NeuRA

Discover. Conquer. Cure.

Neuroscience Research Australia

Profile 2018

Quest for Discovery

Quest for Cures

“My quest is to find a cure for schizophrenia”

– Professor Cyndi Shannon Weickert

“My quest is to uncover the fundamental genetic code of bipolar disorder”

– Dr Jan Fullerton

“My quest is to develop an early detection program for Parkinson’s disease”

– Professor Caroline Rae

“My quest is to help all people reduce their risk of dementia”

– Professor Kaarin Anstey

“My quest is to deliver an in-home program to help prevent falls in seniors”

– Associate Professor Kim Delbaere

“My quest is to develop a new rehabilitation program for those with spinal cord injuries, so they may feel again”

– Dr Sylvia Gustin

Quest for Discovery

Quest for Cures

Professor Peter Schofield

WELCOME

Quest for discovery/quest for cures

Our quest for discovery continues to motivate us to work towards the solutions and cures of tomorrow – today. This year we have welcomed Professor Kaarin Anstey who, with her team, is working on understanding the risk factors for dementia prevention and developing lifestyle guidelines on how to reduce the risk of dementia.

Currently there are over 1,500 new cases of dementia diagnosed each week. It is predicted that by 2050 there will be almost one million Australians with the condition, and many more family members and friends indirectly impacted by its effects. This is a huge problem that is growing and needs more investment. Our goal at NeuRA is to focus on the whole community to enable both a research-led, and technology-delivered set of outcomes that will greatly benefit the community, the family and the individual.

At NeuRA, we are playing a critical role in a global bipolar genome sequencing project aimed at understanding the biological basis of the bipolar disorder using state-of-the-art DNA sequencing. Dr Jan Fullerton and her team aim to unlock the early indicators of this disease so we can identify specific risk factors in young people who are at increased genetic risk of this disorder.

There is a lot we don't know about brain function which can be revealed through identifying gene pathways. Neurocognitive disorders are one of the largest unmet challenges in Australian healthcare. Approximately 3,000 children are born each year with a moderate to severe neurocognitive disorder.

These types of disorders have high management costs and frequently recur within families. By developing genomic testing across a range of neurocognitive disorders, we can provide answers to multiple people. This isn't just providing a diagnosis to a particular family member; It is empowering families through genomic testing to know if there is a chance recurrence and hope for future treatments.

Our quest for discovery is equally matched by our quest to find cures for some of the most debilitating cognitive diseases of the brain. Importantly, early detection of diseases such as Parkinson's disease can improve outcomes for all people and their families in the future, giving them the opportunity to access medical intervention earlier.

Now is the time for high impact, technology-led neuroscience research, and local and global partnerships to successfully navigate the great unknown – the human brain and nervous system.

This profile presents a snapshot of a number of exciting projects which will frame NeuRA's quest for discovery over the coming year.

Ageing well – reduce your risk of dementia

A key focus of our ageing well research is developing a set of guidelines to help people to reduce their risk of dementia. Alzheimer's disease accounts for 70 per cent of all dementia diagnosis. With further use of online technologies, we hope to support early diagnosis of this disease which will benefit long-term outcomes for all.

Schizophrenia breakthrough immune treatment program

NeuRA researchers have completed a breakthrough study advancing the understanding of and treatment for schizophrenia. New trials will be undertaken this year to build on this remarkable breakthrough incorporating immunological approaches into our research program.

Genomic frameworks

Genomic analysis is providing greater insights into the causes of bipolar and neurocognitive disorders. NeuRA is pioneering ground-breaking research using whole genome sequencing to understand the biological base of these conditions. These insights will help development of tools for personalised medicines to better treat bipolar and neurocognitive disorders.

Discovery of spinal cord sensation

A new finding at NeuRA has shown that 50 per cent of all people with a complete thoracic spinal cord injury still have some surviving sensory nerve connections. A new trial later this year will aim to develop new protocols for rehabilitation in tandem with MRI imaging to study the somatosensory pathways which have survived, to understand how to boost messages to the brain to result in some form of sensory return.

Parkinson's disease – an early detection program

NeuRA is focused on the development of an early detection program for Parkinson's disease. Working on the identification of brain patterns using advanced MRI imaging; NeuRA plans to lead a major new research pathway to enable better outcomes for all through much earlier intervention.

Prof Peter R Schofield
FAHMS PhD DSc
Executive Director & CEO

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"QUEST: a search or pursuit made in order to find or obtain something of value or significance."

LIFESTYLE SOLUTIONS FOR OUR AGEING POPULATION

Professor Kaarin Anstey

Professor Kaarin Anstey joined NeuRA in January 2018 to lead an innovative multi-disciplinary team addressing ageing research with a focus on vital community lifestyle solutions around dementia in the Australian community.

Professor Kaarin Anstey

Professor Anstey's team will be working to expand her research programs on the epidemiology of cognition and dementia. The research will focus on identifying lifestyle, brain, and biological risk factors that lead to cognitive decline, and the impact of cognitive ageing on everyday function.

By 2053, 21 per cent of the Australian population will be aged 65 and over and 4.2 per cent aged 85 and over. This unprecedented demographic shift will result in dramatic changes in the need for health and care services. It highlights a critical need for preventive health approaches and interventions to enable older adults to retain their independence. Of those aged 65 and over, 20-25 per cent will have some degree of cognitive impairment, with 5-7 per cent developing dementia.

Professor Anstey believes research can improve how people age through preventive health strategies, the use of technology, and specific skill training. Using psychological and population health approaches, her research programs focus on cognitive ageing and decision-making, interventions to reduce the risk of dementia, interventions to improve driving skill, and longitudinal studies of health and ageing.

Over the next five years, Professor Anstey's research will focus on four key areas including the development of a global research network for dementia prevention and building the evidence base on risk and protective factors for cognitive decline and dementia. She will also research physical and mental resilience in ageing, how cognitive decline impacts on decision-making, and how to keep older drivers on the road for longer, keeping them safer and more independent.

Identifying why some people do not develop cognitive decline and dementia is as important as identifying what places others at risk. Professor Anstey leads a unique Australian cohort study called the PATH Through Life Project. The study has followed young, middle-aged and older adults for 17 years. Through regular assessments, Professor Anstey's team is discovering risk and protective factors for cognitive decline and dementia in Australians including genetic, lifestyle, medical and psychosocial factors.

As the oldest cohort is now in their late 70s, Anstey's team are also evaluating how they are accessing aged care services and the impact of cognitive decline on productive ageing.

Anstey is also the lead investigator on the NHMRC Centre of Research Excellence in Cognitive Health and within this program her team is currently in the final stages of a trial that is evaluating three approaches to reducing the risk of dementia in primary care.

Adults with chronic diseases who would benefit from a lifestyle management program have been randomly allocated to one of three conditions – a weekly email containing information about healthy lifestyle and dementia; a series of lectures about lifestyle modification which is run as a program in practices as usual care, and a dementia-specific program called Body-Brain-Life. Body-Brain-Life involves personalised exercise and diet programs provided by a dietician and exercise physiologist, and online educational modules which assist with personal goal setting.

Building on these initial programs, Professor Anstey's team is in the planning phase of a series of new interventions that incorporate far more up-to-date findings and utilise advances in methodologies and technology. The aim is to make dementia risk reduction interventions as cost effective as possible and tailored to different groups.

STUDY SEEKS TO IDENTIFY THE DETERMINANTS OF SUCESSFUL AGEING

Dr Karen Mather

Dr Karen Mather

Life expectancy has increased steadily over the last century. In Australia, individuals aged 85 and over are one of the fastest growing age groups, doubling in size from 1996 to 2016.

Dr Karen Mather is a Senior Research Fellow at NeuRA and leads the Genetics and Epigenomics Group at the Centre for Healthy Brain Ageing (CHeBA), School of Psychiatry at UNSW Sydney. She is seeking to identify the genetic and epigenetic factors linked to exceptional longevity. The Sydney Centenarian Study administered by CHeBA has over 400 participants aged 95 and over and is the only study of its kind in Australia. The study aims to identify the factors involved in successful ageing.

The research undertaken by Dr Mather and her group investigates why some individuals age well while others struggle with age-related decline and disease. Many exceptionally long-lived individuals escape age-related decline and disease until late in their lives. These individuals present a unique opportunity for research studies on successful ageing.

Family and twin studies show that genetic factors play an important role in living to an exceptional age. Dr Mather is studying a group of exceptionally long-lived Australians from the Sydney Centenarian Study. The study looks to identify the genetic and epigenetic factors associated with exceptional longevity and successful ageing using the latest cutting-edge technology, including whole genome sequencing.

Epigenetics refers to mechanisms that influence how much a gene is turned on or off, which are independent of the DNA sequence. Using the epigenetic clock, Dr Mather and others have shown that exceptionally long-lived individuals have a younger biological age than expected for their chronological age.

"The knowledge generated by this work will lead to a better understanding of the molecular determinants of exceptional longevity and ultimately aid in the development of preventative and treatment strategies to promote health in our ageing population, further supporting families and the community," says Dr Mather.

In the future, collaborations with centenarian studies from around the world will enable larger genetic and epigenetic studies to be undertaken, increasing our capacity to identify factors for successful ageing within and across different ethnic groups.

NEXT STEPS FOR INTERNATIONAL ALZHEIMER'S STUDY

Dr Bill Brooks

The Dominantly Inherited Alzheimer Network Trials Unit (DIAN-TU) is an international clinical trial program for families with the genetic form of Alzheimer's disease. DIAN-TU aims to find a drug to prevent or slow the disease process in people with a genetic mutation known to cause Alzheimer's disease.

DIAN-TU has 36 trial sites in 13 participating countries including Australia, and is led by Professor Randall Bateman of Washington University's School of Medicine in St Louis. Dr Bill Brooks is the Site Principal Investigator at NeuRA in Sydney, Australia.

The first trial, in which two drugs are being studied, will finish at the end of 2019 after all participants have completed four years of treatment with either active medication or placebo.

Preparations are underway to begin trials of a third drug, for which a new group of participants will be recruited.

Families participating in DIAN and DIAN-TU are quite rare, but they hold the key to understanding a lot about Alzheimer's disease because affected people in these families have a known cause for their disease (a genetic mutation), unlike most people with dementia.

"Participating in these demanding and long-term studies is a big commitment, and we are very grateful to the family members who have taken up the challenge and who continue to contribute so generously," says Dr Brooks.

NeuRA's vision for the future is to identify a disease-modifying treatment for Alzheimer's disease that will not only be effective for these rare families but will also benefit the vast majority of people at risk of Alzheimer's disease who do not have a genetic cause.

"We hope to show a means of preventing or reducing the brain changes of Alzheimer's disease. If successful, delivering these changes will also be useful to members of the general community," says Dr Brooks.

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Dr Bill Brooks

A LIFESPAN APPROACH TO INDIGENOUS AGEING

Dr Kylie Radford and the NeuRA Aboriginal Ageing team

Through the Koori Growing Old Well Study (KGOWS) and related projects, the Aboriginal Ageing team led by Dr Kylie Radford is exploring healthy ageing, memory and social and emotional wellbeing, as well as the prevalence and incidence of age-related disorders like dementia and depression in urban Aboriginal populations in NSW.

The KGOWS team has already found the prevalence of dementia in urban and regional Aboriginal communities is three times greater than that of the general Australian population. However, there remains little direct evidence to help understand the key risk factors and underlying causes driving these high rates of dementia, which have now been documented across urban, rural and remote Aboriginal communities in Australia. In addition, low awareness of dementia and aged care services has been identified as one factor contributing to poorer outcomes for older Aboriginal and Torres Strait Islander people, but there is also a lack of well-designed, culturally relevant resources available to support and guide care decisions. The Aboriginal Ageing team at NeuRA is leading innovative research projects in this area, as well as important initiatives to translate these findings into practice with Aboriginal communities.

The primary aim of the longitudinal KGOW study is to find the reasons for the high dementia rates in urban and regional Aboriginal people. The first stage of follow-up is due for completion in 2018 and will provide insights into the social and biomedical risk factors for cognitive decline in this population. The team are looking into the potential associations between age-related diseases like dementia and a range of other life-course factors, both positive and negative, which impact on ageing including – health status, parenting, education, stress and experience of discrimination across the lifespan. Furthermore, recognising that many Aboriginal people are increasingly living to old ages without dementia, this research will shed light on the factors contributing to successful ageing in the KGOW study. During 2018, Dr Radford and the team will develop ageing well resources, based on KGOWS and using Elders' stories and artwork, through the *Sharing the Wisdom of Our Elders project*, which is being supported by the Lowitja Institute (Aboriginal and Torres Strait Islander Health CRC) under the research theme of Strong Elders.

KGOWS has now entered its 10th year and is set to continue this research in close collaboration with multiple Aboriginal community partners over the next five years. This will expand the original study cohort, and introduce leading-edge biomedical assessments, trialling the *Koori Active & Healthy Ageing Program*. The research will further develop capacity in ageing, dementia and social and emotional wellbeing with Aboriginal community researchers, health services and Aboriginal Community Controlled Health Organisations.

Alison Timbery and Dr Kylie Radford

The Koori Dementia Care Project, which is the foundation of the team's knowledge translation program, will also broaden its original platform of workshops to include skills sessions geared towards helping workers and care facilities to implement culturally safe and person-centred approaches for Aboriginal and Torres Strait Islander people with dementia into daily practice.

Finally, building on these projects the team is in the process of developing a new online dementia resource, featuring information and training for Aboriginal and Torres Strait Islander communities. This *Caring for Spirit* project will focus on translating the results of current research into a culturally relevant and accessible online platform, as well as collating and incorporating existing dementia resources into a central source for Aboriginal and Torres Strait Islander people.

The project name echoes the words of Mr Eric Deeral, Chairperson of the Elders' Justice Group, Hopevale Community: "The causes of Aboriginal dementia in Gugu Yimithurr culture is part of a natural process. The body, mind, and spirit naturally get older including the brain... Dementia is a sick spirit, a lost spirit looking for help – we call this Wawu Warra – a sick spirit."

The *Caring for Spirit* resource has been funded by the Australian Government Department of Health and will include interactive training, video content, and culturally relevant information. This program will support individuals, families and communities living with dementia, as well as the health workforce, particularly Aboriginal health workers, who critically provide frontline care in many communities.

Auntie Margaret Anderson and Mr Terry Donovan

> *"Dementia is a sick spirit, a lost spirit looking for help – we call this Wawu Warra"*

Dr Jasmine Menant

LIVING WELL WITH PARKINSON'S DISEASE

Professor Stephen Lord and Dr Jasmine Menant

More than 80,000 people are living with Parkinson's disease in Australia, and of these, approximately two thirds will fall each year. Ensuing injuries, hospitalisations, fear of falling and caregiver burden are devastating, widespread and costly. As the prevalence of Parkinson's disease will double between 2010 and 2040, the associated human and economic burden will also grow. Innovative therapies to improve balance and prevent falls in Parkinson's disease are therefore urgently needed.

"People with Parkinson's disease particularly struggle with taking secure steps, avoiding hazards at short notice or recovering their balance after unexpected slips or trips or if they are knocked or bumped when walking," says Professor Stephen Lord, NHMRC Senior Principal Research Fellow at NeuRA.

To further our understanding of fall risk in people living with Parkinson's disease, researchers at NeuRA conducted a study on the role of attention in stepping and the ability to adjust steps while walking in response to unexpected hazards. This involved a step mat test of reaction time and an obstacle course designed by Joana Caetano, as part of her PhD studies.

This research showed that compared with their healthy peers, people with Parkinson's disease had slower and more variable reaction times in situations that involved a distracting task. They were also less able to adapt their stepping while they were walking. The participants were therefore, more likely to miss step targets and strike the obstacle in their path.

"This impaired stepping and gait adaptability in people with Parkinson's disease increases their risk of falling when negotiating unexpected hazards in everyday life," says Professor Lord.

Professor Lord and his team, Dr Jasmine Menant, Dr Daina Sturnieks, Dr Yoshiro Okubo and PhD student Mr Paulo Pelicioni, are now commencing a study to investigate whether a step training intervention can improve stepping and balance and reduce fall risk in people with Parkinson's disease. As part of this four-month randomised controlled trial, participants will be allocated at random into a control group, and continue their daily activities as usual, or

"This impaired stepping and gait adaptability in people with Parkinson's disease increases their risk of falling when negotiating unexpected hazards in everyday life"

in a training group. Participants in the training group will train in stepping while playing games on an electronic mat connected to their television or computer, for 80 to 120 minutes per week.

"The games are training not only stepping but also thinking abilities. They are inspired from video games such as Tetris, Pacman etc, are fun and their difficulty can be easily adjusted," says Dr Jasmine Menant.

Training group participants will also attend four sessions in the gait laboratory at NeuRA to train their ability to recover from slips and trips. Participants will be fitted with a comfortable harness and asked to walk several times on a special walkway designed at NeuRA which can provide unexpected slips or trips.

"We hope the stepping training program done at home and at NeuRA will result in improvements in people with Parkinson's disease and subsequently reduce fall risk. This study will provide the ground work for a future, larger study that we hope will prevent falls in people with Parkinson's disease," says Professor Lord.

The advances in fall prevention made in this project and the team's future work have the potential to reduce personal and financial costs to individuals, their families, healthcare resources and the community.

Dr Yoshiro Okubo with a research participant

Associate Professor Kim Delbaere

FALLS PREVENTION TECHNOLOGY TRIALS START IN AUSTRALIA AND THE UK

Associate Professor Kim Delbaere

Falls and fractures are a leading cause of hospitalisation in seniors, with one-third of people over 65, and one in two people over 80 experiencing a major fall each year. For older Australians, the social and personal impact of a fall can be enormous; especially when the fall results in mobility-related disability and a sudden loss of independence.

Under the leadership of Associate Professor Kim Delbaere, a new world-first, technology-based program called *StandingTall*© will start trials here in Australia and the UK over the next year, aimed at addressing the needs of correcting falls and balance in seniors.

StandingTall© is an individually-tailored, home-based, fall prevention program developed around a specific set of balance exercises. As an app, the cost of delivery is highly economical and is then easily deliverable across multiple cultures and languages worldwide.

The app includes over 2,000 exercises with video instructions and is designed for older people to use independently at home. It allows participants to choose when and for how long they exercise throughout the week, with a recommended dose of two hours. The exercises are designed to train both static and dynamic balance skills, while standing on the floor, stepping in different directions, or up and down on a box.

This research aligns with local, state, national and international goals to reduce falls in older people, in collaboration with eight project partners in both Australian and UK national health settings.

In Australia, the project has three New South Wales policy partners who will provide strategic advice to implement the *StandingTall*© program across the state. These policy partners are the NSW Office of Preventive Health, the Clinical Excellence Commission and the Agency for Clinical Innovation.

Four Australian-based clinical partners will support the practical implementation of *StandingTall*© into practice. These include two partnering NSW Local Health Districts (Mid-North Coast, Northern NSW), Uniting and Austin Health in Melbourne, Victoria.

In addition, the trial will also involve the UK-based Northern Health Science Alliance.

Commenting on the UK interest, Associate Professor Kim Delbaere says, "it is exciting to see an Australian invention aimed at reducing falls and improving balance in older people starting an international journey, made possible by an NHMRC grant and support from our partners."

"The collaboration with the Northern Health Science Alliance (NHSA) happened quite organically, and it is pleasing to see their recognition of the benefits of this program developed over the last six years at NeuRA."

"This international alliance understands the immense need to curb the rate of falls in seniors, which often leads to hip fractures and loss of independence resulting in greater costs for carers, communities, their families and loved ones," says Associate Professor Delbaere.

Utilising an easy-to-deliver mobile technology platform, StandingTall© has been designed to enable maintenance, tailoring and exercise progressions to be updated online, whilst levels and challenges keep the participants engaged and challenged at their own rate.

"The NHSA, together with the four North Academic Health Science Networks, is delighted to be a UK partner of *StandingTall*©, an exciting international collaboration in falls prevention. We hope this is the beginning of a much wider collaboration between the North of England and the Australian Health system," says Dr Hakim Yadi, Chief Executive of the NHSA.

"There is nothing like this tool in the world. Some of the program's most successful features include its ease of use, the varied tailored options and progressively difficult exercises, and its compatibility with existing fall prevention and self-management programs."

For those living in rural areas, *StandingTall*© is a game changer as it can be delivered to a simple in-home mobile device which can assist in the prevention of falls and hence prevent the need for emergency medical care from a debilitating fall.

"Our previous research has taught us that, to prevent falls, older people should exercise for two to three hours per week, or as little as 20 minutes per day," says Associate Professor Delbaere.

"By embracing technology, we are providing an alternative exercise opportunity, which is engaging, fun and motivating, hoping to generate higher levels of adherence over a longer period of time."

"We believe this innovative program offers huge potential in helping older people across the north which is why we're delighted to be supporting its roll-out in the region," says Dr Yadi.

StandingTall© Application

DATA DRIVES CHANGE IN THE HEALTHCARE SYSTEM

Professor Jacqueline Close

Professor Jacqueline Close

Hip fracture is the most serious and costly fall-related injury suffered by older people. The human cost of a hip fracture is enormous – 25 per cent are dead at one year, 50 per cent do not regain their previous level of function and for 11 per cent, the fracture heralds the end of independent living. In 2016 alone, there were an estimated 22,000 new hip fractures among Australians with a combined direct and indirect cost of $908 million.

Housed at NeuRA, the Australian and New Zealand Hip Fracture Registry (ANZHFR) is co-chaired by Professors Jacqueline Close (NeuRA), and Ian Harris (UNSW) who are working to ensure that every Australian who is unfortunate enough to fracture their hip has access to the best care possible.

"Data is key to the work of the Registry. By collecting, analysing and sharing data across hospitals in Australia and New Zealand, every hospital can see how it performs and how it compares to others. Hospitals use their data to help drive improvement work at a local level," says Professor Jacqueline Close who works clinically as a Geriatrician.

Professor Jacqueline Close with a patient

In its 2017 report, the Australian and New Zealand Hip Fracture Registry highlighted performance against a bi-national guideline and a clinical care standard for hip fracture care and showed marked variation in the systems and processes of care depending on where you are admitted for your hip fracture.

"The variation between hospitals can markedly change the experience for the older person including how we manage their pain, timing of the surgery and the opportunity to start walking again after surgery," Professor Close says.

Orthopaedic surgeon and Registry Co-Chair, Professor Ian Harris added, "Data is a powerful driver of change in the health system. The Hip Fracture Registry is run by clinicians for clinicians and provides hospitals with real-time performance data, allowing them to see how they perform against other hospitals."

Professor Close highlighted the opportunities that remain to improve care further, including the prevention of future falls and fractures.

"Strong evidence exists to support treatment of osteoporosis in this population yet there remains a huge care gap between what we are and should be doing," says Professor Close.

The Australian and New Zealand Hip Fracture Registry located at NeuRA, strives to improve the delivery of hip fracture care in both countries and was recognised nationally by Research Australia with the 2017 Health Services Research Award.

Work continues unabated in 2018 with more hospitals joining the Registry every month. Two-thirds of hospitals across Australia and New Zealand are approved to contribute data, and the team hope to have at least 80 per cent of hospitals signed up to the Registry by the end of 2018.

PREVENTING FALLS WITH TECHNOLOGY

Dr Matthew Brodie from NeuRA's Falls Balance and Injury Research Centre received the Yamaguchi Medal at the International Society of Biomechanics Congress in Brisbane in 2017. The Yamaguchi Medal recognises promising young researchers who excel in their field.

Dr Matthew Brodie

The medal, presented by the Asian-Pacific Association for Biomechanics, for gait and posture research, was awarded to Dr Brodie for his vision of using the latest wearable technologies to study human performance in the real world rather than in a lab. Loss of mobility and a reduction in routine activities contribute to increased morbidity, metabolic disorder, cardiovascular disease and early mortality.

"The data collected from the wearable technology is used to help develop new interventions aimed at improving the walking in people at high risk of falls so that people can remain mobile, independent, active and healthy – avoid serious fall injuries and stay out of hospital," says Dr Brodie.

Over the coming year, Dr Brodie will focus on developing new technology that combines smart socks (incorporating miniature sensors), haptic stimulus (vibrations), auditory cues and mobile phone apps to improve mobility and increase the user's confidence so they can undertake activities of daily living and cardiovascular health.

Working with Associate Professor Kim Delbaere and Professor Stephen Lord, Dr Brodie's two new interventions aim to reduce freezing of gait in people with Parkinson's disease, a disabling symptom causing falls as a patient feels their feet are 'glued' to the floor, and intermittent claudication in people with peripheral arterial disease, a debilitating and intense cramping pain brought on by exercise.

SLEEP AND PARKINSON'S

Professor Danny Eckert

Sleep disruption is a very common feature and directly contributes to poor quality of life in people with Parkinson's disease. Sleep disorders have been reported to occur in as many as 97 per cent of people with Parkinson's disease. In addition to REM behaviour disorder, sleep disordered breathing, including obstructive sleep apnoea, is present in 40-60 per cent of people with Parkinson's.

Dr Danny Eckert with a research participant

Led by Professor Danny Eckert, Principal Research Scientist and Group Leader of the Sleep and Breathing Lab at NeuRA, a new project will be undertaken over the coming year to perform sleep studies to better understand the role of sleep disruption and sleep disorders in people with Parkinson's disease.

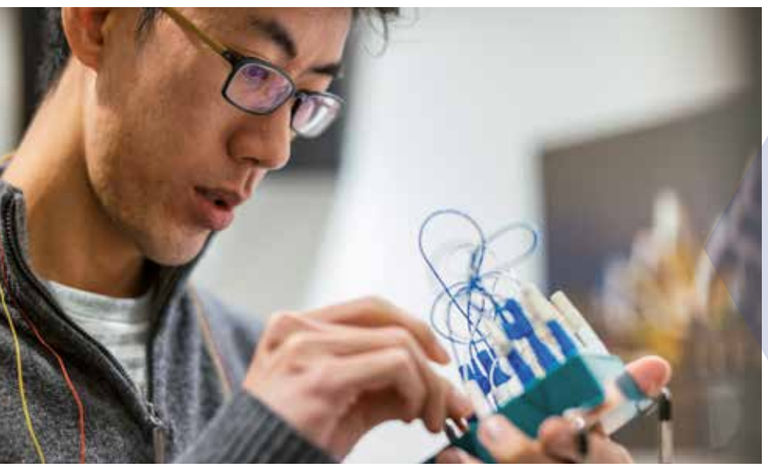
"The NeuRA Sleep and Breathing team has developed new specialised approaches to determine the specific reasons why people develop the most common sleep-related breathing disorder, sleep apnoea," says Professor Eckert.

"The causes vary between people and are different across different disease states. We don't know what the specific causes are in people with Parkinson's disease."

NeuRA's unique targeted approach will be used to deliver tailored therapies to improve sleep disruption based on the specific causes identified. This has the potential to improve quality of life and slow disease progression.

NeuRA's Parkinson's program is combining research in falls, balance and injury, MRI imaging and sleep and breathing. This allows scientists to bring together important elements of research and therapy combining results into one integrated model, specifically designed to better treat people living with Parkinson's disease.

The integration of these three critical steps – better early detection, effective balance therapy and improving the quality of sleep for people living with Parkinson's, will significantly improve the overall quality of life of people living with the disease.



Dr Benjamin Tong

"The causes vary between people and are different across different disease states. We don't know what the specific causes are in people with Parkinson's disease."

Dr Hanna Hensen

SLEEP AND WELLBEING IN PEOPLE WITH MULTIPLE SCLEROSIS

Dr Hanna Hensen

Dr Hanna Hensen is researching the impact that neurodegenerative diseases like multiple sclerosis (MS), in combination with poor sleep, can have on the human body and people's lives.

MS is an auto-immune and neurodegenerative disease that is most commonly diagnosed in young adults between 20-40 years. In Australia, over 23,000 people are affected and worldwide over two million people are diagnosed. MS causes a broad range of symptoms with increasing morbidity and disability. Fatigue is one of the most common and debilitating symptoms, affecting about 70 per cent of the people with MS.

Fatigue is very difficult to treat, and all current therapies are either ineffective or only partially effective in relieving this debilitating symptom.

Poor sleep and sleep disruption are also common in people with MS and can contribute to fatigue and impair cognitive function.

The primary objective of Dr Hensen's research over the coming year is to define the prevalence of sleep disorders and sleep disruption in people with MS and determine the relationship between fatigue and other symptoms of the disease. She is also conducting a detailed sleep physiology study to determine the specific causes of sleep apnoea in people with MS. She then hopes to trial targeted therapies to determine if treating sleep problems can improve fatigue and cognitive function in people with MS.

Dr Hensen hopes her work will reduce fatigue and improve cognitive function to increase the quality of life, productivity and wellbeing in people with MS.

Sleep lab in action

L-R: Professor Lynne Bilston, Associate Professor Julie Brown, Elizabeth Waller

TRANSURBAN ROAD SAFETY CENTRE

Professor Lynne Bilston and Associate Professor Julie Brown

In partnership with Transurban, a safe summer holiday campaign was developed for digital and social media channels. The goal was to bring a heightened awareness to safe travel practices during this busy period on the roads, to continue to work Towards Zero.

This program is part of the integrated research and education approach through the partnership formed from the launch of Transurban's sponsorship of the Transurban Road Safety Centre at NeuRA in May 2017.

Key elements of the summer program focused the development of three key media stories on driver safety: Driver Fatigue, You Can't Beat Sleep; Have You Safely Packed the Kids and It's Important to Secure Your Luggage Before Driving.

A comprehensive range of digital content was created to bring these communiques to life with leading senior scientists at NeuRA including Associate Professor Julie Brown and Professor Lynne Bilston from the Transurban Road Safety Centre.

In addition, Professor Danny Eckert, from the Sleep and Breathing Lab, delivered important evidence-based science on the little understood driver-fatigue syndrome which claims one death per day on average on our roads in Australia.

"Driving while fatigued has reached alarming levels in Australia with 20 per cent of drivers admitting they have fallen asleep behind the wheel at least once. Fatigue related crashes can happen at any time of day, not just late at night. This makes driver fatigue education critical."

Professor Danny Eckert, Head of the NeuRA Sleep and Breathing Lab, said caffeine can't replace a good night's sleep. If you're awake for 19 continuous hours, your level of fatigue is equivalent to a Blood Alcohol Level of .05; By 24hrs this has reached the equivalent of twice the legal limit.

"While you're awake throughout the day, chemicals such as adenosine build up in the brain which make you feel sleepy – this isn't something you can fight," said Professor Eckert.

"Driving fatigued is just as dangerous as driving under the influence and fatigue combined with a legal amount of alcohol is even more likely to result in a crash."

Fatigue is one of the big three killers on NSW roads; whether travelling for a family holiday or a special event, it is imperative to be aware of signs of fatigue. So being able to judge how tired you are before you step behind the wheel is critical to driver safety.

Good sleep starts with good habits which can be introduced at home. Professor Eckert suggests a regular sleep routine and bed time, not using your smart phone one hour before going to sleep to avoid blue light stimulation, bringing the lights down in your environment, and avoiding caffeine after 2 pm. Transurban's Road Safety Specialist Elizabeth Waller also featured in a video on the importance of checking child restraints.

TAKING DRIVER SAFETY MESSAGES TO THE ROAD

The Transurban Road Safety Centre at NeuRA

A digital billboard campaign took the Transurban Road Safety Centre across Sydney during the summer period. Featuring in prominent locations around the Sydney road network, the billboards generated strong exposure and reinforced the important research taking place at the centre.

Working together, Transurban and NeuRA are committed to road safety and alleviating the significant impact of death and injury on our roads. The new facilities provide researchers the opportunity to study a number of growing trends on Australian roads.

These will include aged driver and passenger safety, including using comfort aiders; motorcyclist safety and motorcycle design; rear seat occupant safety and restraint systems.

The Transurban Road Safety Centre accommodates a crash sled capable of reaching speeds of up to 64km/h.

This enables tests that reflect serious crashes on the roads, providing world-class facilities to attract the best and brightest talent, and expediting testing and outcomes to enable a quicker translation of results into practice.

Together NeuRA and Transurban are building a road safety centre to keep all people safe on our roads.

Elizabeth Waller, Transurban Road Safety Specialist

Associate Professor Julie Brown

KEEPING SENIORS SAFE ON THE ROAD FOR LONGER

Associate Professor Julie Brown

Associate Professor Julie Brown is pioneering a world-first study into aged driver safety in the Transurban Road Safety Centre at NeuRA. This study will investigate the use of comfort accessories in cars by older drivers.

Older Australians make up just eight per cent of licensed drivers but account for over 14 per cent of road fatalities. Hospitalisation rates among these older drivers is exceeded only by drivers aged 15–25 years. People aged 65 years and over are up to nine times more likely to be seriously injured in a crash than younger people. The reason most commonly cited for this is the increased frailty associated with ageing leading to a reduced tolerance to crash forces. However, other factors may also impact this risk. In a recent sample review of 380 drivers aged 75 years or older, Associate Professor Brown and her team found while all drivers wore seatbelts, over 25 per cent also used an adaptive comfort accessory such as seat belt padding, seat base cushions, or some form of back support.

"Many of these could negatively impact crash protection and be influencing the disproportional number of older Australians being killed and injured in car crashes," said Associate Professor Brown.

"Previous research into child safety in cars has shown such accessories have a detrimental effect on protection provided by a restraint in a crash. It is quite likely that many of the accessories we saw being used by older drivers would also have a detrimental effect on their crash protection."

The research underway in the Transurban Road Safety Centre is collecting data from older Australians, and clinicians involved in their care, to understand why older drivers are using these types of devices in cars, and in what circumstances they might be needed.

"No guidelines exist anywhere in the world that detail acceptable designs of comfort and orthopaedic aids to be used in a car," says Associate Professor Brown.

Crash testing in the Transurban Road Safety Centre will be used to determine the impact different types of comfort devices have on the protection provided to older people in cars involved in crashes. By identifying what types of comfort and orthopaedic aids are safe to use in cars, this work will lead to the first ever set of guidelines for clinicians and older drivers about what and when comfort accessories should be used in cars.

Mobility is key to healthy, independent ageing and the development of these new guidelines will help to keep our aged drivers safer on the roads for longer.

CONSUMER DRIVEN RESEARCH TO IMPROVE CHILD SAFETY IN CARS

Professor Lynne Bilston and Associate Professor Julie Brown

Child restraint misuse is an ongoing global problem. For child restraints to be effective, they must be installed and used correctly. One of the biggest barriers to correct use reported by parents is that they find the instructions supplied with child restraints difficult to understand and apply.

A three-part study led by Associate Professor Julie Brown is working to transform the way safety information for products are delivered. Knowledge of correct child restraint use is important to child car occupant safety as the protective potential of child restraints is significantly reduced when it is misused.

Simplifying child restraint instructions through design can be a cost-effective way to deliver child restraint information so that people are better equipped in situations where they must transport children safely in a motor vehicle.

The first stage of the study gathered parental feedback on the current information materials supplied with child restraints and discussed how they could be improved. The team then combined the parental feedback with child safety information and good design principles to develop prototype instruction materials; then tested the developed prototype with consumers to explore their effectiveness.

When the team compared the user-centred instructions they developed with current product instructions, they discovered the user-centred instructions were more effective in helping people install child restraints correctly. Now in the third stage of their study, the team are currently recruiting parents to be involved in research to confirm these findings in the real world.

The work of Associate Professor Brown's group has already begun to change how child restraint manufacturers develop instructional materials for parents through the use of clearer labelling and access to instructional videos online.

Involving users in the design process of their instructions was important as it ensured the materials being developed will meet the needs of those using them. In the future, the investigative study may also transform the design of information materials being supplied with other safety products.

INJURY PREVENTION

STAYING IN TOUCH

Dr Ingvars Birznieks

Dr Ingvars Birznieks and his team are researching ways to hack neural communication channels, new methods to improve recovery after stroke and developing knowledge that can be used to build bionic hands.

Dr Ingvars Birznieks with a research participant

Neural code – hacking neural communication to interact with the brain

Touch receptors in the fingertips communicate with the brain using short electrical impulses, called spikes. Dr Birznieks' team are investigating how patterns of spikes are encoding information which is then interpreted by the brain. The research team is also working to discover how to create such spiking activity artificially using non-invasive mechanical stimuli. This technology is unique to the lab at NeuRA and has been developed over several years of collaboration with Dr Richard Vickery from UNSW Sydney. The combined effort of the research teams has led to unprecedented access to neural communication at the level of single neurons. Researchers now have the ability to investigate how spiking activity in those neurons influences perceptual experience.

"With this knowledge and using non-invasive access to this neural communication channel we can 'trick' the brain into thinking it is touching objects that are in fact artificial constructs," says Dr Birznieks.

Stroke – new methods discovered to improve recovery after stroke

When stroke affects nerve centres and pathways involved in processing sensory information from the arm and hand, the loss of sensation can be devastating, however, some recovery is possible.

"New connections may be created but these connections do not necessarily obey the orderly organisation we are used to," says Dr Birznieks. The team found that in some stroke patients the perception of their hand's map becomes 'scrambled', so when a patient is touched in one location, they perceive the sensation as originating from another site. Usually neither patients nor neurologists are aware of this dysfunction.

Research led by Dr Birznieks is providing insights into why many stroke patients suffer poor recovery of motor function for years following a stroke. Correcting how the brain perceives sensory information from the hand may lead to improved daily functioning and new rehabilitation methods.

Dexterity of the human hand – how hand movements are controlled by sense of touch and how this knowledge could be used to build robotic hands

The dexterity of the human hand remains unmatched by the most advanced artificial devices. "This research project combines sensory and computational neuroscience and biomedical engineering to understand the sensory and motor control mechanisms underlying our ability to use tools with our hands," says Dr Birznieks. This research will help inform the development of next generation sensory-controlled bionic systems and other devices including telesurgery robots.

For stroke patients and amputees, this research will also benefit understanding new pathways for their recovery.

Neural code – the language of the nervous system; how to eavesdrop and understand neural communication and how to send our own messages through this channel

Professor Cyndi Shannon Weickert

SCHIZOPHRENIA BREAKTHROUGH

Professor Cyndi Shannon Weickert

Professor Cyndi Shannon Weickert has been on a quest to determine the causes of schizophrenia for over 30 years. She has made a series of breakthrough discoveries that will have a global impact in the way we conceptualise the biological basis of this major mental illness.

Importantly, her recent work is poised to transform the treatment of those with schizophrenia. Her latest discovery has identified immune cells from the blood are found at increased levels in the brains of a substantial subset of those with schizophrenia. These cells were not known to be in proximity to neurons and the identification of these putatively culprit cells suggest they may play a role in disease development or decline associated with schizophrenia that was never previously considered. The discovery will transform global schizophrenia research and open new avenues for developing targeted therapies.

Professor Shannon Weickert says researchers have long thought there were three main cellular types that could contribute to the mystery of what caused schizophrenia with the primary pathology residing in the neuron, the glia, or even the endothelial cells. Her research at NeuRA has identified a fourth player – the macrophage, a type of white blood cell, which was seen in the brain tissue of people with schizophrenia who had high levels of inflammation.

"What we believe is the glial cells are 'angry' and are emitting distress signals and changing the surface of the endothelial cells so that these can catch and reel in monocytes, a type of white blood cell, from the bloodstream and into the brain tissue," says Professor Shannon Weickert.

These monocytes then transform into macrophages once inside the human brain. The macrophage, which means 'big eaters' in Greek, can be thought to be good as these cells digest cellular debris and microbes. However, these cells have a dark side as they can destroy healthy tissue when they go rogue.

"Through the microscope I saw massive amounts of these clusters of small brown-coloured cells packed along the blood vessels in the brain tissue, close to the neurons," Professor Shannon Weickert says.

"Before we thought it was primarily the cells that resided in the brain that were causing schizophrenia and for over a century people have been focusing on neurons and glial cells, but we're the first to show these immune cells are in the brain, in proximity to the neurons and positioned to do damage."

The presence of immune cells in the brain tissue can produce inflammatory factors to further drive the neuronal damage in schizophrenia. Immune cells would only enter the brain to conduct immune surveillance, then may die out or re-enter the bloodstream. In schizophrenia, they may over-react and cause collateral damage.

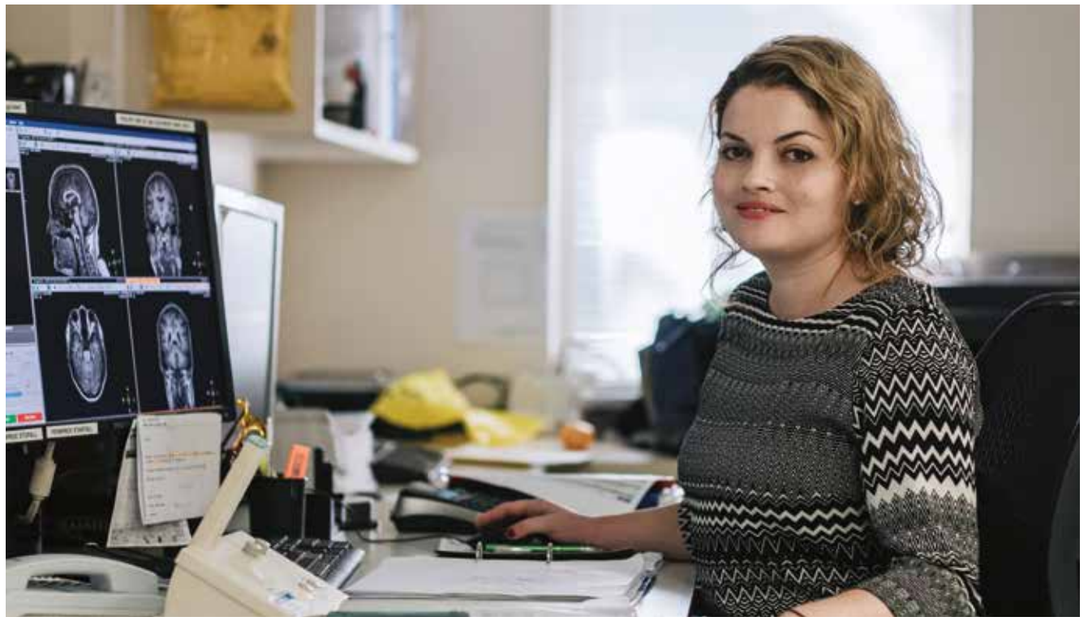
Professor Shannon Weickert's findings suggest that schizophrenia researchers should be working with immunologists to develop treatments that target the immune system.

One in every 100 Australians lives with schizophrenia. No single cause for schizophrenia has been identified, and this has prevented the development of a cure. The current treatments for schizophrenia are designed to suppress these symptoms and do not target the cause of the disorder. These drugs only partially relieve symptoms and can produce unwanted side-effects.

Professor Shannon Weickert said these findings suggest schizophrenia researchers should be working with immunologists to develop treatments which target the immune system.

"This opens whole new avenues for therapy. We may be able to find a way to block entry of these immune cells into the brain to see if that's going to seriously thwart symptoms and improve brain function for people with schizophrenia," says Professor Shannon Weickert.

The inflammation observed in 40 per cent of the study sample, indicates future therapies could benefit a large portion of the schizophrenia community.



Dr Justine Gatt

SETTING A LIFE COMPASS FOR RESILIENCE

Dr Justine Gatt

In a study led by Dr Justine Gatt, researchers at NeuRA are looking at the structure and function of the brain as well as genetics to better understand mental health and wellbeing in adults. This study aims to understand why some people are more resilient to stress than others, and to identify the best ways to help Australians build resilience.

Dr Gatt says resilience plays an important part in everyday mental health and wellbeing and that building resilience is important to help protect against the development of mental health problems throughout life.

"We know that everybody experiences some form of stress in their life – whether it is a major traumatic event such as the death of a loved one, or ongoing daily stresses such as relationship conflict or work demands," says Dr Gatt.

"However, not everybody who experiences these stressful life experiences goes on to develop mental health problems. Some people are resilient."

Over the last 30 years life has become a lot faster. Access to the internet and mobile phones mean people are more 'switched on' than ever. Daily pressures from work, relationships, and managing finances are just some issues faced by Australians.

"For many, these stressors can lead to something more serious such as anxiety and depression. Understanding and developing resilience is key to wellbeing," says Dr Gatt.

"What we're looking to identify is how people who may be more or less resilient differ in terms of their brain structure and function over time, and how genetics and environment modulate these processes."

Dr Gatt is currently using data collected from twins to understand the processes of wellbeing and resilience in the brain and how genetics and environment modulate these processes. The original twin study called TWIN-E was initiated in 2009 and involved the collection of various genetic, neurocognitive, EEG and MRI brain imaging measures in over 1,600 healthy adult twins across Australia.

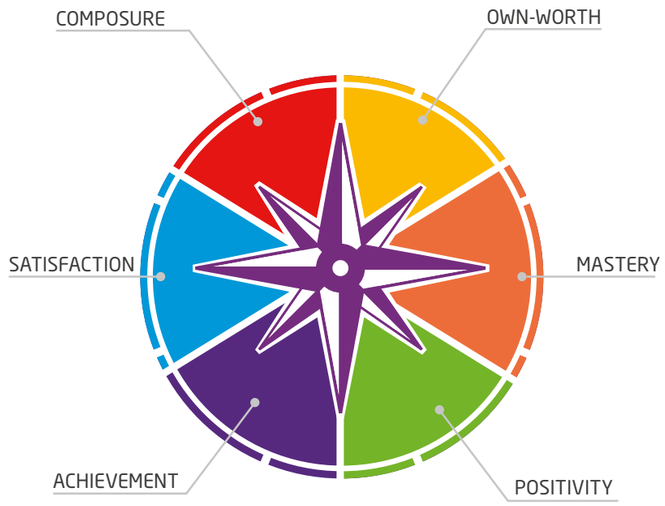
Over the coming year, Dr Gatt will retest these twins for changes in their brain over time. In this project, Dr Gatt and her team will recontact the twins to complete the neurocognitive and MRI imaging testing components again after ten years, and then again after 12 years. The aim of the project is to map the process of resilience and wellbeing onto changes in the brain over time and to identify how our genes and life experiences may modulate these long-term processes. In particular, they are interested in identifying whether there are specific genes that may be associated with increased resilience or a person's sensitivity to their environment. Both positive and negative life experiences are important to consider.

To date, Dr Gatt and colleagues have developed and validated a questionnaire to measure wellbeing called COMPAS-W. This scale contains 26 items and has demonstrated reliability in adults, and in adolescents as young as 12 years of age across six countries (Australia, New Zealand, Canada, China, the United Kingdom and South Africa). Dr Gatt and her team have established that wellbeing is 48 per cent heritable, by using the COMPAS-W scale in the twin sample.

This means that both genetics and environment play a key role in mental wellbeing. The team hope this scale may also guide future work in developing and testing a set of navigation tools that build wellbeing and resilience to stress in the community.

CAN YOU INOCULATE YOURSELF **AGAINST STRESS?**

COMPAS-W Wellness Chart



TIPS FOR RESILIENCE

Composure: Develop positive coping strategies like humour and active problem solving, rather than avoidance, self-blame, venting or substance use, and know your body when you are getting stressed so that you can respond differently

Own-Worth: Know who you are, what you stand for and your values, and preserve them with healthy boundaries

Mastery: Build on your strengths, seek opportunities for growth and be self-reliant

Positivity: Have a positive outlook, seek out and schedule time for fun, and take regular notes of things achieved

Achievement: Identify your life purpose, your talents and interests, and set meaningful goals that satisfy your needs independent of others

Satisfaction with Life: Be fit and healthy, and look after your body too, be mindful and present (pay attention to your five senses), and practice gratitude

MAJOR SEQUENCING STUDY FOR BIPOLAR DISORDER

Dr Jan Fullerton

Around 250,000 Australians are affected by bipolar disorder, a major mood disorder characterised by periods of mania and depression, which can be highly debilitating. People living with b ipolar disorder can face a range of issues, including escalating impulsive and risk-taking behaviour and reduced life expectancy, leading to increased suicide risk and higher rates of general health conditions such as cardiovascular disease.

Current treatments are highly variable for individuals with this condition, and the specific genetic causes have remained largely obscure. A collaborative research project will be led by Dr Jan Fullerton, a Senior Research Scientist at NeuRA, that includes researchers across NeuRA, the Black Dog Institute, UNSW, Prince of Wales Hospital, and the Sax Institute, to establish NSW as a national and international leader in genomic medicine.

The study will utilise over 10 years of administrative health-record data from the Sax Institute's 45 and Up study, the largest cohort study of healthy ageing in Australia, comprising over 267,000 individuals. From this resource, researchers will recruit and obtain genetic samples from 1,200 individuals with bipolar disorder to perform whole genome sequencing through the state-of-the-art genomics facility at the Kinghorn Centre for Clinical Genomics and the Garvan Institute.

"This landmark study will use advanced genomics and administrative data analysis of government health records to address key knowledge gaps in the causes and treatment of bipolar disorder," says Dr Fullerton.

"Bipolar disorder is most commonly treated with lithium, but this is only fully effective for around 30 per cent of patients. Currently, there are no tools to identify which individuals are most likely to respond to lithium, and treatment often entails a frustrating trial-and-error approach on a series of medicines before an effective treatment regime is identified."

The investigator team aims to identify genes and molecular pathways which increase the risk of illness, and genetic signatures which may predict responsiveness to medicinal treatment. The team will also examine genetic signatures which influence general medical conditions more commonly experienced in people with bipolar disorder (such as cardiovascular disease, diabetes and asthma), which further reduce quality of life and significantly impacts the overall health of people living with bipolar disorder.

The project has potential to open avenues for personalised medicine in the future treatment of bipolar disorder, potentially enabling the identification of individual patients who would benefit from specific treatments based on their genetic makeup. This unique study will also contribute to key international collaborative efforts to further the potential for gene discovery, improving our understanding of the causes of this complex and highly heritable psychiatric condition.

Dr Jan Fullerton in her lab

Associate Professor Melissa Green

A LIFE-COURSE APPROACH FOR MENTAL HEALTH

Associate Professor Melissa Green

Associate Professor Melissa Green is leading several projects using linked data from the New South Wales Child Development Study (NSW-CDS), a longitudinal population study that enables a life-course approach to identify risk and protective factors for childhood and adolescent-onset mental health problems. The study methodology entails repeated waves of record linkage for a state-wide population cohort of some 90,000 children and their parents. Record linkage allows data from various sources to be linked but does not reveal participant identity. Administrative records held by various government departments are combined with cross-sectional assessments of developmental functioning for the child at age 5-6 years (Australian Early Development Census) and 11-12 years (the Middle Childhood Survey).

The second wave of record linkage has just been completed, bringing together linked data from more than 20 record sets, up to the children aged 13-14 years. The NSW-CDS is unique in providing population-based evidence on the earliest indicators of childhood vulnerability for mental illness. The study has sufficient power to determine the relationships between relatively rare risk factors and outcomes, to identify early developmental pathways of risk and resilience.

A key finding to date has been the delineation of subgroups of children defined by distinct patterns of developmental vulnerabilities at age five years, among which approximately 10 per cent of the general population appear to represent high risk for mental illness at school entry. The research team are following these children into adolescence and adulthood to determine their mental health and wellbeing outcomes later in life. They can already see the predictive utility of the age-five developmental profiles in mental health outcomes at age 13-14 years.

Funding received this year from the National Health and Medical Research Council (NHMRC) will support the next wave of record linkage as the children reach mid-adolescence (aged 16-17 years). This will bring additional records from Headspace and other national health records that will enable the detection of more commonly experienced mental health issues as the children develop into adulthood.

Ultimately, the study aims to characterise modifiable risk and protective factors that could assist governments in implementing social, educational, and health policies that will prevent or mitigate adverse mental illness and promote resilience. The team are working closely with the NSW Department of Family and Community Services (FACS) via an NHMRC Partnership Grant that is contributing to NSW inter-agency government policy development.

Dr Sylvia Gustin

SPINAL CORD INJURY BREAKTHROUGH

Dr Sylvia Gustin

Researchers from NeuRA, the University of Sydney, and HammondCare have found surviving sensory spinal nerve connections in 50 per cent of people living with complete thoracic spinal cord injuries.

The study, which is part of a decade-long collaboration between the researchers, used cutting-edge functional MRI (fMRI) technology to record neural response to touch. It was NeuRA's Dr Sylvia Gustin who analysed the fMRI images to identify the moment the patient's brain registered the touch.

"Seeing the brain light up to touch shows that despite the complete injury to the thoracic spine, somatosensory pathways have been preserved," explains Dr Gustin.

"It's fascinating that although the patients did not 'feel' the big toe stimulation in the experiment, we were able to detect a significant signal in response to the touch in the brain's primary and secondary somatosensory cortices, the thalamus, and the cerebellum."

For those living with a complete spinal cord injury this means, despite previously believing the communication to the brain had been severed in the injury, messages are still being received.

Dr Gustin describes this new category of spinal cord injury as 'discomplete'.

"The current classification system is flawed. It only contains two types of spinal cord injury – complete and incomplete," says Dr Gustin.

"It is important we acknowledge there is a third category – the 'discomplete' injury, only then we can provide better treatment regimens for the many sufferers of a complete spinal cord injury."

For those newly classified as 'discomplete', this discovery opens up new opportunities to identify those people living with a spinal cord injury that are more likely to benefit from treatments aimed at improving sensation and movement. Because of this study, research participant, James Stanley, now knows he belongs to a new category.

"It is exciting to know that there is a connection there, that my toe is trying to say hello to my brain," says James.

"If medical professionals can work to identify people like me with a 'discomplete' injury earlier, perhaps they can find new treatments and rehabilitation techniques.

"The thought that one day I might be able to feel the sand between my toes again, or the waves wash over my feet gives me hope. It's something Dr Gustin's discovery has made possible."

VIRTUAL REALITY INTERVENTION

International collaboration between NeuRA and University of Alabama, USA

A person with spinal cord injury cannot feel touch. When touch information is forwarded from the periphery, e.g. the big toe, the brain represents a new category – discomplete spinal cord injury – which requires a new approach to rehabilitation. A new phase of this research program will study how to enhance these surviving sensory spinal nerve pathways with an intensive stimulation of the areas which represent touch in the brain to ultimately restore a perception of touch.

Together with Corey Shum and Associate Professor Zina Trost (University of Alabama, USA), Dr Gustin is developing a novel approach of Virtual Reality Walking Intervention (VRWalk) to enhance both the surviving sensory spinal nerve pathways and the touch signal in the brain in people with a discomplete spinal cord injury to finally restore the perception of touch.

The VRWalk intervention is facilitated by a commercially-available head-mounted display and wearable wrist sensors equipped with lightweight accelerometers. These detect participant arm movement during gait motion, translating arm swings into synchronised leg movement in the virtual world.

Participants' arms and legs are represented from a first-person perspective in a fully immersive 360-degree virtual scene. System mechanisms function to optimally map participants' actions to those of the virtual avatar, ensuring that virtual motion is directly related to participant intent (and moderating vestibular discomfort). The system dynamically adjusts sound and haptic feedback from virtual "footfalls", accounting for scene characteristics.

Gaming elements are central to the VRWalk design both to facilitate goal-directed activity through interaction with VR world objectives and to engage active interest. Optimal kinematic configuration in the virtual environment and relationship between physical and virtual body were addressed as part of initial testing by spinal cord injury stakeholders.

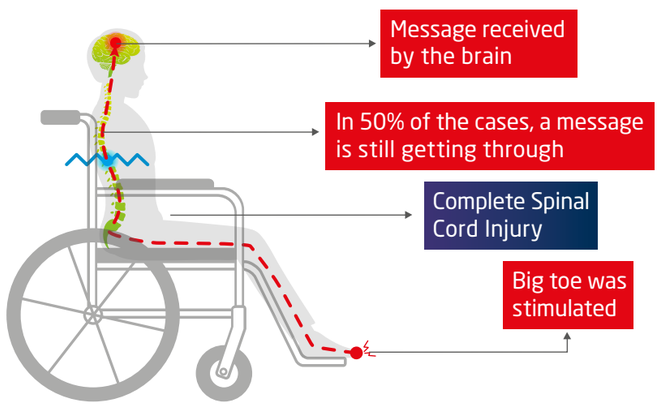
"Our primary aim is to examine whether a 20-day course of 30-minute VRWalk intervention offers clinically meaningful restoration of touch perception in people with discomplete spinal cord injury," says Dr Gustin.

The research team will also use neuroimaging data, focusing specifically on changes in brain areas which represent touch and movement.

As a result of these developments, the research will provide the evidence base to develop new policies for diagnostic classification of spinal cord injuries, e.g. including discomplete injuries, not only in Australia but globally. This would be a game changer and provide a new future for close to 50 per cent of all people currently living with a complete spinal cord injury.

NEW FINDING: ALL SENSATION IS NOT LOST IN THORACIC SPINAL CORD INJURIES

- 50% of people with a complete spinal cord injury tested still have surviving sensory nerve connections in areas of no sensation
- New information tells us messages are getting through to the brain
- These nerves may help improve sensation OR in so me people, contribute to pain



UNRAVELLING THE LINK BETWEEN CHRONIC PAIN AND MENTAL HEALTH DISORDERS

Dr Sylvia Gustin, Brooke Naylor and David Kang

Chronic pain is a significant problem worldwide that results in enormous suffering and costs to affected individuals, their loved ones, and society. The experience of chronic pain is so much more than a sensation. Chronic pain impacts our emotions, cognition and social life. In Australia, an alarming 20 per cent of people with chronic pain have considered suicide.

NeuRA's Dr Sylvia Gustin and her team are at the forefront of unravelling the impact of chronic pain on the brain. People with chronic pain can develop mental health disorders including anxiety and depression. The prevalence of depression in people with chronic pain is as high as 54 per cent and at least 35 per cent experience anxiety. The team's research is investigating the connection between chronic pain and mental health disorders using cutting-edge brain imaging techniques.

One area of the brain particularly vulnerable to the effects of stress is the medial prefrontal cortex (mPFC). The mPFC sits just behind the forehead and is of particular interest when considering emotional and cognitive processing in the brain. Brooke Naylor, a Master's student from the pain imaging team led by Dr Gustin has demonstrated a decrease in glutamate within the mPFC of people living with chronic pain. Glutamate is the main excitatory neurotransmitter in the central nervous system. The decrease of this neurotransmitter is associated with excessive worry, pessimism, fear and doubt.

As part of an independent learning project, David Kang, revealed that people with chronic pain also have a decrease in GABA, within the mPFC. GABA is the central nervous system's main inhibitory neurotransmitter. The decrease in GABA is critical in the development and maintenance of depression. Further research in this area by Anton Paulson has shown people with chronic pain have increased blood flow in the mPFC compared to people without pain.

This research at NeuRA supports the hyperexcitability hypothesis of chronic pain that is underpinned by an excitatory/inhibitory imbalance. This imbalance means that the mPFC has lost its ability to dampen down pessimistic and/or fearful thoughts and emotions which may result in anxiety or depression. On top of this, Daniel Hultberg's work at NeuRA has shown this may be a learned process due to a disrupted connection between the mPFC and the hippocampus, which is critical in learning and memory. This shows that emotional and cognitive learning and memory in people with chronic pain may be maladaptive, resulting in learned worry, pessimism, fear and doubt.

There is an urgent need to develop new therapies for the millions of people living with chronic pain. Dr Gustin's research is fundamental to understanding the underlying mechanisms for the development and maintenance of chronic pain and comorbid mental health disorders so more effective treatments can be developed.

The pain research team at NeuRA

PAIN FREE AND DRUG FREE

Associate Professor James McAuley

Associate Professor James McAuley

Associate Professor James McAuley, says the Australian Government's Therapeutic Goods Administration's rescheduling of over the counter opioids is a positive step in curbing opioid addiction, but it is now more important than ever for clinicians and patients to be aware of opioid-free treatment options for chronic pain.

"Drugs are a great solution to pain for the first one to two days but when pain persists patients need to consider better long-term solutions," said Associate Professor McAuley. "With the restricted access to opioids, this is a good moment for all people to rethink how they manage their pain."

Chronic low back pain is the leading cause of disability in Australia and will develop in 40 per cent of people who experience an episode of low back pain. Research at NeuRA is focused on developing non-drug alternatives to opioids.

"There are many ways people can improve their pain on their own," says Associate Professor McAuley. "We're currently working with the community to deliver pain education and information on self-managing low back pain in a series of public seminars."

By empowering the public with information on pain and self-management, the team is helping people to avoid seeking treatments which may be costly, ineffective or have dangerous side-effects.

To help Australians self-assess and self-manage their pain, the team are currently developing more effective ways to communicate this information.

The MyBack application being developed by NeuRA will deliver targeted advice on back pain to people in their pocket.
In another project funded through the Sydney Partnership in Health, Education, Research and Enterprise (SPHERE), researchers have partnered with global advertising agency Y+R to develop, deliver, and evaluate an online campaign to reach all Australians.

"We want Australians to know their pain better, and to be able to self-assess whether their pain is likely to become chronic," says Associate Professor McAuley.

"What we've seen is highly effective online awareness campaigns which are able to change people's ways of thinking about their chronic health conditions and empower them with the information they need to better understand their experience and to know when they should seek professional help."

Associate Professor James McAuley and Edel O'Hagan

"We want Australians to know their pain better, and to be able to self-assess whether their pain is likely to become chronic"

The medical and research staff at clinical neurophysiology unit

A SHORT HISTORY OF NEURA'S QUEST FOR DISCOVERY

Professor Simon Gandevia

It all started around the kitchen table!

Four passionate scientists, Professors Ian McCloskey, Erica Potter, David Burke and Simon Gandevia, founded the Prince of Wales Medical Research Institute back in 1991. For a few years, we had asked ourselves the right way to establish a new research centre where we could dedicate our efforts to medical research. It was the focus of some dinners around my kitchen table, planning how we would do it. This was really exciting. We all needed a place to conduct our research but there was just no space, focus or potential funds for a new centre in the plans of the Prince Henry and Prince of Wales Hospitals, the University of New South Wales or the federal and state governments.

There was already a strong friendship among the four of us, so we decided to progress our brain research focused on the brain's control of movement and other major body processes. We decided that putting our hats in the ring for a competitive national grant for independent medical research institutes and negotiating an arrangement with the University of New South Wales and the Prince of Wales Hospital, would suit our purpose and provide us with the necessary independence.

This is how turning our dream into a reality began. We now had territory, independence, and the capacity to do long-term brain research. Many thought we were crazy, but we were determined to make it work.

The key thing I had learned and gained from mentors was that high-quality collaboration is essential in science. It generates better ideas, better experiments and better understanding of how things work. The four of us thought that the research undertaken in our small 'tin-pot' shed, a tiny independent medical research institute, would be greater than the sum of its parts. And I think we were right.

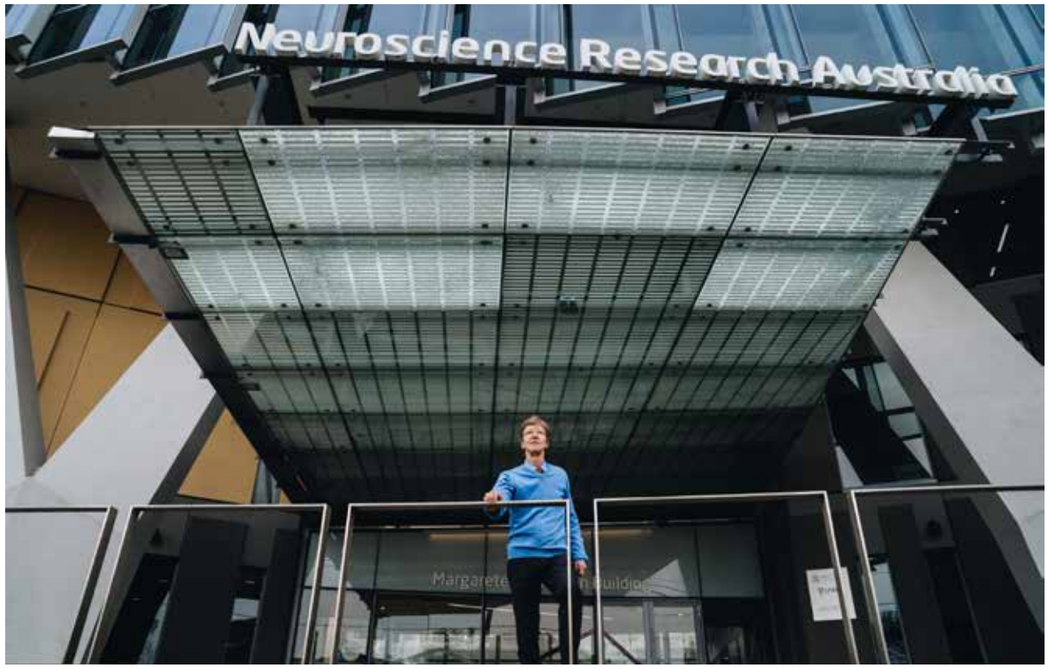
The initial years

We set up as a not-for-profit medical research institute, under a board, and made all the necessary components for beginning a new enterprise. It was a big deal moving our small research groups to what was essentially a non-existent institute.

Risk and rewards

I guess we all took a risk. We were all under pressure to do good science. If we didn't then the whole venture would fail. But we set the place up for a critical reason: so we would be better together rather than as individuals.

And today we have fostered a strongly collaborative environment, with key research infrastructure including our magnetic resonance imaging facility, that encourages greater generation of shared new knowledge, shared values and better outcomes for discoveries and cures.



Professor Simon Gandevia

Vision for a different future

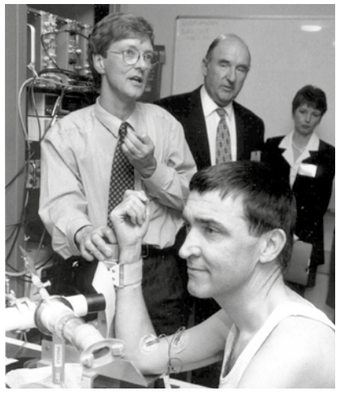
We also focused on making sure that the NSW government understood the importance of independent research and we were historically influential in setting up an infrastructure scheme that was fair and that supported all of the independent medical research institutes. It provided us with critical infrastructure funding on a competitive and transparent basis.

Timeline for NeuRA

Over the past 27 years, we've grown from an initial staff of 20 researchers to over 300 scientists, students and support staff. We have evolved, rebranding as Neuroscience Research Australia in 2010 and have built an impressive building named after our generous benefactor Mrs Margarete Ainsworth. We have international collaborations, breakthroughs in neuroscience research, and a strong vision of our purpose and potential.

I am most proud of the essence of who we are, and that has never changed. We are scientists passionate about our ability to discover new things along the path to understanding and hopefully one day curing, the most debilitating disorders of the brain and nervous system. We have kept the character of the place friendly, supportive and collegiate. We have travelled far, but there is still a journey ahead as we explore the realms of the brain and what it can do and what we can do to it.

Professor Simon Gandevia,
Deputy Director, NeuRA



Clinical staff measuring muscle strength in a patient

THE POTENTIAL BENEFITS OF RILUZOLE FOR TREATING SPINAL CORD INJURY

Dr Ralph Stanford

Recovery of function after acute traumatic spinal cord injury is limited, but the concept of using drugs to protect injured nerve cells offers hope of improving outcomes.

NeuRA's Dr Ralph Stanford has partnered with AOSpine in North America to establish a clinical trial of the drug riluzole in the early treatment of spinal cord injury in Australia.

Three hospitals in NSW (Prince of Wales, Royal North Shore and John Hunter) and the Royal Adelaide Hospital in South Australia have joined 20 other sites in the USA and Canada in an international collaboration to enrol suitable participants in the trial.

Many sites are needed because of the relative rarity of severe spinal cord injury and the stringent selection criteria of the protocol, the principal one being able to initiate trial treatment within 12 hours of injury.

Once a potential participant has consented, they are given a full course of tablets that may contain either active agent or placebo based on a random sequence. Whether they are one or the other is concealed from them and the investigators, which rules-out the possibility of biased recording of outcomes.

The potential benefits of riluzole in treating spinal cord injury were discovered by Professor Michael Fehlings of the University of Toronto, Canada, who is the world lead investigator of the trial. The drug acts to dampen the toxic effects of inflammation within the spinal cord following a compression injury and is given by mouth twice a day for two weeks.

Dr Ralph Stanford

Investigators record neurological function at the time of admission and at scheduled intervals for up to one year afterwards. NeuRA's Dr Claire Boswell-Ruys performs neurological examinations for all cases in Sydney. The effects of treatment will be measured in recovery of muscle strength six-months after injury, as well as indicators of hand function and overall independence.

The trial is ongoing, and 351 cases are required for completion. Of 129 enrolled so far, Australia has been very efficient and contributed 32 at a rate double that of North America. This is testament to the streamlined trauma services in this country and the dedication of the research personnel at all the participating hospitals.

NEW COUGH CLINICAL TRIALS PROGRAM

Dr Bonne Lee and Dr Euan McCaughey

In Australia, there are 350 cases of traumatic spinal cord injury each year. More than half of these injuries will be to the cervical area of the spine (neck), leading to quadriplegia. While quadriplegia is commonly associated with paralysis of all four limbs, it also affects the major respiratory muscles. This reduces cough strength, which can lead to associated respiratory infections.

L-R: Professor Jane Butler, Professor Simon Gandevia, Dr Anna Hudson, Euan McCaughey, Dr Claire Boswell-Ruys, Dr Bonne Lee

Respiratory complications, such as pneumonia and atelectasis, are the leading cause of morbidity and mortality in the first year of quadriplegia. These respiratory complications are particularly prevalent in the first six weeks of injury, with an incidence rate of up to 68 per cent. As well as delaying rehabilitation and reducing quality of life, the number of these complications is a critical determinant of hospital costs.

Dr Bonne Lee and Dr Euan McCaughey, together with Professors Gandevia and Butler and Drs Boswell-Ruys and Hudson, all from NeuRA, are leading the first global trial to investigate the effectiveness of electrical stimulation of the abdominal muscles to reduce respiratory complications in the first six weeks of quadriplegia.

The three-year international collaboration brings together leading research and medical teams from NeuRA, the Prince of Wales Hospital, and the Royal North Shore Hospital in Australia; The Indian Spinal Cord Injury Centre; Chiang Mai University Hospital in Thailand; The Queen Elizabeth National Spinal Injuries Unit and the University of Glasgow in Scotland; and Bach Mai Hospital in Vietnam.

The technique being studied, known as Abdominal Functional Electrical Stimulation (FES), has been pioneered at NeuRA, with our researchers showing that it can improve respiratory function in quadriplegia. However, while respiratory function is a predictor of respiratory complications in quadriplegia, the effectiveness of Abdominal FES to reduce respiratory complications remains unknown. "The knowledge generated by this work will lead to a better understanding of the molecular determinants of exceptional longevity and ultimately aid in the development of preventive and treatment strategies to promote health in our ageing population, further supporting families and the community," says Dr Mather.

Definitive evidence of the effectiveness of Abdominal FES to reduce respiratory complications in qudraplegia will drive the rapid worldwide translation of this low-cost and easily applied technology for this vulnerable patient group. This will lead to decreased morbidity and mortality, reduced rehabilitation time, improved quality of life and result in a large cost saving for global health systems.

Dr Anna Hudson with a research participant

Scientia Professor George Paxinos AO

MAPPING THE BRAIN TAKES ON A NEW DIMENSION

Scientia Professor George Paxinos AO

One of NeuRA's most esteemed researchers and the most cited neuroscientist in the world, Scientia Professor George Paxinos AO, is taking his world-renowned brain atlases into a new dimension. Professor Paxinos is known for his work in defining the brain of not only humans but rodents, primates and even the chicken. These exhaustive definitions are collected together in an atlas each to their own, defining regions and tracts of the entire brain, allowing researchers to generate models of disease and analyse behaviour and enabling neurosurgeons to ensure the most accurate and precise incisions.

These atlases have, until now, been two-dimensional. Comprised of slices of the brain, layered on top of each other, they are defined by the staining of cells. This has led to the impressive discovery of over 1,000 new regions during the four decades since the inception of the first atlas. Professor Paxinos is pushing the boundaries even further with his latest project to construct a three-dimensional atlas of the living human brain and the human brainstem.

By using the most robust MRI technology available, Professor Paxinos is creating the most precise and accurate maps of the brain ever conceived.

"In human neuroscience, researchers and clinicians almost always investigate images obtained from living individuals. Yet, there is no satisfactory MRI atlas of the human brain *in vivo* or post-mortem. There are some population-based atlases, which valiantly solve a number of problems, but they fail to address major needs," says Professor Paxinos. "Most problematically, they segment only a small number of brain structures, typically about 50, and hence are of limited value."

Professor Paxinos aims to define approximately 800 structures in the human brain, and like all his previous atlases, hopes to provide a 'gold standard' for research and clinical practice.

"Just as maps guided explorers of the world centuries ago we need maps of the brain to help guide future explorers of the brain," says Professor Paxinos.

Professor Paxinos' atlases have laid the foundations for almost all neuroscientific research. He continues his exploration of the brain by combining techniques he has developed for decades. Professor Paxinos and his team want to ensure that future explorers can continue to research the brain.

Dr Chris Skliros

RETHINKING HIV AND AGEING

Dr Lucette Cysique

Dr Lucette Cysique and Gemma Howdie

The first generation of people with HIV who were infected decades ago in Australia, are now growing old. These trends are similar in the Asia-Pacific region and worldwide. Dr Lucette Cysique is the Neuro HIV Group Leader and has identified that there is an urgent need for extra resources for the cognitive and mental health care of the ageing HIV+ population. By 2020, 40 per cent of the Australian HIV population will have reached their 60s due to the success of combined antiretroviral treatment, which enable those infected to live almost as long as the general population. However, the ageing HIV population lives with a greater age-related disease burden than people of the same age without the virus, and their ageing syndromes appear to accelerate.

Dr Cysique's work has shown that 30-50 per cent of HIV people with undetectable viral load can still experience mild form neurocognitive difficulties despite being on successful HIV treatment. "It is mild in the sense that it is not severe enough to be called dementia, however this kind of mild memory deficit will interfere with the most demanding aspects of everyday life," says Dr Cysique.

"Also 15-30 per cent may slowly progress towards more serious neurocognitive problems across several years. The variance in prevalence is mostly associated with whether HIV people experienced AIDS or not and whether they were treated early."

Research has shown that HIV-associated dementia can still be detected in 2-4 per cent of HIV people.

"There is concern among the NeuroHIV researcher community as it is unclear how mild forms of neurocognitive difficulties will progress when people approach their late 60s, the age at which all dementia types start to increase in the general population. We need to support, not abandon this first generation who are getting older and help prepare a commensurate healthcare response," says Dr Cysique.

In addition to mild forms of neurocognitive problems, the HIV population in Australia and globally has a higher lifetime prevalence of anxiety and depression symptoms compared to the general population.

In Australia, there has been a lack of comprehensive research on the mental health of HIV-infected people in the last decade. Overseas research has identified that suicidal ideations occur in one in four people with HIV. There is no current data for Australian people living with HIV, and in addition, the general mental health care in Australia has not adapted to support our ageing HIV population.

Dr Cysique says the sudden closure of H2M, the only dedicated mental health service for HIV people in Sydney, at St Vincent's Hospital has impacted the community.

"There needs to be more targeted and stigma-free health services for people getting older with HIV that is delivered by HIV physicians trained in geriatrics or geriatricians trained in HIV. We also need renewed support for HIV community organisation programs that will tackle age-related social isolation whether it is in LGBTQI people with HIV or other vulnerable HIV populations such as migrants from high HIV-prevalent countries, and women.

"Our goal is to produce the required epidemiological data for Australia on those issues to help form an adequate healthcare policy response. We will also continue to work with HIV community organisations to test a diverse set of interventions that we hope will benefit the neurocognitive health and emotional wellbeing of people living with HIV and ageing."

"We are working also with research groups in the Asia-Pacific regions to extend this research program to areas of high HIV prevalence who have also started to demonstrate ageing-accelerated syndromes in their HIV population as well. It is an issue that has global relevance for which we have been developing cross-culturally valid methods of assessment," says Dr Cysique.

UNDERSTANDING HOW GENETIC VARIANTS CONTRIBUTE TO DISEASE

Associate Professor Tony Roscioli

Associate Professor Tony Roscioli

Neurocognitive disorders are one of the largest unmet challenges in Australian healthcare, with 3,000 children born each year with moderate to severe intellectual disability. It has been difficult to make a genetic diagnosis in these disorders due to their remarkable genetic diversity, however genomic technologies are changing this.

Associate Professor Tony Roscioli is investigating the genetic basis of both intellectual disability and oro-facial clefting, as well as the health economics and outcomes of genomic testing in intellectual disability.

"There is a lot we don't know about brain function which can be revealed through identifying gene pathways," says Associate Professor Roscioli.

"Genomic testing allows us to provide answers to multiple people in a family. This isn't just providing a diagnosis to a particular family member, it is empowering families through genomic testing to know if there is a chance for recurrence and to have hope for the development of personalised treatments."

This is a fundamental change in the way we practice genetics, and genomics has started a revolution in providing a diagnosis for families.

"There are more than 1,500 genes which have been associated with intellectual disability so far, and it is estimated that over 1,000 more are yet to be identified," says Associate Professor Roscioli.

"In the past, we relied on clinical diagnosis and gene-by-gene testing to diagnose neurocognitive disorders. This process was time consuming and only partially successful."

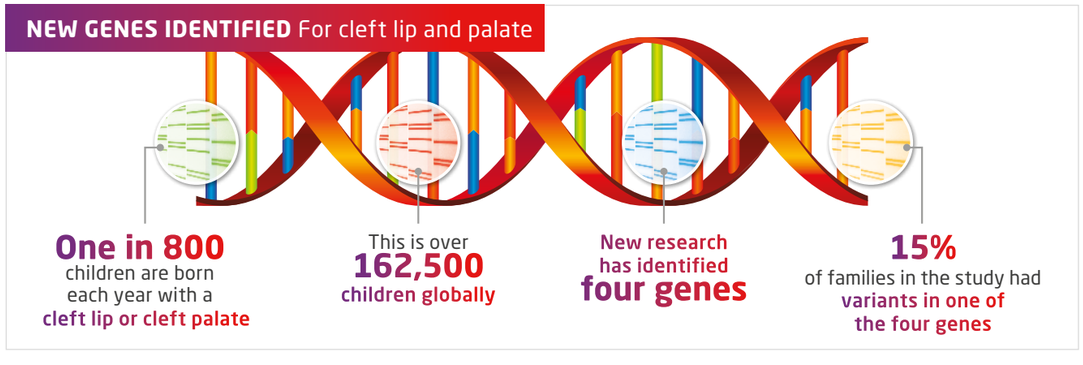
Associate Professor Roscioli leads a team of 30 across Australia who are transforming the diagnosis of neurocognitive disorders by using genomic sequencing.

"This technique has already tripled the rate of diagnosis in people with moderate-severe neurocognitive disorders and has also allowed us to identify several new genes."

Associate Professor Roscioli hopes to develop induced pluripotent stem cell technology (iPS) programs at NeuRA to benefit future research into the functional aspects of genes affecting the nervous system.

In the longer term, he hopes his work will provide the opportunity to develop targeted therapies for developmental neurocognitive disorders.

"Neurocognitive disorders have high management costs and so it is important that treatments are developed to help families."



TAKING A DIFFERENT APPROACH TO PARKINSON'S RESEARCH

Professor Caroline Rae

Professor Caroline Rae is working on an early detection program for Parkinson's disease to identify people most at risk. The program will also identify those in the early stages of the disease so that treatment can be introduced sooner. An interview with Professor Rae expands on this important new approach in Parkinson's research.

Why is your early detection approach for Parkinson's disease important?

Unfortunately, by the time a person is diagnosed with Parkinson's they have lost areas of their brain that are needed for motor functioning. We did an initial study looking at a particular area of the brain affected by Parkinson's disease called the *Substantia nigra* and found that at the point they were diagnosed this part of the brain had deteriorated or died.

This is a critical area of the brain which holds a significant amount of iron and is eroded by Parkinson's disease. By the time a neurologist makes a diagnosis, it is too late to save this important functional part of the brain. It is impossible to remediate when there is nothing left. That is why it is critical to take a different approach to identify the disease well in advance of its symptoms.

What is the *Substantia nigra* and why is it important?

The *Sunstantia nigra* is part of the brain involved in controlling movement, so it has connections up into the motor cortex of the brain. A breakdown in connections reduces the brains ability to control movement in the body, which is a key indicator of Parkinson's disease.

How does MRI technology provide new insights?

We use MRI technology to study brain structure. MRI technology is evolving and is enabling us to measure brain structure in much finer detail, giving us access to deeper parts of the brain. The *Susbstantia nigra* is right down at the bottom of the brain and is an area that has not been easy to image. It's also technically difficult to track the connections from the *Susbstantia nigra* to other parts of the brain. Here at Neu RA, we are one of the few groups in the world currently doing research work at this level.

We use a technique called high angle resolution imaging to look at the wiring between the *Susbstantia nigra* and other parts of the brain that pertain to movement. In controlled studies have found that people have around 500 connections between the *Susbstantia nigra* and the X, but in those with Parkinson's the most we have seen is ten.

Why is it important to catch Parkinson's disease 10-15 years in advance?

We now know that we can run a series of tests well in advance to identify the risk of developing Parkinson's disease using a four-step process. Initially, we developed an ultrasound that provides us with information on the performance level of the *Susbstantia nigra* that will classify groups of people most at risk in the main population. They may have anywhere from 100-300 connections remaining. We can then put accelerators on their fingers to find out how quickly their motor neuron receptors are working. We can then pick up further signs of motor slowing.

So at this early stage can the *Susbstantia nigra* be protected?

Early detection means that people with Parkinson's disease can start treatment much earlier when there is still a good part of the *Susbstantia nigra* left to save. This would be preferable to current treatment that is directed at only the very small remaining area.

Our goal is to identify people at risk or at the very early stages of Parkinson's, providing a net to identify these people before they pass a tipping point when the *Susbstantia nigra* is completely or nearly dead.

My work is aimed at finding biomarkers for the early detection of Parkinson's disease to identify robustly, those people most at risk of developing this disease.

Professor Caroline Rae

Dr Claire Shepherd

THE SYDNEY BRAIN BANK

Dr Claire Shepherd

The Sydney Brain Bank at NeuRA facilitates world-class research and breakthroughs in ageing and neurodegenerative disorders. It has been operating since 2005 and has collected brain tissue from over 500 donors. Globally, the Sydney Brain Bank supplies tissue to 30-40 research projects a year, with many of these projects a collaborative effort with external research institutions.

Led by Dr Claire Shepherd, Director of the Sydney Brain Bank, the team has developed a new method which will allow them to characterise one of the key pathologies underlying Alzheimer's disease using a simpler, cost-effective and less labour-intensive method without compromising on the quality and sensitivity of the diagnosis.

"At the Sydney Brain Bank, we collect, characterise and store the brain tissue from individuals that have died from ageing or neurodegenerative disorders so that we can facilitate medical research," says Dr Shepherd.

"This new method will be advantageous because post-mortem human brain research takes a lot of time and money to do well – we undertake a comprehensive screen of every brain we collect. Doing this more cost effectively will allow us to collect more cases and facilitate more research into ageing and neurodegenerative disorders."

Working with a large number of clinical research programs means the majority of donors have been involved in longitudinal clinical research studies. This data allows researchers to understand the relationship between someone's clinical symptoms in life and the pathology in their brains at death.

There is currently no definitive diagnosis for these disorders in life. The Sydney Brain Bank at NeuRA uses research diagnostic criteria to characterise the brain changes and identify the specific neurodegenerative disease they were suffering from.

During 2017, Dr Shepherd travelled to the UK to visit several British Brain Banks and to work with their researchers to understand their processes and share ideas and techniques.

By working with international researchers, NeuRA aims to strengthen and harness a more collaborative global approach between the various brain banks and to help address many research questions – working together is a more powerful way to go.

The Sydney Brain Bank is funded by NeuRA and UNSW Sydney and our generous donors and receives no government support.

About the Sydney Brain Bank

More than **500** brains in storage

The number of **presentations** or **publications** on discoveries **using brain tissue** in 2016

over **200**

Number of tissue samples supplied: 12,759

Countries where **brain tissue** has been sent:

TISSUE SUPPLIED TO STUDIES IN:

- Parkinson's disease
- Dementia
- Ageing
- Motor neurone disease
- Huntington's disease
- Multiple system atrophy

NEURA BOARD OF DIRECTORS AND GOVERNING COUNCIL

Our discoveries impact the community and help transform the lives of people living with disorders of the brain, their families and the greater community.

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Managing Director, EnergyLogica
Director, 2014 – 2018

"Direction and guidance has come from two leadership groups, the NeuRA Board of Directors until early 2018, which was replaced by the newly formed NeuRA Governing Council."

Board of Directors
Governing Council

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Director, 2016 – present

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BEc FFIA CFRE
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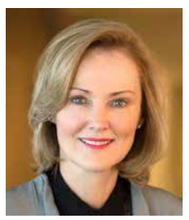
Principal, Resource Capital Advisory Services
Director, 2007 – present



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Director, 2011 – present

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Director, 2009 – May 2018

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Director, 2014 – present

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FAHMS PhD DSc
Director, 2007 – present

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Managing Director, EnergyLogica
Director, 2014 – February 2018

Sophie Wong,
MBMSc
Company Director, Barton Place Limited
Director, 2017 – present

MESSAGE FROM GRANT SIMPSON

With one in five Australians living with a disease or disorder of the brain, the 21st century is indeed the era of the brain.

Grant Simpson, Foundation Director

We all know someone who has been touched in some way by a disorder of the brain. It may be a loved one, a friend, a workmate. These conditions are indiscriminate and touch us all in some way. We at the NeuRA Foundation are committed to building awareness about the community burden of this vital area of public health and funding the important research that needs to take place. We believe that we must act now.

2018 sees a major drive by the Foundation to fund research into Parkinson's disease and dementia. Parkinson's is the second most common degenerative condition after dementia, with more than one person per hour being diagnosed with the disease in Australia. Our goal is to fund critical projects, which will drastically improve the lives of people living with this disease. We also seek to establish a vital new leadership role, the Chair in Parkinson's disease Research. The Chair will work towards discovering better treatments and ultimately a cure for Parkinson's disease.

Taking proactive steps to reduce the risk of dementia is a topic which is top of mind for all of us today. This year, we launched our first practical guide for ageing well, which offered tips on how to reduce the risk of dementia developed from evidence-based research conducted by NeuRA's Professor Kaarin Anstey and her team.

A vital goal of the NeuRA Foundation is to translate our important research discoveries into accessible information aimed at improving the health and quality of life of the community at large. Our NeuRAtalks program seeks to do exactly that. Please visit neuratalks.org to find out more.

We are extremely grateful for our supporters – individuals who donate and leave bequests and trusts and foundation and corporate partnerships funding. Government support is most welcome, but unfortunately does not come close to bridging the gap we have in meeting research staff costs, providing the best laboratories and equipment possible and conducting clinical trials. It is through the generosity of our supporters that we are able to make our vision to discover, conquer, cure a reality.

JOHN'S STORY

My Parkinson's journey began with a slight tremor in the left hand when I was Deputy Premier of NSW. I remember the wavering of my papers when answering questions in question time and not thinking too much about it. By 2010, it was clear that it was Parkinson's disease.

The medication I was prescribed worked well yet the slowness of movement, constant fatigue, difficulty swallowing made life difficult, not to mention the loss of the sense of smell, sleep interruption, increased anxiety, tremor that was difficult to disguise and reactions to the medication including dyskinesia and uncontrolled body movement.

I do wonder what the end will be like but only fleetingly. In the meantime, I trust, with growing confidence that the wonderful researchers and clinicians at NeuRA will banish this debilitating, disease and make the lives of those living with Parkinson's, safer, more fulfilling and more purposeful. With your support and generosity, we can play our part in creating that future.

Hon. John Watkins AM

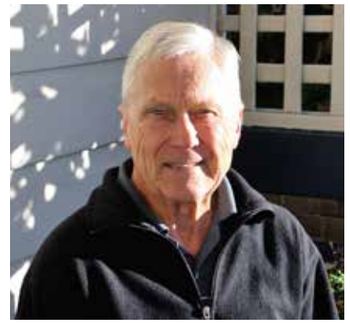
A gift in your Will is a very special way to support the work being conducted at NeuRA and will make a lasting difference to the health and quality of life of generations to come. Whether it is a large or small gift, it plays a vital role in supporting research projects into the future.

STEWART'S STORY

Stewart was living in the USA in the late 1970s and was first exposed to the open-minded spirit of philanthropy where ordinary, everyday people support their chosen charities through leaving bequests.

"On retirement, I decided to follow the US model of philanthropy and went about selecting organisations that I would leave a bequest. Medical research stood out as a prime target. Medical research is something Australia does well and has a proud record and which, by its complexity, attracts highly skilled professionals not only from Australia, but from around the world," says Stewart.

"I am personally committed to NeuRA's important work in their quest to alleviate the burden of disease that many Australians face."



Stewart Horwood

FOOD FOR THOUGHT – SUPPORTING PARKINSON'S DISEASE

Parkinson's disease is the second most prevalent age-related neurological disorder behind dementia. More than 80,000 individuals live with Parkinson's disease in Australia.

Our annual major donor event, the Food for Thought Dinner, was held at NeuRA's Margarete Ainsworth Building, on the evening of 19 May 2018, to highlight the growing prevalence of Parkinson's disease and how NeuRA is responding with critical research in this field.

This is the NeuRA Foundation's key donor engagement event. It's unique in that it combines a stunning dinner with bespoke lab tours across multiple research disciplines and facilities including the Schizophrenia Lab, the Sydney Brain Bank, the Sleep lab and the Falls and Balance Lab. The event has become a highlight on our supporters calendar each year. This year the event highlighted the insidious nature of Parkinson's disease and NeuRA's critical research in this field as well as our vision to expand our research. 95 VIP guests helped us to raise over $400,000 from this one event.

Our guest speaker, the Hon. John Watkins AM, spoke about his personal experience with Parkinson's disease after being diagnosed around eight years ago, after retiring as Deputy Premier of New South Wales. The Food for Thought dinner was the first time that John had spoken publicly about what it is like to live with Parksinon's disease. NeuRA is proud to share this important milestone with him, and we'll continue to work together to make discoveries that help us to understand the disease and hopefully one day find a cure.

NeuRA seeks support for projects that focus on:

- Early detection of Parkinson's disease vulnerability through imaging (MRI) and ultrasound screening with Professor Caroline Rae
- Falls prevention for people with Parkinson's disease using practical and technology-based therapies with Professor Stephen Lord and Dr Jasmine Menant
- Improving sleep for people with Parkinson's disease using novel targeted therapies with Professor Danny Eckert.

"Our biggest challenge and impediment to Parkinson's research is not the lack of research talent or a clear vision of how we conquer the disease. Our biggest challenge is quite simply funding," says Grant Simpson, NeuRA Foundation Director.

NeuRA is committed to driving new research in Parkinson's that will benefit those living with the disease and their loved one.

NeuRA *Food for Thought* event

RENAE'S STORY

When Renae and her family were told their fun-loving mum had been given the devastating news that she had a rare neurodegenerative disease, they were at a loss. They knew, willing as they were, that there was little they could do to alter the outcome.

Unable to change the diagnosis or her future, they banded together to 'do something' and they decided to help fundraise for research so future patients had a better chance.

Renae gathered her large family network and friends who got behind her City2Surf run. She ran the kilometres and they sponsored her by donating generously to NeuRA research.

The results were inspiring, and family and friends felt the love and support they needed during this very tough time. Her proud mum watched her strong courageous daughter and both shared pride in each other.

INTANGIBLE GOODS

How often would we like to be able to offer support, calm, kindness or friendship to a loved one, a colleague or the community we live in?

This is exactly what Mark Starmach and collaborator Elizabeth Commandeur did. They set up a vending machine to dispense gifts to satisfy the emotional needs of Sydneysiders.

They launched their Intangible Goods vending machine and made the topic of mental health more approachable whilst raising funds to support schizophrenia research at NeuRA.

Their aim in taking it out to the community and placing it in the public space, received significant attention and "that's got to be a good thing if it gets people to think about their mental health in a different way," said Mark.


Elizabeth Commandeur and Mark Starmach

THE NEXT FRONTIER

PWC Australia hosted a collaborative event showcasing both NeuRA and the Garvan Institute called the 'Next Frontier'.

The event was designed to highlight the latest breakthroughs in genomics and brain research presented by NeuRA CEO Professor Peter Schofield and Garvan Executive Director Professor Christopher Goodnow.

Joined by researchers Professor Carolyn Sue (Kolling Institute) and Professor Kaarin Anstey (NeuRA) during a panel discussion, this corporate partnership with PwC provided guests with an inspiring insight into some fascinating and groundbreaking research and opened doors for future collaboration between NeuRA and the Garvan Institute.

VALE IAN KENNEDY


Ian Kennedy OAM

It is with great sadness that we announce the passing of Ian Kennedy OAM.

Ian served as a Director of the NeuRA Foundation since 2009 and was a tireless advocate for NeuRA and a voice of wisdom.

Ian co-authored the best-selling Australian marketing book The Power of One to One with Bryce Courtenay and was often referred to as the 'Father of direct marketing'. He won every significant Australian direct marketing award and was inducted into the Australian Direct Marketing Hall of Fame.

As Director of Marketing at advertising agency George Patterson, he was the architect of the Sydney Olympics 2000 ticketing campaign and the 2003 Rugby World Cup. Ian was the National President of The Starlight Children's Foundation and was the Chairman for seven years.

Ian's intelligence, personality and enthusiasm will be greatly missed. He leaves an incredible legacy of helping the Foundation to reach many supporters that share NeuRA's vision to discover, conquer, cure.

COMMUNITY ENGAGEMENT DRIVES NEURA'S VOICE

Community engagement is at the centre of NeuRA's media strategy. We want to ensure we deliver translational science from our researchers to people across Australia.


Liz Courtney, Head of Communications

NeuRA has launched its online seminar platform NeuRAtalks.org to enable our leading scientists to share their insights, breakthrough research and developments for new treatment. The platform hosts short Tedx-style seminars with many of NeuRA's leading scientists across all areas of neuroscience undertaken at NeuRA. The platform provides much-needed access for those living in rural areas and those unable to attend seminars in person.

Supporting the community around mental health education

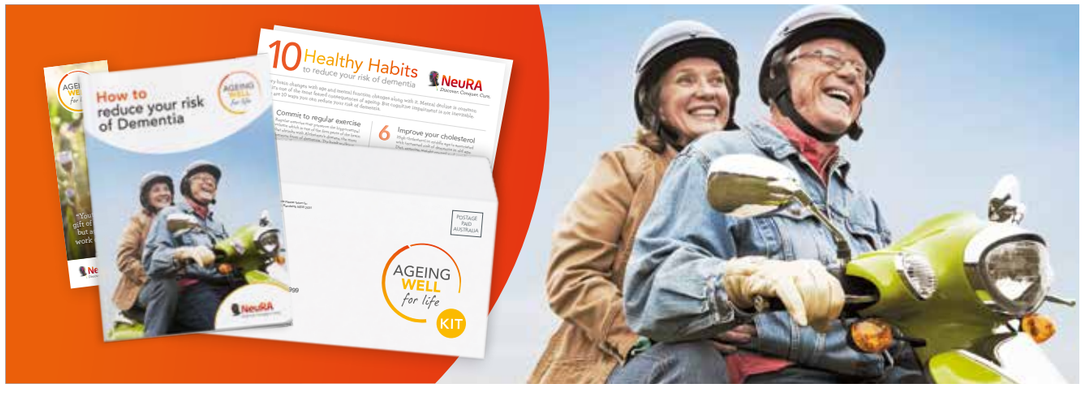
NeuRA hosted a major event 'Lighting the Way' to shine a light on the critical research we are undertaking in the areas of schizophrenia, bipolar, stress and resilience. Our research also highlights the impact of poor sleep on our mental health. During the event we presented a series of community and corporate seminars and opened NeuRA's doors to the public. Our building was lit up for the week to highlight the theme of our event: Lighting the way. We also hosted a community BBQ, a series of meet the researcher events and an informative briefing breakfast for State Government at NSW Parliament House. All the seminars can be viewed online at neuratalks.org.

Ageing Well Week

Ageing Well Week is another initiative NeuRA launched in 2018 in conjunction with the Australian Women's Weekly. We delivered a major seminar series at the Sydney Town Hall and The National Gallery of Victoria. This series explored lifestyle and dietary changes to help people reduce their risk of dementia. It highlighted preventive exercises to address the risk of falls and improve balance as we age, how to keep senior drivers safe on the road for longer and our changing sleep habits and how to modify rest times to support a good night's sleep. The initiative also included the development of a FREE Ageing Well Kit including; a 24-page colour booklet, a Handy Hints Wallchart and a NeuRA bookmark.

Live Streaming on Facebook – follow us!

NeuRA's digital voice continues to grow in tandem with a strong output in the social media space which provides regular content and short updates to our community. For more regular information please join us on Facebook, tune into our livestream events or register at neura.edu.au to receive our quarterly magazine.



"At NeuRA we continue the quest for discovery and cures as we explore the great unknown – the human brain"

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WELCOME

Quest for discovery/ quest for cures

Our quest for discovery continues to motivate us to work towards the solutions and cures of tomorrow – today. This year we have welcomed Professor Kaarin Anstey who, with her team, is working on understanding the risk factors for dementia prevention and developing lifestyle guidelines on how to reduce the risk of dementia.

"Our quest is to cure disorders and diseases of the brain by harnessing the brilliance of science and technology and fuelled by passion and hope."

Currently there are over 1,500 new cases of dementia diagnosed each week. It is predicted that by 2050 there will be almost one million Australians with the condition, and many more family members and friends indirectly impacted by its effects. This is a huge problem that is growing and needs more investment. Our goal at NeuRA is to focus on the whole community to enable both a research-led, and technology-delivered set of outcomes that will greatly benefit the community, the family and the individual.

At NeuRA, we are playing a critical role in a global bipolar genome sequencing project aimed at understanding the biological basis of the bipolar disorder using state-of-the-art DNA sequencing. Dr Jan Fullerton and her team aim to unlock the early indicators of this disease so we can identify specific risk factors in young people who are at increased genetic risk of this disorder.

There is a lot we don't know about brain function which can be revealed through identifying gene pathways. Neurocognitive disorders are one of the largest unmet challenges in Australian healthcare. Approximately 3,000 children are born each year with a moderate to severe neurocognitive disorder.

These types of disorders have high management costs and frequently recur within families. By developing genomic testing across a range of neurocognitive disorders, we can provide answers to multiple people. This isn't just providing a diagnosis to a particular family member; It is empowering families through genomic testing to know if there is a chance recurrence and hope for future treatments.

Our quest for discovery is equally matched by our quest to find cures for some of the most debilitating cognitive diseases of the brain. Importantly, early detection of diseases such as Parkinson's disease can improve outcomes for all people and their families in the future, giving them the opportunity to access medical intervention earlier.

Now is the time for high impact, technology-led neuroscience research, and local and global partnerships to successfully navigate the great unknown – the human brain and nervous system.

This profile presents a snapshot of a number of exciting projects which will frame NeuRA's quest for discovery over the coming year.

Ageing well – reduce your risk of dementia

A key focus of our ageing well research is developing a set of guidelines to help people to reduce their risk of dementia. Alzheimer's disease accounts for 70 per cent of all dementia diagnosis. With further use of online technologies, we hope to support early diagnosis of this disease which will benefit long-term outcomes for all.

Schizophrenia breakthrough immune treatment program

NeuRA researchers have completed a breakthrough study advancing the understanding of and treatment for schizophrenia. New trials will be undertaken this year to build on this remarkable breakthrough incorporating immunological approaches into our research program.

Genomic frameworks

Genomic analysis is providing greater insights into the causes of bipolar and neurocognitive disorders. NeuRA is pioneering ground-breaking research using whole genome sequencing to understand the biological base of these conditions. These insights will help development of tools for personalised medicines to better treat bipolar and neurocognitive disorders.

Discovery of spinal cord sensation

A new finding at NeuRA has shown that 50 per cent of all people with a complete thoracic spinal cord injury still have some surviving sensory nerve connections. A new trial later this year will aim to develop new protocols for rehabilitation in tandem with MRI imaging to study the somatosensory pathways which have survived, to understand how to boost messages to the brain to result in some form of sensory return.

Parkinson's disease – an early detection program

NeuRA is focused on the development of an early detection program for Parkinson's disease. Working on the identification of brain patterns using advanced MRI imaging; NeuRA plans to lead a major new research pathway to enable better outcomes for all through much earlier intervention.

John Grill AO
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FAHMS PhD DSc
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