Allies in Excellence

The Go8's long-standing relationship with the United States

GROUP OF EIGHT AUSTRALIA

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Foreword from CEO, Group of Eight

VICKI THOMSON

As Group of Eight (Go8) Chief Executive, I hope that you find this short publication informative, and its content impressive for what its snapshot says about the strength of the long-standing research relationships the Go8 has with the United States.

Australia's Go8 represents that nation's leading research-intensive universities. Seven of the Go8's eight members are ranked in the world's top 100 universities while 99 per cent of Go8 members' research is ranked as world class or above.

The Go8 has enjoyed a long-standing relationship with the United States; not only your nation's top universities, but your major corporations and your Government agencies such as the National Institutes of Health (NIH), the National Science Foundation (NSF), the Defence Advanced Research Projects Agency (DARPA), Boeing, CISCO and Northrop Grumman.

Geographically the Go8 faces toward the Indo-Pacific and has built a number of warm and valued mutually-beneficial relationships in that region. Throughout this time, Go8 universities' relationships, friendships and research partnerships with the US and its universities have continued to grow and prosper, as we want them to.

For every Go8 university, the US is the largest research partner as measured by co-publication of journal articles. There have been 10,000 co-publications between US and Go8 universities in 2018 alone.

Over the past five years Australia has ranked as the eighth highest co-publisher with the US and if the Go8 were a country it would rank 15th on the list – just behind Brazil and ahead of Sweden, India and Israel.

This publication, produced to mark a 2019 Go8 visit to a number of our US-based research partners, highlights a small sample of Go8 research projects which, because of their US linkages, are able to provide notable benefits to our economies and our communities; and also to the world.

It also includes a precis of some of the Go8's major research partnerships; those we are at liberty to highlight. There is much shared capability that for commercial-in-confidence or security reasons the Go8 cannot display or discuss. And that fact too illustrates the strength of the research relationships that exist between our two nations. The Go8 is proud to be part of that.

Over the past five years Australia has ranked as the eighth highest co-publisher with the US and if the Go8 were a country it would rank 15th on the list – just behind Brazil and ahead of Sweden, India and Israel.

Group of Eight

As Australia's leading research-intensive universities, the Go8 has a number of long-term and significant relationships with major US companies and organisations.

A large proportion of the research impacts that are associated with these relationships cannot be "placed on show" because of commercial in confidence, or security restrictions.

However, below are some examples of the strength of such Go8 partnerships:

At the University of Melbourne, Lockheed Martin has established its first research centre outside of the United States.

An initial $13 million investment by Lockheed Martin, the world's largest weapons manufacturer, has underpinned the Science, Technology, Engineering Leadership and Research Laboratory (STELaR-Lab). The joint research centre is focussed on basic research covering fields such as hypersonics, robotics, artificial intelligence, sensors and communications.

The collaboration was coordinated through the Defence Science Institute which was established in 2010 to facilitate growth of defence science research networks between the State of Victoria and the global defence industry.

The University of Melbourne also has a range of ongoing research relationships with Lockheed Martin.

At the University of Queensland, Dow Chemical's $10 million donation established the Dow Centre for Sustainable Engineering Innovation

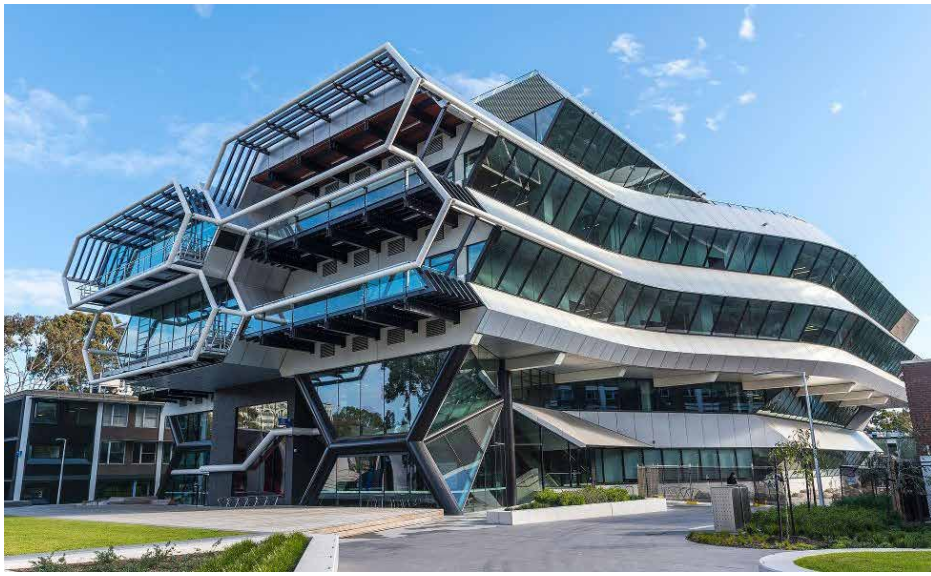
In Brisbane, following a more than 13-year relationship with the University of Queensland, Boeing's research and technology arm (BR&T – Australia) has set up a specially-designed facility within the university's engineering research hub. This is the first time Boeing, which is the world's largest aerospace company and leading manufacturer of commercial jetliners, defence, space and security systems, has co-located research with a university in the Asia-Pacific region.

Some 30 Boeing staff work with UQ researchers and students in fields including engineering, human movements, neuroscience, chemistry, physics and psychology. Projects earmarked include unmanned aircraft and autonomous systems, aircraft simulator technology.

Also at the University of Queensland, Dow Chemical's $10 million donation established the Dow Centre for Sustainable Engineering Innovation. Dow Chemicals is the largest chemical company in the US and one of the world's leading producers of plastics, chemicals, hydrocarbons and agrochemicals.

The Dow Centre concentrates on research into new technologies and processes that can improve the sustainable production and use of chemicals, energy, and transportation. The university has al-

Melbourne's Monash University is the first academic institution outside the United States to join Pfizer's network of research partners



ready delivered innovative research in low-carbon dioxide (CO2) steel and next-generation fertilisers.

Melbourne's Monash University is the first academic institution outside the United States to join Pfizer's network of research partners under the Pfizer Centres for Therapeutic Innovation (CTI). Pfizer is the world's largest pharmaceutical company and CTI brings together leading academic medical centres and disease foundations, along with Pfizer scientists, with the aim of translating promising science into clinical applications.

The University of Sydney has a multi-year global partnership agreement with multinational technology company Microsoft, which reinforces Sydney's significance in the fast-paced, international quantum computing field. The partnership strengthens research and forges critical industrial connections.

For many years, the University of Adelaide has interacted with the Asian Office of Aerospace Research and Development (AOARD) representing the research arms of the US Navy, Army and Air Force in the region.

The Bill and Melinda Gates Foundation has a number of research partnerships with Go8 member universities.

The University of Sydney has a multi-year global partnership agreement with multinational technology company Microsoft

At the University of Melbourne, Lockheed Martin has established its first research centre outside of the United States

For many years, the University of Adelaide has interacted with the AOARD

COMMITMENT TO EXCELLENCE

Each year the Go8 spends **$6.4 billion** on research – **$2 billion** of that is spent on medical and health services research

Go8 industry funding for research is **twice** that of the rest of sector combined

99 per cent of Go8 research is **world class** or above

Seven Go8 members are ranked in the **world's top 100** universities

Half of all research completions in Australia are from a Go8 university

The Go8 receives **two-thirds** of all industry research funding to universities

Australia has **39** public universities and the Go8 represents Australia's **eight leading** research-intensive universities

The Go8 has educated more than **80 per cent** of the Australian-educated Chief Executives of the nation's top companies

The Go8 provides Australia with **100,000** quality graduates each year

The Go8 has some **31,000** research students

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Spinifex

UNIVERSITY OF QUEENSLAND

The drug has wide application with chronic pain now so common it affects one in three people over the age of 65.

EMA401 is based on research led by Professor Maree Smith at the Go8's University of Queensland (UQ). It was commercialised by Spinifex which was founded by UniQuest, UQ's commercialisation company.

In 2015, in early recognition of the massive global potential of the new pain treatment – the first orally-active pain killer for nerve pain with a completely novel mechanism for action – Spinifex was acquired by US-based pharmaceutical giant Novartis International AG for an upfront $AUS260 million cash.

For those with debilitating chronic pain, the discovery of a new and very different drug, EMA401 – for the treatment of inflammatory and (especially) neuropathic pain – is welcome news

This was a deal estimated in total to be worth $AUS1billion and is one of the largest Australian biotech deals in history. Novartis is now conducting international clinical trials with the drug hoped to be on the market in three to five years.

EMA401 has been shown to have the competitive advantage of minimal, if any, side-effects. As a result, it is being hailed as an answer for the many chronic pain sufferers for whom currently available choices cannot manage their pain. The pain is either resistant to available drugs, or, in the process of alleviating the pain the drug causes a number of difficult brain-related side effects that are intolerable, such as dizziness, blurred vision and drowsiness.

EMA401 works by reducing the hyper-excitability of the damaged peripheral nerves that carry pro-pain signals into the spinal cord and brain, so these nerves function more normally

EMA401 works by reducing the hyper-excitability of the damaged peripheral nerves that carry pro-pain signals into the spinal cord and brain, so these nerves function more normally. Most importantly, EMA401 does not cross the blood-brain barrier meaning it cannot cause brain-related side effects.

While it has been developed to target nerve pain such as that commonly associated with cancer chemotherapy, post-herpetic neuralgia (a painful condition that can follow shingles) and other peripheral nerve-injury induced pain such as sciatica, it is thought that EMA401 may also relieve the pain of osteoarthritis which is the most common form of chronic inflammatory pain. Clinical trials will be needed to ascertain this.

The research began in 2003 from Professor Smith's hypothesis that nerve pain could be relieved by blocking a receptor called the angiotensin II type 2 receptor. In 2004, research in animals proved her hypotheses correct. UniQuest recognised the potential drug's global worth and in 2005 filed a patent application and founded Spinifex to advance it.

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Me Tro

UNIVERSITY OF SYDNEY

Professor Anthony Weiss and his team at the University of Sydney have developed of a highly elastic and adhesive surgical glue known as Me Tro

It quickly seals wounds without the need for staples or sutures: a "superglue" that can be squeezed into a deep cut or gunshot wound and seals it shut – all in 60 seconds.

For Me Tro to work it needed one very precise trigger – light. Once applied, a zap of UV light seals everything. In an example of Go8 International research collaboration, Professor Weiss worked with friends in the US from Harvard and Northeastern Universities, and together they developed the idea to add light-activated molecules; combining the Australian team's work with the US light-activating technology.

Professor Weiss says the key to successful research outcomes such as Me Tro is collaboration with

… a "superglue" that can be squeezed into a deep cut or gunshot wound and seals it shut – all in 60 seconds

It may sound like science fiction, but Me Tro can revolutionise emergency care and surgical procedures around the world

great minds from around the world. "If you want to do the best, you need to work with the best," he says. "We do great science and the ability to work internationally allows you the best possible outcomes – it's done through networks."

Me Tro also sends signals to the body to start repairing the wound – at twice the regular speed. It may sound like science fiction, but Me Tro can revolutionise emergency care and surgical procedures around the world. Its ability to stem blood flows is especially relevant for any emergency situation where many people require fast medical assistance, such as war zones, or terrorist attacks.

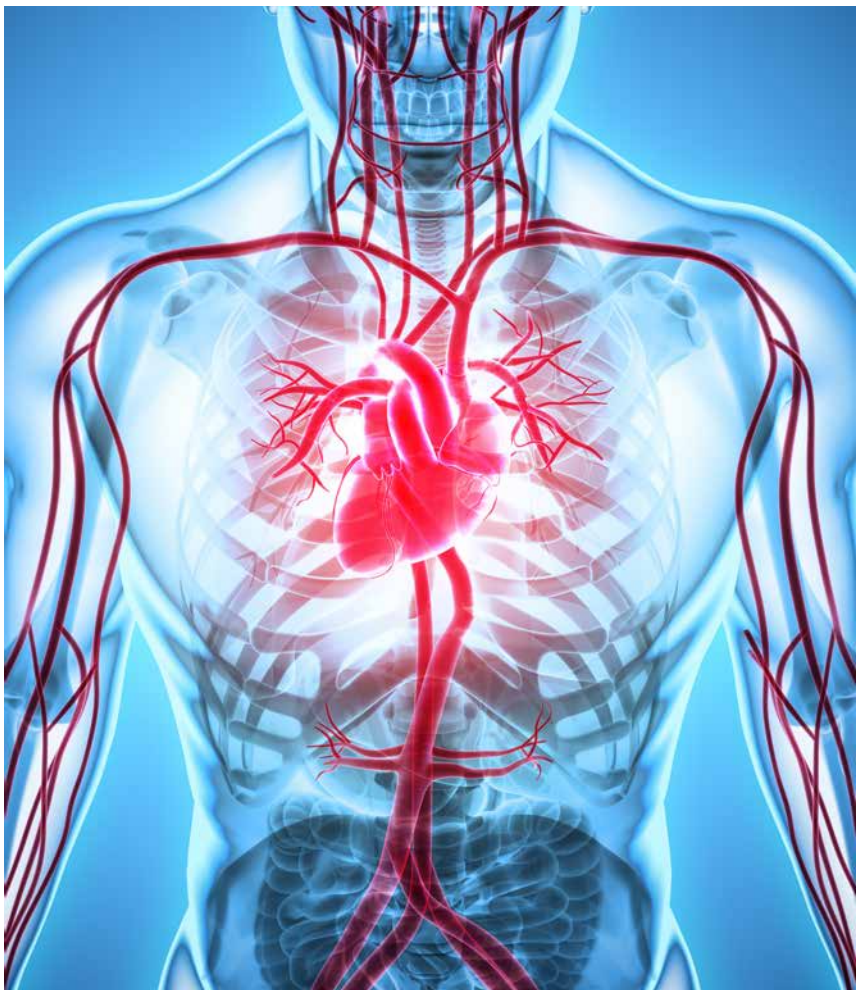
It is ideal for sealing wounds in body tissues that continually expand and relax such as lungs, hearts and arteries that are otherwise at risk of reopening. It also works on internal wounds in hard to reach areas. Professor Weiss describes the process as resembling that of silicone sealants used around bathroom and kitchen tiles. It is provided in a syringe-like tube and acts like a liquid, filling gaps and conforming to the shape of the wound.

The adhesive is made from a synthetic version of a protein called tropoelastin which forms naturally in the growing tissues of newborn babies. It is the precursor to functional elastin which gives skin, blood vessels, lung tissue, ligaments and tendons the ability to regain their shape after stretching and contracting.

As the world leader in tropoelastin research, Professor Weiss was able to create a perfect copy of tropoelastin in the lab, and it is that which has formed the basis for the most flexible surgical glue ever.

The benefit of having an exact replica of a natural protein is that Me Tro does not trigger a patient's immune system response. Importantly it also mimics the natural protein's ability to kick-start the body's healing process. When the wound is sealed and the body has regrown its own cells, Me Tro is broken down by the body like a piece of old skin.

*Professor Weiss has joint US publications on Me Tro with Harvard and Northeastern University: *(Science translational Medicine 2017)*



Eteplirsen

UNIVERSITY OF WESTERN AUSTRALIA

The injectable drug, Eteplirsen, was originally developed at the University of Western Australia which then licenced it to US biotechnology company Sarepta Therapeutics. Sarepta funded the required clinical trial process.

DMD is a rare and fatal muscle-wasting disease, a severe form of muscular dystrophy, that occurs without a known family inheritance. It affects one in 3500 boys worldwide. Normal disease progression results in the patient becoming wheelchair-bound by age 12 and dying by age 30.

Eteplirsen is the first treatment that addresses the cause of the disease and the hope is that it will slow its progression and keep patients mobile for longer, with improved quality of life. Those affected by DMD have a genetic defect and do not produce dystrophin a protein required for muscle health. Their muscles, including heart and lungs gradually waste.

Eteplirsen is the first treatment that addresses the cause of the disease and the hope is that it will slow its progression and keep patients mobile for longer, with improved quality of life

The world's first disease-modifying drug for sufferers of Duchenne Muscular Dystrophy (DMD) is now on the market in the United States after accelerated approval in 2016 by the US FDA

Dementia

UNSW SYDNEY

A vital $3.2 million grant from the USA's National Institutes of Health is enabling the Centre for Healthy Brain Ageing (CHeBA) at UNSW Sydney to broaden its international research collaboration within COSMIC (the Cohort Studies of Memory in an International Consortium)

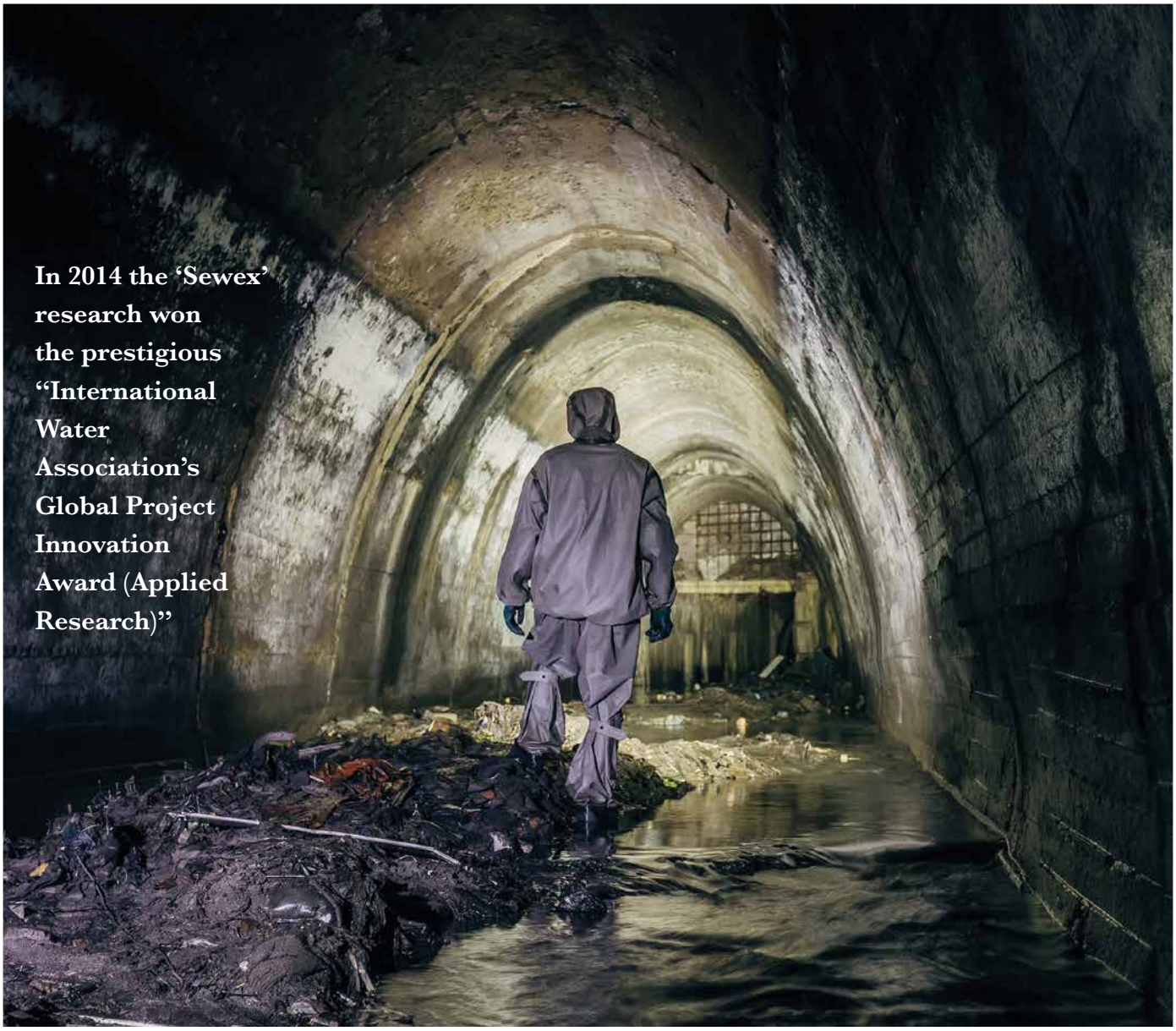
> "COSMIC is truly an international effort. It currently has 30-member studies from five continents and potentially data from more than 90,000 participants."

The grant is specifically to determine what factors are common for cognitive decline and dementia in all human populations irrespective of race, ethnicity and socioeconomic development.

"Ageing is intricately connected with cognitive decline and there is an increasing proportion of life lived with cognitive impairment as age increases," said CHeBA Co-Director Professor Sachdev.

The funding supports the bringing together of studies into cognitive ageing internationally to allow a better understanding of the determinants of ageing and neurocognitive disorders. This single large data base will share studies that longitudinally examine change in brain function and the development of dementia in people aged over 60.

"COSMIC is truly an international effort," says Professor Sachdev. "It currently has 30-member studies from five continents and potentially data from more than 90,000 participants." CheBA aims to make a difference to the worldwide understanding of dementia for improved outcomes in prevention and earlier diagnosis as well as earlier and more effective interventions.



In 2014 the 'Sewex' research won the prestigious "International Water Association's Global Project Innovation Award (Applied Research)"

Sewex

UNIVERSITY OF QUEENSLAND

Following a $21 million, five-year project, "Put Science into Sewers" – the largest sewer-related research project ever undertaken – a Go8 research team at the University of Queensland has delivered the world's municipalities the tools necessary to save them multiple millions of dollars in sewage system replacement and maintenance costs

It is also improving sewer design and already has a solid footprint across the United States where the total annual cost of corrosion in the sewer network was stated as US$13.75 billion in 2000, and the systems themselves had an asset value then of more than one trillion dollars. These systems must be maintained, regardless of cost, to ensure public health by preventing the spread of disease such as cholera.

An exclusive 'Sewex' licencing agreement was negotiated with USP Technologies, an Atlanta-based leading provider of chemical treatment programs for water and wastewater. In the US, USP are classed as "problem solvers with a strong environmental focus".

Sewerage system corrosion and odour is recognised as a huge problem for water utilities globally and the research team discovered a cost-effective and sustainable method of significantly delaying the replacement of aging or damaged sewage pipes, and also decreasing associated pipe odours. "Put Science into Sewers" translated innovative science and engineering into practical solutions with major economic outcomes

In 2014 the 'Sewex' research won the prestigious "International Water Association's Global Project Innovation Award (Applied Research)". The research impact has already delivered documented savings of $400 million to the Australian water industry alone.

Corrosion and odour problems in sewers are most often caused by bacteria on the sewer wall reacting with sulphates in the wastewater to form hydrogen sulphide. This enables sewer bacteria to form corrosive sulphuric acid which chemically eats away at the pipes.

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The new technology uses free nitrous acid to remove the bacteria that adhere to the inner surfaces of sewer pipes, and so halts the production of hydrogen sulphide at its source. This highly effective solution costs less to use than other methods, is used intermittently, and provides longer duration control. It can also be used in sensitive environmental areas and to treat small sewer pipes.

One of the research project's key outcomes has been its 'Sewex' model; the world's most advanced mathematical model for predicting where hydrogen sulphide will occur and therefore where both preventative methods and remediation will have most impact. This is critical because sewage networks include many kilometres of underground pipes through varying topography. This can lead to network "hotspots" where corrosion is accelerated and where odours cause community complaints.

The wastewater industry states that sewers around the world are under serious threat of deterioration. Engineers estimate the average lifespan of sewers at between 50 and 100 years, however deterioration requiring replacement or expensive maintenance is occurring in many areas in far fewer years, with asset losses worth billions of dollars globally.

Asset losses due to sewer corrosion cost Australians in the order of $100 million each year. The 'Sewex' technology has already saved many millions of dollars in sewer system replacement and maintenance costs and is now available and being utilised in larger municipalities in China and Europe as well as the US.

Hatchtech

UNIVERSITY OF MELBOURNE

Head lice, the bane of families and schools around the world – has a new and acclaimed global weapon thanks to University of Melbourne researchers. It is a weapon worth more than $100 million annually in the United States

It is a weapon worth more than $100 million annually in the United States.

Xeglyse Lotion is a novel next generation single-application prescription head lice product. With active ingredient abametapir, it overcomes the costly and inconvenient cycles of retreatment for head lice infestation.

Despite the head lice prevalence and high cost to the community, before the advent of Xeglyse there had been few major advances made to managing head lice. It still required a repeat treatment because of lice hatched from eggs that had survived a first treatment, and which were not able to be physically removed by nit combing.

The vital and successful phase 3 clinical trials of Xeglyse were carried out in the United States in 2014. Xeglyse success was the culmination of 15 years of work for Dr Vern Bowles who founded spin-off company Hatchtech Pty Ltd in 2001 when Deputy Director of the Centre for Animal Biotechnology at Melbourne University.

Hatchtech is a speciality pharmaceutical company developing technology for the control of invertebrate pests. Xeglyse is its lead product. Financial agreements worth $279 million were signed in 2015 with pharmaceutical giant Dr Reddy's Laboratories for Xeglyse commercialisation and sale in countries from Russia to Venezuala, India to the US.

The University of Melbourne retains its position as a shareholder and investor in Hatchtech. It describes the success of Hatchtech as a prime example of the impact of world-class university research, and as positive evidence that research can progress from a university lab to market.

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Elastagen

UNIVERSITY OF SYDNEY

Replicating elastin, the same building block that nature provides in skin, a Go8 research team has developed a 3D replacement skin, a pioneering medical material that is soft and flexible

The much-lauded invention, from the laboratories of Elastagen Pty Ltd, a University of Sydney spinoff, has its most obvious benefit in cancelling out the major limitations of skin grafting for burns victims. But it has a long list of other applications. As examples, it can also assist with advanced healing of broken bones, damaged lungs and chronic wounds, plus it has uses in a suite of surgical procedures where it will replace sutures, and its usage extends to being an aesthetic product that will correct stretch marks and acne scars.

In February 2018 Elastagen Pty Ltd announced that it had entered into a definitive agreement under which Allergan plc, a leading global biopharmaceutical company would now commercialise the invention and acquire Elastagen Pty Ltd for some US$120 Million. Completion of the transition was approved by Australia's Foreign Investment Review Board. Allergan plc is headquartered in Dublin Ireland, and is well-known for its focus on skin pharmaceuticals. It has had a strong aesthetic focus through its highly successful Botox and skin filler products.

The 3D replacement skin's developer, Professor Anthony Weiss, had formed clinical stage biotechnology company Elastagen Pty Ltd in 2005 to capitalise on 20 years of research. Professor Weiss is the main inventor and scientific expert behind the Intellectual Property licensed by Elastagen from the University of Sydney.

His 3D replacement skin ensures that a patient's skin can function normally, because to do so, it is crucial to repair its deeper layer, the dermis, which

Professor Weiss' team has not only developed an entirely synthetic form of skin's own elastin; they had to develop an ingenious way of spinning it into a matrix of fibres to create the flat sheets required

provides the skin's elasticity. However, until Elastagen's work, even the newer burns treatment of "spray-on" skin, while very effective at sealing the wound, had only been able to repair the skin's top layer, the epidermis.

Patients with severe burns have been left with grafted skin that can't regulate temperature, and scarred skin that always feels and looks foreign and half numb. Their limbs can be left rigid. In this 3D replacement skin breakthrough, a skin scaffold called Tropoelastin is placed across burns to replace the deep damaged layers of skin.

The Tropoelastin is identical to that present in human tissue. Professor Weiss' team has not only developed an entirely synthetic form of skin's own elastin; they had to develop an ingenious way of spinning it into a matrix of fibres to create the flat sheets required. The team painstakingly progressed from creating milligrams of the fibre to kilograms, enough for diverse human applications.

With sheets of Tropoelastin laid on the damaged site, a synthetic skin forms. According to Professor Weiss it halves skin repair time, with resulting economic benefits for both patient and health system. It allows a patient's own blood vessels and cells to grow through it, becoming a soft flexible replacement skin that can sweat, and have hair follicles regrow. It significantly minimises or removes scarring.

"Our technology has come a long way from the lab bench at the University of Sydney towards developing products for patients around the world," he says.

According to Professor Weiss it halves skin repair time, with resulting economic benefits for both patient and health system

Go8 and US students collaborate to make a global food waste difference

ARIZONA STATE UNIVERSITY (ASU) & UNSW SYDNEY

Students from the US and the Go8 found themselves competing on a unified front to create solutions to divert waste away from landfills while at the same time driving new businesses

A diverse group of 70 interdisciplinary students at Arizona State University (ASU) and UNSW Sydney created teams at their respective universities to take part in the inaugural PLuS Alliance Circular Economy ResourCE Hack.

The innovation hack has been designed to find zero-waste alternatives for transitioning to a circular economy. The grand prize was awarded to ASU team "Farmers' Friend''.

The winning team has received $2000 and now has the support of UNSW Sydney and ASU to build their prototype and further develop skills.

In the final quarter of 2018 the students from both universities tested and pitched multiple new solutions focused on reducing food waste, shifting consumer behaviour, phasing out single-use plastics and construction and deconstruction waste mitigation.

The "Farmers Friend" solution to reduce food waste involved developing an app connecting micro farmers in developing countries to consumers at places such as schools, programs for the elderly, nongovernmental organisations or restaurants using a guaranteed pricing model.

The pitch idea came from one student's travels in India and an overheard conversation about how perfectly good-to-consume mangoes were being thrown away during peak harvest. The students were astounded to learn the extent of the post-harvest food loss that India suffers from every year.

The students now see the app as coming to fruition with the potential to reach developing countries such as the Philippines where most of the family of one of the ASU team lives.

The hack was organised by an ASU-based business accelerator designed to help startups and entrepreneurs take their circular economy-focused enterprises to market. It was initially funded through a grant from the US Economic Development Administration.

ECONOMIC IMPACT

The total economic impact of the Go8 universities is **$66.4 billion** each year to Australia

Go8 is a major national employer of more than **50,000**; employing over **40 per cent** of the university sector's academic and professional staff

The Go8's need for services in its capital city locations delivers some **$19 billion** into the economy each year

Every $1 of Go8 research income delivers almost **$10** in benefits to the community

The Go8's international student market contributes **$17.98 billion** to the nation's export market

One in three international university students who choose to study onshore in Australia study at a Go8 university

Go8 international students support more than **73,000** jobs in Australia

Gardasil

UNIVERSITY OF QUEENSLAND

Globally lauded cervical cancer vaccine Gardasil was developed at the Go8's University of Queensland (UQ)

UniQuest, UQ's commercialisation company licensed the Gardasil intellectual property to CSL Ltd in Melbourne which sub-licensed it to US-based Merck & Co. Inc – one of the largest pharmaceutical companies in the world, in 1996. Today it is Merck's top vaccine by sales.

Australia became the first country in the world to roll out a national cervical cancer immunisation campaign, to protect young women from the strains of human papillomavirus (HPV) that cause 70 per cent of cervical cancers.

Cervical cancer is the second most common cancer in women, estimated to kill about 275,000 women each year. Now Gardasil is used in more

Now Gardasil is used in more than 130 countries and has led to an up to 90 per cent decrease in the prevalence of HPV in countries with high levels of immunisation

than 130 countries and has led to an up to 90 per cent decrease in the prevalence of HPV in countries with high levels of immunisation.

Gardasil also protects males against HPV and teenage boys are now also being vaccinated. In the US it has been recommended for males since 2011.

Professor Ian Frazer an immunologist, and Chinese virologist the late Dr Jian Zhou, created virus-like particles that could mimic HPV but were non-infectious, activating the body's immune response and protecting against future infection.

Professor Ian Frazer said he was simply in the right place at the right time. "I just happened to be in the right lab in Melbourne, with the right people around me and the right prompt," he said.

"That's the other thing about science, it's a lot of hard work but ... also, you have to have luck. We realise now that about 20 per cent of cancers are caused by virus infections," Professor Frazer said. "We picked a winner ... because we picked a cancer that was caused by an infection. It's much easier to prevent an infection."

The vaccine will have enormous economic benefits also with a significant reduction in the health system costs associated with preventing and treating cervical cancer, anal cancer and genital wart treatments and ongoing surveillance of affected patients after treatment.

In late 2014, the FDA approved the next generation 9 valent vaccine, Gardasil 9, which protects against an additional nine high-risk HPV types and could potentially increase the protection rate for cervical cancer to around 90 per cent.

Observations from the past decade are that the HPV vaccines if delivered effectively to the majority of 10–12 year-old girls in the developing world from today forward should lead to the global elimination of new cervical and HPV associated cancers by 2050

Professor Ian Frazer, injecting Gardasil

It has also been noted that there has been a dramatic reduction in genital warts since the introduction of the vaccine – a reduction of over 80 per cent in new presentations with genital warts amongst young women and men.

There is particular interest worldwide that the current vaccines could also assist with reducing the levels of other cancers associated with HPV such as some neck and head cancers – and whether the vaccine might also prevent re-infection after successful treatment for HPV associated disease, and therefore avoid the need for ongoing surveillance of women treated for the infection.

Observations from the past decade are that the HPV vaccines if delivered effectively to the majority of 10–12 year-old girls in the developing world from today forward should lead to the global elimination of new cervical and HPV associated cancers by 2050.

The current challenge is how to deliver universal vaccination in the developing world, where cervical cancer incidence is high and strategies for prevention are non-existent or ineffective.

Drug manufacturing companies have sharply reduced their vaccine charges for the developing world to assist, and there are further subsidies for countries with an annual GDP of less than US$1580 a person.

Ketamine

UNSW SYDNEY

The world's first randomised control trial assessing both the efficacy and safety of Ketamine for such a use has been led by a team of researchers from UNSW Sydney and the Black Dog Institute (a not-for-profit facility founded in 2002 for the treatment, diagnosis and prevention of mood disorders.)

… unlike currently used anti-depressants which can take some weeks to deliver any result, the impact of Ketamine is very fast

It is now considered that animal anaesthetic medication Ketamine, also used in human surgical procedures and a number of medical tests, could be an effective antidepressant when delivered in repeated intravenous doses to elderly patients

One reason this use for Ketamine is attracting research interest is because, unlike currently used anti-depressants which can take some weeks to deliver any result, the impact of Ketamine is very fast.

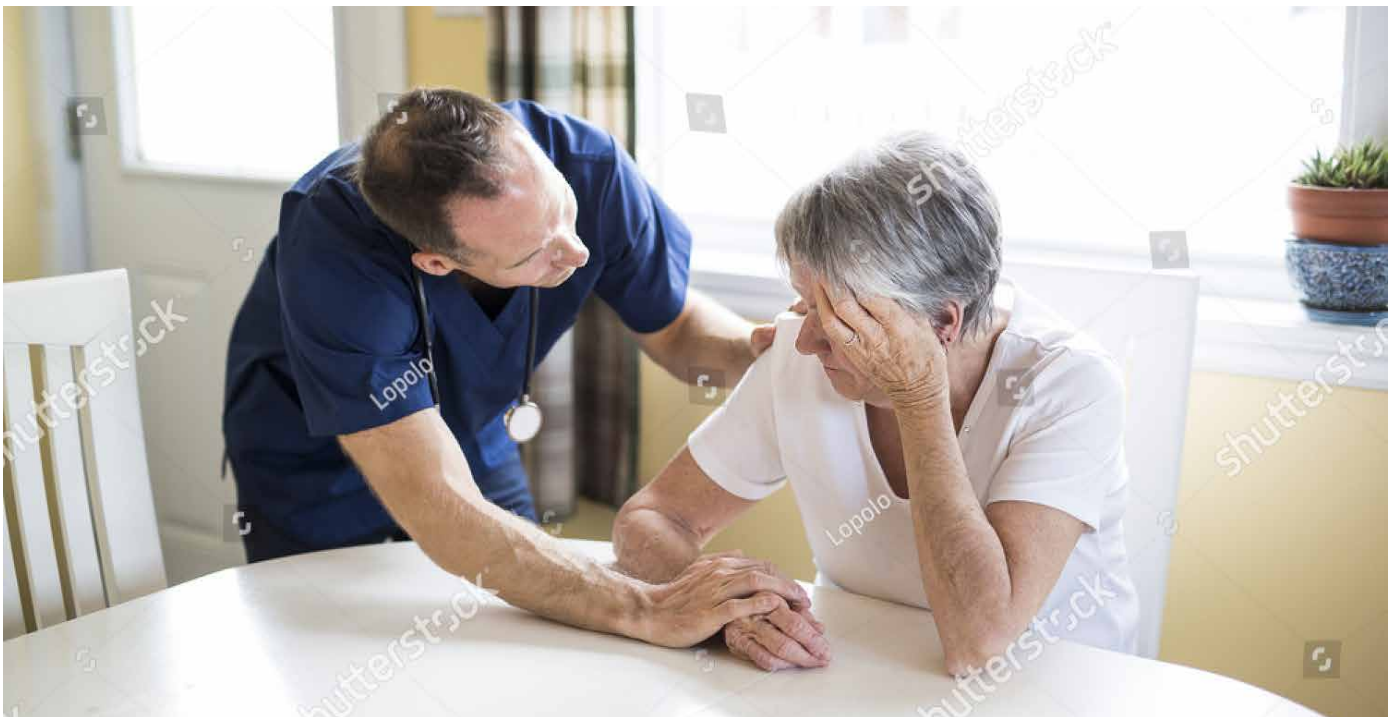
The trial results are an insight into the antidepressant potential and limitations of Ketamine, also known by its party and date-rape drug-of-abuse name "Special K". In the study published in the American Journal of Geriatric Psychiatry, 16 participants aged over 60 years received increasing doses of Ketamine over a period of five weeks.

The participants, who had treatment-resistant depression, received doses optimised for each of them using a new dose-titration approach developed by Professor Colleen Loo, UNSW Professor of Psychiatry, and collaborators. None of the

None of the patients experienced severe or problematic side effects, and treatment by a simple subcutaneous injection proved a safe and effective method for administering the drug

patients experienced severe or problematic side effects, and treatment by a simple subcutaneous injection proved a safe and effective method for administering the drug.

By the six-month follow-up, 43 per cent of participants who completed the trial had entered remission. Repeated treatments also resulted in a higher likelihood of remission, or, a longer time to relapse, with an overall response and remission rate of 68.8 per cent for the patients receiving Ketamine.



NexGen

UNIVERSITY OF QUEENSLAND

University of Queensland (UQ) startup NexGen Plants Pty Ltd has discovered technology that enables development of disease-resistant plants by manipulating a plant's genomes instead of using genetic modification (GM)

This breakthrough offers farmers around the world the potential for improved yields, and plant breeding companies a unique competitive advantage.

With the assistance of Uniquest, the University's commercialisation company, NexGen is now commercialising the technology for food, fibre, energy and ornamental crops in a research and development collaboration with global company Syngenta Ltd.

The US Department of Agriculture recently gave NexGen (in collaboration with Texas A&M) 'non GM' approval for a salt-resistant rice and NextGen is currently strengthening ties to plant biotech companies in the US.

One of the biggest threats to world food security comes from plant viruses, bacterial disease and environmental conditions, such as drought, which can quickly ravage crops. With a global population expected to reach 9.3 billion by 2050, and with world cereal yields and agricultural production in decline since 1961, a new approach is needed to ensure efficient food production.

In 2009, UQ's Professor Peer Schenk found crop viruses can be neutralised through selective breeding to make use of naturally-occurring virus-resistant traits. The cornerstone of this technology was the discovery that plant viruses produce RNA – a class of small molecules that can modulate the plant's defence response to virus attack.

Professor Schenk and his team of researchers at UQ's School of Agricultural & Food Sciences, had found a non GM approach to virus resistance. The fact there has been significant consumer concern about GM crops, which has led to higher and more onerous regulatory requirements and market disadvantage compared to non-GM crops, makes Professor Schenk's non GM technology particularly attractive to global food producers.

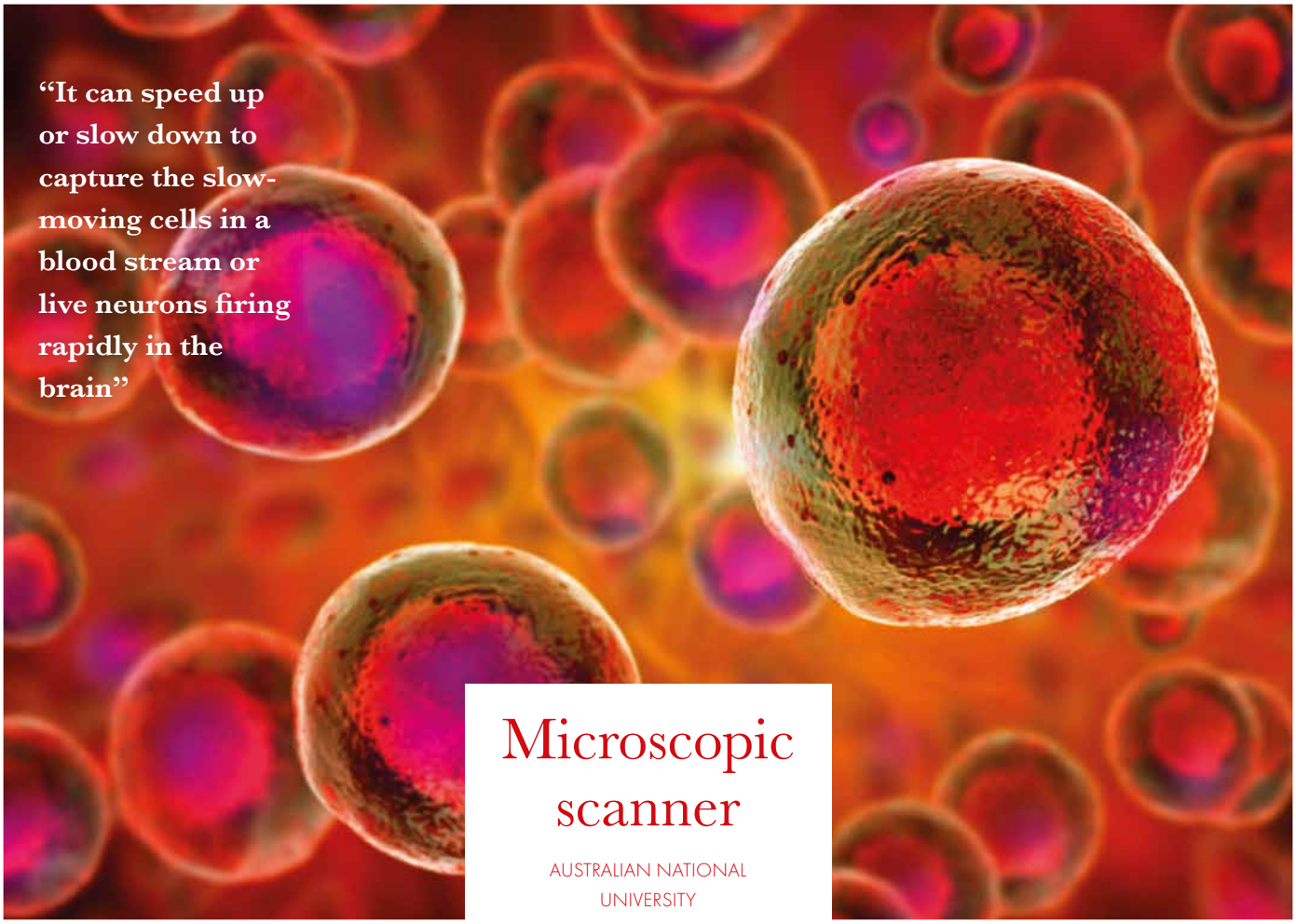
By replicating natural selection it truncates a process that could take millions of years into just 12 to 24 months

It provides a quick way for breeding companies to select for naturally-occurring virus and diseases-resistant traits in commercial crop varieties. By replicating natural selection it truncates a process that could take millions of years into just 12 to 24 months.

The research team screened a range of high value crops including: sugar cane, soybean, maize, rice, potato, wheat and cotton for the potential to develop long lasting virus resistance using their IN-Ttrait™ technology.

The technology can also be used to create salt and heat-tolerant crops, as well as enhance nutritional and favourable consumer traits such as fruit shape, size and fragrance, and even increased shelf life.

With a global population expected to reach 9.3 billion by 2050, and with world cereal yields and agricultural production in decline since 1961, a new approach is needed to ensure efficient food production



Microscopic scanner

AUSTRALIAN NATIONAL UNIVERSITY

In collaboration with leading experts in the US and Australia, Australian National University engineers have built an advanced microscope using barcode laser scanner technology that can film moving blood cells and neurons firing in living animals

The sophisticated microscope will enable scientists to analyse complex medical problems ranging from blood disorders and cancer to neurological disorders. It uses technology that is similar to retail barcode scanners and office laser printers.

"It can speed up or slow down to capture the slow-moving cells in a blood stream or live neurons firing rapidly in the brain" said the project's lead researcher Dr Steve Lee, a biomedical optics engineer.

The sophisticated microscope will enable scientists to analyse complex medical problems ranging from blood disorders and cancer to neurological disorders

A typical barcode scanner bounces a laser beam off a polygonal mirror with up to 10 facets to register patterns. The researchers used a more powerful laser, and a 36 facet polygonal mirror. The image resolution is the same as conventional, commercially available microscopes, but the speed is doubled. It can capture videos at 800 frames per second, and can function as a real time imaging solution.

The researchers used advanced electronics, and a flexible, customised open source software. The microscope took little over a year to build. Dr Lee is now collaborating with a US-based industry optics partner to further expand the capability of his team's invention.

Protagonist

UNIVERSITY OF QUEENSLAND

Protagonist Therapeutics is a biotechnology company spun out of the University of Queensland's (UQ) Institute of Molecular Biosciences (IMB) and has its headquarters in Menlo Park California

It discovers and develops orally-stable peptide drugs, giving patients a potential alternative to injectable-only biologic drugs.

Protagonist Therapeutics listed on the NASDAQ in 2016 raising US$90 million in its oversubscribed IPO of 7.5 million shares. In 2017 Protagonist granted Janssen the exclusive worldwide rights to PTG-200, a first-in-class oral peptide.

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Work on this peptide pill for irritable bowel syndrome is underway and Protagonist has completed phase one trials in the US Food & Drug Administration's three-phase approval process for use of peptides for ulcerative colitis and is in pre-clinical trials for a peptide drug for Crohn's disease.

Peptide-based drugs have significant benefits including the fact they have a high potency at a low dose. They are also very selective in that they tend to bypass healthy tissue and bind only to their target, producing fewer side effects for patients. The downside is they are rapidly metabolised and therefore require frequent administration to the patient.

The IMB's Associate Professor Mark Smythe has been leading the innovative work to overcome the limitations of peptide drugs, building a "super peptide". This will deliver in pill form a drug that can hit the targets for which large molecule injectables have been the only solution.

Uniquest, UQ's commercialisation company created Protagonist Therapeutics in 2001 securing external investment in 2006.

ImpediMed

UNIVERSITY OF QUEENSLAND

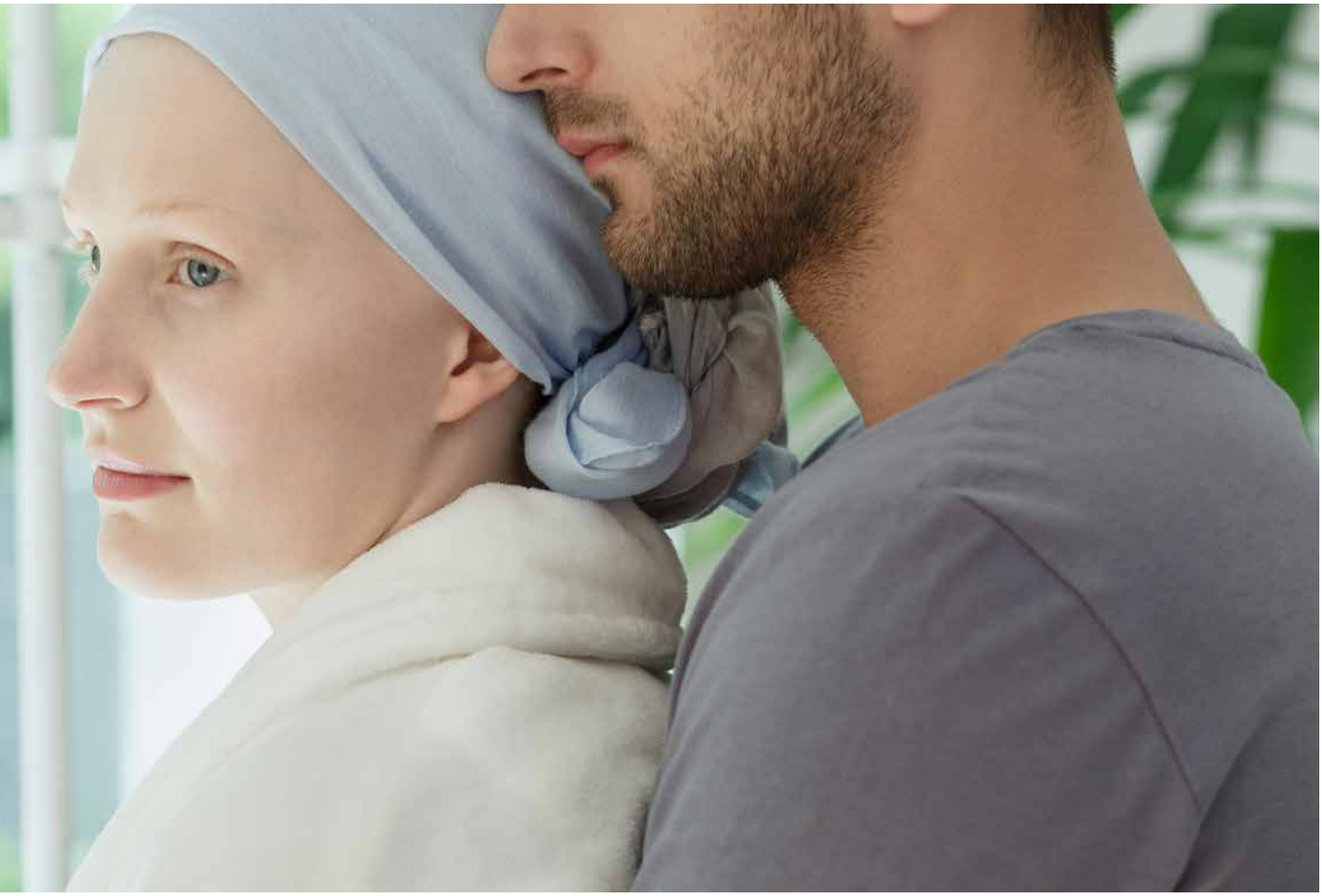
More cancer patients will now have access to early lymphedema detection because of ImpediMed's L-Dex device

ImpediMed is an ASX-listed medical device company, with offices in Brisbane and San Diego California.

The L-Dex device has become the first FDA-cleared medical device to use bioimpedance spectronomy (BIS) to assess lymphedema. The BIS technology was developed by Dr Leigh Ward at the School of Chemistry and Molecular Biosciences of Go8 member, the University of Queensland (UQ).

Following a valuation from the Centres for Medicare and Medicaid Services (CMS), US physicians and hospitals will be able to seek reimbursement for the use of the device. This US market alone is worth over $350 million a year because lymphedema is not uncommon.

The procedure is painless. It measures extracellular fluid differences in the arms and legs of women, and in the legs of men, and takes just minutes to perform with an immediate result.



As an example, one in five cancer patients have lymphedema of the arm after breast cancer treatment. It occurs when cancer, or the effects of cancer treatment, block the normal fluid drainage channels of the lymphatic system.

The L-Dex device produces a lymphedema index (or L-Dex) that assists doctors determine if a patient is building up excess fluid in an at-risk limb. The procedure is painless. It measures extracellular fluid differences in the arms and legs of women, and in the legs of men, and takes just minutes to perform with an immediate result.

The technology can also measure body composition and be applied to nutritional support in HIV-AIDS, perinatal medicine and animal production," Dr Ward said.

UniQuest, the University of Queensland's commercialisation company was an ImpediMed founder in 2000 and ImpediMed is now recognised as a world leader in the development and distribution of medical devices that use BIS and bioimpedance analysis technology.

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Glycaemic Index

UNIVERSITY OF SYDNEY

The "Low GI diet" is now a household name, and eating pattern, around the world

A GI symbol has been developed to help people make nutritionally healthy choices when shopping, and in the US where the US Centre for Disease Control and Prevention (CDC) has estimated that more than 30.3 million Americans have diabetes, the American Diabetes Association now incorporates specific recommendations on glycaemic load into its advice to diabetics.

A low GI diet has been proven to help lower blood pressure in those with diabetes (having been originally developed for people with this disease) before its wider role in healthy eating and weight loss was established. It has also provided much-needed facts to the otherwise contentious debate surrounding so-called good and bad carbohydrates.

The low Glycaemic Index (GI) is a scientifically based measure of carbohydrate quality, showing how fast certain carbohydrates are digested and hit the bloodstream. Carbohydrates that break down slowly during digestion and release glucose more gradually into the bloodstream have a low GI, and are proven to be better for weight loss, weight maintenance and blood glucose levels. The sustained energy of low glycaemic carbohydrates also helps make a person feel fuller for longer.

The low GI research was undertaken by Professor Jennie Brand-Taylor of the University of Sydney into how carbohydrates are digested. Her research focussed on all aspects of carbohydrates including diet and diabetes, the glycaemic index and insulin resistance. The research results set out how a low

The focus on assisting those with diabetes has not diminished even as the high profile weight loss benefits of a low-GI diet have made global headlines

GI diet helps normalise blood sugar, prevent insulin resistance, prevent fatigue and make a person more energised.

The focus on assisting those with diabetes has not diminished even as the high profile weight loss benefits of a low-GI diet have made global headlines. Professor Brand-Taylor has co-authored a number of diabetes-specific books including the "new glucose revolution" series that helps people manage diabetes and pre-diabetes using the glycaemic index.

In 2014 Professor Brand-Taylor co-authored, with Australia's CSIRO, the "Total Well-being Diet" to assist healthy weight.

In the US where the US Centre for Disease Control and Prevention (CDC) has estimated that more than 30.3 million Americans have diabetes, the American Diabetes Association now incorporates specific recommendations on glycaemic load into its advice to diabetics

Professor Simmons works to deepen the research relationship between Australia and the United States

UNSW SYDNEY

2018 Australian of the Year and UNSW Sydney quantum physicist Professor Michelle Simmons has been appointed Honorary Patron of the Mateship program by the Australian Embassy in the United States

The program looks to strengthen the countries' future cooperation on science, innovation and space policy.

Professor Simmons has strong research relationships within the US,and was Australia's representative at the 2018 White House Summit for Advancing American Leadership in Quantum Information Science. She is an expert in quantum computing and has pioneered unique technologies internationally to build electronic devices at the atomic scale.

As Director of Silicon Quantum Computing Pty Ltd and of the Australian Research Centre of Excellence for Quantum Computation and Communication Technology at UNSW Sydney, Professor Simmons is, with her team, at the forefront of developing a silicon-based quantum computer: a powerful new form of computing that could transform information processing.

The Mateship initiative, a campaign by the Australian Embassy in Washington DC, promotes the strong Australia-US bilateral relationship. In 2018 it celebrated its 100th anniversary. Professor Simmons will serve as Honorary Patron of Mateship in recognition of her personal contribution to the bilateral relationship through her significant work and collaboration with US-based research teams. "It is an honour to be involved with the Mateship campaign, particularly as it looks to the future of science and technology," said Professor Simmons.

"Collaboration underpins successful partnerships and it is something that we, as Australians, do really well. I look forward to contributing to the alliance in my role as an Honorary Patron of Mateship."

DNA specialist helps identify worst serial killer in US history

UNIVERSITY OF QUEENSLAND ALUM / US DEPARTMENT OF JUSTICE

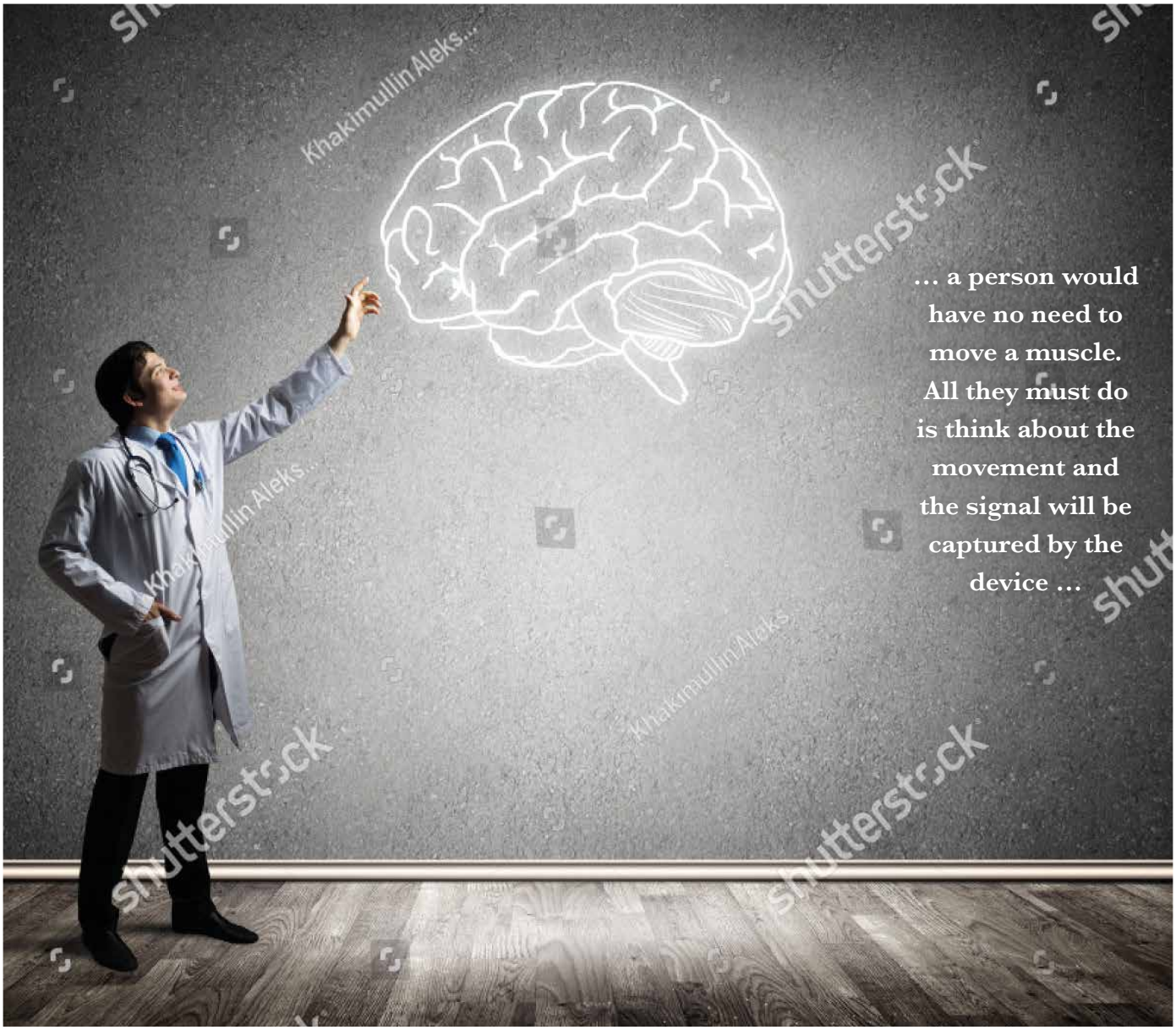
Closing the coldest of cold US cases is the driving passion of Dr Angela Williamson a University of Queensland alum who is now a senior forensics policy adviser to the US Department of Justice and a consultant to the FBI's Violent Criminal Apprehension Program (VICAP)

Professor Williamson studied molecular biology and biochemistry and is a strong proponent of improving shared criminal case data such as DNA across State lines. She does not court publicity but attracted media attention recently when she was credited for her determination and exhaustive efforts identifying and investigating a number of linked murder cold cases. This led to the interviewing of Samuel Little, now described as the worst serial killer in the US.

The interview of Little, already serving three life sentences for murder, saw him confess to more than 90 murders across multiple States over more than 50 years.

The interview of Little, already serving three life sentences for murder, saw him confess to more than 90 murders across multiple States over more than 50 years. So far 38 of those murders have been confirmed and Professor Williamson continues her work to confirm the others.

Professor Williamson also oversees the Federal Department of Justice's National Sexual Assault Kit Initiative (SAKI) which provides grant money to jurisdictions to test DNA from previously untested rape kits; working to alleviate a national backlog and cold cases from many decades ago.



Stentrode

UNIVERSITY OF MELBOURNE

Medical science and engineering have come together to develop a tiny device, that could one day allow those who have lost the use of their limbs through disease or injury to move them again using the power of thought

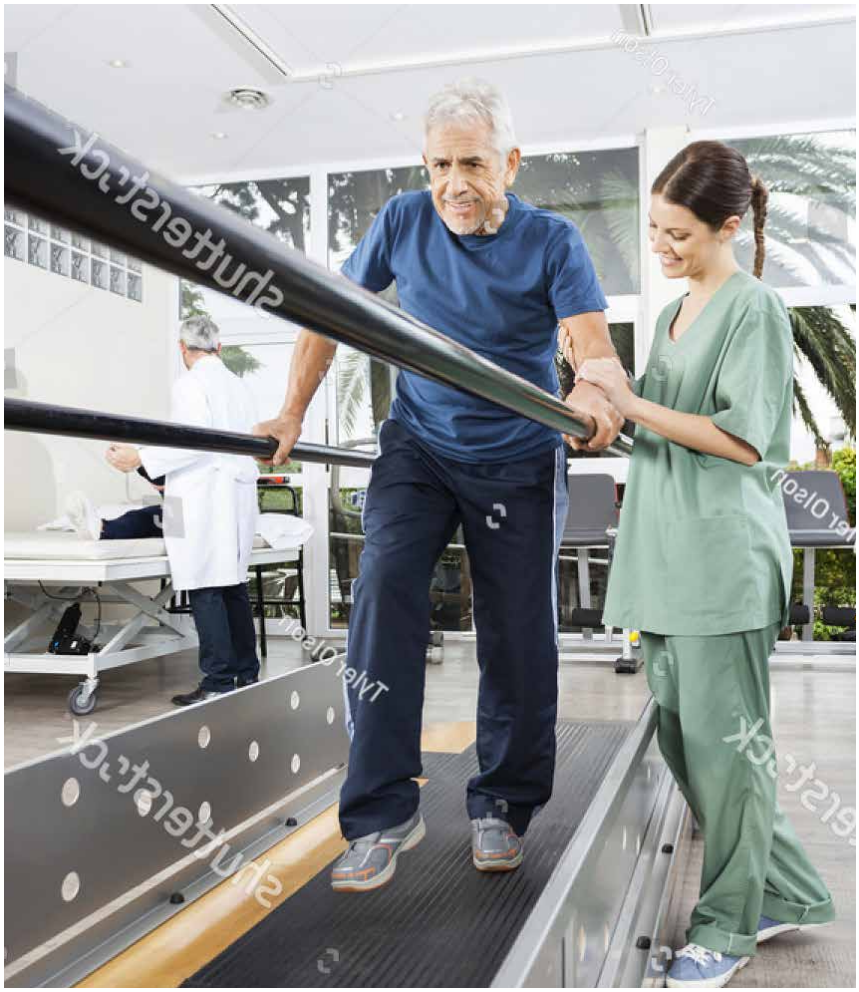
Smaller than a paperclip, the device is implanted into a blood vessel next to the brain's motor cortex

Smaller than a paperclip, the device is implanted into a blood vessel next to the brain's motor cortex. The researchers, at the Go8's University of Melbourne, have had their work funded by the US Defence Advanced Research Projects Agency (DARPA), Australia's National Health and Medical Research Council (NHMRC), the US Department of Defense, US Office of Naval Research Global, the Australian Defence Health Foundation, and the Brain Foundation. They have called the invention a stentrode.

After initial proof-of-concept research demonstrated the capability of the device to pick up neural signals that could be used to control external equipment, the device is now being commercialised out of Palo Alto California at small technology company Syncron which was co-founded by the co-leaders of the University of Melbourne research team – Professors Nick Opie and Thomas Oxley.

The stentrobe is currently under FDA review, and planning for first in human trials. If a trial is successful, it is anticipated the technology could become commercially available in as little as six years. The tiny slender, cigar-shaped bundle of fine wires and electrodes now known as a stentrobe was designed to be implanted using a catheter fed up through the groin and into a blood vessel near the motor cortex, the part of the brain which controls movement.

Once implanted, it picks up signals that a person would normally send to their limbs from their brain to create the required movement. Instead, using the stentrobe, a person would have no need to move a muscle. All they must do is think about the movement and the signal will be captured by the device and sent to a wireless antenna unit implanted in the chest, which will in turn be sent to an external receiver.



QUE Oncology

UNIVERSITY OF QUEENSLAND

International joint venture QUE Oncology, Inc. (QUE) is working to address unmet medical needs and the side-effects of cancer treatment

The clinical-stage biotechnology company was jointly established in 2013 by UniQuest, The University of Queensland's commercialisation company, and Emory University, based in the United States.

QUE licensed intellectual property from research at both UQ and Emory University. In 2017, QUE raised A$21.5 million in series A investment from the Brandon Capital-managed Medical Research Commercialisation Fund (MRCF) and Uniseed. The investment enabled further development of its leading drug Q-122.

Q-122 is an oral non-hormonal drug designed to treat hot flushes in breast cancer survivors who are undergoing hormone therapy.

In around 70 per cent of breast cancer cases, the growth and behaviour of the tumour is influenced by oestrogen and progesterone. Treatment to manage hormone-sensitive breast cancer typically results in the long-term suppression of oestrogen. This leads to induced menopause in women, with significant symptoms including debilitating hot flushes and night sweats.

Hormone replacement therapy cannot be used to manage this because of a risk the cancer will recur or progress; meaning women taking oestrogen-blocking drugs have fewer options to manage and treat their debilitating side effects. This makes Q-122 an exciting potential new drug.

In 2014, QUE successfully completed a Phase 1b Q-122 clinical trial which saw the frequency of hot flushes in participants reduced by nearly 60 per cent. In some cases, a 100 per cent reduction of symptoms was reported

Despite advances in breast cancer management, treatment side-effects often adversely affect quality of life. For some patients, the side effects of treatment to destroy their cancer are so problematic they stop treatment altogether.

QUE is looking for solutions for those breast cancer patients who face such debilitating side-effects from traditional treatments and to provide those undergoing breast cancer treatment with a better quality of life.

In 2014, QUE successfully completed a Phase 1b Q-122 clinical trial which saw the frequency of hot flushes in participants reduced by nearly 60 per cent. In some cases, a 100 per cent reduction of symptoms was reported. These results positioned QUE to move Q-122 into further clinical trials, including a dose-defining Phase II study of 130 women at multiple sites in the US and Australia which began in late 2018.

Q-122 is an oral non-hormonal drug designed to treat hot flushes in breast cancer survivors who are undergoing hormone therapy

Solar

UNSW SYDNEY

The Go8 is home to world-leading solar PV researcher Professor Martin Green known as the "father of PV" and he is Director of the Australian Centre for Advanced Photovoltaics at UNSW Sydney

Sales of systems containing this solar cell exceeded US$10 billion in 2017, and are predicted to exceed US$1 trillion by 2040

In 2018 he became the first Australian to be awarded the Global Energy Prize, likened to an energy Nobel prize, yet he and his team prefer to stay out of the media where possible.

When Green as a young student first became "hooked" on solar PV some 40 years ago it was mainly used to fuel space-ships and no-one was interested in it except NASA. Now Green and his team have revolutionised the efficiency and costs of solar PV with his technology strongly supported by global sales including being a US leader.

The enormous reduction in the world's cost of photovoltaic solar systems is directly related to his scientific efforts, and to his students then establishing manufacturing centres in Asia.

In 1989, it was Green's team who supplied the first photovoltaic system with an energy conversion rate of 20 per cent. In 2014 he headed the development team that first demonstrated the conversion of sunlight into electricity with an energy conversion efficiency of 40 per cent.

Among his many breakthroughs, Green invented the PERC solar cell which accounted for more than 24 per cent of the world's silicon cell manufacturing capacity by the end of 2017.

In doing so his fundamental and applied research has transformed the global energy sector, creating the highest efficiency solar cells using techniques that have made them accessible to the world through commercialisation.

Sales of systems containing this solar cell exceeded US$10 billion in 2017, and are predicted to exceed US$1 trillion by 2040.

Professor Green is also co-inventor of the laser-doped selective emitter solar cell used in solar panels worth more than $1 billion in sales between 2009 and 2011.

Among his many breakthroughs, Green invented the PERC solar cell which accounted for more than 24 per cent of the world's silicon cell manufacturing capacity by the end of 2017

Professor Matt Sanders

Triple P

UNIVERSITY OF QUEENSLAND

A parenting program now recommended globally was developed at the Go8. Triple P (Positive Parenting Program) offers tailored support to meet parents' different parenting needs

It has programs for those with children up to 16 and is regarded globally as one of the most extensively evaluated evidence-based parenting programs.

The American Academy of Paediatrics has recommended Triple P be integrated into services provided by US medical practices to reduce the toxic effects of poverty on children's health. Triple P has also been showcased at the White House as part of an initiative to improve outcomes for boys and young men of colour – and all youth – illustrating that quality research can inform programs to improve the lives of individuals and families, while also providing community-wide benefits. Triple P has 87 granted US patents.

Using Triple P, parents learn a range of strategies to suit their family. They develop skills and routines to help raise happy and confident children, to manage misbehaviour, to set rules and encourage the behaviour they want to see. Utilising a wide range of support from light touch seminars to more intensive group-based and one-on-one programs, they also learn to hold realistic expectations about themselves and their children.

Demonstrated community outcomes of Triple P include a reduction in child maltreatment indicators in communities where Triple P has been made widely available; reduced numbers of children with clinically elevated behavioural, social and emotional problems, and reductions in parental stress rates. The program has also been shown to help provide an environment where children can learn.

With the support of UniQuest, UQ's commercialisation company, Triple P progressed from academic endeavour to a scalable, sustainable, global program with more than 62,000 practitioners trained to deliver it

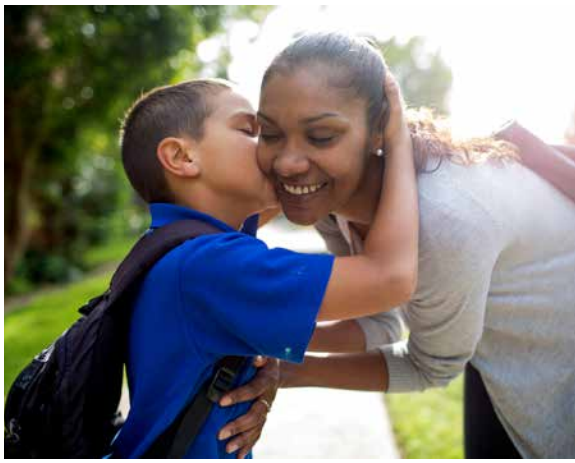
Typically, research shows that in families using Triple P, parents become more confident, use more appropriate discipline, have less parental distress, and couples' relationships improve. Children become happier, less anxious, have better peer relationships, and children with behaviour problems significantly improve.

Triple P began in 1979 as the PhD thesis of Professor Matt Sanders of the University of Queensland. Professor Sanders today remains at the heart of Triple P's development at UQ's Parenting and Family Support Centre, where he is Director and a Professor of Clinical Psychology.

With the support of UniQuest, UQ's commercialisation company, Triple P progressed from academic endeavour to a scalable, sustainable, global program with more than 62,000 practitioners trained to deliver it. In 2001 UniQuest played a major role in establishing a licence for commercial partner, Triple P International Pty Ltd, to disseminate the program worldwide.

Triple P can now be accessed online and a parallel system, Stepping Stones Triple P, has been developed for parents of children with disabilities.

The American Academy of Paediatrics has recommended Triple P be integrated into services provided by US medical practices to reduce the toxic effects of poverty on children's health



Demonstrated community outcomes of Triple P include a reduction in child maltreatment indicators in communities where Triple P has been made widely available

We'd like to talk to you about all the things we can't talk about.

Defence research and innovation are vital to this nation's security. That's why the defence projects with the highest classification are entrusted to Australia's most established universities.

Partnering with companies like Boeing and Lockheed Martin in the areas of [redacted] and [redacted] has already led to breakthroughs that are expected to [redacted] by the end of [redacted].

In-depth studies into [redacted] have major implications for military engagement in the future. We've been working closely with the U.S. Department of [redacted], the U.S. Department of [redacted] and their National Security Agency on the [redacted]. By early 2017 we are expecting to launch the [redacted] into orbit.

Because [redacted] is achieving speeds of up to [redacted] times the speed of sound, it has the potential to completely change the way [redacted].

With 36,375 kilometres of coastline to protect, it's clear that today's radar is [redacted]. However, [redacted] is going to revolutionise Australia's surveillance capabilities. At the same time a network of research has been established to [redacted]

[redacted], [redacted] and better align Defence priorities.

3D printing with materials such as [redacted] and [redacted] plus ultrasonic milling mean that prototyping of [redacted] is becoming more streamlined than ever before.

Every aspect of Defence, from [redacted] to cyber-security is being impacted by our work. Advances in areas such as quantum computing and biomedical diagnostics are taking Australia's Defence to a place where [redacted] will finally be possible.

To make sure we're able to take a more strategic approach to Asia-Pacific security we're bringing together the brightest [redacted] and giving them the [redacted] support they need to [redacted].

Australia's most established universities, often referred to as the Group of Eight, attract top performing students. Many of them will go on to become members of Australia's Army, Air Force and Navy. They will also have the opportunity to work on [redacted] and [redacted] not to mention [redacted].

GROUP OF EIGHT AUSTRALIA

MEMBERS

CRICOS Code: 00126G

CRICOS Code: 00008C

CRICOS Code: 00120C

CRICOS Code: 00123M

CRICOS Code: 00116K

CRICOS Code: 00098G

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