2018 | 008

INSPIRE

RESEARCH AUSTRALIA SHOWCASES HEALTH & MEDICAL RESEARCH

brainpark™

BUILDING BETTER BRAIN HEALTH FOR AUSTRALIANS

END-USERS DRIVING MEDTECH INNOVATION

GENETIC MARKERS FOR BREAST CANCER

RESEARCH AUSTRALIA

CONNECTING • ENGAGING • INFLUENCING

Message from CEO

The health and medical research sector has transitioned to a new era and the opportunities this brings are significant. Its includes getting researchers to connect to industry and industry to invest in research. It is about empowering consumers to take charge of their own health and encouraging more investment into health and medical research. These initiatives and associated activities are driving change across the sector and enabling new ways of collaborating and information sharing.

And the early results are promising. Different ways of doing things and more importantly, getting people to see things differently to how they always have in the past, is producing the sorts of new outcomes we need.

Whether it be through programmes such as the Medical Device Partnering Program or treating addiction and compulsive disorders and advancing the way we treat diseases, Australian researchers are producing incredible, high impact outcomes.

This edition of INSPIRE highlights these and other remarkable stories such as the discovery of dozens of new genetic markers for breast cancer through to healthcare delivery by designing contemporary hospitals that meet the needs of all patients. Healthcare is complex, and it is imperative that evidence-based health and medical research, along with the integration of clinical care delivers the best possible outcomes to patients. After all, it is all about the patient at the end of the day.

The cases you will read in this edition of Inspire highlight why health consumer literacy is such an important part of our sector. The Research Australia Opinion Poll has, for the past 15 years, tested consumer knowledge on a range of issues and sought consumer opinion on what is important to them. Health and medical research has been at the top of their list for the duration and sharing stories of research across our sector helps advance this literacy.

We want Australians to understand the connection between health and medical research and an improved health system. And importantly, we want governments to measure the return on investment in health and medical research because this measurement reflects the value society places on improved health outcomes.

That's why sharing your case studies and highlighting your research is such a valuable opportunity to provide practical examples of the enormous contribution your work makes to all Australians and how fortunate we are to have the brightest minds doing the most incredible things for us all.

2018 is looking like a very promising year for health and medical research – let's keep talking about it.

Nadia Levin
CEO & Managing Director

Publisher
Research Australia Ltd

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Who can submit articles?
Any current member of Research Australia who would like to share a relevant story that affects their organisation including, philanthropic donations and their outcomes, research findings, and any other related health and medical research topic that affects the Australian population.

Submission guidelines & deadlines
For information regarding how to submit and publishing deadlines visit the Research Australia website.

RESEARCH AUSTRALIA
CONNECTING · ENGAGING · INFLUENCING

SAVE THE DATE!!

RESEARCH AUSTRALIA HEALTH & MEDICAL RESEARCH AWARDS NIGHT 2018

THURSDAY 8 NOVEMBER 2018

The **16th annual Research Australia Health & Medical Research Awards** will be held in Sydney on Thursday 8 November, 2018. Join us to celebrate the best of Australian health and medical researchers. Our Awards bring together the Who's Who of the entire health and medical research pipeline, including researchers, government, health corporates, pharmaceutical companies and consumer interest groups to honour our Award recipients. It will be a night to hear from our sector leaders, catch up with colleagues and old friends, exchange stories and reflect on the year's achievements.

Keep an eye out on the Research Australia website in coming weeks for more information about each Award and how to nominate.

For now, please Save The Date in your diary so you don't miss this night of nights!!

When:	Thursday 8 November, from 6.30pm
Where:	Sydney, NSW (Venue TBC)
Dress:	Black Tie

For more information about any aspect of this year's Awards, contact the Research Australia team via email admin@researchaustralia.org or phone 02 9295 8546.

We look forward to seeing you there!

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Australian Health & Medical Research

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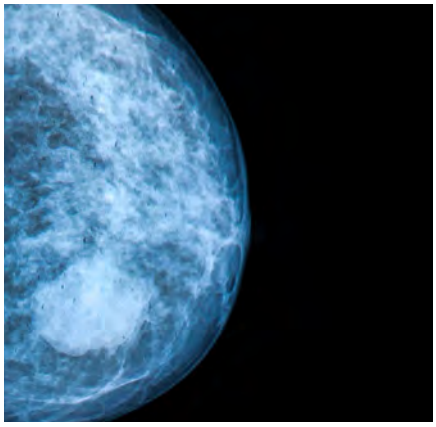
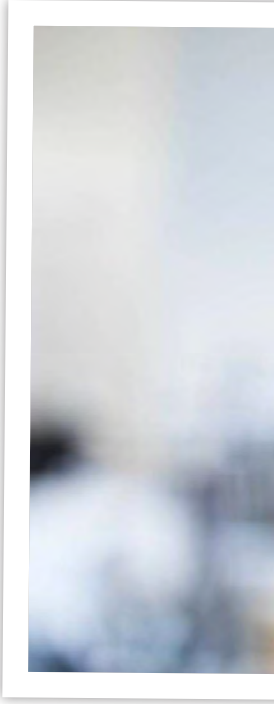


END-USERS DRIVING MEDTECH INNOVATION



The success of Flinders University's Medical Device Partnering Program is set to spread across the nation.

The Medical Device Partnering Program (MDPP) is as an ideas incubator, growing the South Australian medical devices sector. Over the last nine years this unique engagement model has leveraged the research expertise of universities to solve real world problems in collaboration with end-users, health experts and the local industry.

Established at Flinders University by Professor Karen Reynolds, the Program has from the beginning aimed to overcome the inherent challenges universities face in their contribution to the development of new medical devices.

A NEW APPROACH

"Universities have a wealth of expertise to bring to the development of new medical devices. However, sometimes the work we do isn't as relevant as it should be, and we can be incredibly slow at negotiating research agreements, especially when IP is involved," explains Professor Reynolds.

"The Medical Device Partnering Program overcomes those barriers by simplifying a process for collaborating, and removing traditional expectations around IP ownership."

From the outset, the MDPP challenged traditional paradigms of invention and IP creation. Rather than 'push' university technology towards applications, it invited inventors and those who identified problems to submit ideas for new medical device innovations. Since it began over 9 years ago, the Program has considered over 350 ideas – nearly 40 ideas every year that would have otherwise gained little traction.

The ideas that are brought to MDPP span a range of solutions: therapeutic devices, diagnostics, hospital equipment and accessories, implantables, surgical instruments, assistive technologies, software and simulation tools. Nearly half of those ideas have come to the Program simply as a concept, and half have been early stage prototypes.

> ***"It has connected more than 120 of those ideas to teams of experts through its collaborative workshops. By facilitating focused two-hour conversations between the inventor, researchers, health experts, end-users and those engaged in the product development process, the ideas have been refined and future plans developed.***

Often this process has had surprising results – transforming the understanding of the problem and the market, and rethinking the potential solution. Other times the workshops have resulted in fast fail, either because the problem has been debunked, or because it is has become apparent that the technical solution isn't feasible.

EXPERTISE, NOT FUNDING

A differentiating feature of MDPP is that it doesn't issue funding. Instead, through the Program clients receive 250 hours of research support to further develop their idea, alongside a detailed market evaluation. 78 projects have been selected by an independent evaluation panel and been completed, de-risking ideas and adding value to companies. Three-quarters of those projects have resulted in a prototype being developed. Another quarter have achieved technical, clinical or market validation.

Despite the major contributions made by a range of partners, the client retains full ownership of all intellectual property throughout the course of the Program. Many universities have been challenged by this model, as it goes against traditional ideas of the value of expert contribution. However, a recent review demonstrated that this was a key reason why clients engaged in the Program. For the

Re-Timer, **MDPP client. Worn by: Albert Ruiz, Research Associate, Flinders University**

MEDICAL DEVICE PARTNERING PROGRAM

client it simplifies the process and ensures value is built in the company. For the researchers and the clinicians involved, they have seen value in efficiently using their expertise to realise impact and build meaningful long-term relationships with industry partners.

DELIVERING ECONOMIC IMPACT

Increasingly, the success of the Program is being evidenced by its economic contribution. In the last four years it has been funded by the Government of South Australia's Department of State Development, who have measured its economic impact. In that time, the Program has contributed to 2 new products now sold on the market, 11 patents filed, 11 products in clinical trials, 10 new SMEs and 33 job opportunities.

Allan Perriam, Managing Director of Innovo Healthcare, was supported by the Program in the development of the 'U-Stand Frame', a portable frame now manufactured in Adelaide and sold around Australia.

"The MDPP has thus far been the best value for money we have spent to date," explained Allan.

"It is my firm belief that had we not received such support from the MDPP, our project would have taken considerably longer and cost significantly more to bring to market."

GOING NATIONAL

Last year MDPP received funding from MTPConnect, the Australian Government's medical device and pharmaceutical growth centre, to undertake a feasibility study on expanding the Program nationally. After completing an initial review of the program and meeting with key stakeholders across Australia, a Steering Panel of enthusiastic partners is now determining how this will be best achieved.

The potential to realise significant benefits across Australia is apparent. If the scale of operations in South Australia can be replicated across the nation, within 5 years we would see thousands of new ideas coming through the

Engaging diverse expertise, Medical Device Partnering Program at Flinders University Left to right: Alan Perriam, inventor, nurse and CEO, Innovo Healthcare; Aisha Sirop, Innovations Manager, Medical Device Partnering Program, Flinders University; Anthony Papageorgiou, Mechanical Engineer, Flinders University

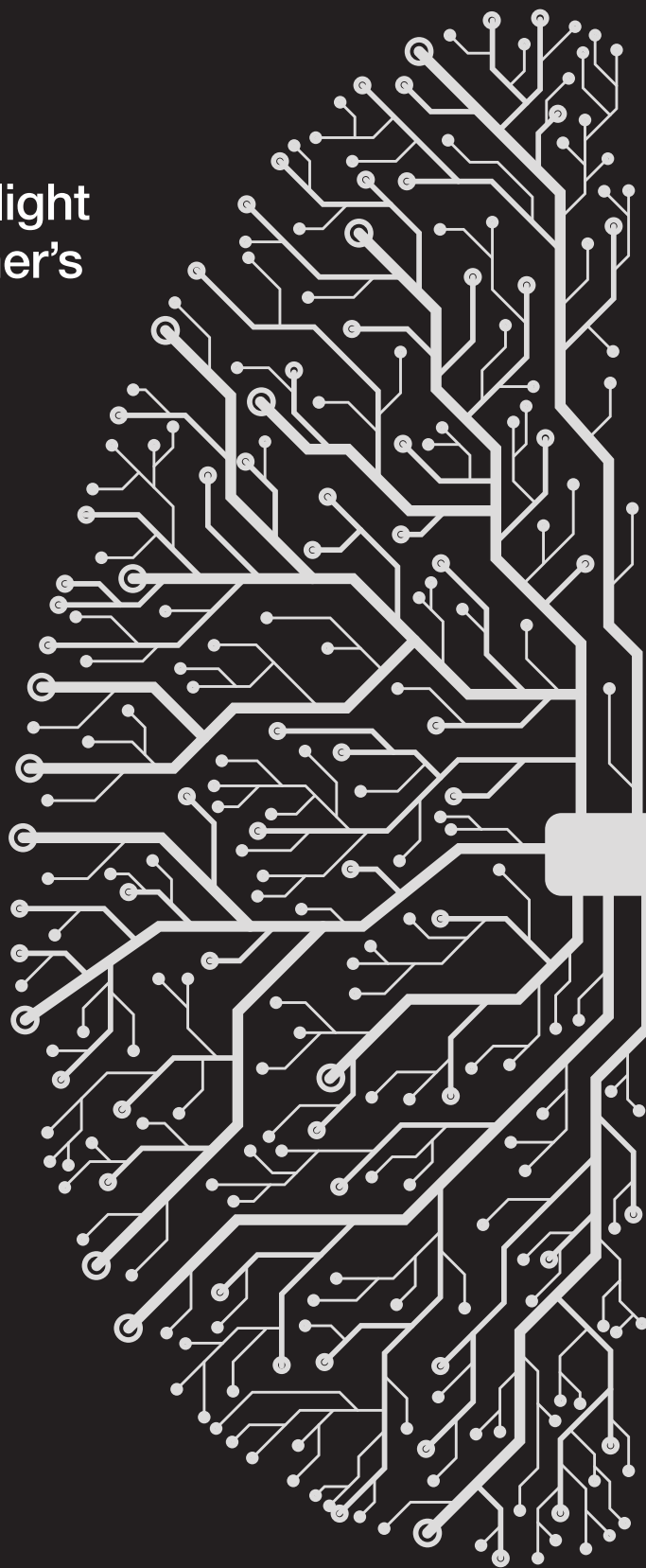
Flinders University at the Tonsley Innovation Precinct, where the Medical Device Partnering Program is headquartered

Program, progress more than 200 product ideas and expect over 180 new companies to be formed. In an industry where we are seeking ambitious growth, the Medical Device Partnering Program provides a catalyst for new innovation.

Authors: Jo Close, Manager, Strategy Development, Health Technologies, **Flinders University. Professor Karen Reynolds**, Director, Medical Device Partnering Program, **Flinders University**. **Dr Keith McLean**, Director Manufacturing, **CSIRO. Dr Buzz Palmer**, CEO, **The Actuator**

NEW WAY TO SEE BRAIN DECLINE IN ALZHEIMER'S DISEASE

A new imaging technique sheds light on cognitive decline and Alzheimer's with some surprising results



Researchers at the Florey Institute of Neuroscience and Mental Health have used a breakthrough imaging technique to describe in micro-detail the brain degeneration that occurs in people with Mild Cognitive Impairment (which will include subjects with early Alzheimer's disease), and in the full-blown disease.

It improves on previous brain pathway mapping by drilling down to the precise locations of brain degeneration in living Alzheimer's patients, and sheds new light on the underlying cognitive degeneration in Alzheimer's.

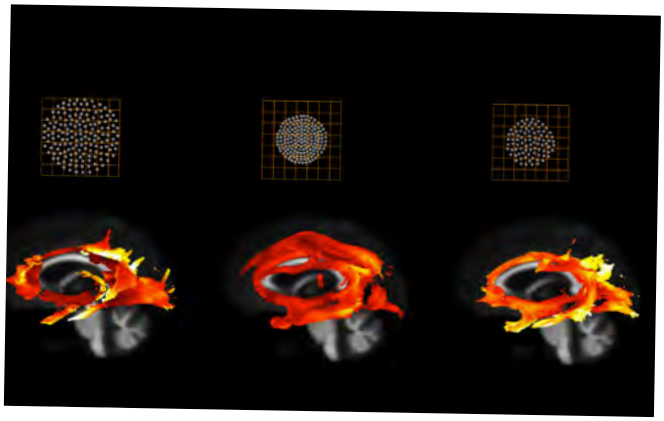
The team analysed brain scans from 177 Australians who were part of the Australian Imaging, Biomarkers and Lifestyle study. The participants were either cognitively healthy, had Mild Cognitive Impairment, or had been diagnosed with dementia due to Alzheimer's disease.

In addition to using fixel based analysis, a new algorithm created by team member Dr Thijs Dhollander also contributed to the extraordinary detail of their results. The algorithm, called 'single-shell 3-tissue constrained spherical deconvolution', clearly separates the contributions to the MRI signal from the brain's neuronal pathways, the grey matter (neuronal cell bodies), and the cerebrospinal fluid which bathes and supports the entire brain. Including this specialised analysis gave the researchers confidence that the locations of brain degeneration they identified were extremely accurate, and among the most precise measurements of brain pathway degeneration in living Alzheimer's patients yet seen.

As well as studying Alzheimer's patients, this study included a population of patients with Mild Cognitive Impairment – which will include some people at an earlier stage of Alzheimer's.

ALZHEIMER'S AND COGNITIVE IMPAIRMENT ARE DIFFERENT

Alzheimer's disease is associated with abnormal production and buildup of a peptide called amyloid beta,



Brain fibre pathway degeneration was quantified with unprecedented detail in Alzheimer's disease patients using a novel magnetic resonance imaging analysis technique called fixel based analysis (FBA).

and those MCI subjects with high amyloid beta are more likely to progress to having Alzheimer's disease.

Professor Alan Connelly, who led the study, said, "Interestingly, the mildly affected patients with low amyloid had more fibre degeneration in particular brain regions than those with high amyloid levels. This suggests that firstly, specific degeneration of certain brain areas will not necessarily be useful in predicting which mildly impaired individuals will progress to Alzheimer's disease, and secondly that degeneration of this pathway is related to cognitive impairment, regardless of the buildup of the amyloid peptide.

> ***"This is an important advance for a field still struggling to come to grips with what exactly causes Alzheimer's. Our study shows we still have a way to go in interrogating the natural history of this insidious disease.***

Lead author Remika Mito says, "This study was conducted by comparing the averages of each group of patients against each other, in order to give us the most statistically, and biologically, relevant results. In the future, we want to be able to compare an individual patient against a normal, healthy standard, to see how far along the disease trajectory they are. Or we could compare back to their previous scans to determine what effect a new medication is having as part of a clinical trial for example."

FIXELS AND VOXELS EXPLAINED

Fixel based analysis uses more advanced modelling of the diffusion MRI signal than other techniques to enable comparisons between specific fibre populations within voxels (hence the term, 'fixel'), which allows the team to measure the fibre density or the fibre cross-section of each fibre bundle within a voxel. They can also combine the two into a composite measure called fibre density & cross-section, or FDC.

Authors: Dr Tom Keeble, Neuroscientific communicator at **The Florey Institute of Neuroscience and Mental Health. Remika Mito** is a third year PhD candidate at **The Florey Institute of Neuroscience and Mental Health. Professor Alan Connelly** is Head of Imaging at the **Florey Institute of Neuroscience and Mental Health.**

FORGET THE COUCH: ONLINE THERAPY WORKS JUST AS WELL

The MindSpot Clinic online services helps manage anxiety,depression and chronic pain.

More than 80,000 people around Australia have accessed anxiety and depression assessment services since 2013 through Macquarie's revolutionary digital mental health portal, the MindSpot Clinic, which is fully funded by the Australian Government Department of Health.

The clinic now also delivers interventions to help people with chronic pain manage their disability and distress.

"MindSpot prioritises services and interventions that can help the largest number of people," says Professor Nick Titov, who is Director of MindSpot and co-Director of Macquarie's eCentreClinic.

"Many of the people who use our service haven't had treatment before, and many report that they're not going to seek treatment elsewhere, for a range of reasons, including stigma and concerns about privacy."

Professor Titov is a clinical psychologist who led the development of the innovative service and now heads up a team of more than 50 people who provide assessment and treatment for adults with anxiety, depression and chronic pain.

"People often think about going to the psychologist or psychiatrist as a deeply emotional and traumatic experience, which invariably involves recounting your deepest, darkest fears," he says.

"But the MindSpot team have taken the approach of finding ways to help people who have anxiety and depression to manage their symptoms, without dwelling on the past.

"These symptoms are obviously incredibly distressing and disabling, but we know people can learn to manage them, and we teach people practical skills that they can use to deal with them."

CONVENIENCE A DRAWCARD

Many people struggle to take time off during business hours to go and visit a therapist, making the convenience and accessibility of online services a big drawcard.

"People can access our service 24/7; therapists are available until 8pm most nights, and once they've registered with us they can access the resources and information."

Internet-delivered services can also complement therapies offered face-to-face, he says.

"Some of the people we work with have such severe symptoms that they aren't able to see a professional face-to-face," he explains.

People with severe anxiety or social phobia can find it overwhelming to leave their home. "Working with us can help them build enough confidence and skills to then be able to see somebody face-to-face for further support and treatment."

> ***"MindSpot is a great example of stepped care. "People can use our service and then step up to more intensive face-to-face treatment; but they can also step down to our service – so, after an in-patient admission, or after working with their therapist or psychiatrist face-to-face, we can provide them with some additional support afterwards," Nick says.***

ASSESSMENT, INFORMATION, AND TREATMENT

Many people come to MindSpot for assessment and information rather than treatment.

Getting an assessment and information gives people agency, and the service can be accessed quickly and easily, he says – and MindSpot also helps people make informed decisions about what they can do next.

"Some people go on to treatment with us, others decide

Professor Nick Titov, Director of MindSpot and co-Director of Macquarie's eCentreClinic.

to manage their symptoms themselves, while we help others learn about and then access other services."

> ***"We support people to learn practical psychological skills that can help them manage their own symptoms in the long term. We found that most of the people we work with actually just want to talk to somebody, and want to learn about their symptoms."***

In comparison, face-to-face appointments with a psychologist or a psychiatrist generally only happen after a GP referral, and the process often takes a few weeks to arrange because GPs and mental health professionals often have substantial waiting lists.

ALL AGE TREATMENT

Despite a perception that young people are the main adopters of online solutions, the average age of MindSpot clients, surprisingly, is around 36 years – which mirrors the average age of clients who see a psychologist or a psychiatrist face-to-face.

"That's a concern because we know the average age of onset of symptoms of anxiety and depression is in late childhood or early adulthood, so it seems people still wait for at least a decade before they seek support or treatment," says Nick.

Around 400,000 people a year visit the MindSpot website and many complete the site's anonymous online quizzes, which ask about symptoms of anxiety and depression and give high-level recommendations.

Each year, around 20,000 of these then choose to complete an online or a telephone-based assessment. Many go on to discuss treatment options with MindSpot staff and perhaps access their clinical services.

> ***"The people most likely to want to talk to us during treatment by telephone calls on a weekly basis are male and likely to be older males – and that's a group who often don't want to engage in psychological treatment,"***

He thinks part of the reason is convenience; part of it, a sense of stigma. "Engagement rates are really high because so many of them find it easier to get help online or by phone rather than seeing someone face-to-face."

He sees another positive product of online therapies – helping older people improve their lives.

As people age, he says, they become more resilient and confident – and often make a decision to learn to manage symptoms they have sometimes had since they were teenagers.

"Sometimes older clients will tell us, 'I've had these symptoms for decades, and now I'm in my 60s or 70s or even 80s, I want to get rid of the symptoms so I can enjoy what time I have left."

Author: Fran Molloy is a journalist, part-time university lecturer, freelance editor and copywriter, as well as a Walkley Awards judge and a member of the Federal Council for the Media, Entertainment & Arts Alliance (MEAA).

brainpark™
BUILDING BETTER BRAIN HEALTH FOR AUSTRALIANS

A new, research-driven solution to fast-track knowledge from cognitive and clinical neuroscience into the community and help improve brain health of Australians is on its way…

Every day, millions of Australians are affected by compulsive disorders, including addictions and obsessive compulsive disorder (OCD). In fact, Australians have some of the highest rates of addictive and compulsive problems in the world. According to the latest Mission Australia Youth Survey of over 22,000 Australians, addiction is the number one national issue concerning our youth.
Shockingly, 80% of those needing help with addiction and mental illness won't engage with treatment services, with those who do engage usually relapsing.
Current treatments are just not cutting it. Services are often over-stretched, inaccessible, or ineffective. That is, until now.

EXERCISE AND MINDFULNESS AFFECT OUR BRAINS, BUT HOW?

Growing evidence shows that elements of our lifestyle, e.g. regular physical exercise and mindfulness meditation, have a potent effect on brain and mental health, including brain regions and cognitive mechanisms implicated in compulsivity. What remains unclear is how these simple, cheap and non-invasive interventions work (i.e., the basic mechanisms), and for whom.

Both exercise and mindfulness show promise in helping to reduce the severity of clinical depression and anxiety, as well as breaking the cycle of compulsive behavioural patterns. They can be a preventative strategy to combat addictions and compulsions, by increasing resilience against the stresses of modern living, with exercise also able to increase brain plasticity – the brain's potential to unlearn old habits and learn new ones – to enhance the effectiveness of concurrent mindfulness meditation or other technology-based targeted interventions.

Indeed, there have been enormous technological advances in measuring and modulating brain circuitry and function that hold therapeutic promise. For example, advanced technology platforms such as therapeutic virtual reality (VR) can be used to immerse individuals into realistic, yet safe, environments, such as the 'gamblers' zone' (a well-known phenomenon that maintains maladaptive gambling behaviour) or 'a dirty bathroom' (which may induce a cycle of compulsive washing in people with OCD). We know that these maladaptive behaviours are partially driven by features of the environment. Therapeutic VR enables us to place the individual in various contexts to both measure responses and intervene right there and then with the hope that they generalise to the "real world" settings.

BULIDING A *brainpark*™

Together with award-winning architects, Splinter Society, the Monash Institute of Cognitive and Clinical Neurosciences (MICCN) and Monash Biomedical Imaging (MBI) are building *brainpark*, a cutting-edge clinical research platform and the world's first research facility dedicated to developing lifestyle and technology-based interventions to help those experiencing substance and behavioural addictions and other compulsive conditions.

An artist's impression of *brainpark*, the world's first research facility dedicated to developing lifestyle and technology-based interventions for addictions and compulsive disorders

brainpark is supported by generous investments of David W. Turner Endowment Fund and Monash University, including MICCN and MBI.

brainpark™ will

- be a radical departure from the traditional research lab and clinical treatment setting and immerse people in an interactive and energising environment, maximising engagement in safe, effective and accessible interventions. Our focus is on empowerment and wellness, not just illness.
- concentrate on the underlying neurological, psychological and environmental drivers of addictive and compulsive behaviours – not the substance or behaviour itself – to empower people to help themselves and, with the latest thinking in brain research, help them create healthier lives.
- be co-located with state-of-the-art MBI facilities, enabling a seamless incorporation of brain imaging and assessments to determine the effectiveness and mechanisms of how lifestyle and technology-based interventions work.
- uniquely undertake new research to determine how specific combinations of lifestyle and technology-based interventions best work and what types of people benefit from what kinds of combinations.
- change the way people with addictions experience their addiction, receive interventions, and participate in science.
- open its doors in the latter half of 2018, with an exclusive, behind-the-scenes Community Open Evening scheduled for August 2018. More information coming soon (www.monash.edu/neuro-institute, *brainpark*.com).

The interventions include:

- **Physical Exercise:** indoor and outdoor gyms, immersive spin studio, and an exercise physiology lab.
- **Meditation:** indoor and outdoor meditation studios.
- **Cognitive Training:** dedicated cognitive training and assessment spaces, including VR tools.
- **Virtual Reality:** two VR studios, including therapeutic-VR and exergaming capabilities.
- **Brain Stimulation:** capacity for Transcranial Magnetic Stimulation and transcranial Direct Current Stimulation.

These integrated interventions are expected to break the cycle of addiction and compulsive disorders, and improve psychological outcomes.

WORLD-FIRST

As a world-class, world-first research platform, *brainpark* will house the nation's best neuroscientists and utilise the latest knowledge in brain sciences through a comprehensive research program and linked capabilities that drive a paradigm shift in the assessment, classification and treatment of addictions and OCD. It will provide researchers with significant opportunities for clinical research and translation that aren't currently available.

Our team at Monash are at the forefront of brain research into how addiction and compulsive behaviour is understood. Professor Murat Yücel, MICCN's Addiction Program Lead, has recently been named in the top 1% of the most Highly Cited (HiCi) researchers in the world by Thomson Reuters, for the second time. He has outlined the key benefits of *brainpark* for researchers, clinicians, investors and the community.

Author: Professor Murat Yücel is the David Winston Turner Chair in Addiction and Mental Health, an NHMRC Principal Research Fellow, and currently leads the Addiction research program at the **Monash Institute of Cognitive and Clinical Neurosciences (MICCN)**. Professor Yücel has recently been named in the 1% of the most Highly Cited (HiCi) researchers in the world by Thomson Reuters, for the second time.

$25 MILLION, 25 MILESTO
THE FUTURE OF MOTOR

Thirty years ago, Australia's fledgling motor neurone disease (MND) scientific community comprised just a handful of researchers. From this foundation, the Motor Neurone Disease Research Institute of Australia (MNDRIA) has been the linchpin in building and sustaining a nationwide, world-class MND research workforce.

Members of Australia's MND research community – 13th MND Australia Conference, University of Sydney, November 2017

MNDRIA's landmark report – $25 Million, 25 Milestones: Changing the future of motor neurone disease

ONES: CHANGING NEURONE DISEASE

Since the awarding of the first, modest grant in 1987, MNDRIA has invested more than $25 million to fund Australia's most comprehensive MND research program spanning a range of research, from discovery to healthcare. To recognise this achievement and the generosity of the many Australians who funded this research, Federal Assistant Minister for Health, the Hon. Dr David Gillespie MP, launched the *$25 Million, 25 Milestones: Changing the future of motor neurone disease report* at the 13th MND Australia Research Conference in November 2017.

CHANGING THE FUTURE OF MND

The landmark report details 25 high-impact, MNDRIA-funded advancements helping to change the future of MND. This compilation of milestones brings hope to more than 2,000 people living with MND in Australia.

For the vast majority of people living with MND, their diagnosis comes out of the blue, with no known family history. MND can strike anyone at any time. It insidiously robs individuals of their ability to move, swallow, communicate and breathe. Each day, at least two Australians are diagnosed with this debilitating condition and two more will die. The cost of MND to Australia is estimated to have been $2.37 billion in 2015. The human cost of this devastating disease is incalculable.

While there is still much to learn about MND, understanding of this complex condition globally has transformed over the last decade. MNDRIA has played an integral role in this transformation. The community has donated every dollar of MNDRIA's $25 million investment, including more than $7 million via the State MND Associations. This incredible effort is a testament to the community's commitment to changing the future of MND. Every dollar of each donation goes to supporting research excellence identified through a rigorous process. MNDRIA supports only the best research with the greatest chance of developing effective treatments and improving the lives of people with MND.

RESEARCH IMPACT

MNDRIA funds and promotes a comprehensive research program focussed on understanding the causes of MND, and finding effective treatments and ultimately a cure for MND. In April 2017, all researchers who have been funded by MNDRIA were invited to make a submission to the organisation about their research achievements. Twenty-five significant MND research milestones were identified.

Firstly, the development of the MND research workforce has been fundamental to building research capacity and collaboration in Australia with over $5.3 million invested in a range of postdoctoral fellowships since 2002. Most fellowship recipients continue to work in MND and/or neurological diseases, with several rising to be among the world's leading MND researchers. MNDRIA PhD scholarships co-funded with the National Health and Medical Research Council (NHMRC) and MNDRIA PhD scholarship Top-up Grants have also helped to attract a number of early career researchers to the field.

The second milestone in this report is another important capacity-building initiative known as the SALSA-SGC, a national consortium of researchers at nine centres working together to find the genes involved in sporadic MND. This collaborative program was established in 2015 thanks to the generosity of the community participating in the 2014 ALS/MND Ice Bucket Challenge. A further 23 milestones outlined in this report demonstrate how MNDRIA research has:

- **Advanced our understanding** of the causes of MND
- **Provided significant insights** into many clinical aspects of MND
- **Identified new diagnostic and prognostic tools**
- **Identified potential MND treatments** now undergoing further testing
- **Supported clinical trials**
- **Contributed to improving care.**

These findings are pivotal to the incremental progress of MND research with implications for people with MND, their families and clinicians. Each milestone highlighted in the report is another step forward in defeating MND.

While MNDRIA has largely supported grants-in-aid to seed innovative projects as well as fellowships and scholarships as part of workforce development, special grants to support major initiatives have been awarded competitively to outstanding researchers when exceptional funds became available through large donations. These include the MND Australia Leadership Grant (2013 – 2016), the MND Australia Ice Bucket Challenge Grant (2015 – 2018) and the Betty Laidlaw MND Research Grant (2016 – 2018).

Research is the only way to stop MND. MNDRIA is indebted to the intellect and dedication of MND researchers across the nation as well as the generosity of donors and supporters who fund this research. The enormity of this benevolence reflects the immense impact of MND on the community and the collective determination to end MND. As we acknowledge the achievements of the last 30 years and look to the future, we remain focused on working together for a world without MND.

Author: Stephanie Williams and **Rachel Rizk**, MND Australia

RETHINKING HOSPITAL DESIGN TO BETTER SUIT PATIENTS

The challenge of rebuilding ageing hospitals is an opportunity to better meet the needs of patients, old and young, but it requires specific planning.

Few would argue that many of our public hospitals are in dire need of an update – many of our older hospital buildings are no longer fit for purpose and major investment in refurbishing or rebuilding them is sorely needed. The announcement of over $400 million for hospital upgrades in the 2017 Victorian state budget and similarly in the New South Wales budget is welcome news.

Many older hospital wards are dark and cramped, with little to no space for storage or for patients, visitors and staff to move around freely. On many of our existing wards there is nowhere to keep equipment within reach of patients, inadequate storage space, limited ability to control light or temperature and no privacy to discuss concerns with staff.

New builds offer an opportunity to create environments that support our ability to both provide and receive the best possible care. In order to do this however, we must keep in mind who it is that will be using these facilities and what they will need.

BUILDING FOR AN AGEING POPULATION

Victoria's population, like most of the world's, is ageing. While this has been described as one of medicine's greatest achievements, it also means we are now faced with the prospect of living our lives with the complexity of multiple health conditions, and as a result the likelihood of more trips to hospital whether this be as an inpatient or for outpatient appointments. Half of the people who find themselves in a hospital bed in Victoria for more than a night are over the age of 65 and those older than 85 are one of the fastest growing hospitalised groups. With these numbers in mind, it is becoming more and more essential that our environments are designed, and our staff are equipped, to cater for the needs of this cohort.

DESIGNING FOR CHRONIC CARE AND LONGER STAYS

Hospitals were once places where a person went when acutely ill or injured, and either left having been cured or died. As more of us live for longer with complex chronic conditions, hospitals are increasingly places we visit on multiple occasions as part of the management of these conditions, even though the majority of the management occurs in the community setting. However, our hospitals are still designed with acute illness in mind – where a patient is primarily confined to bed until discharge. Our patients now need to be able to mobilise, to have spaces for families and carers to spend time, to have places to eat and drink outside of bed. We need to rethink the environment of the hospital with these factors in mind.

VICTORIA LEADING THE WAY

The Victorian Government has been instrumental in ensuring hospitals have access to evidence based resources to assist them to improve their environment for older people. Between 2011 and 2013 the Department of Health and Human Services supported 32 Victorian health services to conduct environmental audits and provided funds to address the issues identified using the resource Improving the environment for older people in health services: An audit tool (2006). The audits noted deficiencies in existing infrastructure and equipment across both acute, subacute and outpatient settings. These included appropriate seating; bathrooms; flooring; lighting; proximity to car parks; signage and wayfinding. Retrofitting these items was not only expensive, in many cases it was simply not possible.

DESIGNING FOR OLDER PATIENTS

A recent review of this audit tool, conducted by the National Ageing Research Institute for DHHS, has included an

extensive consultation process. These consultations have identified that while capital projects must comply with the Australian Health Facility Guidelines and a series of other building codes, these guides do not mention older people as a vulnerable group. The danger with this omission is that unless a member of the project planning team has an interest in designing for older people, or the facility is being designed specifically for older people, there is a significant risk that this oversight will remain just that. An omission which will ultimately impact the time our biggest patient cohort will spend in hospital, increase the risk of premature readmission and ultimately lead to poorer short and longer terms outcomes. There is also the danger that we will need to spend more money in the future to retrofit environments to the requirements of older people.

> ***Within just two days of people over the age of 65 being admitted to their local hospital they are at risk of developing a range of issues such as reduced mobility, pain, delirium and falls.***

If an older person does experience any of these conditions in hospital, they can expect to spend more time in hospital and it may ultimately impact on their ability to return to their usual way of life. Moreover these risks are not widely understood, and are largely avoidable by implementing a range of inter-related strategies, one of which is incorporating some key design elements that promote the participation of older people and their families in their care. Elements that optimise normal routines such as sleep, access to bathrooms, regular mobilisation, cognitive stimulation and independence with regular nutrition and hydration play a major role not only in someone's recovery but in preventing these risks.

There is a great deal of attention promoting good design when planning hospital environments for children, who like older people, benefit from a welcoming and calm place that balance the need for best care, options for privacy and social engagement, and the need to exercise control over core everyday needs and function.

Ideally you won't need to visit a hospital either as an inpatient, outpatient or a visitor, but the next time you do, look around. How easy is it to find your way? Are the signs easy to read and placed just above head height? Are there chairs of different heights, and do they have armrests? Is there adequate natural light? Is the car parking close to the site? Hospital staff are encouraged to use the updated audit to evaluate the environment for improvement. It is available on: *www.health.vic.gov.au/older-people-in-hospital*.

Designing for older people is not at the exclusion of the needs of other hospital users. In fact, when we design for the needs of older people, we improve the usability of the environment for everyone.

Authors: Paulene Mackell, Research Stream Leader: Health Reform, **National Ageing Research Institute. Kathryn Squires,** Research Officer, **National Ageing Research Institute. Frances Batchelor,** Senior Research Fellow and Director Clinical Gerontology, Program Manager Melbourne Ageing Research Collaboration, **National Ageing Research Institute**

GENETIC MARKERS FOR BREAST CANCER DISCOVERED

The discovery of 72 new genetic markers is a game changer with the potential to drive earlier screening, better treatment and preventative risk-reduction medications.

Professor Georgia Chenevix-Trench

The discovery of 72 previously unknown genetic markers for breast cancer may help to change the age at which women are offered mammogram screening and how often.

QIMR Berghofer Medical Research Institute's Professor Georgia Chenevix-Trench, one of the leaders of the international collaboration behind the biggest ever genetic study of breast cancer, said the research could help in the development of a predictive test.

She said it may mean better and earlier screening for women, particularly those who were at higher risk of breast cancer.

"Many women are offered mammogram screening when they are middle-aged, but if we know a woman has genetic markers that place her at higher risk of breast cancer, we can recommend more intensive screening from a younger age," Professor Chenevix-Trench said.

Professor Chenevix-Trench said the discovery was "hugely significant" for its potential to shape breast cancer research for the better over the next decade.

"This work helps us to understand why some women are more at risk of developing breast cancer than others and what genetic markers we should be looking for in order to assess that risk," she said.

MORE THAN ONE TYPE OF BREAST CANCER

"If a woman has a mutation in the BRCA1 or BRCA2 gene, it is particularly significant because it won't be long before this information can be incorporated into a genetic test to give a more precise estimate, not only of whether a person might get cancer, but when and what type of cancer."

The study found 65 genetic variants that predisposed women to overall risk of breast cancer, and a further seven variants that put women at higher risk of oestrogen-receptor negative breast cancer, which doesn't respond to drugs like tamoxifen.

Published in Nature and Nature Genetics, the international collaborations analysed data from 275,000 women across the globe.

It was made possible through collaboration between the Breast Cancer Association Consortium (BCAC) and the Consortium of Investigators of Modifiers of BRCA1/2, which is led by Professor Chenevix-Trench.

> ***"The newly discovered markers bring the number of known variants associated with breast cancer to around 180, but Professor Chenevix-Trench said she believed the findings could have broader implications.***

"I think this research will be a game changer for understanding common complex disease genetics because the methods we developed to identify particular flags can be applied across other diseases," she said.

"It will be a long time before it changes treatment, but I think ultimately it will do that, too."

QIMR Berghofer senior researcher Dr Jonathan Beesley said one of the key findings was that scientists could predict which neighbouring genes the risk variants acted upon.

He worked alongside colleagues at QIMR Berghofer, including Functional Cancer Genomics specialists Associate Professor Stacey Edwards and Associate Professor Juliet French, to conduct lab tests that confirmed some of these predictions.

"We were able to show for the first time that these risk genes are often the same ones that are mutated during the development of breast tumours, which tells us much more than we knew previously about the genetic mechanisms that may cause breast cancer," Dr Beesley said.

"We think this ability to pinpoint the genes associated with risk of breast cancer will eventually enable us to develop more effective screening interventions, risk-reduction medications and treatments."

IDENTIFYING TREATMETNS

Professor Chenevix-Trench said understanding the biology behind the different risk variants was vital in terms of identifying potential drug targets for treatment.

"Every single one of these genetic markers has the potential for finding new drug targets that might not only treat breast cancer but might be used to reduce the risk of breast cancer," she said.

"You don't know which one of them is going to be the best drug target. It might be one we've already found, or it might be one we've yet to find."

Professor Chenevix-Trench said the development of a preventative drug was front of mind.

"The classic example is you can prevent an enormous number of cardiovascular events with the use of statins, which target a gene that's involved in risk of cardiovascular disease," she said.

"If we could do the same for breast cancer, we might well be able to prevent a large number of breast cancers in the future."

Author: Professor Georgia Chenevix-Trench is the head of the Cancer Genetics Laboratory and the Department of Genetics and Computational Biology at **QIMR Berghofer Medical Research Institute in Brisbane**.

NEW COATING FOR MEDICAL DEVICES TO REDUCE INFECTION

In a world- first, scientists from the University of New South Wales have shown that when an anti-microbial peptide called Melimine is coated onto medical devices it reduces the rates of microbially-driven inflammation.

ADDRESSING A WORLD-WIDE PROBLEM

Infections associated with medical devices (ranging from contact lenses to replacement organs) are a significant world-wide problem and very difficult to treat. All biomaterials used in or on the body can fail due to microbial colonisation, and implanted devices account for approximately 50% of all hospital infections. Once bound to a surface, microbes form into biofilms that afford them up to 1000 times the resistance to biocides (disinfectants, antibiotics) and our immune system, making them very difficult to eradicate. Indeed, once infection occurs the only management option is often removal of the medical device.

The current methods to control microbial colonisation of devices are essentially good hygiene practice/aseptic technique whilst implanting or using the device, design features to reduce microbial colonisation, and antimicrobial coatings on the devices. Whilst these can reduce the likelihood of a device-related infection they are not optimal.

PREVENTING MICROBIAL COLONISATION

We have developed a cationic peptide coating, Melimine, that upon attachment to polymers, metals or glass results in >99.9% reduction in microbial colonisation. Attached Melimine outperforms other antimicrobial peptides when bound to a surface. Melimine and its derivatives are effective against Gram-positive and Gram-negative bacteria (including methicillin-resistant Staphylococcus aureus, MRSA), fungi and protozoa and it is more active than other cationic proteins on surfaces. Melimine-coatings have a number of highly desirable characteristics. They are resistant to the action of proteases, and can be sterilised by autoclaving and gaseous ethylene oxide. Melimine is not cytotoxic to mammalian cells at well above active concentrations with a therapeutic index of 200,000 (i.e. the concentration for optimal antimicrobial activity is 200,000 less than concentration at which it kills mammalian cells).

Perhaps even more importantly, we cannot induce bacteria to become resistant to Melimine or its derivatives. If we grow bacteria in sub-inhibitory concentrations of melimine they never develop resistance, whereas when we grow them in similar conditions with the antibiotic ciprofloxacin they rapidly develop resistance. As importantly, Melimine-coatings show no evidence of allergic or inflammatory reactions in our animal models or in our human clinical trials.

PREVENTING CONTACT LENS INFECTIONS

We work with many different types of medical devices and biomaterials, and one of our main focuses is contact lenses. There are approximately 140 million contact lens wearers worldwide, and the number of contact lens wearers is increasing significantly in markets such as China and India, with India having around 1 million contact lens wearers and a predicted 13% compound annual growth rate (CAGR). Whilst contact lenses provide excellent vision correction, they can lead to keratitis; inflammation of the cornea (the transparent organ overlying the pupil).

> ***Contact lens-associated keratitis is caused by microbial colonisation of lenses and leads to significant vision loss in 3 per 10,000 wearers per year, even with aggressive antibiotic therapy.***

We have recently completed an NHMRC Development grant funded project investigating whether Melimine-coatings can reduce keratitis associated with microbial colonisation of contact lenses. Excitingly, the results show that the Melimine-coated lenses produced a 50% reduction in keratitis. This is the first time in the world that a cationic peptide coated onto a medical device has been shown to be effective. This result will, we hope, encourage further research and development of our Melimine-coated biomaterials.

REDUCING INFECTION IN COCHLEAR IMPLANTS AND BONE TRANSPLANTS

We are already working in conjunction with Cochlear Ltd. on ARC funded projects to examine the use of our coatings on their devices. More than 300,000 people worldwide have received cochlear devices. Although their infection rate is relatively low (2–4%) almost half of these cases require device explant, despite aggressive antibiotic therapy. Furthermore, the frequency of major complications is approximately 1.5 times higher in paediatric patients.

In 2016 we began a new NHMRC Development project with Australian Biotechnologies Pty Ltd. to test Melimine's ability to prevent bone infections during surgery. Bone is the most commonly transplanted tissue worldwide. Infection rates can be as high as 32% depending on factors such as severity of trauma, site of trauma, and health of the individual, and as high as 50% in open severe trauma fractures. Infections lead to non-healing, revision surgery and twice the rate of limb amputation.

Use of medical devices is becoming much more common, and they are an important part of modern medicine. We hope that antimicrobial coatings such as ours will improve their performance for patients and clinicians, and provide real cost savings to the healthcare system in the future.

Authors: Prof Mark Willcox, Prof Naresh Kumar, Dr Debarun Dutta, Dr Ren Chen UNSW Sydney.

THE LAST WORD

IS AUSTRALIA ASLEEP AT THE WHEEL?

I have just returned from a nine-week immersion course in cutting edge technology at Singularity University in Silicon Valley, sponsored by Google. I was privileged to be one of 90 people from 47 countries selected to attend.

I returned exhilarated but also saddened by the realization that Australia is rife with complacency and legacy thinking.

Surprisingly, the majority of my Australian colleagues, whilst intelligent and committed people, are not aware of the tsunami of exponential change that is about to hit Australia and indeed the world, or pay no more than lip service to it.

I consider myself a Futurist, deeply aware of global change, and even I was surprised by what I learnt from 130 of the world experts in new technologies and future forecasting.

Australia is a lucky country and we are incredibly fortunate to live here, but it is time we stopped taking this for granted. We seem to have lost our curiosity and interest in engaging with the wider global landscape.

Why does this matter now? It matters because we should no longer be a country of Agriculture, Mining and Tourism, or perhaps we should resign ourselves to these.

Human development over the last 250,000 plus years has been local and linear, whereas human development over the last 50 years has been global and exponential. There has been a consequent explosive growth of technologies and tools. This growth is moving the rapid growth in the global economy away from traditional industries.

In addition, there has been an exponential reduction in cost in underpinning technologies of the future, for example of bandwidth, data storage, DNA analysis, solar modules and Lidar, a key component of self driving cars.

Because of the exponential growth of computing speed, once something can be digitized it can become dramatically less expensive and available to everyone, though it often is underwhelming at first, the pace of change accelerates rapidly. As the marginal cost approaches zero, the domain explodes and the problem space shifts – are we as a country ready to move from scarcity to abundance? This will mean a complete rethink of how we do business as a nation. To do so requires optimism and belief in what is possible. It also means taking some risks and betting on winners.

The International ecosystem is delivering extraordinary technological change. Moore's law is writ large. The price - performance of computers doubles every 18 – 24 months. Examples of this include exponential growth in supercomputer power, transistors per chip, processor performance and dynamic RAM memory bits per dollar. Technologies that are accelerating rapidly include, AI and machine learning, Robotics, Nanotechnology, Biotechnology, Medicine, Genomics, Neuroscience, Cloud computing, Quantum computing and 3D printing. We can be at the forefront of these however we are rapidly losing ground.

> ***"Self-driving vehicles, drone delivery, underwater drones, robotics, synthetic meat, precision medicine are all here. To focus on the present is to focus on the past. We must direct our eyes to the future or we will be left behind.***

There are an increasing number of global challenges and disruptions to the ecosystem in which we operate. Herein lies great opportunity if we are ready to pivot and rethink our approach nationally. Governments, Ministers, Boards, CEOs and Executive teams must continuously update themselves, create open discussions, listen intently, and not shy away from contentious and difficult topics.

Entrepreneurship is the nonstop navigation of uncertainty,

not the slow and steady incremental growth favoured by Australia. Exponential thinking supporting 10 times (10X) multipliers is critical, aiming for a mere 10% is simply not enough. We need to develop moonshot thinking. Moonshot thinking will require redefining our identity as a country, our values, what we hold true, our culture, our behaviour and how work gets done, celebrating cognitive diversity.

> ***We need to reframe the discussion and unlearn what we have learned. We need to challenge cultural and social stereotypes and be less precious about who does what. Changing culture is not enough, we must build the infrastructure to support it. Australia can be a global innovation platform.***

Collaboration, connection, belonging are basic human drivers and in an increasingly global world we cannot use the tyranny of distance as an excuse. New business models are required. As David Rose of Gust declares "Any company designed for success in the 20th century is doomed to failure in the 21st". Let's take the best of what is quintessentially Australian and combine that with the best globally. We must get back ahead of the curve and as it is an exponential curve there is not much time.
Michelle Simmons, brilliant Australian of Year, is leading an international consortium to develop quantum computing nails it "If you want to create the quantum world you need to control the quantum world '.
The enormous transformational potential of Big Data and Precision Medicine is a case in point. There are many issues and challenges that have to be addressed in the creation of this new ecosystem, notably in relation to the data privacy, data provenance, data integration and data access, to optimize applications and opportunities, and build capacity for the exponential medicine of the future. Transformative pathways and frameworks for implementation are critical and they are not happening.

A recent Research Australia poll reiterates the trust Australians have in health and medical researchers and yet it can still take 10-15 years for research to convert to a market product or service. Business models are changing globally, and Australia is lagging.
Mindset is so important. Is it OK to make mistakes? The Australian psyche is such that we rarely tolerate failure and at the same time we are mowing down tall poppies. It is time to divest ourselves of our convict guilt and embrace our diversity, intelligence, innovation and capacity to develop and commercialise extraordinary 10X global businesses.
Public policy, open debate, looking to the future now, integration of ideas, fast and agile commercialization of research, products and services is not part of everyday Australian discussion, especially in the public service, despite the release of the 2030 Plan – the government's strategy for Australia's innovation future.
The world is not made up of atoms, it is made up of stories. It is time to rewrite ours and to ditch the rhetoric. Australians have so much to be proud of. We are leaders in many spheres and our grit and determination are legendary. This will not be enough if we continue to stand still.
Autonomy is the desire to steer your own ship. Mastery is to steer it well. Purpose is the need for the journey to mean something. When the whole team is driving toward a singular purpose with incredible speed, that's group flow in action. Come on Australia - time to grab the wheel and drive world-class innovation before the car drives us.

Jenny Morawska
Director, Research Australia

Authors: Jenny Morawska is a futurist who has been Deputy CEO of Federal Finance, Industry, Science and Resources departments, CEO of a Biotechnology Company, Senior Executive at Westpac and Executive Director of Price Waterhouse. She is a Director of Research Australia.

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