MONASH
University

MONASH
INSTITUTE OF
MEDICAL
ENGINEERING
(MIME)

IMPACT
REPORT
2022

"MIME is proud to be an integral and growing part of the Victorian and Australian MedTech ecosystem, contributing to the development of MedTech innovation and connecting clinicians, researchers and industry."

The most significant advances in healthcare technology are increasingly the result of collaboration between Health and Medical Researchers, Engineers, Designers, and IT specialists - which is why the Monash Institute of Medical Engineering (MIME) was formed.

MIME fosters links between the Monash University faculties of Medicine, Engineering, IT and Design and with a range of industry and MedTech ecosystem partners. Through our unique partnership with Monash Partners Academic Health Science Centre we work directly with clinicians to identify unmet medical needs and provide seed funding, commercialisation support and education for promising research and researchers.

Want to know more? Visit monash.edu/mime or watch the video below.

Professor John Forsythe
Co-Director, Monash Institute of Medical Engineering (MIME)

1:01 / 4:09

MIME's vision is underpinned by three strategic pillars:

Health and social impact
Workforce capacity building
Intellectual property discovery and translation

Professors Patrick Kwan and John Forsythe, MIME Co-Directors.

As we reflect on 2022, MIME acknowledges all those we worked with in an effort to improve human health outcomes.

Our commitment to solving unmet clinical needs by facilitating innovative MedTech teams and solutions has remained strong, as have our links to healthcare professionals, community members, researchers, students and industry.

2022 saw MIME:

- Continue to work in partnership with Monash Partners Academic Health Science Centre as their medical technology innovation platform, and our University faculty partners to improve the delivery of healthcare
- Engage more widely with internal and external stakeholders, including establishing partnerships with Monash Business School (Centre for Health Economics, Global Executive MBA program and Capstone Industry student project program), Australian Medtech Manufacturing Centre, and Consortia for Improving Medicine with Innovation and Technology (CIMIT), and hold an industry collaborator and networking event
- Receive welcomed government support to lead our new business and market support program, the 'MedTech Commercialisation Advancement Program (MCAP)' to aid Victorian MedTech innovation
- Provide $500,000 in Seed Funding across 10 projects to meet unmet clinical needs

- Establish the MIME Industry Advisory Committee and MIME Clinical Advisory Committee
- Support 15 Healthcare Innovation Summer Scholarships for students to achieve innovative IT/engineering/design app-based solutions to real world health problems
- Recognise and encourage female students in STEMM through our Women in STEMM Student Leader Awards, Advancing Women's Success grant and funding of a Women Leading Tech award
- Deliver a new look website and join Twitter @MonashMIME
- Deliver and promote various collaborative educational and workforce development opportunities for stakeholders. Watch past webinar recordings HERE.

We look forward to strengthening our efforts in the coming year.

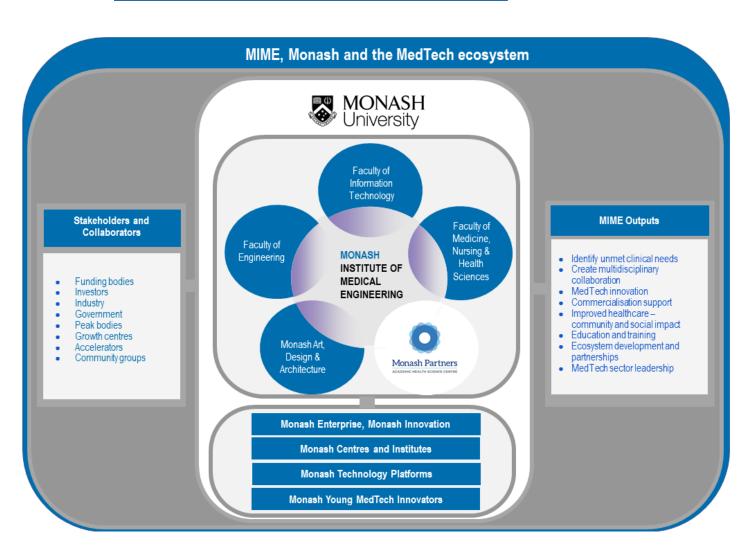**Professors Patrick Kwan and John Forsythe, MIME Co-Directors**

$9.5M of project-focused grants awarded to a total of 17 grants for projects funded from 2019 onward (non-exhaustive)

Through our partnerships we work to improve the delivery of healthcare via the acceleration of new technology development, trials, commercialisation and adoption.

MIME is proud to partner with:

- Monash University Faculty of Medicine, Nursing and Health Sciences
- Monash University Faculty of Information Technology
- Monash University Faculty of Engineering
- Monash University Faculty of Art, Design and Architecture, and
- Monash Partners Academic Health Science Centre

MIME, Monash and the MedTech ecosystem

A wearable sensor to record the impact of artificial light on our bodies to prevent chronic disease is currently being produced.

Research Leads, Associate Professor Sean Cain, from the Faculty of Medicine, Nursing and Health Sciences along with Professor Jon McCormack, from the Faculty of Information Technology, Monash University is leading a team to produce a powerful clinical tool that will help overcome unhealthy modern light behaviour.

Historically, we identified day and night via signals from the sun, with light entering our eyes and signalling the master clock in our brain which informed our body of the time of day. These days, we spend most of our time indoors under artificial lighting conditions which is in stark contrast to what we evolved in. We no longer have strong signals for day and night. Our bright days and dark nights that helped our bodies organise the rhythms of activity and repair throughout our bodies have been replaced with an irregular twilight that affects our internal clocks, contributing to chronic disease.

"We are not aware of the damage we are doing to ourselves via our light choices. We evolved to seek light because in our natural history, the only light available was good for us. We now have light whenever we want, at the push of a button. It's like our modern-day ready access to high carbohydrate food; now that we can have it whenever we want, we over-consume. Light is another junk food for the body," said Associate Professor Cain.

"Our unhealthy light behaviour is resulting in chronic diseases such as poor sleep quality, impaired muscle function, insulin resistance or type 2 diabetes, liver disease, depression/mental health issues, cardiovascular disease and/or hypertension," said Associate Professor Cain.

MIME Seed Funding top-up has enabled the redesign of a wearable lightweight sensor prototype that records the impact of different lights (fluorescent, overhead LED, sunset, phone LED) on the body sending feedback to a smartphone.

Through app-based modelling, the device can calculate the impact of ambient light on our clock.

"Unlike vision, the effects of light on our clock are non-conscious. We are not aware of how confusing our light signals are. Our device essentially makes the unconscious conscious, making us aware of how healthy and unhealthy our light behaviour is," said Professor Cain.

"This device, which is cheap to produce and pinned to clothing close to eye level will provide real-time feedback on light environments while enabling us to guide people towards healthy light cycles. It will be a powerful clinical tool that will reduce chronic disease and help manage circadian rhythms," said Professor Cain.

In addition to the wearable sensor, this project intends to integrate the light measuring device with home smart lighting systems, which are becoming increasingly common. This would allow these systems to deliver individualised control of light delivery.

"We know some of the worst light we encounter is just before bed. Therefore, we have also created a bedside lamp with a healthy warm light that is also a wireless phone charger and a wireless sensor charger. The lamp portion is also removable for late night bathroom visits," said Associate Professor Cain.

"It doesn't take long for people to see the benefits of healthy light cycles. The technologies our team is developing will make it easier for people to experience the benefits. The body craves regularity and rewards us for it. Getting our lights right is the most important first step," said Associate Professor Cain.

A new digital intervention to support eating disorder treatment for patients who are on extensive waitlists is currently being developed.

Eating disorders have one of the highest mortality rates of any mental health diagnosis. Despite the significant physical, mental, and social consequences associated with eating disorders, more than 75% of these individuals do not access appropriate treatment. Early intervention and support are recommended in the prevention of eating disorders.

Research leads, Associate Professor Gemma Sharp, Head, Body Image & Eating Disorders Research, Department of Neuroscience, Monash University and Senior Clinical Psychologist, Alfred Health and Dr Jue (Grace) Xie, Faculty of IT, Monash University said this new single session intervention chatbot will assist human therapists support patients currently on extensive wait lists.

"Existing wait lists to see psychologists and the prevalence of eating disorders were heightened dramatically by COVID," said Associate Professor Sharp and Dr Xie.

"Digital mental health interventions have been increasing in popularity and efficacy, with chatbots being one such format. A chatbot allows the provision of information and services through a conversational interface, which is available on messaging platforms, websites, and apps."

"We are co-designing a personalised single session chatbot intervention in consultation with clinicians and those with lived experience of eating disorders."

"It provides an initial consultation, via GP referral, with new patients who have been diagnosed with an eating disorder before they commence in person treatment with a psychologist."

"Early intervention is crucial for patients. The goal of our chatbot isn't to replicate a person, our chatbot is focused on being factual and educational. A single session given to someone sitting on a waitlist can make a significant difference and reduce the risk of them becoming more unwell while they wait for in-person treatment," said Associate Professor Sharp and Dr Xie.
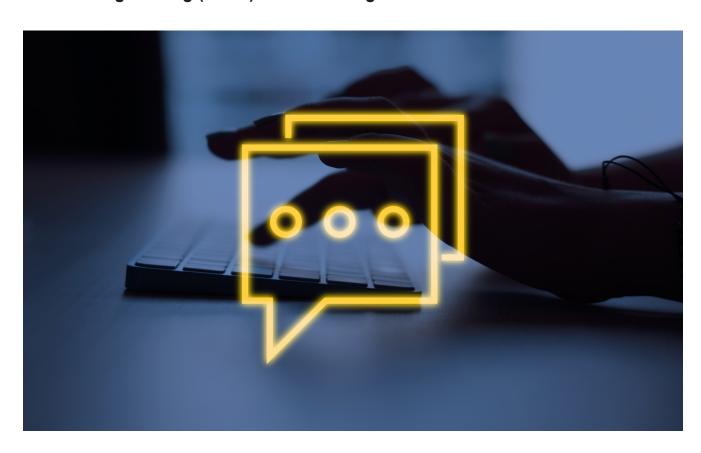
The response to the chatbot has been positive with patients and clinical psychologists supportive of the intervention.

"Chatbots reflect a unique opportunity to target those affected online by providing psychoeducation and coping skills, filling the gap in service provision and ensuring affected individuals access appropriate treatment in a timely manner," said Associate Professor Sharp and Dr Xie.

Next steps in the development including prototyping and pilot testing.

New software has been developed which delivers advanced sound quality of heart and lung monitoring for preterm and full-term babies, which can also be used by parents at home.

The software, used in conjunction with digital stethoscopes, delivers state-of-the-art screening and monitoring capability and more accurate diagnosis of respiratory issues in our most vulnerable babies and children.

It can be used in hospitals or at home and offers better diagnosis and real-time monitoring for babies. This is also of particular value in low to middle-income countries where health resources may be limited.

Stethoscope-recorded chest sounds contain important cardiac and respiratory information that informs clinicians on the health status of newborn babies. This crucial information can enable timely assessment for signs of serious health risks, potentially improving neonatal survival and reducing long-term morbidity risks.

However, low quality chest sounds due to noise from the external environment, other internal body sounds, or the device itself, can hinder the use of conventional or digital stethoscopes and complicate monitoring and diagnosis, or worse - can lead to misdiagnosis.

Research lead, Dr Faezah Marzbanrad, Department of Electrical and Computer Systems Engineering, Monash University said this easy to use software offered a solution.

"Respiratory issues are common in preterm babies. The software we've created removes all of the surrounding noise from chest recordings so the heart and lung sound are separated and very clean. This enables doctors and nurses to listen to them very clearly without interference and better diagnose any potential issues."

"The software is very easy to use, whether you are a doctor in a hospital setting or a parent in the middle of the night worried about a baby. A parent can record their baby's chest sound and send it to a doctor for real-time analysis," says Dr Marzbanrad.

When used in a home setting, the software automatically gives the parent a score on the quality of the chest sound they have recorded, so they will know whether it is good enough for the doctor to analyse or they need to reposition the digital stethoscope and collect another sample. This is particularly useful in rural or remote settings or if parents want to keep their baby at home and monitor them.

"They can put their digital stethoscope to a newborn's chest and collect sound. It can be very specialised placement on the back or chest to get the sound that is needed by a doctor, so the software will guide them to the right location," said Dr Marzbanrad.

"It's not always practical to get to a doctor and on many occasions breathing problems happen overnight when you can't get to a doctor. This ensures that you can record the sound in real-time and it's something useful for the doctor to assess," said Dr Marzbanrad.

Next steps will see the software trialled in conjunction with new digital stethoscope hardware at the Monash Children's Hospital. It is then expected to be available internationally.

This project highlights our partnership with Monash University, Faculty of Engineering and was made possible thanks to Monash Institute of Medical Engineering (MIME) Seed Funding.

Monash University and Blundstone Australia have created a hi-tech boot concept designed to address the specific needs of doctors, nurses and other healthcare professionals.

Monash's Design Health Collab and SensiLab partnered with Blundstone Australia to incorporate the latest technology and design techniques to increase personal safety and comfort in demanding healthcare environments. The design was shortlisted for the prestigious Designers Australia Awards 2022.

Healthcare workers were at the forefront of the project, with the design team regularly conducting workshops with doctors, nurses and other health specialists to ensure the boot addressed challenges specific to the industry, including comfort, durability and hygiene.

Dr Rowan Page, from Monash Health Design Collab, says the technology captures rich information about the day-to-day challenges faced by the wearer, and uses machine-learning techniques to provide real-time feedback and task classification.

"We've integrated a sensor system that analyses multiple parts of the foot to provide real-time feedback via a smartphone app that detects abnormalities and highlights potential issues," said Dr Page.

"The shoes classify different tasks undertaken throughout a work shift and can identify different postures, changes in walking gait and the lifting of heavy loads.

"The visualisation of this data can show areas of high pressure on the body across the workday and highlight potential problem areas."

With further development, the technology could highlight safety concerns, such as injury risk and fatigue, and prevent accidents before they occur.

The team's research highlighted comfort and hygiene are priorities for healthcare workers when selecting shoes for work. The boot's upper - the material covering the foot - provides chemical and bacterial resistance to the wearer.

Blundstone Joint-CEO Adam Blake says people rely on Blundstone boots to protect them in all sorts of environments.

"We strive to be an innovator and collaborator that leverages the best science and technology, seeking to partner with leading expertise and knowledge," he said.

"Partnering with Monash's Design Health Lab and SensiLab has been a great opportunity for Blundstone to dive deeply into understanding the needs of workers within the healthcare space".

Sustainability and ethics are also at the forefront of the design. The concept boot uses synthetic and plant-based materials, a computer-knitted collar that eliminates material waste, an upper that provides chemical and bacterial resistance, and a sole made from a recyclable polyurethane.

Whilst a concept boot has been delivered, these learnings are still in development. Blundstone will continue its focus in this area and hopes these learnings will translate into future product developments.

This project highlights our partnership with Monash University, Faculty of Art, Design and Architecture and was made possible thanks to Monash Institute of Medical Engineering (MIME) Seed Funding.

In 2022, MIME worked with the 65km for Cystic Fibrosis community and Monash Partners Academic Health Science Centre in an effort to help make life easier for those living with cystic fibrosis (CF).

After consultation with those living with CF and clinicians working in this space, we welcomed the development of new and meaningful solutions to the real-world problems of people living with CF.

New research is investigating how lung disease develops in young children with cystic fibrosis to inform treatment options.

Lead researcher, Dr Paul King from Monash University said currently not much is known on lung immune responses in young children.

"Cystic fibrosis lung disease arises from lung inflammation that causes the activation of lung white blood cells, such as neutrophils and macrophages. This results in the development of bronchiectasis, a chronic condition where the airways thicken from inflammation and infection, and over time, progressive lung destruction," said Dr King.

"Bronchiectasis occurs in very young children with cystic fibrosis, but the processes responsible have not been well understood. In this study,

we explored the role of a white cell inflammatory pathway called extracellular trap formation in the development of lung damage.

"We clearly found very strong involvement of extracellular traps from lung samples in young children both with cystic fibrosis and also in other children with chronic airway infection," said Dr King.

A key finding of the study is that the inflammatory response can be prevented with currently available therapeutic medications and therefore have direct implications for the treatment of young children.

"This study establishes a new paradigm which may finally explain how young children with cystic fibrosis develop lung disease," said Dr King.

The Monash Institute of Medical Engineering (MIME) funds and supports projects to co-develop new technological solutions to unmet clinical needs whilst project managing them along the commercialisation pipeline.

Through our funding, MIME fosters extraordinary research-based, community focused, clinician-led, industry-building innovations with the ultimate beneficiary being the Australian community and beyond.

In 2022:

$500,000 in MIME Seed Funding

10 Seed Funded projects to meet unmet clinical needs

15 Healthcare Innovation Summer Scholarships (HISS) awarded

2 HISS digital tools developed impacting patient care

6 Women in STEMM Student Leader Awards presented

MIME Seed Funding accelerates the development of new medical technologies that address significant unmet clinicals needs. Clinicians of all disciplines work in partnership with IT/digital health, engineering and art/design researchers to discover new medical technologies.

A new conversational digital intervention is being developed to promote preconception health and empower women to adopt and maintain healthy lifestyle behaviours.

A woman's behaviour during their reproductive years has the potential to impact their fertility, pregnancy outcomes and overall health; regardless if they want to fall pregnant.

Little is currently known about this with digital interventions that promote behavioural change presently not available.

A new form of digital software being developed by Dr Jue Xie, Dr Ruth Walker, Dr Ling Wu and Associate Professor Jacqueline Boyle from Monash University is set to change this and promote preconception health and trigger women to take actions and make small changes to their lifestyle that can have long-term impact.

"For those who are actively planning to become pregnant, ideally women should be supported to adopt and maintain health behaviours months, and even years, before conception. This notion is also relevant to those not planning on falling pregnant as health behaviours will have implications on general health and wellbeing," said Dr Walker and Associate Professor Boyle.

"Despite the documented benefits of preconception care, many women do not access it. And, of those who do, many find the care they receive is inadequate. Digital health interventions offer an option for women to engage with personalised risk assessment and information when it is convenient for them."

"Although there is an abundance of existing digital wellbeing solutions, they rarely cover information related to preconception health, do not offer social connections for health from those with lived experience or do not provide emotional support, leaving them ineffective."

"We understand that women in the age group we are targeting (18-45 years) are busy, and can sometimes be inpatient and lack motivation to engage with new digital services."

"We believe our engaging, intuitive and trustworthy "human-like" interactive virtual agent software can be an effective solution to communicate preconception care for Australian women. It provides women with the opportunity to talk to someone via easily accessible social media platforms already used in their everyday life. This will work to identify and mitigate risk factors prior to pregnancy, and improve long term health outcomes for women and children," said Drs Xie and Wu.

Next steps in the research involve building a prototype and integrating the software into existing social media platforms.

More information on Seed Funding HERE

HISS is a partnership between Monash Young MedTech Innovators (MYMI), Monash Institute of Medical Engineering (MIME) and Monash Partners Academic Health Science Centre, to demonstrate the untapped student innovation ecosystem at Monash University and educate future innovators within healthcare.

The program connects clinicians who seek a technological solution to frontline health problems with high performing undergraduate and masters students from across Monash University motivated to develop new medical technologies.

Clinicians and students work together over 12 weeks to evaluate concepts for new technologies and create innovative proof-of-concept prototypes with potential for tangible real-world clinical outcomes.

Students from the Monash Institute of Medical Engineering (MIME) and Monash Young Medtech Innovators (MYMI) have teamed up with Monash Health speech pathologists and their patients to develop technology to assist people living with aphasia to communicate.

Combining tech skills, clinical expertise and a lived experience of aphasia has resulted in Project QWERTY, a unique customisable website that offers a high-tech but simple-to-use solution to a life-changing health care problem.

Project QWERTY allows people with aphasia to improve their written skills and can be used on a tablet or desktop device for greater independence and access to rehabilitation.

Aphasia is a neurological disorder and communication disability which can affect the ability to speak, read or write language. Currently, there are 140,000 Australians living with aphasia which can range from mild to severe. Cognition can remain intact.

Notably, Hollywood celebrity Bruce Willis recently announced that he was suffering from aphasia.

Aphasia can be caused by stroke, brain

tumour or brain injury with 38% of stroke survivors impacted by aphasia. It can have a significant impact on all areas of a person's quality of life.

"This website allows people with aphasia to practice typing and spelling words that are meaningful to them, such as the names of friends and family or even their own personal details so they can independently fill out the paperwork when they go to an appointment," says speech pathologist Jenny Walsh, a co-creator of Project QWERTY.

Speech pathologist Grace Schofield who also worked on the project says the website is easy to use and very practical.

She recently used the website to help a patient practice words that enabled them to continue running their own business.

"Some people will use the website as a tool to ultimately enable them to return to work by targeting words that are unique to their workplace, others may use it to access an online newspaper or even footy scores. It's all about giving people with aphasia independence to live their lives," she says.

The project was funded through the Healthcare Innovation Summer Scholarships (HISS), supported by MIME and MYMI, along with support from Monash Health and their volunteers.

This project was made possible thanks to a Healthcare Innovation Summer Scholarship (HISS).

More information on Healthcare Innovation Summer Scholarships (HISS) HERE

The Monash Institute of Medical Engineering (MIME) is committed to creating more opportunities for women across healthcare and medical technology innovation. Diversity is essential as we lead the discovery, creation and translation of technologies that will improve human health.

In 2022, MIME held the Monash Institute of Medical Engineering (MIME) Women in STEMM Student Leader Awards. These aim to recognise, celebrate and support women students at Monash University who are contributing to innovation in healthcare and medical technologies.

Six awards were awarded with successful undergraduate/postgraduate students receiving $1,000 to support their studies and exclusive invitations to participate in a series of MIME networking opportunities throughout 2023.

Further Women in STEMM initiatives supported by MIME in 2022 included:

- Advancing Women's Success Grant
- Sponsoring the winner of the Women Leading Tech award.

More information on Women in STEMM HERE

Julie Dao
PhD candidate
Medicine, Nursing and Health Sciences MORE

Iliana Ginnis
PhD candidate
Art, Design and Architecture
MORE

Qianya Zhao
Undergraduate
Engineering and Medicine, Nursing and Health Sciences MORE

Jacquie Johnstone
Undergraduate
Art, Design and Architecture and Information Technology MORE

Pia Campagna
PhD candidate
Medicine, Nursing and Health Sciences MORE

India Macpherson
Undergraduate
Art, Design and Architecture
MORE

Looking to 2023, MIME will:

- Build engagement with external collaborators and stakeholders
- Add to the breadth of support we offer to our partner clinical and research teams, with an increased focus on commercialisation outcomes, and
- Attract MedTech-focused businesses and industry partners to create new collaborations and innovative co-developed products to address unmet clinical needs.