Health Sciences at UNSW

UNSW Science research into human health ranges from the study of microbes, genomes, anatomy and optometry to human behaviour. Our researchers explore the complexity of human biology and behaviour with an aim to mitigate disease, improve human health and increase social harmony.

We are an international leader in neuroscience and mental health, the prevention of eye disease, rare neurodegenerative disorders, nanomedicine, personalised medicine and the effects of climate change on human health.

Researchers partner with healthcare providers, not-for-profit organisations, industry partners and medical research institutions to deliver a holistic approach to medical science. Ongoing investigations will enable rapid translation of new clinical paradigms from bench to practice and lead the way to appropriate management of chronic and treatable illnesses.

The long-term economic and social returns will include increased productivity, lower costs of health care and lower health service use. Ultimately, individuals suffering from illness and disease and their communities will live richer, fuller and happier lives.

Further industry support, in partnership with government funding, will allow us to maintain this important leadership role in health sciences.
Ageing Futures Institute

While the challenges of population ageing are pervasive and complex, productive ageing brings with it enormous social and economic benefits.

Led by Scientia Professor Kaarin Anstey, the UNSW Ageing Futures Institute is a global leader in ageing research, making a positive impact on the social, wellbeing, design and economic dimensions of ageing. Professor Anstey’s identification of risk factors for dementia and cognitive decline have had meaningful impact, via translation into assessment tools, interventions and policy.

Productive ageing brings enormous human potential that can be channeled into social, cultural and economic innovation. The UNSW Ageing Futures Institute conducts research and translates it into policy and practical outcomes to enable optimal ageing for individuals and society.

By taking a life course approach, the Institute generates robust evidence to influence health, fiscal and social outcomes and policies – nationally and internationally.

These findings not only empower older people, but also inspire communities and governments to view ageing positively and to adopt technologies and policies that facilitate ageing well.

“Population ageing is one of humanity’s most pressing challenges. The 2015 World Report on Ageing reports that the health of older adults is not keeping up with increasing longevity. Without intervention addressing social disadvantage in early life and throughout adulthood, inequalities will compound over the life course. This has the potential to place great strain on many health care and welfare programs.”

Professor Kaarin Anstey
Professor of Psychology UNSW
Senior Principal Research Scientist, NeuRA
Why invest in Ageing Futures?

The UNSW Ageing Futures Institute is a focus for UNSW researchers working on projects such as:

• in-car technology assessing and identifying at-risk older drivers
• World Health Organisation guidelines for dementia risk reduction
• falls detection
• ageing in jail
• policy needs for active ageing
• carer wellbeing
• supporting Aboriginal and Torres Strait Islander people to age well.

Professor Anstey was awarded a prestigious ARC Laureate Fellowship in September 2019. Her continued research will significantly advance understanding of cognitive ageing through the adult life course.

The MIND Diet

Following a diet designed to increase brain health in the long term appears to reduce the odds of cognitive impairment and disorders including Alzheimer’s disease and dementia.

A research team led by Professor Kaarin Anstey reviewed the potential protective effects of the ‘Mediterranean-DASH Intervention for Neurodegenerative Delay’ diet, also known as the MIND diet.

The MIND diet is based partially on the Mediterranean diet, but incorporates foods specifically relevant to brain health. It is characterised by 15 dietary components with a focus on green leafy vegetables, berries, whole grains, olive oil and small amounts of red meat.

“This study has shown for the first time, outside of the United States, that the MIND diet reduces the risk of dementia,” says Professor Anstey who led the study team.

The investigation followed 1220 adults aged 60 and older, for a period of 12 years. During this time, a dietary pattern that followed the MIND diet was linked to 19% reduced odds of developing clinically diagnosed mild cognitive impairment or dementia.

The study will help researchers develop concrete recommendations for reducing the risk of dementia in Australia and around the world.

“Research centres in ageing typically focus on a specific aspect which risks overlooking the importance of interrelationships between the various areas. At UNSW we already do considerable research into ageing ranging from dementia through to superannuation policy. The Ageing Futures Institute provides a framework to bring it all together, in a truly multi-disciplinary way.”

Professor Nicholas Fisk, Deputy Vice-Chancellor (Research)
Big data and artificial intelligence – driving personalised healthcare of the future

Big data-driven artificial intelligence (AI) techniques are revolutionising medical research. Dr Fatemeh Vafaee’s AI-empowered Biomedicine Lab is at the forefront of this exciting medical innovation, which is poised to have a significant impact on our healthcare.

Dr Vafaee and her team develop cutting-edge AI and machine-learning methodologies to interpret large-scale molecular and clinical data. This big-omics data is utilised to develop personalised medicine and precision healthcare solutions.

Computational biomedicine research closes the gap between basic research and clinical application by:

- improving personalised medicine by developing minimally-invasive disease predictors from patients’ blood samples
- facilitating tailored treatment through the identification of disease-associated rare cell-types from single-cell data
- reducing the cost and timeframe of drug development
- reducing the risk of type 2 diabetes through personalised health monitoring
- developing downloadable/online toolkits for clinical settings.

The AI-empowered Biomedicine Lab has achieved numerous successful outcomes including the accurate predictions of colorectal cancer, the identification of markers for non-invasive cancer diagnosis and the identification of less toxic cancer treatment drugs.
Shaping a cure for cancer

Dr Kris Kilian, who holds a joint appointment in the Schools of Materials Science and Engineering and Chemistry, is leading a team of researchers building geometrically patterned tumours to better understand patient-specific disease and to aid drug development.

The current best practice for developing anti-cancer drugs involves adding potential drugs to cells cultured on flat plastic surfaces that do not reflect the topographic complexity of tumour tissues. This could inadvertently lead to viable drugs being rejected.

However, Dr Kilian's team have developed a 'soft lithography' technique, inspired by manufacturing processes used in silicon chip generation, to create a patterned ‘stamp’ which geometrically mimics the surfaces of microtumours. The resulting microtumour array can then be used to study cancer progression, develop new drugs, or as a method to screen drugs on a patient’s own cells to determine what drugs work best.

We’ve developed new cell-culture materials through materials engineering that better reflect the environment of real tumours,” Dr Kilian says.

“Our vision is to use our chips to both understand a patient’s disease, and to assign the right therapy to the right person quickly and accurately. We believe these advances show great promise for easing the suffering of people struggling with cancer.”

Stopping the spread of microbial infection

Microbial colonisation of medical devices accounts for 50% of all infections that start in hospitals. These infections cause increased morbidity and mortality and are associated with a significant cost to Australia’s healthcare system.

Professor Mark Willcox from the UNSW School of Optometry and Vision Science is a world-leading medical microbiologist specialising in ways to control the microbial colonisation of medical devices. His work focuses on designing antimicrobial contact lenses, catheters, orthopaedic devices and new antibiotics. He has translated his research from the laboratory through to successful clinical trials and real-world applications in clinical settings.
Boosting good cholesterol – mystery solved
raising hope for smarter drugs

A protein that transports cholesterol inside cells could be the key to developing drugs to boost ‘good cholesterol’.

The breakthrough discovery – by School of Biotechnology and Biomolecular Sciences Professor Rob Yang and his team of researchers – opens the way for new drugs to increase the body’s good cholesterol levels. And this knowledge could also be used to develop a new strategy to fight cancer.

Until now, drugs including statins – the most prescribed and profitable class of drugs in history – have targeted ‘bad cholesterol’, also known as LDL. But while statins are effective at lowering LDL levels, they do little to increase the levels of good cholesterol.

“Knowing the molecules that deliver cholesterol to the plasma membrane itself is a huge step forward,” Professor Yang says.

This question had stumped scientists for many years. “When we started this project, we were not sure we would find anything. So we were very excited to solve this mystery.”

Another intriguing prospect raised by this research is that the rampant growth of cells that characterise cancer could be stopped in its tracks by reducing the amount of cholesterol produced, since this is vital for the structure of the cancer cell’s membrane.

Professor Yang estimates it will be another 10 years before these ideas lead to the development of marketable pharmaceuticals. Until then, it is a long road of further research and development, finding the right strategy, screening potential compounds and then testing them in animal models.

Professor Yang was also part of an international study into the seipin protein, which plays a role in regulating fat storage. This research may have implications for strategies for fighting obesity and diabetes. The study brought together scientists from UNSW, Tsinghua University, Princeton University and Hebei Medical University (China). More research is now needed to find whether the new understanding of the seipin protein can be used to tackle the obesity and diabetes epidemics. “We have made a breakthrough, but we don’t know about therapeutic applications yet,” Professor Yang says.
Professor Olivier also conducted a study recommending that motor vehicles shouldn’t be allowed to go faster than 40km/h in high pedestrian areas if we are to reduce the likelihood of pedestrian deaths. “Pedestrians struck in vehicle crashes are the largest group of traffic fatalities worldwide – and excessive speed is the biggest factor in such crashes. We wanted to see how the likelihood of a pedestrian dying in a crash changed at different speeds – and our study is the largest to date with data on over 37,000 pedestrians.” The work is an international collaboration between researchers at UNSW Sydney and UHasselt in Belgium.

Diabetes breakthroughs via mathematical modelling

Associate Professor Adelle Coster uses applied mathematics in the areas of biomedicine and biology – using approaches including dynamic systems analyses, stochastic modelling, queueing theory to answer important healthcare questions.

Using data-driven mathematical modelling, significant emergent complex behaviours of the insulin signalling pathway have been disentangled. Of importance, this includes the finding that the insulin dose affects not only the timing of the resulting glucose transport in fat cells, but also the magnitude.

“This was a novel outcome of my mathematical modelling which otherwise would not have been discovered.”

Statistics making a direct impact on road safety

Professor Jake Olivier from the School of Mathematics and Statistics applies statistical methods to research risks to vulnerable road users. Statistical evidence is the basis for well-informed decisions which can be translated into road safety policy.

Professor Olivier conducted a systematic review of the research literature assessing bicycle helmet effectiveness to mitigate head, face and neck injury in a crash or fall. Forty studies were included in the meta-analysis with data from more than 64,000 injured cyclists. The results support the use of strategies to increase the uptake of bicycle helmets, with helmet use associated with reduced risk of serious and fatal head injury.

A subsequent study has shown a clear link between Australia’s mandatory helmet laws and a significant reduction in cycling fatalities, demonstrating they led to an immediate 46% drop in fatalities and have saved billions of dollars in medical costs.
Contact details:

Professor Emma Johnston
Dean of UNSW Science
E: e.johnston@unsw.edu.au
T: +61 2 9385 7916

Professor Paul Munroe
Deputy Dean (Research)
UNSW Science
E: p.munroe@unsw.edu.au
T: +61 2 9385 4432