2021-22

Bionics Institute Annual Report

Bionics Institute

The Bionics Institute is an internationally recognised, independent medical research institute that solves medical challenges with technology.

We lead the world in the research and development of innovative medical devices and therapies to improve human health.

Our multidisciplinary team comprises world-class scientists, engineers and researchers, and our laboratories are located in St Vincent's Hospital Melbourne, close to our clinical collaborators.

Together, we transform the lives of people with a range of conditions, including hearing impairment, vision loss, Crohn's disease, Parkinson's disease, epilepsy, stroke, rheumatoid arthritis, incontinence and diabetes.

Contents

Medical bionics is a multidisciplinary field of research combining **bio**(logy) and (electro)**nics** to develop devices that electrically modulate or monitor neural activity to provide innovative treatments for a range of medical conditions.

Our Year at a Glance

$100K+ RAISED

in our tinnitus appeal

Vagus nerve stimulation device breakthrough with no side effects

18
Research publications

Students

23 student placements

2 PhDs conferred

NEWS coverage

- **8** television news stories
- **4** newspaper stories
- **4** radio features

Staff

36 new staff members onboarded in the last financial year, including **11 new researchers**

39 GRANT APPLICATIONS LODGED

Total grant money awarded
$2,044,329

Professor Colette McKay

elected Fellow of the Australian Academy of Health and Medical Sciences

Donations and philanthropic support

PRIVATE DONATIONS	TRUSTS & FOUNDATIONS
$476,578	$337,732

TOTAL
$814,300

Nanotechnology breakthrough to help hearing loss

COMMUNITY OUTREACH

5 information events
14 public events

GIRLS IN STEM MENTORING PROGRAM

expanded to **5 schools**
24 high school participants

Message from our Chair

I am delighted to present this Annual Report for the 2021–22 financial year. It highlights our achievements and the progress of our research to develop medical devices that could transform millions of lives around the world.

This year I joined researchers and research support staff at a staff conference titled 'Better Together'. It was great to witness the energy and passion in the room and work with the team to build on the Bionics Institute's wonderful culture of innovation and collaboration. We are fortunate to have a great group of people at the Institute.

Innovation lies at the heart of the Bionics Institute, and a great example of this is our vagus nerve stimulation research, which is a step closer to creating drug-free treatments for debilitating diseases such as rheumatoid arthritis, diabetes and Crohn's disease.

Building on the pioneering spirit of our founder, Professor Graeme Clark, our hearing researchers have made great strides in developing an objective measure of tinnitus; a new infant hearing test; and drug therapeutics for hearing loss.

Brain research has long been a key strength of the Bionics Institute, and delivering new diagnostic and treatment technologies to the clinic for epilepsy and Parkinson's disease is becoming a reality through our spin-off companies, Epi-Minder Pty Ltd and DBS Technologies Pty Ltd.

It was a great pleasure to join 160 guests at the official opening of Neo-Bionica in September 2021 by The Hon. Jaala Pulford, Minister for Innovation, Medical Research and the Digital Economy. The world-class prototype manufacturing facility is a testament to the vision and hard work of the Bionics Institute team, who were immersed in designing and building Neo-Bionica over the previous 3 years.

Neo-Bionica, a joint initiative between the Bionics Institute and the University of Melbourne, will significantly increase the speed of medical device development from initial concept to clinical application for the benefit of patients around the world.

We welcomed three new members to the Board of Directors this year and will benefit enormously from the wealth of business experience of Ms Hannah Crawford, experienced executive director; Ms Sujata Stead, CEO of the Occupational English Test (OET); and Mr Mike Younger, Portfolio Manager at Prime Value Asset Management.

Mr John Stanhope AM
Chair

I would like to thank outgoing Board member Christina Hardy for her contribution to the Board between 2008 and 2021. I am honoured to work with such a dedicated Board of Directors and look forward to supporting the Bionics Institute team, under the leadership of CEO Robert Klupacs, to continue building our reputation as a world leader in medical device development.

"I look forward to continuing to build our reputation as a world leader in medical device development."

Message from our CEO

The 2021–22 year has seen rapid growth of the Bionics Institute and bold steps to speed up the development of medical devices to improve human health.

It has been a year of moving forward and new beginnings.

We have seen excellent progress in our research into medical devices with a focus on brain research, hearing research, and autoimmune and chronic condition research, which is detailed below.

We also paved the way to expand into two new areas of research in our campaign to attract two senior researchers to join our team. We welcomed 36 new staff, including talented scientists and engineers who are keen to innovate and create new solutions to improve the lives of people with challenging medical conditions.

To reflect our position at the cutting-edge of technology and as a world leader in the development of medical devices, we rebranded the Bionics Institute and launched a new website, which showcases the impact of our research.

In September 2021, we officially opened our spin-off company Neo-Bionica, in partnership with the University of Melbourne.

Attracting clients from around the world under the leadership of Chair Lusia Guthrie and CEO Dr Ludovic Labat, Neo-Bionica fills an unmet need for expertise and excellence in the development and manufacture of medical device prototypes. We look forward to its future expansion.

Fast translation of research concepts into the clinic

At the Bionics Institute, we have a laser focus on translating our research concepts as quickly as possible into medical devices that will benefit patients.

A large proportion of medical research taking place today may take 20 to 30 years to benefit patients.

In sharp contrast, our medical devices could be in clinics within just 5 years.

In addition, many of the medical devices under development at the Bionics Institute provide drug-free alternatives to current treatments and more accurate diagnostic tools, which could lead to huge savings in health costs.

Highlights of the fast progression of our research concepts this year include:

Vagus nerve stimulation research

We moved forward this year with the development of a device to reduce inflammation in rheumatoid arthritis, with results showing that stimulation of the abdominal vagus nerve improved limping, inflammation and ankle swelling in a pre-clinical model.

Hearing therapeutics

We are currently validating therapeutic technology to lay the foundation for a future clinical trial by developing a manufacturing process and quality management system to enable the manufacture of a clinical grade drug delivery system suitable for a first-in-human trial.

EarGenie®

We have made great progress with our test of speech sound discrimination, which is now more than 95% accurate in individual babies. This means EarGenie will significantly help audiologists to confidently fast track early intervention for children born with hearing impairment. Our next steps are to update our prototype EarGenie ready for external research labs to fast-track clinical data collection and our route to a commercial product.

Tinnitus

Since publication of our initial findings last year, which showed our innovative test is a viable technique for measuring tinnitus-related brain activity, we have collected data of patients with and without tinnitus, allowing us to replicate and confirm our findings in a larger dataset. Our next steps are to use our objective measure to evaluate potential tinnitus treatments.

Investing in people with talent and vision

The Bionics Institute has bold plans for growth and the development of transformational medical devices over the next 20 years.

To realise our plan, we have sought out world-class medical researchers with a visionary mindset, passion for improving human health and track record of achievement to lead our research.

I am delighted to say that we attracted some excellent candidates and appointed Professor Kate Hoy as Head, Cognitive Disorders Treatment Program, starting in August 2022.

Professor Hoy joins us from Monash University where she was Head of Interventional Neuropsychology and Deputy Director at the Epworth Centre for Innovation in Mental Health. A qualified clinical neuropsychologist, Professor Hoy is an internationally recognised brain stimulation researcher and has published over 125 scientific journal articles.

The team is preparing to launch a world-first clinical research trial to investigate whether an effective brain stimulation treatment for depression may also improve cognition in Alzheimer's disease to fight memory loss, and we look forward to seeing the results.

Professor Hoy joins our world-class team of scientists and engineers, led by our visionary and passionate heads of research: Professor James Fallon, Chief Technology Officer and Head of Research Operations; and Principal Scientist Professor Colette McKay, Head of Translational Hearing Research.

Inspiring the next generation of researchers

In 2017, the Principal of Ivanhoe Girls' Grammar School asked if our scientists could mentor her students to give them some insight into careers in STEM.

Our inaugural Girls in STEM Mentoring Program started with just two students. It has grown exponentially to include 24 students from five schools, mentored by 14 leading female scientists from the Bionics Institute and Seer Medical.

Our vision is for this program to become national so that students from every high school in Australia can benefit from this opportunity.

I am delighted to say that the program is gaining momentum and will more than double in 2023.

I would like to take this opportunity to thank our mentors, who take time out of their busy schedules to inspire the next generation of researchers.

Message from our CEO *cont.*

Thank you for supporting innovation for life

Our innovative research would not be possible without financial support. I would like to say a heartfelt thank you to our individual donors, philanthropic trusts and foundations for their support.

Our scientists, researchers and clinical collaborators are extremely grateful.

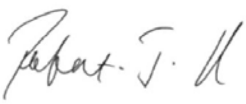
Philanthropic donations provide vital funding for early-stage research and are essential for success in our applications for competitive government grants.

We gratefully acknowledge the research funding we receive from the Federal and State Governments. This funding included a grant from the Medical Research Future Fund to use a novel brain imagining technique to fast-track earlier treatment for infants with auditory neuropathy.

I would like to thank our dedicated Board, led by Chair John Stanhope, for their support and welcome our new Board members, Hannah Crawford, Sujata Stead and Mike Younger.

Together we look forward to building on this growth to translate our research as quickly as possible so it can benefit people in just a few years. I am incredibly proud of the achievements of our scientists, engineers and research support staff and hope you enjoy reading about our progress in this year's Annual Report.

Mr Robert Klupacs
CEO



"I am incredibly proud of the achievements of our scientists, engineers and research support staff and hope you enjoy reading about our progress in this year's Annual Report."

Our Board

We would like to thank the Board of Directors for their dedication and commitment to the mission of the Bionics Institute.

John Stanhope AM
Chair

John Bryson
Deputy Chair

Brian Jamieson
Treasurer

Charles Bagot

Phil Binns

Associate Professor Stella Clark AM

Hannah Crawford

Roger Gillespie OAM

Christina Hardy

Ken Jefferd

John Simpson

Sujata Stead

Dr Sherryl Wagstaff

Mike Younger

Our Impact

There are seven key research groups at the Bionics Institute, led by Professor James Fallon, Professor Hugh McDermott, Professor Colette McKay, Associate Professor Chris Williams, Associate Professor Rachael Richardson, Associate Professor Andrew Wise and Dr Mehrnaz Shoushtarian.

These teams are supported by our excellent capability providers: the pre-clinical research team led by Dr Peta Grigsby; the histology team led by Ella Trang; the engineering team led by Owen Burns and Alex Thompson; clinical projects managed by Dr Sally Herring; our electrode fabrication team led by Ross Thomas; and data analytics provided by Dr Gautam Balasubramanian.

Report from our Chief Technology Officer and Head of Research Operations

Culture is such a key part of our success at the Bionics Institute; I'm delighted with the resilience, ingenuity and creativity shown by our amazing research teams throughout 2021 and into 2022. Collaboration and maintaining connections both internally and with the biotech community has been a focus and we've had some exciting successes to share.

Strengthened capabilities

With a focus on recruitment over the last twelve months, we have had impressive growth at the Institute. While we're still small, we have such diversity across our teams and we are starting to reap rewards with the flexibility this gives us. When we have novel ideas, we can tap into the skills of our pre-clinical, engineering, and electrofabrication teams and see early-stage progress much faster than before.

I'm pleased with how far we have come this year and am excited for where we are going with our research. I was asked recently, "You used to be the Bionic Ear Institute, what do your current projects have to do with the cochlear implant?" My response was that the cochlear implant is all about interfacing with the nervous system – stimulating and recording. If we can use that principle to help someone, that is what we will do.

Excellent progress

A number of our teams working on early-stage projects have made excellent progress this year. In particular, our Optogenetics team expanded our world-leading research in combining optical and electrical stimulation beyond the cochlea. The team have now extended the technique to include stimulation of the retina and the peripheral nervous system. This new paradigm offers the potential for unprecedented control of neural activity to treat a range of conditions and I look forward to seeing it progress through pre-clinical studies over the next few years.

Our teams have also been busy improving many of the techniques we utilise to develop our technologies. These techniques often impact across a number of different projects and allow our work to continue to be at the forefront of research in this rapidly developing neuromodulation space. Particular highlights for me this year have been the development of new imaging techniques by our histology team to allow unprecedent detailed visualisation of the interface between electrodes and the neural tissue they are stimulating, and new electrode arrays developed by our electrofabrication team that incorporate both LEDs and electrodes for our optogenetic work.

Collaboration is key

One of the biggest challenges we face post-COVID is learning how to collaborate in what we now know as the 'new normal'. Our research teams were privileged to be able to do more face-to-face work over 2021 and 2022 than some other industries, and that's been critical given the nature of what we do.

This in-person meeting of minds is often the flint to the fire. It enables us to discuss seemingly routine ideas from one discipline of research and apply it to another, sparking innovation and new ways of thinking. We are taking those engineering insights, sprinkling in some biological understanding and addressing a clinical need – that's the magic.

Collaboration is key *cont.*

One exciting example of this is how we are combining two of our strengths: the burgeoning field of optogenetics and the well-established field of deep brain stimulation. Specifically, we are investigating the potential of optical stimulation to improve precision in the electrical stimulation delivered by these medical devices. This research promises to expand the range of medical conditions that can be treated, and it came about through cross-discipline discussions within our teams.

Backing ourselves

> *"With innovation at the heart of what we do, I'm proud to see us investing in our own ideas and supporting early-stage ideation through the Bionics Incubator Fund (BIF)."* BIF

The BIF supports our researchers to develop new medical devices or adapt an already existing technology for a different condition - leveraging what we already know. BIF research projects are marked throughout the annual report with the BIF symbol above.

Several of our BIF projects are in (or approaching) clinical trial stage, including our abdominal vagus nerve stimulation device. By taking technology from our inflammatory bowel disease (IBD) project, we've been able to accelerate the development of a treatment for rheumatoid arthritis. The two devices use a similar therapeutic stimulation strategy, dampening the body's overactive immune response. The world-first clinical trial for the IBD device is underway with the Austin Hospital in Melbourne, and we are now planning a clinical trial for rheumatoid arthritis.

The launch of our medical device prototype manufacturing facility, Neo-Bionica, in 2021 has proven to be an asset for our researchers and the global med tech industry. A joint initiative of the Bionics Institute and University of Melbourne, Neo-Bionica has enabled staff across the organisation to learn about the challenges of medical device commercialisation and get a greater understanding for where bioelectric technologies are heading.

Community connection

Throughout the year we held regular online public events to share with the community who we are and what we do. These webinars provide a platform for our research teams (including clinicians and patients/patient advocates) to discuss how our research will address an unmet need. The flood of enquiries we receive following these events really highlights the impact of our research; the stories graciously shared by our community reinforces why we are focussed on finding solutions to challenging medical conditions.

Professor James Fallon
Chief Technology Officer and
Head of Research Operations

We also strengthened connections with our professional networks through our hybrid face-to-face and online public research seminars. These are not only an opportunity to showcase our research but also to invite external guest speakers to talk about what they're working on. We look forward to continuing this program and building further relationships with collaborators across Australia and abroad, particularly as international travel has recommenced.

All in all, we've had another very successful year and there are some exciting milestones on the horizon for many of our projects.

Brain Research

We made great strides with our research and development of medical devices to improve outcomes for people with conditions affecting the brain. This research encompasses new technology to enhance deep brain stimulation treatment for Parkinson's disease; development of an objective measure of rigidity in Parkinson's disease; continuing improvements to the device that monitors seizures in people with epilepsy; and early-stage research into a device to aid rehabilitation after stroke.

Case study

Taking the guesswork out of Parkinson's assessments

For years after Katrina was diagnosed with Parkinson's disease, she put on a brave face; not wanting those around her to know the toll the disease was having. Each time she visited her neurologist, she pushed through the exercises required and always said she was doing great – never really telling the specialist that she was struggling. This influenced her Parkinson's assessment score to remain the same for a number of years – meaning that from a clinical perspective, it seemed her Parkinson's progression was stable.

"It wasn't until I owned up and said, *I'm not really doing that great, I do get really tired*, that we got to the nuts and bolts of how I felt," Katrina explained.

Bionics Institute researchers are in the early stages of developing a wearable device called the Bionics Institute Rigidity Device (BiRD) to help patients like Katrina. The BiRD device, designed to be placed on the hand, has sensors that record hand and finger movement in response to a miniature motor that pulls the finger back and forth. In only 2 minutes, it can give precise information on the level of rigidity in the patient, supporting clinicians to objectively measure Parkinson's disease symptoms.

Currently, accurate assessments of Parkinson's patients can be challenging for clinicians, especially when small changes in their symptoms occur in response to treatment, or if there are long periods of time between assessments. Katrina says that having this technology available to those with Parkinson's and their specialists would be life changing, as early-stage clinical trials have shown that the device can distinguish between people with and without the disease as well as track the results of therapy. "It's very hard to diagnose Parkinson's – I saw three neurologists, a vascular surgeon, a neurosurgeon and two or three other specialists and no-one made a diagnosis.

"They might have suspected but they weren't sure. Having early intervention options is key to supporting people with Parkinson's and those overseeing their care."

About our BiRD technology

Our research team is developing the Bionics Institute Rigidity Device (BiRD) to monitor muscle rigidity (stiffness), one of the four main symptoms of Parkinson's disease, alongside hand tremor, slowness and poor balance. Worn on the palm of the hand, the device uses sensors to detect the amount of effort required to move a finger. The more rigid the muscles, the greater the effort required to move it. The device aims to help clinicians objectively measure symptoms, which might even lead to early diagnosis of Parkinson's in some patients.

Learn more

Learn more about our BiRD device from Dr Thushara Perera in this short video on our website.

Research report BIF

Improving rigidity assessments in Parkinson's disease

Led by Dr Thushara Perera, our researchers are developing a device that enables objective measurement of muscle rigidity, a common symptom of Parkinson's disease.

Medical practitioners need accurate ways to measure the symptoms of Parkinson's disease so they can tailor and improve treatment to maximise quality of life. However, the symptoms of Parkinson's disease can change over time and doctors need to continuously adjust treatment to ensure therapy is just right.

Currently, health professionals rely on seeing or feeling changes to symptoms as treatment is tweaked and fine-tuned. Accurate assessment can be challenging for clinicians, especially when small changes occur in response to treatment, or there are long periods of time between assessments. In addition, the pandemic has challenged health professionals to manage patient therapy via telehealth, highlighting another need to develop innovative solutions to measure symptoms remotely.

Our research is focused on the development of a wearable device called the Bionics Institute Rigidity Device (BiRD), an exo-skeleton that is placed on the hand for 2 minutes to give precise information on the level of rigidity. Early-stage clinical trials have shown that the device can distinguish between people with and without the disease as well as track efforts of therapy. The next step is to test the device in a larger clinical trial, with the aim of characterising device performance across a variety of people with Parkinson's disease.

Research highlights

This year, we welcomed our very first participants into a clinical study. The team worked diligently over the last 12 months to finalise all details required to start the clinical trial, ensuring our specialised nurses were trained in data collection, obtaining final approvals from our collaborating hospitals, fine-tuning our electronic database for efficient data storage and manufacturing our BiRD prototypes. These third-generation BiRD technologies also underwent extensive preliminary testing, which resulted in design improvements and modifications in preparation for the clinical trial.

Thanks to this hard work, our clinical study is now actively recruiting people with Parkinson's disease treated with deep brain stimulation and healthy volunteers. Many participants with Parkinson's disease have found participation insightful as they often leave data collection sessions with a renewed sense of appreciation for just how much deep brain stimulation therapy positively impacts their lives.

Meet the team

Led by Dr Thushara Perera, the BiRD team comprises Dr Melissa Louey, Amanda Goy, Ella Flanagan, Daniel Williams-Wynn, Sally Herring and Asif Mohammed, in collaboration with Associate Professor Wesley Thevathasan.

Research report

Monitoring and predicting seizures in epilepsy

Associate Professor Chris Williams' research team has worked closely with leading neurologist Professor Mark Cook from St Vincent's Hospital Melbourne over the past decade to develop a seizure monitoring device that can record brain activity (EEG) long term. Implanted under the scalp, Minder® was designed to monitor seizures outside the clinic and allow patients to go about their daily lives, rather than attend multiple hospital stays for conventional EEG recordings.

An estimated 50 million people worldwide live with epilepsy and as many as one-third are unable to control seizures with medication. Epileptic seizures can affect movement, and cause temporary loss of awareness, sensation and mood. Seizures are mostly unpredictable, which means people with epilepsy may not be able to work or drive. A way to reliably predict seizures would make it easier for people with epilepsy to carry out everyday activities. It would also benefit their safety, mental health and employability.

Data recorded by a wearable processor connected to the device is stored in the cloud and analysed in real time by expert technicians. This provides clinicians with an accurate, long-term record of seizures, which can be used to tailor drug treatments, reduce the likelihood of seizures and improve life for people with epilepsy.

In 2018, Professor Mark Cook and the Bionics Institute set up a commercial venture, Epi-Minder Pty Ltd, to manufacture, get regulatory approval and market this technology to ensure it benefits patients around the world.

Research highlights

The first-in-human clinical trial of the Minder device started with two patients implanted at the end of 2019. Since then, additional patients have been implanted and tested at St Vincent's Hospital Melbourne.

Data from the clinical trial is being used to assess the long-term safety and stability of the device. The team have conducted further experiments and continue to process data, focusing on optimising the analysis process to produce clinician-friendly reports.

The clinical trial data will also be used by the team to develop the next generation implant and move towards a larger, multi-centre clinical trial.

In 2021, Epi-Minder formed a collaboration with Seer Medical to extend the capability of the device to predict seizures using cloud technology. The new technology will use an app-based platform to warn patients of impending seizures via their phone, allowing them to move to a safe place and regain more control over their lives.

Meet the team

Led by Associate Professor Chris Williams and Professor Mark Cook, the Epilepsy team comprises Alexia Saunders, Owen Burns, Dr Yuri Benovitski, Rodney Millard, Mark Harrison, Associate Professor Graeme Rathbone and Dr Alan Lai, in collaboration with Dr Rohan Hoare, Dr John Heasman (Epi-Minder), Associate Professor Wendyl D'Souza and neurosurgeons Mr Kristian Bulluss and Associate Professor Michael Murphy.

Research report

Aiding rehabilitation after stroke

Associate Professor Chris Williams' research team is in the early stages of developing a device to enhance recovery and guide management after stroke. The small implant is designed to be positioned under the scalp and uses embedded electrodes to stimulate the part of the brain responsible for controlling body movement.

Physiotherapy, an important way to improve function and reduce disability following a stroke, can be boosted using electrical stimulation of affected brain regions. However, the equipment currently used in research is bulky and needs to be used in a clinic.

The aim of this research is to provide an implantable device that stimulates the affected regions to boost the treatment provided during physiotherapy appointments and while the patient is carrying out exercises at home. This will increase both the speed and effectiveness of rehabilitation.

In addition, our researchers have shown that the relationship between muscle function, stroke severity and brainwave activity can be used to assist with the overall management of patients following a stroke. The next steps will be to develop and test a closed-loop stimulator that can record EEG brain activity to detect adverse events and provide clinicians with the information needed to determine ongoing treatment.

Research highlights

While continuing to develop the technology for stimulation in rehabilitation, the team is also investigating if the same technology could be used to monitor the brain following a stroke. This would enable clinicians to identify secondary and tertiary episodes and assess cognitive function.

Meet the team

Led by Associate Professor Chris Williams, the Stroke team comprises Dr Matt Petoe, Alexia Saunders, Dr Yuri Benovitski, Owen Burns and Associate Professor Graeme Rathbone, in collaboration with Professor Clive May and Associate Professor Michael Murphy.

Research report

Enhancing deep brain stimulation treatment for Parkinson's disease

Professor Hugh McDermott's research team is focused on the improvement of deep brain stimulation (DBS) for the treatment of Parkinson's disease and other movement disorders. DBS involves the implantation of electrodes into the brain to deliver electrical impulses that block the abnormal brain signals causing symptoms in conditions such as Parkinson's disease.

There are currently two challenges with deep brain stimulation. Firstly, inserting the electrode into the correct part of the brain is very difficult, and surgeons often depend on the person being awake to give feedback on symptoms to ensure it has been placed correctly.

Secondly, stimulation is applied at a constant level based on discrete programming sessions following surgery. However, symptoms and the need for specific levels of stimulation continually fluctuate and the lack of flexibility can result in too much or too little stimulation, leading to unwanted side effects or poor symptom control.

The research group previously discovered that certain neural clusters in the brain respond to electrical stimulation with a large signal, known as Evoked Resonant Neural Activity (ERNA). Since this discovery, the group has been undertaking research to establish how the ERNA signal can be used to improve accuracy of positioning and effectiveness of the therapy for Parkinson's disease treatment.

The practical outcomes of the group's research will include a new software system that enables clinicians to implant DBS electrodes in anaesthetised people with greater precision using the ERNA signal. This will also include an implantable DBS device that automatically adapts stimulation therapy to suit each person's unique needs as they vary over time.

In 2019, the Bionics Institute set up a company, Deep Brain Stimulation Technologies Pty Ltd (DBS Tech), to further develop and commercialise this technology and ensure it benefits people around the world.

Research highlights

The year has been very successful for the DBS team despite the continuing effects of the global pandemic. Our work has accelerated towards practical outcomes from the research based on the ERNA brain signal. Working closely with the Bionics Institute's commercial partners is expected to lead to highly successful products that will benefit clinicians as well as people living with Parkinson's disease and other challenging disorders.

This year's achievements include:

- Successfully recording ERNA in people living with Parkinson's disease and other clinical study participants, demonstrating the ease and value of routine use of our systems in the operating theatre.
- Deploying and refining our advanced intra-operative system to assist clinicians in DBS surgery.
- Developing an implantable DBS research system that will be capable of recording ERNA chronically and automatically controlling stimulation.
- Investigating the potential use of ERNA-like signals from other regions of the brain in relation to treating other neurological disorders such as epilepsy.

- Completing the process of filing for regulatory approvals in the UK to enable two prestigious neurosurgical research centres to participate in our clinical studies.
- Expansion of the DBS team in Melbourne to include additional research clinicians and specialised medical device engineers to undertake activities on an accelerated timeline towards commercially significant outcomes.
- Ongoing collaboration with the Bionics Institute's commercial venture, DBS Tech, which is driving the rapid translation of the research into practical outcomes.
- Expanding the patent portfolio protecting commercial use of ERNA-based devices, with seven patents now granted internationally.

Funding and research communication highlights

Professor Hugh McDermott's team was supported by funding from the National Health and Medical Research Council, the Victorian Medical Research Acceleration Fund, the Global Innovation Linkages grant program, and the Biomedical Translation Bridge Program, an initiative of the Medical Research Future Fund. Further funding support was contributed by private investors via the Institute's spin-off company, DBS Tech.

Meet the team

Led by Professor Hugh McDermott, the Deep Brain Stimulation team comprises Angus Begg, Deanne Dawe, Amanda Goy, Dr Kiaran Lawson, Dr Wee-Lih Lee, Ashton Moorhead, Dr Thushara Perera, Dr Matt Petoe, Thomas Tonroe, Associate Professor Wesley Thevathasan and Dr Paul Minty (DBS Tech), in collaboration with Mr Kristian Bulluss (St Vincent's Hospital) and Dr San San Xu (Austin Hospital).

Research report

Pre-clinical research into deep brain stimulation for Parkinson's disease

Deep brain stimulation (DBS) uses electrodes inserted into specific regions of the brain to deliver therapeutic electrical stimulation for the treatment of Parkinson's disease. Pre-clinical research was completed this year into the characteristics of the ERNA brain signal and how it can be used to guide electrode insertion into the correct location during surgery. Additional studies investigated the performance and stability of new electrode coatings and found that conductive hydrogel coatings significantly improved the performance of DBS electrodes in the brain and were stable over 8 weeks.

Funding and research communication highlights

Our researchers were invited to publish this data in the Frontiers in Neuroscience (volume 15, published November 2021).

Meet the team

Led by Professor James Fallon, the pre-clinical DBS team comprises Dr Tomoko Hyakumura, Dr Joel Villalobos, Dr Wendy Adams and Michael Warburton. Key collaborators include Dr Ulises Aregueta-Robles, Wenlu Duan and Professor Laura Poole–Warren (UNSW).

Two early-stage projects focused on Parkinson's disease

Stimulating the feet to improve gait disturbances

Gait disturbances in Parkinson's disease are very common and result in increased falls, injury, and reduced quality of life. Despite the prominence of these symptoms, few therapeutic options are available for gait disturbances and often, walking does not return to normal. This project plans to explore a novel treatment for gait disturbances in Parkinson's disease using different forms of electrical and vibrotactile stimulation applied to the feet. Effects of stimulation will be assessed by recording brain electrical activity using EEG, and by performing gait analysis.
Bionics Institute researchers Dr Mehrnaz Shoushtarian, Professor James Fallon and Michelle Bravo.

Using hybrid stimulation to improve deep brain stimulation therapy BIF

Deep brain stimulation (DBS) is well-established treatment for Parkinson's disease. Although beneficial, limited precision of neural activation and serious side effects remain major issues with this therapy. We recently discovered that hybrid stimulation, a combination of electric and optogenetic stimulation, improves the precision of neural activation. This research will explore the potential of this technology to improve the selectivity of neural stimulation via deep brain stimulation.
Bionics Institute researchers Dr Niliksha Gunewardene, Associate Professor Rachael Richardson, Dr Tomoko Hyakumura, Dr Joel Villalobos, Kyle May and Jerico Matarazzo.

Autoimmune and Chronic Condition Research

Using electricity to alter the activity of nerves has given rise to a broad range of promising new treatments for autoimmune diseases and chronic conditions that are poorly controlled by drugs. Using this technology, our researchers, led by Professor James Fallon, have developed a device that provides therapy via the vagus nerve to prevent the recurrence of Crohn's disease. Our researchers are using this vagus nerve technology with different types of electricity to provide therapy for rheumatoid arthritis and type 2 diabetes, plus targeting a different nerve to improve bladder control.

Case study

The crippling impact of Crohn's

For more than 80,000 Australians, Crohn's disease infiltrates every aspect of life. There is currently no cure for Crohn's disease, which involves severe inflammation and swelling of the intestines. Those with the condition manage pain, tiredness, weight loss and lack of appetite with steroids and immunosuppressants. Joel was diagnosed with Crohn's in 2001 at just 16 and has tried multiple drug treatments, each failing after a few years. Joel explained: "The steroids work but only while you're on them. As soon as you stop, you relapse. Steroids also have a lot of side effects – which are almost as bad as the disease itself."

Bionics Institute researchers are working to find an alternative treatment for Crohn's disease. Our team has developed a small, implantable medical device that stimulates the vagus nerve and kick-starts the body's natural anti-inflammatory response. This technology could prevent recurrence of Crohn's disease and provide an alternative to drug therapies, which can cause crippling side effects. One of the side effects Joel experienced was anxiety. "No-one told me that I would have anxiety from the drugs, so I didn't know that's what was happening … I thought there was something wrong with me," Joel said. "It got to the point where I didn't want to go anywhere because I was anxious all the time and I was having panic attacks when I was in public – so I just isolated myself a lot."

Like more than 80% of people with Crohn's, Joel eventually needed surgery to remove damaged sections of his bowel, as drug therapies were no longer effective. He had two operations to remove approximately 100cm of small bowel. After recovering from the second surgery, his Crohn's returned in just 6 months. "So now I'm in the position where I have an uncertain future as the doctors are running out of options," he said. While having Crohn's disease has made him appreciate the good things in life, Joel would welcome a new treatment so that those in his position don't have to go through the same journey.

"It's such a blessing that people have a passion for this problem and are working to develop a cure so that those with Crohn's can have a better quality of life."

Combatting inflammation with electricity

Bionics Institute researchers are developing a medical device that stimulates the vagus nerve to activate the body's natural healing processes and suppress the damaging inflammation caused by Crohn's disease.

The tiny piece of technology – the size of a thumbnail – is inserted onto the vagus nerve at abdomen level via keyhole surgery. The safe and painless stimulation from the device could potentially replace drug therapies and prevent the recurrence of Crohn's in patients who have stopped responding to medication.

Learn more

Learn more about our vagus nerve device from Professor James Fallon in this short video on our website.

Research report

Preventing recurrence of Crohn's disease

In 2015, the Bionics Institute started research into a new bionic therapy for the treatment of inflammatory bowel disease, which includes ulcerative colitis and Crohn's disease.

Around 80% of people with Crohn's disease, characterised by inflammation of the gut, eventually need surgery to remove sections of the bowel if drug treatments stop working. The benefits of surgery are often temporary, and so our research aims to provide an alternative therapy to prevent recurrence and effects of the disease.

Within just 4 years, the research team, then led by Professor Rob Shepherd and Professor John Furness (Florey Institute of Neuroscience and Mental Health) designed, tested and validated a prototype device ready for a first-in-human clinical trial.

Under the guidance of Professor James Fallon, our team has continued to develop the device, that uses electricity to stimulate the vagus nerve – a nerve that runs from the brain to the gut and controls the body's natural anti-inflammatory response.

A key innovation is the location stimulated by our device. We chose to stimulate the vagus nerve in the abdomen, rather than in the neck as others do, to maximise the therapeutic benefit while minimising any unwanted side effects.

Powered by a small battery, the device will stop damaging gut inflammation, prevent the need for further surgery and transform the lives of people living with Crohn's disease.

Research highlights

This year, we received approval to start our first-in-human pilot clinical trial in Crohn's disease patients with our collaborators at the Austin Hospital Melbourne. This trial is set to start recruiting patients in the second half of 2022. The first patients to receive the device will be patients already scheduled for bowel resection surgery and they will have our device implanted in the same operation.

Funding and research communication highlights

Professor James Fallon's team is supported by the US Government's Defense Advanced Research Projects Agency.

Meet the team

Led by Professor James Fallon, the Crohn's disease team comprises Dr Sophie Payne, Owen Burns, Ross Thomas and Professor Rob Shepherd. Key collaborators include Professor John Furness, Professor David Grayden, Professor Bob Jones, Mr Graham Starkey, Mr David Proud and Associate Professor Peter De Cruz.

Research report **BIF**

Lowering blood sugar levels in type 2 diabetes

Along with its anti-inflammatory potential to treat Crohn's disease and rheumatoid arthritis, we are also utilising vagus nerve stimulation to develop a drug-free treatment that drives the body's natural processes to treat type 2 diabetes.

The aim of our research is to develop a medical device that selectively activates the vagus nerve to lower blood sugar levels. The device will be implanted using keyhole surgery and connected to a remote control that can be used to switch on stimulation after eating to control blood sugar levels and improve the health of people living with type 2 diabetes.

Research highlights

Using stimulation that predominately activates nerve fibres connecting the brain to the organs, called efferent vagus nerve stimulation (eVNS), we have shown that it is possible to reduce blood glucose levels in pre-clinical models of type 2 diabetes. This remained effective after 5 weeks of implantation of the device.

Further work is currently underway to modify the eVNS protocol so it can be delivered by existing clinical grade commercially available stimulators and to determine the mechanism of action.

Funding and research communication highlights

This research was published in the journal *Physiological Reports* (volume 10:8, published April 2022).

Meet the team

Led by Professor James Fallon, the Diabetes team comprises Dr Joel Villalobos, Dr Sophie Payne, Dr Tomoko Hyakumura and Amy Morley. Key collaborators include Associate Professor Glenn Ward, Professor Johannes Prins, Associate Professor Sofianos Andrikopoulos and Professor Richard MacIsaac.

BIF supported project

The **Bionics Incubator Fund (BIF)** supports our researchers to explore new research ideas. Look out for this symbol throughout the report and learn about some of our early-stage BIF projects on p43.

Research report **BIF**

Reducing inflammation in rheumatoid arthritis

Dr Sophie Payne's team is working on a revolutionary new treatment for rheumatoid arthritis. Based on technology developed for Crohn's disease, the new device will stimulate the vagus nerve to kick-start the body's natural anti-inflammatory response in a similar way. Stimulation of the vagus nerve can dampen the inflammation that causes joint pain and stiffness, allowing people with rheumatoid arthritis to move freely without constant pain.

In contrast to vagus nerve treatments for rheumatoid arthritis trialled by other research institutes, this device is positioned on the vagus nerve in the abdominal cavity, rather than at neck level. This means that unwanted side effects to the heart and lungs are avoided.

Although a range of drug treatments is available for rheumatoid arthritis, they can cause unpleasant side effects, and a significant proportion of patients with rheumatoid arthritis don't respond to treatment. This new device aims to provide a drug-free treatment that will give people with rheumatoid arthritis a new lease on life.

Research highlights

This year we submitted for publication our completed study that showed in a pre-clinical model of rheumatoid arthritis, abdominal vagus nerve stimulation significantly improved limping, inflammation and ankle swelling.

Funding and research communication highlights

In November 2021, our new nerve treatment research was the focus of the Bionics Institute's 'Rethinking Rheumatoid Arthritis' virtual event. Dr Sophie Payne and Professor James Fallon provided the community with insight into rheumatoid arthritis and how this ground-breaking research could provide much needed relief to those suffering from pain caused by the disease.

Presentations on this research were also made to members of the Victorian Lions Foundation in February 2022 and to members of the Adelaide Club in May 2022.

Dr Payne featured on Channel 9 News speaking about the Bionics Institute's vagus nerve device. Watch the news story on our website.

Meet the team

Led by Dr Sophie Payne, the Rheumatoid Arthritis team comprises Professor James Fallon, Dr Erol Harvey, Amy Morley, Dr Tomoko Hyakumura and Robert Klupacs. Key collaborators include Associate Professor Evange Romas.

Research report

Improving bladder control to prevent incontinence

Bionics Institute researchers are developing new technology for neuromodulation and recording of the pelvic nerve, with the overarching aim of developing adaptive control over bladder function to help patients with a range of conditions, including urinary incontinence.

Our team is investigating ways to control the key nerve that targets the bladder (the pelvic nerve) to either induce or delay urination, giving a person more control over when they need to urinate. To achieve this, we have patented new 'sensing' technology that uses signals from the pelvic nerve to determine bladder pressure and allows precise timing of stimulation to be delivered.

This stimulating and sensing device will allow adaptive control over bladder function and, if successful, patients will never have to worry about incontinence again. This technology will be welcomed by people with incontinence due to conditions such as diabetes, spinal cord injury and multiple sclerosis.

Research highlights

We continued to develop and validate our patented 'sensing' technology to detect bladder nerve activity with a high specificity and selectivity for fibre type (sensory vs motor) and class (fast vs slow).

We also continue to test the long-term stability of the technology, even in the presence of diseases such as cystitis; optimise our stimulation strategies to delay or inhibit urination; and develop our new histological method to enhance visualisation of the electrode-tissue interface in situ.

Funding and research communication highlights

Professor James Fallon's team is supported by a grant from the US National Institutes of Health Common Fund's Stimulating Peripheral Activity to Relieve Conditions (SPARC) program.

This research was published in the *Journal of Neural Engineering* (volume 18:6, published November 2021).

Meet the team

Led by Professor James Fallon, the Bladder Control team comprises Dr Sophie Payne, Dr Tomoko Hyakumura, Jerico Matarazzo, Chris Bowman, Amy Morley, Chiara Braida and Lisa Dyball. Key collaborators include Dr Peregrine Osborne, Dr Calvin Eiber and Professor Janet Keast.

Hearing and Vision Research

The Bionics Institute has a long, proud history of developing medical devices to diagnose and treat hearing and vision impairment. We continue to seek new ways to improve the cochlear implant, originally developed by the Bionics Institute's founder Professor Graeme Clark; develop diagnostic tools for infant hearing and tinnitus; restore hearing to people with age-related hearing impairment; and conduct bionic eye research.

Case study
Ending the torment of tinnitus

The ringing, buzzing and whirring noises experienced by those with tinnitus can be excruciating.

Affecting one in 10 people globally, there is no treatment available to cure the relentless condition – only ways to control the symptoms, that don't always work.

Deb, a qualified midwife from Geelong, has tried white noise, masking, psychology, hearing aids and natural remedies. Nothing has worked.

"It has ruined my life and the lives of people like me who have severe tinnitus. Every day is about coping, not living," Deb explained.

"It's like a gas leak in my head with multiple layers of hissing around the clock."

Researchers at the Bionics Institute are developing a way to measure tinnitus by recording brain activity. Our aim is to develop a reliable diagnostic test that clinicians can use to measure the severity of tinnitus, with the hope that this research will then pave the way for new treatments to be developed.

New treatments could end the torment of tinnitus for people like Deb, who can't escape the constant, debilitating sounds.

"I can't sleep. I can't watch TV. I can't concentrate enough to read or write. It's kicked up my depression and anxiety.

"An objective test will give researchers the knowledge they need to find a treatment and change the lives of people like me living with severe tinnitus," Deb concluded.

Detecting an invisible condition

Our ground-breaking tinnitus research uses an optical imaging technique to measure changes in the brain triggered by tinnitus. Light reflected into a cap placed on a patient's head provides our team with detailed information on the person's brain activity. This data is recorded on a computer and analysed by our researchers.

Results from our initial research show differences in brain activity between people with and without tinnitus, as well as those experiencing tinnitus at different severity levels.

Learn more

Learn about our tinnitus research from Dr Mehrnaz Shoushtarian in this short video on our website.

Research report

Establishing an objective measure of tinnitus

Tinnitus is described differently by everyone who experiences it, and reliance on self-reported symptoms makes diagnosis and monitoring of this condition difficult.

Our tinnitus research team, led by Dr Mehrnaz Shoushtarian, has developed a new way of objectively measuring tinnitus using a non-invasive optical imaging device.

The device shines near-infrared light over the head using light sources set into a cap. This light technology, known as functional near-infrared spectroscopy (fNIRS), measures changes in blood oxygen levels in the brain. The light reflected back is recorded, providing detailed information on brain activity. Analysis of data recorded from a small research study has enabled us to distinguish between mild and severe tinnitus with 87% accuracy.

Finding a way to measure the presence and severity of tinnitus will inform diagnosis and treatment selection and could lead to the development of new treatments.

Research highlights

Since publication of our initial findings, which showed fNIRS is a viable technique for measuring tinnitus-related brain activity, we have collected further data from individuals with tinnitus and healthy participants over the past year.

We now have a dataset of over 110 patients with tinnitus and 60 healthy participants, allowing us to replicate and confirm our findings in a larger dataset. We have also collected physiological measures in addition to fNIRS signals to further refine our objective measure.

In total, we have been approached by over 500 patients with tinnitus from around the world expressing interest in taking part in our study.

An important application of our objective measure is the evaluation of tinnitus treatments. We have therefore initiated discussions with a broad range of collaborators undertaking development of a range of potential tinnitus therapeutic approaches. Our next steps are to use our objective measure to evaluate potential tinnitus treatments.

Funding and research communication highlights

We presented this research to the Australia New Zealand Tinnitus Interest Group in June 2022.
Our tinnitus research garnered significant media coverage, including Channel Seven News, ABC Radio Melbourne, 2SM Radio and the Finding Genius Podcast.

Meet the team

Led by Dr Mehrnaz Shoushtarian, the Tinnitus team comprises Michelle Bravo, Shreyasi Datta and Professor James Fallon.

Research report

Ensuring hearing impaired infants get the best start in life

Professor Colette McKay's team has developed a new hearing test to help children born deaf or hearing impaired to develop speech.

Babies born with hearing impairment can miss out on the vital stimulation they need to learn to talk. If the right treatment isn't found in the first months of life, they never catch up with their peers and suffer permanent language delay.

The earlier hearing loss is identified, and the baby provided with either a hearing aid or cochlear implant, the sooner the baby can start learning to speak, and the better language development will be.

Our test, called EarGenie®, uses near-infrared light (functional near-infrared spectroscopy or fNIRS) to analyse how the baby's brain responds to sounds. While listening to sounds, babies wear a band containing small light sources and light detectors. When the brain responds to a sound, there is a change in oxygen level that can be recognised using specialised EarGenie software.

The current newborn hearing test can indicate how severe the hearing loss is for many babies, but it does not give key information about whether a baby can discriminate between sounds. Parents have to wait until their baby is at least 9-18 months old before audiologists can determine if their device is helping them to develop language.

The EarGenie test aims to ensure all babies born with hearing impairment are diagnosed correctly and provided with the correct treatment as early as possible. This in turn will give them the ability to hear and distinguish between the sounds that teach them to speak and give them the best chance to succeed in life.

Research highlights

We resumed testing babies with EarGenie after COVID-19 lockdowns were lifted and have made great progress with our test of speech sound discrimination, which is now more than 95% accurate in individual babies.

This is a great achievement and means that EarGenie will significantly help audiologists to confidently fast-track early intervention. We will know much earlier whether a cochlear implant would be a better option than a hearing aid.

Our PhD students have also made much progress. Ishara Paranawithana has shown how the connectivity between different parts of the brain's language networks change with age, a result that will help us to evaluate the language development of hearing-impaired infants. Steven Lee has made significant progress in understanding how a sleeping infant's brain and heart respond to hearing sounds and hearing a novel sound. This understanding is underpinning our development of tests for EarGenie that provide crucial information about the impact of hearing loss.

Our next steps are to update our prototype EarGenie and place it into the hands of external research labs to fast-track clinical data collection and our route to a commercial product.

Funding and research communication highlights

Professor Colette McKay's EarGenie work is supported by a Development Grant from the National Health and Medical Research Council, a grant from the Federal Government's Medical Research Future Fund, and funding from the Victorian Lions Foundation and the Passe & Williams Foundation.

Meet the team

Led by Professor Colette McKay, the EarGenie team comprises Dr Mikhail Korneev, Dr Julia Wunderlich, Dr Darren Mao, Dr Gautam Balasubramanian, Associate Professor Gérard Loquet, Mica Haneman, Steven Lee and Ishara Paranawithana.

Learn more

[Learn more about our EarGenie research from Professor Colette McKay in this short video on our website.]

Research report
Individual optimisation for cochlear implant users

Researchers in Professor Colette McKay's hearing research group are investigating why some cochlear implant recipients do not understand speech as well as others.

This work aims to help clinicians (and patients) build an understanding of an individual's specific neurological barriers, with the aim of enabling cochlear implant users to hear with confidence.

Long-term goals of the project are to design, implement and evaluate clinical techniques that will overcome the unique barriers of each patient, meaning that cochlear implant recipients will be able to hear better in noisy classrooms, communicate better in workplaces and confidently participate in interactions with loved ones.

Research highlights

In a longitudinal study, our researchers have been assessing three factors that can affect speech understanding with the cochlear implant: uneven or poor survival of auditory neurons in the cochlea; difficulty processing information in the auditory brain pathways; and detrimental brain changes because of deafness. We have recruited 29 study participants so far and published three papers that showed the brain regions that respond strongly when people are listening to a story, and how those differ for very new cochlear implant users.

Our preliminary result comparing two different ways to estimate the pattern of neural survival in the cochlea (electrophysiology and behavioural measurements) shows that for many cochlear implant users there are regions of very poor nerve survival, and that both methods can locate these regions. This work was ably assisted by Masters of Clinical Audiology student Helena Bujalka and undergraduate researcher Victoria Shi.

Our next steps are to use this patient-specific information to guide how devices are programmed and tailor clinical rehabilitation techniques to improve speech perception for cochlear implant recipients.

Funding and research communication highlights

This research is funded by project grants awarded to Professor Colette McKay from the National Health and Medical Research Council and from the Passe & Williams Foundation.

Meet the team

Led by Dr Tommy Peng, as part of Professor Colette McKay's hearing research group, the Individual Optimisation for Cochlear Implant Users team members include Mica Haneman and Jamal Esmaelpoor. The team actively collaborates with Assistant Professor Maureen Shader (Purdue University) and Assistant Professor Beth Jelfs (University of Birmingham).

Research report **BIF**

Controlling nerve activity with light and electricity

Electrical stimulation is very efficient at activating neural activity and is central to bionic devices, such as those that restore hearing and vision, or alleviate the symptoms of Parkinson's disease.

However, electrical stimulation does not discriminate between the numerous types of nerves found in the brain and the periphery, and the electrical current spreads easily to unintended nerves. This lack of precision has implications for bionic devices. For example, it can cause sounds to be distorted for those with devices such as cochlear implants.

Our Optogenetics team, led by Associate Professor Rachael Richardson, is investigating how combining light with electrical stimulation can increase precision and selectivity of neural modulation via a simple genetic modification that is targeted to specific nerve types.

Research highlights

The Optogenetics team has been examining hybrid neural modulation in the cochlea, retina and peripheral nervous systems in pre-clinical models. The nerves were first made responsive to light via a genetic modification with a light-sensitive ion channel. Our researchers then implanted tiny light emitters and electrodes to provide pulses of light and electricity near the nerves, while recording the corresponding neural activity.

In the cochlea and retina, we found that nerves could be activated more precisely with light than with electrical stimulation. Furthermore, hybrid stimulation (combining light and electrical stimuli) enabled the nerves to respond more faithfully than when stimulated just with light. This advance could allow us to increase the number of electrodes on bionic devices. For people with a cochlear implant or a bionic eye, this would lead to significant improvements in the way recipients hear or see.

Peripheral nerves, such as the sciatic nerve, consist of a bundle of many different nerve fibres that carry signals either towards muscles to get them to move (motor fibres) or in the opposite direction with information about touch and pain (sensory fibres). It is difficult to selectively address the nerve fibres of interest with electrical stimulation.

Our team has selectively modified only the sensory fibres of the sciatic nerve to be responsive to light, while leaving the motor fibres unmodified. With light, we were able to modulate activity exclusively in the sensory fibres. With hybrid stimulation, we were able to achieve the same response with very low light intensities and much smaller electrical pulses.

Collectively, our research provides proof of principal that we can selectively modulate nerve activity in mixed nerve populations, with safe light levels, very low electrical levels, precise timing and high spatial precision. The Optogenetics team is currently exploring how this technology can be applied to a peripheral nerve device for the suppression of peripheral chronic pain conditions.

Research report

Controlling nerve activity with light and electricity *cont.*

Funding and research communication highlights

Associate Professor Rachael Richardson's research into hybrid stimulation of the cochlear and retina was supported by an Ideas Grant from the National Health and Medical Research Council. Associate Professor Richardson's peripheral nerve research was supported by the Bionics Incubator Fund.

Our work has been presented in the scientific journal *Expert Opinion on Biological Therapy* (volume 22:6, 689-705, published May 2022), in public science forums (Convergence Science Network 2021) and as a conference presentation (Aikenhead Centre for Medical Discovery Research Week 2021).

Meet the team

Led by Associate Professor Rachael Richardson, the Optogenetics team comprises Professor James Fallon, Associate Professor Andrew Wise, Dr Jason Marroquin, Dr Alex Thompson, Dr Niliksha Gunewardene, Jerico Matarazzo, Elise Ajay and Ajmal Azees.

They work in collaboration with Professor Paul Stoddart (Swinburne University), Dr Anita Quigley and Professor David Garrett (RMIT University), Professor Michael Ibbotson, Dr Wei Tong, Dr Emma Brunton and James Begeng (National Vision Research Institute), Professor Stephen O'Leary and Professor David Grayden (University of Melbourne), and Dr Patrick Ruther (University of Freiburg).

Learn more

Learn more about our optogenetics research from Associate Professor Rachael Richardson in this short video on our website.

Research report

Investigating combination treatments for hearing loss

Initially, cochlear implants were provided only to people who were profoundly deaf, but they are now routinely provided to people with partial hearing loss. A combination of stimulation via a cochlear implant and a hearing aid in the same ear has been shown to improve speech understanding, particularly in noisy environments, and to increase the aesthetic quality of sound. However, nothing is known about the physiological mechanisms underlying these benefits.

Our research aims to address this knowledge gap by measuring the patterns of neural activity in the auditory centre of the brain evoked by speech sounds. We will then assess how the pattern of neural activity relates to discrimination between the different speech sounds, which is a vital aspect of hearing.

Research highlights

This year, our Cochlear Hearing Investigation team commenced experiments for this hearing loss project. We also recruited a PhD student to the team to produce computer models to fast-track future research.

Funding and research communication highlights

Professor James Fallon's team is supported by a Discovery Projects Grant from the Australian Research Council.

Meet the team

Led by Professor James Fallon, the Cochlear Hearing Investigation team comprises Professor Dexter Irvine, Associate Professor Andrew Wise, Dr Alex Thompson, James Firth, Sayward Barone, Peta Grigsby and Trung Nguyen. They work in collaboration with Professor David Grayden.

Research report

Restoring hearing loss with therapeutics

Hearing impairment affects millions of people worldwide. The most common cause of hearing impairment is damage to the delicate sensory cells within the inner ear, which can occur following exposure to loud noise or as a consequence of ageing.

Despite this condition having a significant impact on people's lives, there are currently no clinical treatments for hearing impairment. Our researchers are working to change that and treat hearing loss.

We are developing a world-first treatment for hearing impairment using nanotechnology. This technology delivers nanoengineered particles loaded with a drug, called growth factors, to the inner ear. Once delivered into the inner ear, the growth factors repair damage to the delicate sensory cells that are important for the detection and perception of sound.

Research highlights

Using pre-clinical models of hearing impairment, our current research is validating the therapeutic technology to lay the foundation for a future clinical trial. We are developing a manufacturing process and quality management system to enable the manufacture of a clinical-grade drug delivery system suitable for a first-in-human trial.

Funding and research communication highlights

Associate Professor Andrew Wise's team is supported by grants from the US Department of Defense, the National Health and Medical Research Council and the Passe & Williams Foundation.

Meet the team

Led by Associate Professor Andrew Wise, the Hearing Therapeutics team comprises Dr Niliksha Gunewardene, Professor James Fallon, Dr Erol Harvey, Robert Klupacs, Associate Professor Rachael Richardson, Dr Yingjie Hu, Dr Mikhail Korneev, Ella Trang, Patrick Lam, Alexandra Hill, Philippa Kammerer, James Firth, Sayward Barone, Dr Peta Grigsby, Trung Nguyen and Victoria McLeod. They work in collaboration with Professor Frank Caruso and Dr Sherryl Wagstaff.

Learn more

[Learn more about our nanotechnology research from Dr Yingjie Hu in this short video on our website.]

Research report

Associating cognitive decline with hearing loss

Associate Professor Gérard Loquet's team is interested in the possible association between age-related hearing loss and cognitive decline.

Compared to younger adults (who can process sound and visual information well), elderly people have a lesser ability to see and hear clearly, resulting in changes to brain function.

As a result, integrative mechanisms at the cortical level in elderly people take on a bigger role so that they can maintain adequate brain function, such as the ability to identify speech in noise. In mild cognitively impaired people, these audio-visual integrative processes are altered.

Our research will use both a behavioural test and non-invasive neurophysiological recording (EEG) to identify patterns between healthy and pathological populations, with the aim of determining an early biomarker for the onset of cognitive impairment.

This will then contribute to the development of an early screening tool based on brain connectivity that can be used by clinicians, supporting the early diagnosis of dementia.

This research has the potential to change clinical practice by integrating neuroimaging tools in routine checks, in turn helping those who are at risk of developing dementia and the clinicians who are trying to treat them.

Research highlights

This year we received ethical approval for a pilot study investigating the role of multisensory integration in the association between hearing loss and prodromal Alzheimer's disease. Formal agreements were also established with the Dementia Centre, Monash University, St Vincent's Hospital and the Florey Institute for participant pre-screening. We recruited four students to conduct literature reviews to clarify and refine the evidence needed to address the link between hearing loss and dementia.

Funding and research communication highlights

This new research line is investigator-driven and supported by the Bionics Institute and an anonymous donation in order to attract additional funding in the coming year, when feasibility will be established through the pilot study.

Meet the team

Led by Associate Professor Gérard Loquet, the team comprises Emily Birthisel, Giacomo Goddard, Huaien Yang and Yan Hong Toh.

Research report
The Australian bionic eye

In 2021, the bionic eye program completed its two-year feasibility study of a second-generation bionic eye. In collaboration with the Centre for Eye Research Australia and CSIRO, we successfully demonstrated that this device is safe and provides significant improvement to quality of life and functional vision for four recipients. This bionic eye device is most suitable for people suffering from the later stages of inherited retinal diseases such as retinitis pigmentosa. In partnership with the Australian medical technology company Bionic Vision Technologies Pty Ltd, the next step is to initiate worldwide clinical trials ahead of seeking regulatory approval in key markets, subject to additional capital funding.

Research highlights

Upgrades to the external video processing unit have been successfully trialled with the Melbourne bionic eye recipients throughout 2021–22. This work uses artificial intelligence to understand the visual environment and provides more meaningful prosthetic vision for activities of daily living.

Funding and research communication highlights

The results of this project have been published in the clinical ophthalmology journal, *Translational Vision Science and Technology* (volume 10, published August 2021), and shows that the system encourages more independence, social interactions, and awareness of the environment.

Next generation bionic eye

In partnership with the University of Melbourne, University of New South Wales, Swinburne University of Technology, Centre for Eye Research Australia and Bionic Vision Technologies, work has begun on the next generation bionic eye that will incorporate a multichannel stimulation strategy to improve visual acuity.

Research highlights

Development of the multichannel stimulator capable of delivering the new stimulation strategy has progressed, with delivery of initial prototype device expected in late 2022.

Funding and research communication highlights

Professor James Fallon and this team are funded by a National Health and Medical Research Council (NHMRC) Grant (2014380).

Meet the team

Led by Professor James Fallon, the Bionic Eye team comprises Dr Matt Petoe, Associate Professor Chris Williams, and Owen Burns. They work in collaboration with Associate Professor Penny Allen, Lisa Lombardi, Lauren Moussallem and Dr Carla Abbott (Centre for Eye Research Australia), and Associate Professor Hamish Meffin, Prof Anthony Burkitt, Prof Michael Ibbotson, Prof David Grayden and Dr Martin Spencer (University of Melbourne).

Investing in the Future

The Bionics Institute has bold plans for growth and the development of innovative medical devices. To realise this plan, we're investing in training the next generation of researchers and ensuring they have access to multidisciplinary experts and world-class research facilities. We're proud to offer unique study opportunities for short-term student research projects and internships, as well as major graduate research projects for PhD and Masters by Research degrees.

From intern to industry

How things work has always fascinated Asif Mohammed, but it wasn't until he took a robotics course as part of his mechanical engineering degree that he realised his passion was in biomedical engineering. He applied for an internship with the Bionics Institute as he was drawn to the variety of skills offered by the role and the practical application of the research. "At the Bionics Institute, you get to work with servos, motors and you're programming as well. I've learned so much and I've loved being involved in projects that you can realistically see being implemented."

Asif's initial 3-month internship with the Deep Brain Stimulation team was extended to 12 months, and he completed his Capstone unit before being asked to stay on as a member of the team. Now in his final semester studying Mechatronics and Advanced Manufacturing, he has continued his work on the Institute's Parkinson's disease project under the guidance of Dr Melissa Louey, who is facilitating the Bionics Institute Rigidity Device (BiRD) clinical trial.

Asif Mohammed

"Through the clinical trials, I've been able to interact with people who might potentially get to use this device in the future, which is really nice," Asif said. Looking to the future, Asif is keen to continue to use his biomedical engineering skills. "Pursuing a PhD or Masters is still something I'm considering and I've had some really great advice from people at the Bionics Institute about my future."

"I do know that being able to help people is a career path I want to follow."

PhD student spotlight

Ajmal Azees commenced his PhD studies in October 2020 at the Bionics Institute in collaboration with the Biomedical Engineering program at RMIT University.

An accomplished student, Ajmal completed his Bachelor of Science (Electrical and Information Engineering) with first-class honours at the University of Ruhuna (Sri Lanka), where he received multiple accolades including the Vice Chancellor's list award and Dean's award. Whilst studying and working at the university, Ajmal also developed a non-invasive screening tool to detect anaemia called 'HemoX', which he presented in more than 12 countries and received several international invention awards.

Ajmal Azees

Ajmal came across the Bionics Institute while exploring the bionic eye project. Impressed with the research conducted at the Bionics Institute, his fascination with new technology led him to join the Optogenetics team. "Completing my PhD at the Bionics Institute has given me so many opportunities to become a good researcher in the neuroscience field. It is an honour being mentored by world-class researchers and scientists," he said.

Ajmal's PhD project at the Bionics Institute is titled: 'Developing next generation neural stimulation devices'. This project will investigate the efficacy of a hybrid neural stimulation device that combines light emitting diodes (LEDs) and platinum electrodes to harness the precision of optogenetic stimulation, while maintaining the efficiency and speed of electrical stimulation.

Amgen Scholars Program

Jessica Gonzalez joined the Bionics Institute as part of the prestigious Amgen Scholars Program to gain experience in a laboratory setting while completing her Bachelor of Advanced Science at UNSW.

Jessica Gonzalez

With links to Harvard and Cambridge, the Amgen Scholars Program selects high-achieving undergraduate students from across four continents to undertake an 8-week placement at a leading institute or university.

Working under Dr Sophie Payne and Professor James Fallon as part of the Institute's Peripheral Interface Neuromodulation team was an invaluable experience for Jessica. "It was great to have a strong female role model [Dr Sophie Payne] in science," she said.

This project focused on developing technologies to restore bladder control in patients with urinary incontinence, and provided an opportunity for Jessica to conduct project work independently. "I've been involved in the experimentation and analysis sides of research, observed surgeries and been in group meetings to hear about all the projects, which has been good exposure."

Jessica shared details of her placement and research project at the Amgen Scholars Symposium – the final event of the program enabling scholars to showcase their work to peers and invited industry guests. The placement at the Bionics Institute has affirmed Jessica's academic aspirations. She plans to continue her studies into an honours year and has ambitions of undertaking medicine or completing a PhD in the future – specifically in physiology or electrophysiology.

> *"I would definitely recommend the Bionics Institute to students. I'm so glad I got this project as my first preference."*

Girls in STEM Mentoring Program

The Bionics Institute is passionate about inspiring young women to choose a career in science, technology, engineering and mathematics (STEM). In 2022, five schools from Melbourne and Geelong took part in our Girls in STEM Mentoring Program, enabling high-achieving students to learn about pioneering research.

Over a 6-month period, leading female researchers from the Bionics Institute and Seer Medical provided 24 students with insight into study pathways for STEM careers, and mentorship for science communication.

The program's welcome event in May 2022 allowed students to meet their mentors face-to-face and see inside a laboratory, before they continued with monthly online meetings to develop literature reviews and research presentation skills. We are proud to be supporting scientists of the future and are pleased to extend the program to more schools in 2023.

Field Rickards Annual Awards for Leadership and Impact

We were delighted to welcome Professor Emeritus Field Rickards to our final staff meeting of 2021.

Professor Rickards started his career as a PhD student with Professor Graeme Clark in the Bionic Ear program. He made a substantial contribution to hearing research during his career and held a number of prestigious roles at the University of Melbourne. He joined the Bionics Institute Board of Directors in 1988 and finished his term in 2020.

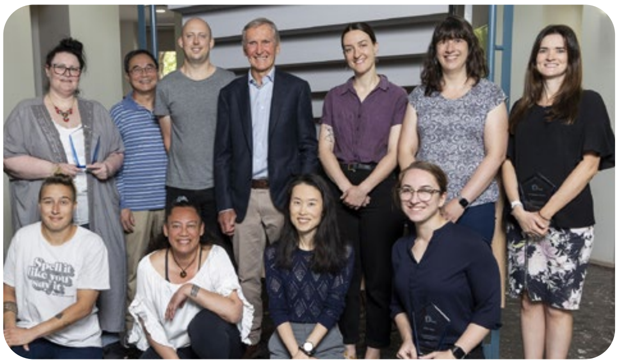
In recognition of his long service, we were delighted to offer the inaugural Field Rickards Annual Awards for Leadership and Impact.

In 2021, these were awarded to:

Best Researcher
Dr Sophie Payne

Best Student
Ms Elise Ajay

Best Research Team
Bionics Institute Pre-Clinical Research Team



Neo-Bionica launch: A new era in medical device development

The opening of new manufacturing facility Neo-Bionica on 28 September 2021 ushered in a new era in medical device development capability in Victoria.

The first facility in Australia with the bioengineering expertise and technology needed to create medical devices for clinical trials, Neo-Bionica was officially opened by The Hon. Jaala Pulford, Minister for Innovation, Medical Research and the Digital Economy.

A joint initiative of the Bionics Institute and the University of Melbourne, the state-of-the-art laboratory is located at St Vincent's Hospital Melbourne.

The Victorian Government contributed $4 million to this initiative to support the fit out of Neo-Bionica with essential equipment; provide funding for applied research jobs; and support a voucher program to help industry start-ups commercialise medical prototypes.

> *"Neo-Bionica has the latest cleanroom technology needed to create implants for human trials, as well as the latest engineering equipment, 3D printers and, most importantly, the combined expertise of our highly-trained engineers, scientists and clinicians."*
>
> *– Robert Klupacs, CEO, Bionics Institute*

Great ideas lead to great innovations

The Bionics Incubator Fund (BIF) supports our researchers to explore new research areas and establish strong clinical collaborations. Pilot feasibility data can then be used to attract additional external funding in the coming years.

To apply for funding, researchers pitch an idea for a new medical device or adaptation of existing technology for a different condition – focusing on innovation and invention.

Projects that received BIF support during the year are indicated by the BIF symbol in the research reports.

Some of our other BIF projects include:

Improving residual hearing function in cochlear implant patients with gene therapy

Exploring the use of gene therapy to regenerate lost hair cells in the inner ear that mediate sound and balance.

An increasing subset of cochlear implant recipients have some residual hearing in the low frequencies, which enables them to better perceive fine pitch differences. These differences are important for speech recognition in noisy environments and improved appreciation of music. However, a significant number of cochlear implant recipients experience a progressive loss of hearing over time. This research will significantly improve the outcomes for patients with cochlear implants.

Bionics Institute researchers: Dr Niliksha Gunewardene, Professor James Fallon, Associate Professor Andrew Wise, Associate Professor Rachael Richardson, Aliki Batististatos, Trung Nguyen and Dr Peta Grigsby.

Optogenetic hybrid stimulation of peripheral nerves

Investigating the potential of optical stimulation to improve precision in the electrical stimulation delivered by medical devices.

The peripheral nervous system has accessible connections with the body's organs and systems, providing the opportunity to treat an increasing number of conditions with electric medicine techniques. However, a limitation of delivering electrical stimulation in mixed peripheral nerves is the difficulty in discriminating between functional fibre groups, leading to unwanted side effects and reduced treatment efficacy. This research promises to expand the range of health conditions that can be treated with bionic devices.

Bionics Institute researchers: Associate Professor Rachael Richardson, Dr Sophie Payne, Professor James Fallon, Dr Niliksha Gunewardene, Dr Alex Thompson and Elise Ajay.

Great ideas lead to great innovations *cont.*

Counting the cost – three-dimensional quantification of the cochlea

Developing a method of analysing cellular morphology within an intact cochlea to provide a high resolution, three-dimensional image where cells can be qualitatively and quantitatively assessed.

The complexity of the cochlea, a structure in the inner ear, presents many challenges to researchers wishing to study hearing. Traditional histological preparation of the cochlea via sectioning and staining is not only time and labour intensive but can only provide a partial understanding of the cellular morphology of the tissue. If realised, this technique could enable unprecedented insight into the response of the cochlea to a wide variety of injuries and treatments.

Bionics Institute researchers: Ella Trang, Alex Hill, Lisa Dyball and Patrick Lam.

Discovering new disease targets for vagus nerve stimulation

Expanding the Bionics Institute's vagus nerve stimulation technology to utilise novel thin-film fabrication techniques to develop a miniaturised peripheral nerve array for the abdominal vagus nerve.

We have developed a cuff electrode array designed for long-term implantation onto the abdominal vagus nerve. This technology has been used to validate the safety and efficacy of vagus nerve stimulation to treat Crohn's disease, rheumatoid arthritis and diabetes. There are numerous pre-clinical genetic models of human diseases, which are an essential tool for understanding mechanisms of disease and discovering new therapies and the aim of this research is to validate which conditions could potentially be treated by the technology.

Bionics Institute researchers: Professor James Fallon and Dr Sophie Payne

Philanthropy

Our life-changing research is made possible thanks to the generosity of our supporters. Every donation, no matter what size, makes a real difference – helping our engineers and scientists to continue their pioneering work for real world impact.

Message from Philanthropy

Thank you to all our generous donors for supporting our life-changing research. It has been another activity-filled year for the fundraising team. We were thrilled to host a number of in-person events in 2021-22, providing opportunities for us to showcase the life-changing work of the Bionics Institute. We also hosted some public webinars, enabling the community to connect with our researchers and hear how philanthropic support allows us to advance our research projects.

As part of our community fundraising program, a group of staff members, friends and family undertook the major challenge of taking on Mount Bogong in December 2021. We were really thrilled to be able to raise $13,000, which we directed to our highest priorities fund.

Our Christmas 2021 appeal raised over $20,000 for our rheumatoid arthritis treatment. We are now focused on accelerating the start of first-in-human clinical trials for this innovative vagus nerve device, which offers a pain-free and drug-free future for people suffering from rheumatoid arthritis. We received widespread media coverage about our research following a webinar to launch the appeal and we have continued to receive support for our vagus nerve project, led by Dr Sophie Payne.

We were delighted to welcome back some of our long-standing donors to the Bionics Institute in April 2022, the first in a series of biannual events to celebrate our donors. We were so pleased to see people in person again and to have the opportunity to thank people, trusts and foundations personally for their loyal and generous support for our research over the last thirty-six years.

Ann Fazakerley
Head of Philanthropy

Through a new partnership with Chapel & York, our overseas donors are now able to receive local tax incentives through local donations in local currency. Although our research is based in Melbourne, the impact of our work truly has global reach, and we hope in the future to encourage more donors outside Australia.

The 2022 tax appeal for our tinnitus research raised over $102,000 – the highest amount that we have ever raised in an appeal. We are grateful to everyone who contributed, and an especial thank you to our board members who showed great leadership and provided match funding. The funds raised will help us develop and trial a new objective test, to help silence the torment of tinnitus. With one in ten people worldwide suffering from tinnitus, there is an urgent and pressing need to offer an objective measure of the condition, paving the way to future potential treatments.

To support our expanding philanthropic efforts, we were pleased to strengthen the Fundraising team this year, with Melissa McShane joining as Development Manager and Lucy Hooper as Development Officer.

“We are most grateful for the continued support of the community; every gift, no matter how large or small, is put to effective use and makes a real difference to our work. Thank you.”

Achieving more together

Developing innovative solutions for some of the world's most challenging conditions requires funding from several sources. Philanthropic support from trusts and foundations provides a core of Bionics Institute funding, allowing us to undertake innovative and creative research programs that can lead to life-changing products.

> *"Without our partnership with Passe & Williams, we wouldn't have the vital funds needed for our scientists and engineers to progress their life-changing research."*
>
> *– Professor James Fallon, Chief Technology Officer and Head of Research Operations, Bionics Institute*

One foundation with which we have enjoyed a long relationship is the Passe & Williams Foundation, set up in 1986 by the visionary Barbara Slatter, who saw how difficult it was for young scientists and doctors working in the Ear, Nose and Throat field to receive financial support for specialist training. Coincidentally, the Bionics Institute, then known as the Bionic Ear Institute, was founded that same year.

The Passe & Williams Foundation is a charitable foundation, improving people's lives through advancing ear, nose and throat research, surgery and care. The motto of the Foundation is "Semper ad Excellentiam Persequendam", or "Always in Pursuit of Excellence" and we are delighted that the Bionics Institute has received funding from the Passe & Williams Foundation to allow our researchers also to pursue excellence.

> *"The Passe & Williams Foundation funds only the best people and projects in the Australian and New Zealand Ear, Nose and Throat field. The Bionics Institute is a hive of excellence in medical research, with an impressive track record of generating life-changing outcomes. It is always a pleasure to support the Institute and its exceptional people."*
>
> *– Dr Jeanette Pritchard, CEO, Passe & Williams Foundation*

Achieving more together *cont.*

The Institute is built on the forward thinking of researchers, scientists and engineers who drive our research and accomplish incredible things. The current recipients of Passe & Williams funding are the latest in a long and distinguished line of Bionics Institute researchers who have benefited from this funding.

Professor Colette McKay:
Conjoint Grant, awarded 2020 (with Dr Markus Dahm)

Project: Detecting and ameliorating the impact of neural dead regions in cochlear implant users.

Associate Professor Andrew Wise:
Senior Fellowship, awarded 2021

Project: Delivering hearing therapeutics to the clinic.

Dr Darren Mao: Junior Fellowship, awarded 2021

Project: Objective assessment of hearing ability in hearing-impaired infants.

> *"The Passe & Williams Fellowship has been a rare and wonderful opportunity for me. It has provided crucial funding for our research into improving language outcomes for infants born with a hearing loss, which will lead to significantly improved quality of life. The fellowship has also enabled me to further my development as an up-and-coming researcher and leader."*
>
> *– Dr Darren Mao*

We are most grateful that support from the Passe & Williams Foundation allows us to have an even greater impact on the lives of people living with hearing loss. We could not do what we do without their partnership and commitment to our work.

A tribute to a generous supporter

“She acted from the heart, keeping in mind the hearts of others.”

– Friend of Joy Buckland

This year the Bionics Institute was saddened to learn of the death of Miss Joyce Buckland. Joy was a regular donor to the Institute for many years and her generosity supported several ground-breaking research programs. Joy’s friends and family described her as having endless energy and an appetite to learn and grow, which is perhaps why she was initially drawn to the innovative work of Professor Graeme Clark and the Bionics Institute. We are so grateful that Joy’s generous spirit lives on through a significant Gift in Will, helping to sustain our life-changing research into the future.

Joy was born in Ballarat in 1931 and was the youngest of seven children. During her childhood, Joy was very involved with the Brownies and Girl Guides, where she learnt valuable practical skills. She later took up nursing and trained at Ballarat Base Hospital, continuing a placement there before moving to Melbourne where she trained as an orthopaedic nurse at the Royal Children’s Hospital.

As part of her nursing career, Joy had the opportunity to travel to the UK, which sparked a lifelong love of international travel. She later moved to Geelong to take up a position in the children’s ward at Geelong Hospital, where she also cared for adult burn victims and became a well-respected educator, teaching nursing and later lecturing at Deakin University.

Joy became connected to the work of Professor Graeme Clark and the then Bionic Ear Institute through her sister, Ruth Morris, who was a teacher for deaf children in the 1970s, originally teaching in her back sunroom, before the establishment of Taralye school in Blackburn.

Professor Clark fondly remembered Ruth in a message to Joy when she made her first donation to the Bionic Ear Institute in 2001.

“To Joy Buckland, in appreciation for your help and in memory of Ruth Morris whom I knew well. I greatly appreciated her talents.”

– Professor Graeme Clark

Joy had strong faith and values, always ready to help those less fortunate. She was the niece of prominent Victorian philanthropist William Buckland and continued the family legacy of philanthropy, giving generously during her lifetime to many charities across the health and social welfare sectors, both in Australia and internationally. We are honoured that Joy was a supporter of our research and that we are to be able to continue Joy’s legacy through this Gift in Will.

We would like to thank Joy’s family for helping us learn more about Joy’s life and, of course, Joy herself, for her continued generosity to the Bionics Institute, both during her lifetime and after her death.

Arthritis appeal

Our 2021 Christmas appeal focused on a new nerve treatment developed by researchers at the Bionics Institute that is bringing hope to people with rheumatoid arthritis.

Forty per cent of people who suffer from this chronic and debilitating condition do not respond to drug treatments. They continue to live without relief from the pain and inflammation caused by the disease. Our device uses electricity to stimulate the vagus nerve and trigger the body's natural anti-inflammatory response. This dampens the inflammation caused by rheumatoid arthritis, reducing pain and stiffness and allowing people to move freely, without the need for drugs.

This exciting new treatment was the focus of our 'Rethinking Rheumatoid Arthritis' appeal webinar, which enabled the community to learn more about the device from our research director Professor James Fallon and lead arthritis researcher Dr Sophie Payne. Invited guest speakers also discussed the gaps in current treatment options, plus the effects of rheumatoid arthritis on patients, carers and families.

We are incredibly grateful to all those who supported our appeal and helped raise over $20,000 to create a drug-free and pain-free future for those with rheumatoid arthritis. Thanks to this generosity, we are speeding up our research to get the revolutionary new treatment into human clinical trials as quickly as possible – an important first step towards improving the lives of millions of people around the world.

A new appeal record

A special thank you to our Board of Directors

Our 2022 tax appeal was our most successful appeal to date, raising over $100,000 towards our new objective test for tinnitus. The first of its kind, the test will support doctors to scientifically diagnose the condition in the clinic.

To launch the appeal, we held our 'Measuring tinnitus – detecting an invisible condition' webinar in May 2022, where Dr Mehrnaz Shoushtarian and Professor James Fallon shared details of this ground-breaking research with supporters. They were joined by an invited clinical expert and a patient, who provided first-hand accounts of treating and living with tinnitus. We also highlighted the impact that Bionics Institute research could have in the future.

Funds from the appeal will enable our tinnitus team, led by Dr Mehrnaz Shoushtarian, to continue participant testing and to validate research findings in a larger study. Through this extended study, the team aims to see patterns in the data that indicate different subtypes of tinnitus – subsets that may benefit from certain treatments. This could then pave the way for the development of much needed treatments so that this debilitating condition could be personally managed for individual patients.

The success of this appeal was made possible thanks to our Board of Directors who generously provided $50,000 in matching funds. We thank the Bionics Institute board for their leadership and generosity in supporting this year's appeal and our overall mission to improve the lives of those living with challenging medical conditions.

Bionics takes on Bogong

December 2021 saw the first of our new annual fundraising events with the theme 'Bionics takes on…'. Over 40 staff, friends and family hiked 1,986m to the top of Mount Bogong (Victoria's highest peak), raising $13,000 for the Institute.

After many months of training and an incredible effort, everyone taking part reached the top of the mountain via the challenging Staircase Spur trail and were rewarded with breathtaking views.

This new initiative is a wonderful opportunity for our team and their loved ones to come together, challenge themselves and (most importantly) have fun, while raising money towards the Institute's life-changing research.

We thank everyone who took part and all our generous donors, and we look forward to our 2022 event 'Bionics takes on the Yarra', where we will be hiking 16km along the banks of the beautiful Yarra River in Melbourne.

We hope that events such as these may inspire members of our community to think about how they may be able to support the Bionics Institute through a personal challenge or fundraising event – all ideas are welcome. Together, we can do great things.

Learn more

Learn more about Fundraising for the Bionics Institute on our website.

Our supporters

We would like to acknowledge all the individuals and organisations who have supported us this year – your support really does make a difference.

Mr Ashkan A
Mr Donald Adams
Mr Peter Adams
Dr Wendy Adams
Ms Louise Adamson
Mrs Margaret Ahern
Ms Laura Ahto
Mr Kemal Ajay
Ms Valentina Aksonova
Mr Robert O Alberts AO RFD RD
Dr Michael Allam
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Mr John Barbagallo
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Ms Tanya Barnes
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Mrs Meg Bentley
Mr Martin Bergström
Mr Rick Berry
Mr & Mrs Neville & Diana Bertalli
Mr Philip Binns
Dr Nilla Biondo
Mr Andy Blume
Mr Antonio Bonaccurso
Ms Dorothy Bourke
Mr & Mrs Andrew & Rosalind Bradey
Ms Susan Bree
Mr Alastair Bridges
Mr John Brown
Mr Paul Brown
Mrs Sue Brown
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Ms Lucy Chen
Ms Yun Chiang
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Mr Kale Duncan
Ms Tania Duncan
Mr Barry Dunn
Mr & Mrs Wes & Jane Dunn

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The Eirene Lucas Foundation
The Passe & Williams Foundation
The William Angliss (Victoria) Charitable Fund
Victorian Lions Foundation Inc

We also extend our grateful thanks to those supporters who wish to remain anonymous.
Thank you

External Engagement Committee

Our External Engagement Committee provides valuable assistance in driving engagement with our supporters.

John Simpson
Chair

Caroline Chernov

Jim Hayman

Kunal Rastogi

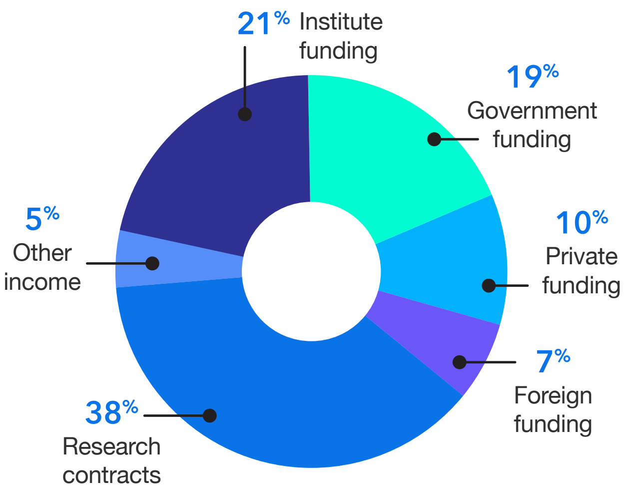
Michael Stillwell

Financial Statement

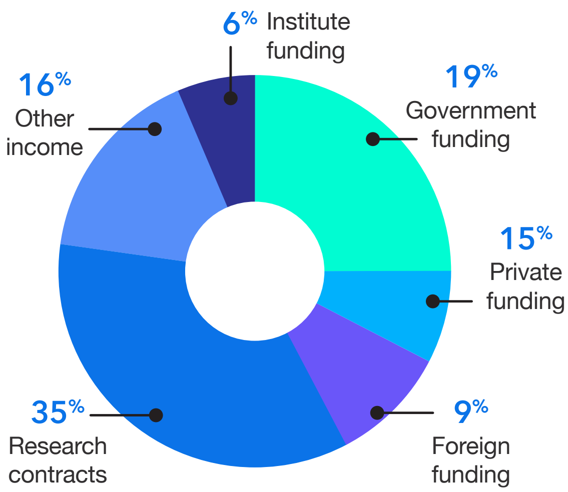
ABRIDGED FINANCIAL STATEMENT
for the year ended 30 June 2022

CONSOLIDATED INCOME STATEMENT	2022 $	2021 $
REVENUES FROM ORDINARY ACTIVITIES		
Federal Government grants	1,600,558	1,748,382
Victorian Government grants	1,041,863	693,519
Foreign grants	913,223	1,220,327
Trusts & foundations	864,057	490,859
Public fundraising	610,918	1,386,774
Research contracts	5,392,959	4,575,328
Investment & interest income	1,815,836	590,641
Other income	701,600	2,107,238
TOTAL REVENUE FROM ORDINARY ACTIVITIES	12,941,014	12,813,068
less Expenditure on ordinary activities	(14,137,545)	(11,337,905)
(DEFICIT)/SURPLUS ON ORDINARY ACTIVITIES	(1,196,531)	1,475,163
Gain on sale of property and fixed assets	687,979	9,511,007
(Loss)/gain on available-for-sale financial assets	(1,623,038)	2,303,842
Share of loss in associates	(2,037,513)	(750,000)
NET (DEFICIT)/SURPLUS	(4,169,103)	12,540,012

FUNDING OF OUR RESEARCH



2022



2021

CONSOLIDATED STATEMENT OF FINANCIAL POSITION	2022 $	2021 $
Current Assets	6,815,863	7,988,129
Non-Current Assets	22,216,275	26,409,384
TOTAL ASSETS	29,032,138	34,397,513
Current Liabilities	5,785,821	6,935,855
Non-Current Liabilities	1,707,749	1,753,987
TOTAL LIABILITIES	7,493,570	8,689,842
NET ASSETS	21,538,568	25,707,671
TOTAL INSTITUTE FUNDS	21,538,568	25,707,671

Full audited financial statements are available from the Institute's registered office by request.

Bionics Institute
384-388 Albert Street
East Melbourne VIC 3002
AUSTRALIA
P (03) 9667 7500

www.bionicsinstitute.org
enquiries@bionicsinstitute.org

ABN 56 006 580 883
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