales who is committed to ensuring that Aboriginal and Torres Strait Islander people and their health are at the core of the Medical School curriculum and that the research undertaken by the Medical School works towards Closing the Gap. Leading an emerging research hub focussed on the social and emotional wellbeing of Aboriginal and Torres Strait Islander peoples, Dr Sutherland brings a holistic approach to health.

The Aboriginal and Torres Strait Islander team aims to convey the value of bringing Indigenous knowledge and leadership to excellence in education and research, as well as policy consultation. The team's strong engagement with Aboriginal Health and Community Services, such as Winnunga Nimmityjah, and other peak Aboriginal Health organisations has allowed medical students to conduct high impact research.

In an exciting collaboration with, ANU, University of Manitoba, Lincoln University, and indigenous Communities, Dr Sutherland is Revitalising Indigenous Food Traditions and Knowledges (RIFTk). Colonisation has taken much from indigenous people, including food Knowledge Systems. This

collaboration aims to rebuild the understanding of traditional foods and food practices focussing on how indigenous people have used food as medicine over millennia. This work will advance knowledge and ultimately contribute to improving the social and emotional wellbeing (SWEB) of Aboriginal and Torres Strait Island people and indigenous people globally.

In response to the “black summer” bushfires of 2019/2020, Dr Sutherland has worked with Aboriginal communities on the South Coast to understand the environmental damage, and the trauma suffered. He is a leading voice and collaborator on the National Pandemic Response Plan for the Mental Health and SEWB of Aboriginal and Torres Strait Islander people.

Dr. Stewart Sutherland and the Aboriginal and Torres Strait Islander team



“Health is not merely the absence of disease in the physical body, but involves the social and emotional wellbeing of the person, community and environment.” - Dr. Stewart Sutherland

Perspectives and Research on Interdisciplinary Medical Education (PRIME) Team

The PRIME team, led by Associate Professor Krisztina Valter, Associate Professor Alexandra Webb and Dr Lillian Smyth, seeks to answer crucial questions about the future of medicine, how best to prepare future clinicians and develop medical education practices. Their goal is to advance the education and training of the “doctor of the future”.



Medical Education

The ANU Medical School is at the forefront of advancements in medical education, developing cutting edge-workshops to advance teaching and learning, representing the Medical School at international conferences and publishing widely. The team (Dr Georgia Pike, Riemke Aggio-Bruce, Mila Knezovic, Dr Suzanne Estaphan, Associate Professor Gerry Corrigan and Kat Esteves) mobilised during the COVID-19 pandemic to support online delivery of our medical curriculum. The experiences of lockdown and its impacts on wellbeing, learning approaches, online learning, academic performance, informal study groups, and clinical skills acquisition are all being explored. The outcomes of this research will inform the re-imaging of medical education for the future. Associate Professor Katrina Anderson a primary care physician, and one of the leaders of primary care training at Medical School. Her research focuses on multi-level learning in the GP context. She leads the Healers Art Program to aid empathy development in medical education.

Innovative Anatomy Education

The Medical School is a leader in the use of visual arts techniques to aid learning. The innovative visual arts and learning program has been implemented in anatomy classes leading to a new theme of work in the Australian and New Zealand Association of Clinical Anatomists field. The team, Associate Professors Valter and Webb collaborating with Elisa Crossing, Dr Lillian Smyth and Dr Ajay Limaye, regularly publishes their work and present at conferences.

The Social Experience of Learning

Learning is not simply a transmission of information, but is a social experience. Dr Smyth leads a program of research examining the social experience of learning in order to inform the effectiveness of the curriculum, improve student wellbeing and develop novel approaches to learning. This research has a practical focus, with immediate applications to policy and practice. Dr Smyth has provided expert advice across campus to develop and evaluate programs that contribute to ANU student education and wellbeing.

The Social Foundations of Health and Medicine

Our team of social scientists apply a range of multi-disciplinary approaches to the critical study of health and health care. We combine social science with population health, clinical medicine, education, medical science and policy, to generate innovative translational research, while critically examining the foundations of medicine and health care delivery.

With a focus on diversity and equity in health and health care, our programs of work cover an array of contemporary issues.

Our Global Social Medicine research program addresses global insecurities in health; forced migration, settlement and health; climate change and health. Professor Phillips has advised the WHO and UNHCR on responsive systems of health care for migrants and refugees, and changes in international screening policies for humanitarian entrants.

Our Humans at the Centre research program works to improve the lives of drug users, sufferers of violence, those with mental illness and asylum seekers, with many of our programs focusing on critical examination of health care and policy. Our research has led to changes in service design for refugees, and the evidence of impact of overdose harm reduction interventions for drug users. Dr Anna Olsen is the Australian lead of a multinational project funded by the Economic and Social Research Council on the experiences of women who use drugs.

Our Critical Questions in Health program addresses pressing contemporary questions such as conscientious objection; gendered safety in health care institutions; and end of life care. Associate Professor Louise Stone has led the first study exploring the sexual abuse within the medical profession, which has attracted international attention about safe workplaces for women. Dr Nathan Emmerich brings a bioethical lens to questions such as conscientious objection and notion of morally permissible mistakes.

The efforts of our researchers in the last five years have been recognised through awards for research impact, invitations to address prestigious international assemblies, and success in attracting research funding of over \$5 million. We provide training for students and professionals in applied and translational social sciences in health. Our doctoral program frames these programs through a specialised focus on health and health care in Australia and South-East Asia.

Pill testing at Canberra music festivals

Testing the constituents of pills is a harm minimisation approach which, prior to 2018, had not been trialled in Australia. Dr Olsen led the ground-breaking evaluation of Australia's first pill-testing service at a Canberra music festival. Her research demonstrated that pill-testing has a role in preventing harm and impacted on young people's decision-making about drugs. The pill-testing report release was one of the most prominent harm reduction news stories of 2019, reaching a potential audience of 9.4 million. The findings have been instrumental in building the Australian evidence base around pill-testing, and Dr Olsen has been invited to present on this work to the Australian National Advisory Council on Alcohol and Other Drugs and the Queensland Mental Health Commission.





General Practice and Primary Care Research

ANU Medical School GP researchers conduct research that helps to articulate, measure, and value primary health care within the broader health care system. The team which included Medical School researchers Professor Kirsty Douglas, Dr Penny Burns, Associate Professor Louise Stone and Dr Jason Agostino, as well as an active Practice Based Research Network of GPs, drives primary health care research in the region and contributes to research across the whole College. They work in partnership with ACT Health, building a direct pipeline between research, clinical provision and policy.

At the coal face of healthcare for our nation, the team produces high impact policy and practice relevant research. Mobilising during the COVID-19 pandemic the Medical School GP researchers spearheaded local and international projects that produce essential knowledge on needs of the primary health care system, telehealth, geomapping and disaster response frameworks. Major programs of work include:

- The ACT Health Kindergarten Health Check and its associated policy research has produced regular outputs and multiple publications exposing the relationship between physical activity and mental health and tracking childhood obesity.
- With a large program of work on cardiovascular disease the team has directly impacted national Indigenous cardiovascular disease screening guidelines and received funding to improve management of cardiovascular disease risk for dementia prevention in Indigenous Australians.
- The primary health care system provides an arena for collating big data on population health as well as investigating associated practical and ethical issues. Professor Douglas is a CI on a novel project measuring absolute cardiovascular risk using mammography and machine learning of big data. Dr Melinda Choy has led work on the Digital Divide including hosting a high level policy roundtable in association with the Crawford School.

Rural Clinical School Research

With the ultimate aim of “rural proofing” health systems across the vast areas of Australia that exist outside of major cities, the ANU Medical School Rural Clinical School provides academic and clinical support to rural and remote Australia. The Rural Clinical School research program is working to translate health policy to rural Australia, improving practice of care and ultimately leading to better health and wellbeing of remote and regional areas. Key programs of work include mental health care, end-of-life care, e-health use and literacy, chronic illness, health workforce development, and medical education. The team (Professor Amanda Barnard, Associate Professor Malcolm Moore, Dr Claudia Slimings, Dr Nyoman Sutarsa, Sally Hall and Suzanne Bain-Donohue) was awarded a 2020 Global Research Partnership Scheme grant to establish a partnership with Udayana University in Indonesia, advancing the health of rural workforces and communities across both nations.



Theme 2: Decoding Health and Disease

For decades, researchers studying health and diseases have devoted most of their time to understand what risk factors predispose us to disease, and how we might better diagnose and treat it. This team plans to decode the complexities of health and disease, providing best practice healthcare solutions for our region and beyond. At the heart of this research theme is a combination of fundamental and translational research bringing together over 30 researchers with diverse expertise in molecular biology, microbiology, pharmacology, proteomics, immunology, neuroscience, RNA biology, pathology and genomics. This team places the ANU Medical School in a position to discover new ground-breaking insights into the mechanisms causing healthy ageing and chronic diseases, as well as collaborations across the ACT Health Sector, and national and international networks to drive ideas from clinic to bench and back again. What follows are research highlights from members of the Medical School Decoding Health and Disease theme.



Vision Science

Eyesight is perhaps the most valued sense we possess. Our sight allows us to take in a huge amount of information and influences the way we perceive the world. According to the World Health Organisation, globally at least 1 billion people experience a vision impairment that could be prevented or hasn't been addressed. Without research into the prevention of vision loss from retinal degenerations, it is guaranteed that **1 in 7 people** will lose the sense of sight.

Retinal degenerative diseases including age-related macular degeneration (AMD), a leading cause of irreversible blindness in the world, are the areas that Dr Riccardo Natoli, Associate Professor Rohan Essex and Associate Professor Krisztina Valter and their growing team of early to mid-career researchers are exploring. Partnering with leading members of the Medical School and John Curtin School of Medical Research including Professor Trevor Lamb, Professor Ted Maddess, Professor Christian Lueck, and Professor Chris Nolan, Vision Sciences is focused on exploring the specific pathological causes of retinal degenerative diseases, allowing for the development of novel therapeutic strategies for these complex diseases.

A Vision for the Future

Dr Natoli is a prominent researcher in both foundational and translational sciences. His work on microRNA, small gene regulators, has won him an ANU Translational Fellowship in 2019, and enabled the establishment of commercial partnerships and funding from Beta Therapeutics, Genentech, EyeCo and MuPharma. His research into diagnostics using miRNA garnered national media coverage, reaching 2.3 million people in 2018-2019 and in 2019 he was awarded the ACT Tall Poppy research prize for his research and outreach programs. In 2017, Dr Natoli established Clear Vision Research lab to provide a framework for supporting the next generation of vision researchers, as well as a school outreach program called the 'Young Visionaries' to promote

the importance of scientific curiosity and eye health. Working with ANU Advancement, a PhD scholarship - the K.T. Tan scholarship, is to be awarded to a PhD student this year to foster an entrepreneurial minded vision scientist.

Saving Babies Sight

Associate Professor Valter is a world-renowned expert in photobiomodulation, a non-invasive treatment that uses red light to reduce oxidative damage and inflammation, for the treatment of retinopathy of prematurity, a developmental form of blindness. She has established strong collaborations with prominent vision scientists and clinicians both nationally (Prof Abdel-Latif Mohamed (Neonatology), Prof Jane Dahlstrom (Pathology), A/Prof Rohan Essex, Dr Riccardo Natoli) and internationally (Prof Janis Eells University of Milwaukee, USA) which helped secure funding from the private practice fund

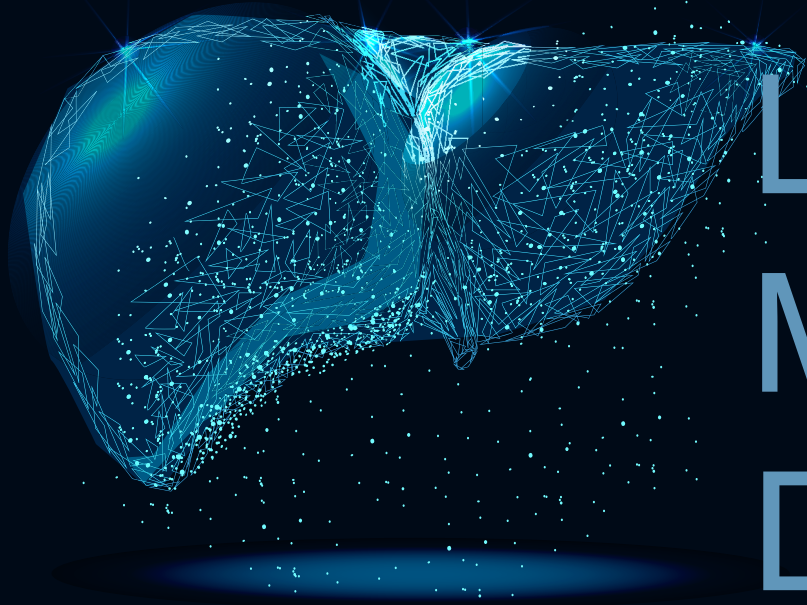
to further develop this groundbreaking technology. She has further developed strong industrial ties with Lumithera, MultiRadiance and Bendor Research to develop photobiomodulation devices for the treatment of retinal diseases, and improving health outcomes to pre-mature neonates.

The Future is in Sight

The Vision Science group is progressing plans for an ACT Retinal Personalised Medicine Centre located at the ANU. The Centre would be a breeding ground for novel therapeutic development of currently incurable visual disorders. Driven by Dr Natoli, Associate Professor Essex, and Associate Professor Valter, this Centre will bring together expertise from across the ACT and the country, drawing on the molecular, animal model and clinical expertise of this group to provide improved health solutions to currently incurable retinal conditions.

ACT Retinal Genomics

Associate Professor Essex is an ophthalmologist who holds appointments at Canberra Hospital, the Royal Victorian Eye and Ear Hospital, Melbourne and the Medical School. Dr Essex leads a bi-national retinal surgery registry, is on the steering committee for Save Sight Registries (University of Sydney), and was recently appointed Chief Medical Information Officer (CMIO) for the ACT. His contribution to the field of real-life outcomes of retinal disease, particularly macular hole and macular degeneration is considerable. Through his appointment as CMIO, Associate Professor Essex is exceptionally well placed to bring the academic and clinical streams together, both in the field of retinal disease, but also more broadly across the health system. Work led by Associate Professor Essex is underway to explore the feasibility of linking the territory-wide digital health record to the results of whole exome sequencing, commencing with the work already done by Canberra Clinical Genomics, then using the expertise of the Genome Informatics Laboratory and the computing power within the National Computational Infrastructure at ANU.



Liver and Metabolic Diseases

Ageing and chronic liver disease lead to deaths from cirrhosis and primary liver cancer (hepatocellular carcinoma, HCC). HCC is among the top 3 causes of cancer death worldwide. In recent years, non-alcoholic fatty liver disease (NAFLD), a condition associated with overweight and its metabolic complications, has overtaken hepatitis C, hepatitis B and alcoholic liver disease as the most important causes of cirrhosis and HCC.

The ANU Medical School researchers, Professor Geoffrey Farrell and Professor Narci Teoh have been at the forefront of liver disease research in Australia and internationally, with work that traverses fundamental discovery, clinical studies and implementation of research into policy and clinical practice. Major contributions include:

- A community outreach program of curative treatment for hepatitis C and antiviral intervention against hepatitis B, removing these conditions as indications for liver transplantation and lessening their impact on HCC incidence.
- Seminal contributions to the understanding of the mechanisms of liver cell injury and inflammatory recruitment that cause NAFLD transition from simple steatosis to non-alcoholic steatohepatitis (NASH) that leads to cirrhosis. These include a pivotal roles of free cholesterol and the NLRP3 inflammasome.
- Demonstration of a protective effect of the pharmacological agent seladelpar against NASH. Seladelpar is currently being taken forward to phase 3 clinical trials for NASH.

- Characterisation of the role of cell cycle molecules that promote cell proliferation in driving hepatocarcinogenesis.
- Demonstration in a small animal model that exercise can abolish the increased risk of HCC associated with obesity and diabetes. At the same time a prospective human cohort, inclusive of obese individuals, has confirmed that regular physical activity substantially reduces death from cirrhosis and HCC.
- Use of serial liver stiffness measurements to determine which persons with NAFLD/NASH are at greatest risk of progressive disease and warrant more aggressive interventions.

In collaboration with Professors Farrell and Teoh, Professor Chris Nolan and Dr Viviane Delghingaro-Augusto have been investigating the mechanism of diabetes development in the same and related small animal models. Their focus is on the insulin producing pancreatic islet beta-cells and how insulin hypersecretion leading to hyperinsulinism drives the metabolic syndrome and its associated conditions of NASH, type 2 diabetes and atherosclerotic cardiovascular diseases.

Our Health in our hands (OHIOH)

The ANU has established a grand challenge scheme that is predicated on the assumption that difficult and important problems can be solved by taking ambitious and interdisciplinary approaches. The inaugural grand challenge was awarded to a team of researchers from the College of Health and Medicine (CHM) and College of Engineering and Computer Science (CECS), called Our Health in Our Hands (OHIOH).

OHIOH aims to transform health care, through deep personalisation of medicine, through embedding innovative diagnostic and health monitoring capability into clinical environments and everyday life, supported by novel data solutions, irrespective of location or social circumstances, using the ACT and SE-NSW region as the testbed. A co-design approach, which includes disease affected participants themselves, their families and carers, their clinical carers and OHIOH researchers is being used.

The program has chosen to focus on two diseases, type 1 diabetes (T1D) and multiple sclerosis (MS), both being chronic diseases of autoimmune origin which require ongoing monitoring and adjustment of therapies. Central to the success of this grand challenge is the establishment of OHIOH MS and T1D research cohorts, which are being led at the

research-clinic interface by ANU Medical School researchers. The multidisciplinary paediatric and young adult diabetes teams are now highly engaged partners in OHIOH. This coordinated program will provide a model for advanced health care in the 21st century.

Medical School researchers, Professor Matthew Cook (OHIOH co-chair, genomics and bioinformatics lead), Professor Christian Lueck (multiple sclerosis clinical lead) and Professor Chris Nolan (type 1 diabetes clinical lead) are key members of the interdisciplinary OHIOH research leadership team. The OHIOH research program brings together four research themes focusing on T1D and MS. The research themes are:

- I. Biomarkers and devices for diagnosis and disease monitoring - to discover, design and develop novel biomarkers and wearable/portable medical sensing devices to enable the frequent collection of personal phenotypic information;
- II. Genomics and bioinformatics - to integrate genomic variation with detailed phenotypic characteristics to increase likelihood of precision in diagnosis to enable more effective and personalised care;
- III. Big data - Machine learning and artificial intelligence approaches will be used to integrate complex phenotypic and genomic data, making possible personalised clinical decision making that is accessible at the clinical interface.
- IV. Health experience - transforming existing provider-centred health care delivery systems to person-centred systems through a person-focused clinical, ethical and legal framework.

For more information see
<https://www.anu.edu.au/research/research-initiatives/our-health-in-our-hand>



Pathology

A photograph of Professor Jane Dahlstrom, a woman with long brown hair and glasses, wearing a black and white jacket. She is sitting at a desk in a lecture hall, with a chalkboard filled with handwritten notes and diagrams in the background.

What do chronic diseases have in common? They all rely on the work of Pathologists to diagnose, drive treatments and often predict prognosis for patients.

Thanks to the relationships that have been cultivated by Professor Jane Dahlstrom within her team at ACT Pathology, and amongst national and international collaborators, the ANU Medical School has been able to publish ground breaking research on a wide array of diseases. Their work is influencing research and policy making, nationally and internationally.

Microbiology

Landmark findings on antibiotic resistance by the Department of Microbiology have improved policies and actions in Australia and overseas resulting in better measures to control levels of resistance. Their work has informed the current WHO guidelines on medically important antibiotic use in food animals. As a result, McDonald's global food policy now restricts the use of "critically important antibiotics" for human health in contracts from their meat suppliers.

Haematology

Over the last 5 years the Department of Haematology has had 32 national or international clinical trials in active recruitment or follow up. One of the stand outs is the MURANO international clinical trial for management of lymphomas. The study discovered a successful combination of drugs resulting in significantly higher rates of progression free survival from cancer than a previously used combination of drugs.

Chemical Pathology

In Chemical Pathology, researchers have gained international attention with their reference interval studies, which are in short supply in the literature. The AUSSIE Normals study led to reference intervals for a healthy Australian population and is being used to introduce uniform reference intervals in all pathology laboratories around Australia and New Zealand. In addition, the study showed there is an age effect in cardiac troponin concentration, which is used for diagnosing heart attacks. The LOOK (Lifestyle Of Our Kids) study on Australian children was the first large study on truly healthy children. It has influenced a number of international studies, including the Canadian CALIPER study where their methodology of participant selection was changed on the basis of the LOOK data.

Anatomical Pathology

Academics in the Department of Anatomical Pathology, and collaborators, have attracted more than \$3.5 million of funding to support research over the past 5 years. Funding bodies include NHMRC, Cancer Council, Private Philanthropy and the Canberra Hospital Private Practice Fund. Research areas include cellular mechanisms of disease, cancer drug development and pregnancy outcomes.

Professor Dahlstrom and her team represent an important bridge between medicine and fundamental science. Their focus on discovering and treating diseases is supporting the sustainability of the health system and providing better health outcomes for the general population.

Immunology, Genomics and Personalised Medicine

Professor Matthew Cook is the Professor of Medicine, immunologist and clinical researcher at the ANU Medical School and The John Curtin School of Medical Research. His research focuses on explaining the genetic basis and cellular mechanisms of primary human immune deficiency diseases. He has been central in establishing a number of research programs including Canberra Clinical Genomics (CCG), the Phenomics Translational Initiative (PTI), The Australian Genome Health Alliance (AGHA) and Our Health in Our Hands (OHIOH, page 27). These programs extend Professor Cook's research and clinical approach beyond immunology to multiple medical conditions, placing the ACT at the forefront of personalised medicine.

Canberra Clinical Genomics

Canberra Clinical Genomics (CCG) is a flagship translational medicine program that was established as a substantial joint initiative of Canberra Health Services (CHS) and ANU and is now the sole provider of publicly funded whole exome sequencing for the ACT. CCG obtained NATA accreditation for whole exome sequencing (WES) in 2018 and is therefore one of only a very small number of providers of this service in Australia. This diagnostic platform supports research at the Medical School and across the ANU to find possible new causes of genetic diseases.

Australian Genome Health Alliance

In 2015, the NHMRC awarded a \$10M grant under a Targeted Call for Research scheme aimed at resolving obstacles in implementing genomics into routine clinical practice. Clinicians, researchers and genetic counsellors from the Canberra Hospital and ANU form a hub of the Australian Genome Health Alliance (AGHA). Professor Cook is leading one of the AGHA rare disease flagships (Genetic Immunology) which comprises a network of clinicians and researchers from across Australia. With 200 families already enrolled, this Medical School-led research program has advanced discoveries of mechanisms of immune disease.

Phenomics Translation Initiative

The Phenomics Translation Initiative (PTI) is an ambitious and remarkable collaboration that spans discovery of disease mechanisms to cutting edge clinical practice. The PTI is \$10M award from the Medical Research Future Fund that supports the development of research platforms that will help us advance the quest to link genetic variation (genotype) to the manifestations of disease (phenotype). The PTI is patient-focussed and is already developing models for cancer, eye disease, immune diseases, and developmental disorders.

Fundamental Research

The power of fundamental research

The ANU Medical School has a large program of fundamental research covering research disciplines such as immunology, neurology, vision sciences, metabolic disorders, microbiology and infectious diseases drawing expertise from across the school and other colleges across the ANU. Our program of fundamental research aims to address root problems in health. Through practices in the lab, we aim for huge societal impact. Without the type of research performed by ANU Medical School researchers Associate Professor Richard Callaghan, Professor Kevin Saliba, Dr Denisse Leyton and their teams, the foundation for breakthroughs in medicine wouldn't exist.

Building blocks to disease control and treatment

Associate Professor Callaghan and his team are focussed on membrane transport which is essential for the growth, stability and defence of cells in the body. Disruption of membrane transport contributes to the development, or progression, of many diseases, and it also plays a role in the failure of many therapeutic strategies. By understanding the contributions of membrane transport processes to disease, the team is creating the building blocks for future treatments and disease control, including for overcoming resistance to chemotherapy in cancer, preventing vision loss, and the development of novel therapies for Alzheimer's patients. Recently, the team has generated a significant technological breakthrough by developing a nanoscale semi-synthetic membrane mimic that will greatly accelerate the pace of research with transporters, including for drug discovery.

Understanding infectious diseases

One of the world's major health issues is bacterial infections. Dr Leyton and team study autotransporters which are responsible for infectious diseases such as diarrhoea, whooping cough, cholera, chlamydia, and bacterial meningitis. Autotransporters help establish infection and contribute to disease by disrupting the hosts immune system. Their work will enhance understanding of how autotransporters are assembled into bacterial outer membranes, and how they function to mediate infection and disease once they get there. This offers new opportunities to treat bacterial infections.

Tackling the malaria parasite

With no malaria vaccine available and the rise in antimalarial drug resistance, new antimalarial drugs are urgently needed. Professor Saliba's team is working to overcome this major health problem by exploring the disease-causing red blood cell stage of the human malaria parasite *Plasmodium falciparum*. This stage of the parasite's lifecycle requires an extracellular supply of several vitamins in order to survive. The mechanisms by which the parasite acquires and metabolises these vitamins are potential antimalarial drug targets and the team is investigating various vitamin analogues as antimalarials.

Trauma and Orthopaedic Research Unit (TORU)

The Trauma and Orthopaedic Research Unit represents a remarkable collaborative research success story. The unit was established by Professor Paul Smith at Canberra Hospital in 2000. Since establishment of a laboratory arm in 2005 at ANU, TORU has developed as an important nexus between the clinic, medical school and laboratory providing a rich environment for research, medical education and clinical excellence. TORU takes a healthy approach of collaboration that involves the University of NSW (ADFA), University of Canberra, as well as the universities of Cardiff, Melbourne and Auckland. Dr Diana Perriman leads the clinical team and facilitates the Unit's collaborative approach to research.

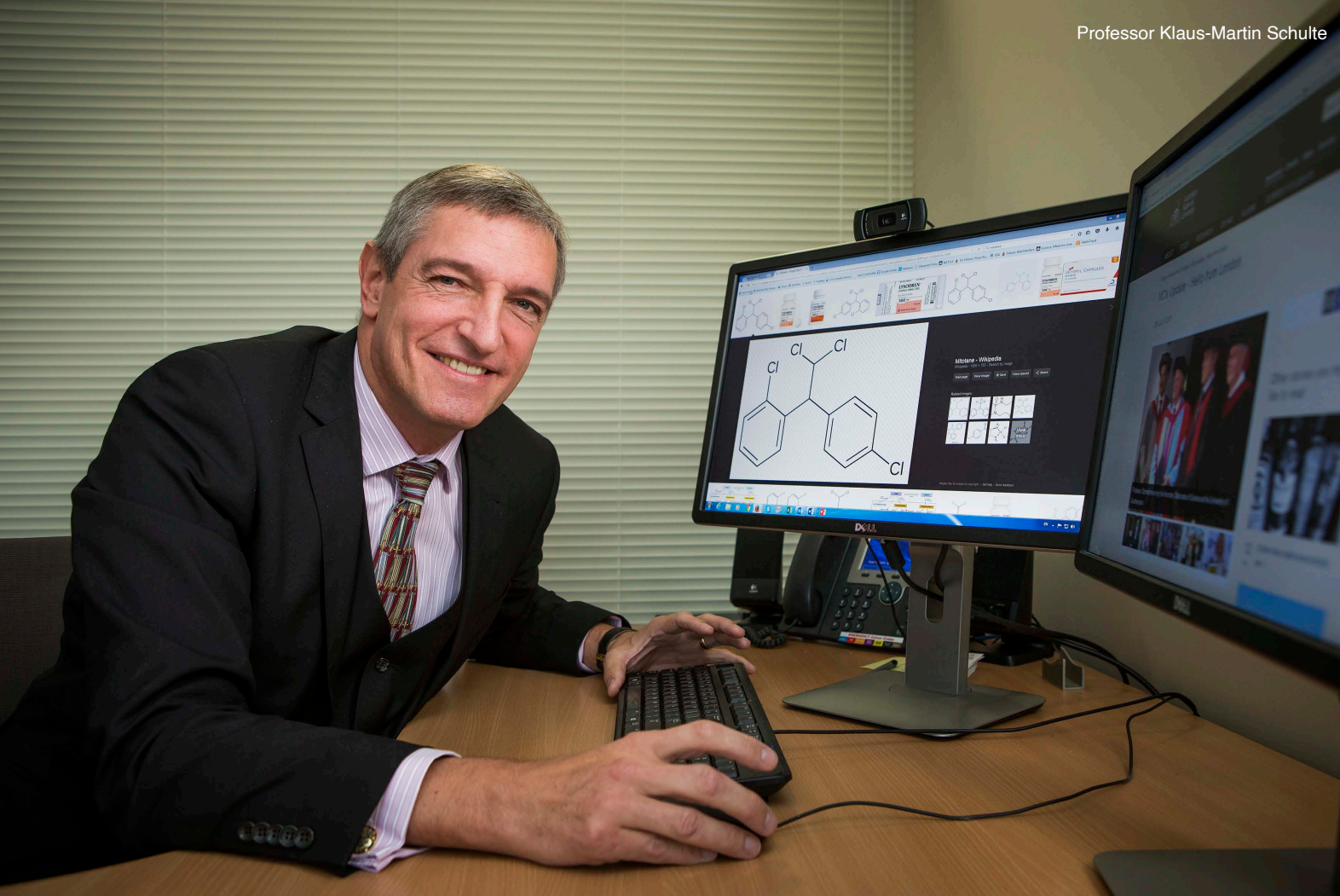
Leading research that facilitates important discoveries in osteoarthritis, rheumatoid arthritis and advanced implant technology, TORU aims to improve the lives of those affected by diseases of the bone. Innovative research driving clinical practice change includes:

- Novel therapies to prevent bone fractures and increased healing rates.
- Identification of new, longer lasting materials for use in knee replacements.
- Developing image registration technology to improve diagnostic and treatment outcomes.
- Trailing the effectiveness of different surgical techniques in knee replacement.
- Investigating the aetiology and treatment of gluteal tendon disease in collaboration with Dr Angie Fearon from the University of Canberra.

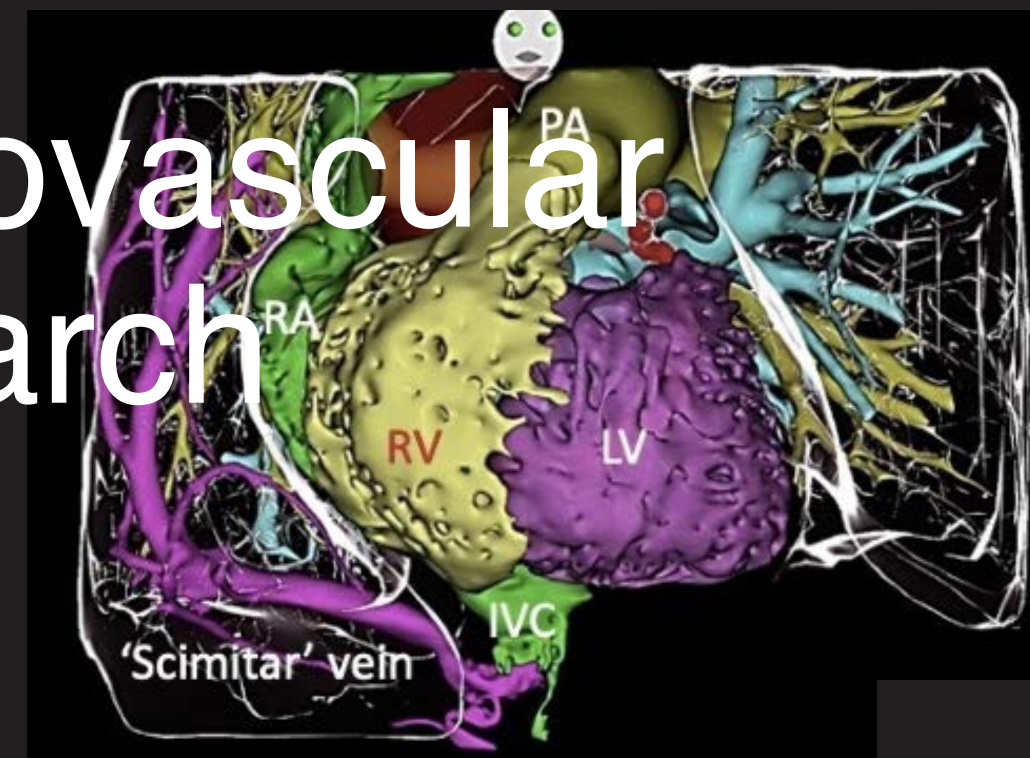
- The team has been running a long-term randomized clinical trial examining deep flexion of the knee joint in six degrees of freedom before and after implantation of three different knee replacement designs.

Associate Professor Rachel Li leads the laboratory team in the John Curtin building as an ANU Medical School academic. The team's innovative work on genetic biomarkers for bone diseases is aimed at the prevention of bone fractures and increased healing rates of fractures through novel therapies.

In addition to providing world-class research, the TORU team uses their expertise to educate upcoming generations of academic surgeons. Trainees participate in research and develop skills in connecting evidence and practice in a clinical setting.



Cardiovascular Research



ANU Medical School cardiovascular research is led by clinician researchers with expertise in the fields of cardiac imaging, heart failure, cardiac electrophysiology and clinical trials.

heart schematic

Cancer research

The team is undertaking an exciting collaborative project on the cellular stress response at the intersection of soft-tissue tumours and DNA Damage Response (DDR)-deficient epithelial cancer to enable the investigation of molecular mechanism of sarcoma and emerging actionable drug targets.

Using novel technology to conduct investigations into the cellular stress response, and its association with cancer, the Cancer Research team are paving the way for new evidence and possible treatments. The team is undertaking an exciting collaborative project on the cellular stress response at the intersection of soft-tissue tumours and DNA Damage Response (DDR)-deficient epithelial cell cancers to enable the investigation of the molecular mechanisms underlying sarcoma and emerging actionable drug targets. Employing the ACRF Biomolecular Resource Facility, including its unique robotic drug screening platform and 3D-bioprinting platforms, the collaborative team (Professor Klaus-Martin Schulte,

Professor Ross Hannan, Professor Eduardo Eyras, Dr Christina Carroll, Anne Steins, and Dr Lex van Loon) are shedding light on DNA damage in order to identify possible mechanisms for cancer treatment and prevention. Internationally, the project is set to cooperate with Dr Robin Jones, a world leader in clinical sarcoma care at the Royal Marsden Hospital, London, UK. The project is funded by a generous personal donation from the Miami-based Max-Lindemann-Memorial Foundation, with a further philanthropic grant from the UK-based Alexander-Pigott-Wernher Memorial Foundation, both received through Professor Schulte.

Professor Walter Abhayaratna is a staff specialist cardiologist at Canberra Health Services with sub-specialty research interests in preventative cardiology and heart failure management. Since 2007, he has been the Director of Clinical Trials at ACT Health, overseeing an increase in clinical trials by 400%, with an extension towards earlier phase clinical trials and the implementation of a 'Hub and Spoke' governance structure that includes core research support functions to ensure that the quality of research will continue to increase our National reputation as a Clinical Trials Centre of Excellence.

Professor Abhayaratna's key research achievements in heart disease have been through his leadership in investigator-led clinical studies. Examples of his contributions include:

- Determining echocardiographic parameters associated with risk of cardiac arrhythmias and heart failure.
- Providing an evidence-base to inform best-practice for atrial fibrillation management.
- Showing that increased body mass and adiposity and decreased cardio-respiratory fitness are

associated with arterial stiffening in healthy prepubescent children in participants of the Canberra-based Lifestyle of Our Kids (LOOK) Study.

Associate Professor Rajeev Pathak is a staff specialist and consultant cardiologist at Canberra Health Services with sub-specialty expertise in cardiac electrophysiology. Since 2018, he has established Cardiac Electrophysiology (EP) services at the Canberra Hospital using 'state-of-the-art' multi-modality imaging techniques to increase the safety and effectiveness of therapy for life-threatening cardiac arrhythmias. He has commenced EP PhD fellowship program through ANU.

Associate Professor Pathak and Professor Abhayaratna led research which established the benefits of healthy lifestyle measures and weight loss on the longer term prevention of atrial fibrillation recurrence. Rajeev has contributed to a large number of studies on the use of catheter ablation techniques for multiple types of cardiac arrhythmias. They have each contributed to national and international guidelines on the management of heart failure and cardiac arrhythmias.

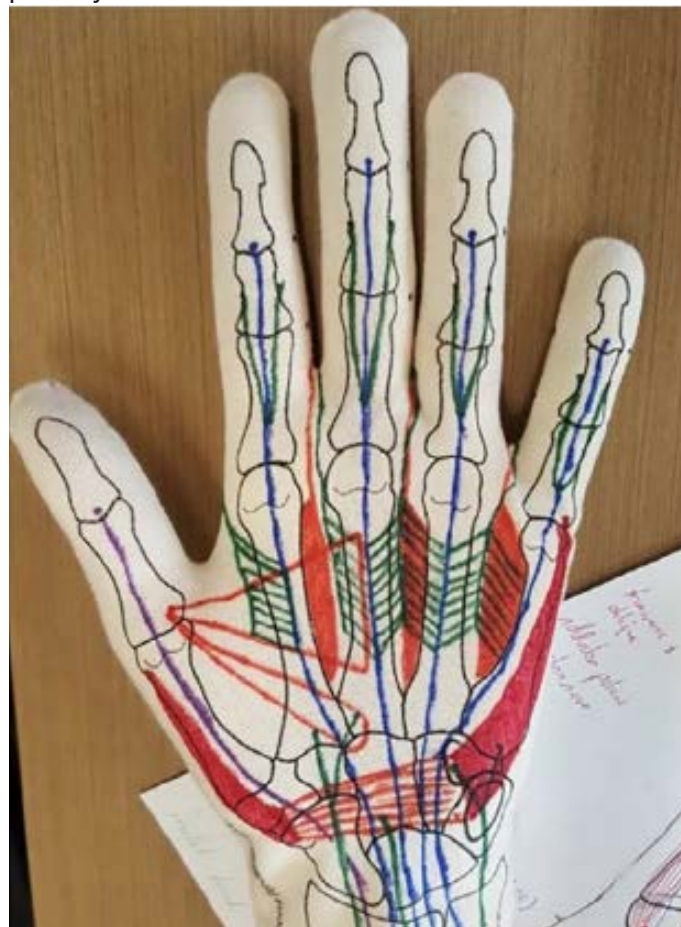
Early Career Researchers: the future of research

Early Career Researchers (ECRs) of the The ANU Medical School are driving research in response to the climate and COVID crises, mental health, rural health, digital health, medical education, vision and cancer care, and metabolic diseases. Their enthusiasm and dedication is bringing new ideas and fresh perspectives and building on the work of established researchers to strengthen the future position of the Medical School.

Future of Society and Health

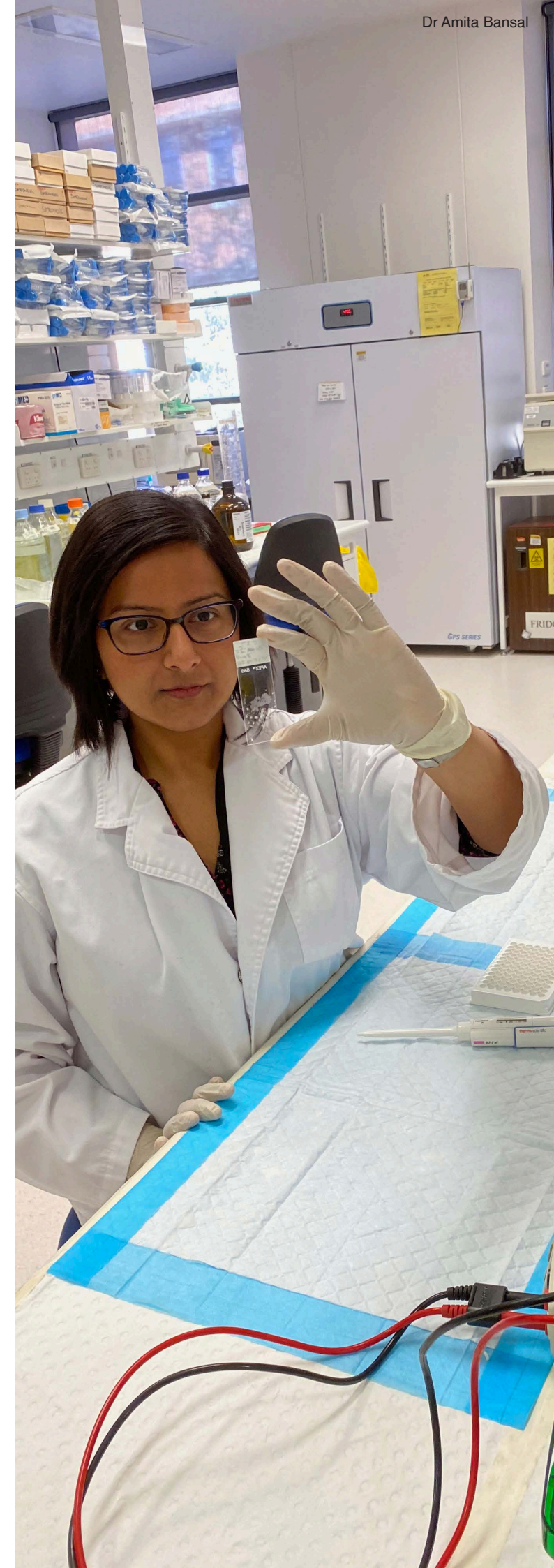
The Medical School ECRs are pursuing key priorities in the future of society and health: the future of education; social connectedness, wellbeing and rural health and clinical practice. Alongside the COVID hub, **Dr Lillian Smyth** also collaborates with international colleagues on the social psychology of access, inclusion and equity and associated outcomes in higher education. **Dr Georgia Pike** is leading a study on non-verbal clinical skills training, as well as collaborating on several others. **Dr Suzanne Estaphan** is building on her background in medical physiology (with a particular focus on oxidative stress and inflammation) with a move into pedagogy research. In 2020, she is working on projects examining e-learning resource usage, online assessment, PBL decisions-making and the impact of informal study groups. **Suzanne Bain-Donohue** and **Dr Sutarsa Nyoman** focus on benefiting communities within the university's catchment area, health equities in rural and remote areas, rural health systems and policy. They have secured research funding through the Global Research Partnership Scheme (Indonesia – ANU Rural Health (INA-RH) Initiative) and a Rural and Remote Medical Services (RaRMS)/ANU Rural Clinical School partnership. **Dr Kathleen O'Brien** is a part of a long-term project, using the Kindergarten Health Check (a long running series of cross-sectional surveys of all children in their first year of school in the ACT), on the relationship between physical activity and behavioural and mental health disorders. **Dr Melinda Choy** works

to improve the digital health divide. Her main collaborative project is a qualitative study exploring how patients with chronic disease experience digital health', funded by the RACGP and IPN Medical Centres (with a team including Dr O'Brien and **Dr Katelyn Barnes**). Dr Choy also convened series of roundtables on digital health for those who are socio-economically disadvantaged in partnership with Good Things Foundation Australia and funded by an ANU Policy Greenhouse Collaboration Initiative Grant. Dr Barnes also leads The Afterhours Project - an 84-hour snapshot of medical care provided after 6pm weekdays and over the weekend, across the ACT and is involved in Building PracNet - Practice Based Research Networks for the laboratories of primary care research.



Decoding Health and Disease

The Medical School ECRs are working on basic and translational research in aging and chronic disease, including vision, cancer and metabolic diseases. **Dr Joshua Chu-Tan** is a researcher in the Clear Vision Research Group and works on functional microRNA that can be used in treatment for age-related macular degeneration. He has won two Bootes Foundation Grants. In 2019 Dr Chu-Tan, along with **Riemke Aggio-Bruce**, won a National Science Week Grant to develop a community event in which they ran a "blinded" art class. Riemke Aggio-Bruce focuses on novel therapeutics and diagnostics for the currently untreatable form of age-related macular degeneration. She was Chief Investigator on a successful Discovery Translational Fund grant on a diagnostic for retinal degenerations, that is currently progressing towards a clinical trial. **Dr Dandan Tian** leads research to investigate novel targets/ molecular pathways involved in the early onset of obesity-associated liver cancer and interrogate the mechanism of liver cancer development. She also works on Urso intervention in the prevention of bile acid toxicity and liver cancer in Atp11c mice. **Dr Amita Bansal** holds Chief Investigator A (CIA) funding from Diabetes Australia to investigate how environmental exposures alter 3D genome of pancreatic islets and increase long term diabetes risk. She is also a co-Principal Investigator (PI) of an Australia-wide collaborative study funded by JDRF Australia to investigate the role of Tregs in diabetes kidney disease in people with diabetes.



Research output

In the period between Jan 2017 and July 2020:

105



ANUMS researchers contributed

917

Field-Weighted
Citation Impact

Scholarly

Articles

2.49

1.78

2.21

3.99

2017
- July
2020

2017

2018

2019

“6824
citations



50M in
funding

Publications

For a list of The ANU Medical School
publications from 2015-2020 please visit:

<https://medicalschool.anu.edu.au/research/publications>



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