



Australian e-Health
Research Centre

The Australian e-Health Research Centre

Annual Report 2024-25



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Acknowledgement of Country

CSIRO acknowledges the Traditional Owners of the lands, seas and waters, of the area that we live and work across Australia. We acknowledge their continuing connection to their culture and pay our respects to their Elders past and present.

CSIRO is honoured to partner and collaborate with Aboriginal and Torres Strait Islander communities across the nation and we acknowledge the contributions of all Aboriginal and Torres Strait Islander people, staff and partners towards our vision for reconciliation.

Contents

The Australian e-Health Research Centre	2
Foreword by the Chair and CEO	4
Board of Directors	7
Management and Leadership	10
Annual e-Health Research Colloquium	14
AEHRC in the news	17
Awards	19
AEHRC and Queensland Health.....	20
The Health Data Semantics and Interoperability group	22
The Transformational Bioinformatics group.....	48
The Biomedical Informatics group	64
The Digital Therapeutics and Care (DTaC) group.....	86
The Health System Analytics group	108
Vacation student projects	123
NHMRC and MRFF grants.....	128
AEHRC and e-Health program staff, students and visitors	142
Publications.....	149
Financials.....	14962

The Australian e-Health Research Centre

The Australian e-Health Research Centre (AEHRC) is the largest digital health research program in Australia with over 150 scientists and engineers and a further 50 higher degree research students. As CSIRO's national digital health research program, the AEHRC has offices across Brisbane, Sydney, Melbourne, Canberra, Adelaide and Perth. AEHRC is world-wide unique in covering the full value chain in health care, from basic science all the way to delivering technology and services into the healthcare system.

Our Centre was established in 2003 with initial funding from a partnership with the Queensland Department of State Development and CSIRO. In 2007, the partnership was extended for a further five years with funding from CSIRO, Queensland Health and the Department of Employment, Economic Development and Innovation. In 2012, 2017 and 2022 the partnership was again extended each time for a further five years.

We are a full health and biomedical informatics research program, undertaking:

- applied research in bioinformatics, including genomics and medical imaging
- health informatics, including clinical informatics and data interoperability
- health services research, including mobile health, tele-health and sensing technologies.



With additional investment from CSIRO and funding from state health departments and federal health agencies, we support the digital transformation of healthcare around Australia. Through our research program, we also develop and deploy leading edge information and communication technology innovations in healthcare to:

- improve service delivery in the Queensland and Australian health systems
- generate commercialisation revenue
- increase the pool of world-class e-health expertise in Australia.

Our current strategy engages the research capability of our five research groups – Health Data Semantics and Interoperability, Health System Analytics, Biomedical Informatics, Transformational Bioinformatics and Digital Therapeutics and Care – to continue to tackle Australia's healthcare system challenges and expand the impact of our research. The challenges set out in this strategy are to:

- transform health with data and artificial intelligence
- transform healthcare delivery with virtual care
- enable efficiencies in healthcare systems
- innovate and develop digital technologies for precision healthcare.

Our research program is informed through strong partnerships with the health industry, including clinicians, researchers, health service executives and the health IT vendor community.

Over half our staff are located in the STARS Hospital on the Herston Health Precinct in Brisbane, while in Sydney we occupy offices at the Westmead Health Precinct. In Melbourne we are located at Parkville and in Perth we are located on the Kensington CSIRO site. Our locations enable us to develop strong relationships with the state-based health departments, clinicians and academics.

We continue to deliver to national programs, with key projects with the Department of Health, Disability and Ageing (DHDA) and the Australian Digital Health Agency (the Agency). We also work with scientists from across CSIRO, contributing to projects with the Human Health and Biosecurity programs in CSIRO Health and Biosecurity and with teams across CSIRO.

Foreword by the Chair and CEO

The transformation of Australia's healthcare system using digital technology continues to accelerate — particularly with the increasing appetite for solutions driven by artificial intelligence technologies. The Australian e-Health Research Centre continues to be a driver of this transformation — partnering across the healthcare sector to deliver science-based innovations that improve patient outcomes, clinician productivity and technologies that underpin the use of digital technologies in healthcare.

Throughout the last 12 months we've delivered significant projects to our joint venture partners — CSIRO and Queensland Health — also to our national partners — including the Agency, the DHDA and the Department of Foreign Affairs and Trade (DFAT), as well as hospitals, research partners, universities and other Australian and global collaborators.

It is really encouraging to see our scientists deliver projects that use world-leading science — and this can be seen through the quality of our publications and international conferences. Over the past 12 months this has included:

- Impact of sleep: Sleep discrepancy and brain glucose metabolism in community-dwelling older adults - PubMed <https://pubmed.ncbi.nlm.nih.gov/39735205/>
- CapBuild: a cloud-design tool to accelerate translation of gene therapy applications, Nucleic Acid research (IF=16) <https://doi.org/10.1093/nar/gkaf422>
- AskBeacon: enabling safe genomic data exchange by making the global exchange standard more accessible through large language models 10.1093/bioinformatics/btaf079
- Future-proofing genomic data and consent management 10.1093/gigascience/giae021.
- SQL on FHIR - Tabular views of FHIR data using FHIRPath

Another indicator is the number of our NHMRC and MRFF grants which received funding. We partnered on 8 grants awarded this year-providing key technology to support trials and studies of new technology to solve complex medical, clinical, and health service challenges.

We have continued to work across Queensland Health to support their digital transformation in line with the Queensland Health 2032 strategic plan. This year we established a new project — Enabling FHIR in QLD (EFIQ) — which provides dedicated training opportunities, FHIR connectathons and FHIR project opportunities. The program supports the continued adoption of the FHIR standard across Queensland Health. While EFIQ is a new project we continue to grow our impact in many other areas with Queensland Health. The M♡THER mobile health program to support pregnant women with gestational diabetes has now supported over 12000 women through their pregnancy — and has been adopted by 8 hospitals across Queensland. Our seminal patient flow study with the Emergency Medicine Foundation and University of Queensland has been accepted by Queensland Health and we are working with them how change can be implemented. We have also now established the Queensland Ageing and Dementia Study cohort with QIMR Berghofer, University of Queensland and Queensland Health to enable dedicated

Alzheimer's disease studies in Queensland. This is by no means an exhaustive list and there are many other projects throughout this report of our collaborative work with Queensland Health.

Being part of CSIRO also gives our teams the opportunity to partner across many different science areas. This year our teams worked with the Australian Centre for Disease Preparedness (ACDP) across genomics and interoperability, with the Human Health program on surveillance technologies and our Data61 research unit in areas of AI. Ensuring that we engage across CSIRO is the best way of identifying new technologies to bring into healthcare — and of course to share our digital expertise with other sectors.

The use of AI in healthcare continues to grow — and while much of the focus is on the use of generative AI technologies such as AI scribes, there continues to be growth in the adoption of AI in areas such as medical imaging, genomics, sensors and other types of data. Throughout this report there are some examples of our technologies in these areas supporting better health outcomes as well as clinical research.

Interoperability has always been part of our agenda for transformation but this year it was a big-ticket item nationally and internationally as we led multiple interoperability initiatives. The National Clinical Terminology Service for the Agency achieved two important milestones this year — refreshing the platform used for authoring and release of the Australian version of SNOMED CT and the successful release of an updated data model for Australian Medicines Terminology (AMT). You can read more about these changes in the report — including how they will support better clinical decision support. Also delivered this year nationally through the Sparked national FHIR accelerator were several data exchange standards. These were the result of over 2000 expert hours from over 1000 community members and over 150 hours of meetings — a monumental, collaborative effort from everyone involved. These standards, along with how they are starting to be implemented, are detailed in this report. We have also been building SMART on FHIR apps for national use — such as for the cardiovascular risk algorithm for the National Heart Foundation.

Nationally we have also worked with the National Climate Service to understand the potential impact of climate change over the next fifty years in two key areas — mutation of viruses and impact on hospitals of greater heat stress on the population. These reports have been accepted by the minister and were recently published.

Internationally our teams are building a strong collection of projects in the Indo Pacific. Our genomics team are working with an Indonesian pathology company to deliver an approach to precision health care for Indonesia — while our interoperability team is leading the Standards Capability Project as part of the Department of Foreign Affairs and Trade Partnerships for a Healthy Region program.

Last year we reported that our Quality Management System (QMS) was certified under the ISO13485 Software as a Medical Device regulation. This year we harnessed our new capability in two projects and are preparing the documents for another technology to be approved as a Class 2b medical device.

In Indigenous health, the team worked with Aboriginal and Torres Strait Islander peoples and organisations in a self-determined approach to AI possibility in health to build an evidence base for a more inclusive AI development and governance ecosystem, strengthening the cultural safety and efficacy of AI-driven health in Australia and beyond.

This 2024-2025 AEHRC Annual Report provides an overview of our research — including our research groups, platform technologies, project reports and project updates. The report this year highlights many of our successes and ongoing projects — demonstrating our ongoing central role in Australia’s transition to a digitally enabled healthcare system.



Richard Royle
Chair
The AEHRC

A handwritten signature in black ink, appearing to read 'R. Royle'.

David Hansen
Chief Executive Officer
The AEHRC

A handwritten signature in black ink, appearing to read 'D.P. Hansen'.

Board of Directors

Richard Royle

Richard has over 30 years' senior executive experience in the public, for profit and not-for-profit private hospital sectors in Australia and is the immediate past President of the Australian Private Hospitals Association.

Richard oversaw the successful implementation of Australia's first fully integrated digital hospital in Hervey Bay as the group CEO of UnitingCare Health in 2014. In 2016, he was appointed the startup CEO of the newly established ADHA — putting into practice one of his recommendations from a landmark Federal Government review he led in 2013 on digital health in Australia.



Tanya Kelly (from Feb 2023)



Dr Tanya Kelly is currently Deputy Director-General at Queensland Health, leading the eHealth Queensland Division. She leads the digital health vision for Queensland's public health priorities in support of broader health system reforms. A Fellow of the Australian and New Zealand College of Anaesthetists (FANZCA), Dr Kelly is an experienced and active senior clinician, who has held clinical leadership roles including as Director of Anaesthesia and as Clinical Director for Digital Health within the Sunshine Coast University Hospital. As the immediate past Chair of the Queensland Clinical Senate, a peak body that provides strategic clinician and consumer led advice to Queensland Health, Dr Kelly is keen to ensure that healthcare in

Queensland is safe, highly effective and maximises the opportunities provided by clinician and consumer co-design, to provide a responsive healthcare system. Dr Kelly recognises that digital health is a key change driver within the health system and is passionate about ensuring digital health is enabling both positive outcomes today but also amplifies innovation into the future. Dr Kelly is also an advocate for the broader collaboration needed across the ecosystem, particularly alignment with the national digital health agenda in addressing whole of system challenges and enabling reforms. Beyond her clinical practice, Dr Kelly has qualifications in clinical redesign, business and is a Certified Health Informatician (CHIA). Dr Kelly is also a member of the AEHRC Board, a joint venture between CSIRO and Queensland Health, and the Australian Digital Health Agency Board.

Brett Sutton (from December 2023)



Professor Brett Sutton is a Director at CSIRO, Australia's national science agency, leading the Health & Biosecurity Research Unit, comprising over 350 researchers and support staff in areas of digital health, human health and plant, animal and environmental biosecurity.

A qualified public health physician, he brings extensive experience and clinical expertise in public health and communicable diseases, developed through roles in government, emergency medicine, and international fieldwork.

Before joining CSIRO, Brett served as Victoria's Chief Health Officer and Chief Human Biosecurity Officer, heading the Health Protection Branch within the Victorian Department of Health.

With specialist knowledge in tropical medicine and infectious diseases, Brett has worked extensively in lower-middle-income countries and complex humanitarian settings, including in Afghanistan, Ethiopia, Kenya, Timor-Leste, and Fiji.

Brett's career reflects his passion and commitment to advancing health outcomes in Australia and globally.

Professor Sutton is a Fellow of the Royal Society for Public Health, a Fellow of the Australasian College of Tropical Medicine, and a Fellow of the Australasian Faculty of Public Health Medicine (AFPHM). He is also a member of the Faculty of Travel Medicine.

Rae Donovan (from December 2024)

Dr Rae Donovan is the Acting Chief Clinical Information Officer for eHealth Queensland as well as a Senior Emergency Consultant at the Princess Alexandra Hospital, a tertiary hospital and trauma centre in Brisbane.

Rae has held various leadership roles within Queensland Health's digital transformation through chairing the peak digital health clinical advising groups, ensuring advocacy for digital transformation through implementation of EMR and other technologies, as well as providing strategic advice and guidance on digital health enterprise business as usual activities and optimisation projects.

Previously Rae was the Medical Director, Digital Health & Informatics at Metro South Health as part of an interdisciplinary clinical team that works with the organisation to assist in the digital transformation of the Health Service to help improve care delivery and clinical and organisational outcomes.

Rae's priority is to advocate and engage clinicians across Queensland to ensure continuous evolution within the digital ecosystem can occur that will improve clinical outcomes and clinician and consumer experiences.



Megan Astle



Dr Megan Astle is the Deputy Director, Health & Biosecurity at CSIRO and an experienced higher education and research professional with a background in biomedical research. Megan has a demonstrated history of developing and delivering major impact-focused research ventures at the interface of industry, research and education, and most recently led the health and medical research portfolio in the Victorian Department of Health.

Megan previously held research development roles at the University of Melbourne and Monash University. At Melbourne Uni this included as Director, Medical Research Future Fund (MRFF) Initiatives and

Associate Director Major Bids and Missions. At Monash, she led the University research strategy and planning for the Victorian Heart Hospital Project and is passionate about enabling impact-directed research.

Richard Symons

Minutes Secretary

Allan Caldwell

Finance Manager, CSIRO Health & Biosecurity

Meetings

10th December 2024

1st April 2025

19th June 2025

Management and Leadership

Dr David Hansen

CEO and Research Director, Australian e-Health Research Centre



Dr David Hansen is CEO and Research Director of the Australian e-Health Research Centre. David leads the research program of over 160 scientists and engineers developing information and communication technologies to improve the safety, quality and efficiency of healthcare.

David is a member of the Australian Digital Health Agency Council for Connected Care and board member of the Australasian Institute of Digital Health (AIDH).

David is passionate about the role of information and communication technologies in health care and the role of digital health in developing a safe, efficient and sustainable healthcare system in Australia.

Dr Denis Bauer

Group Leader, Transformational Bioinformatics

Dr Denis Bauer leads the Transformational Bioinformatics group and is an internationally recognised expert in machine learning and cloud-based genomics. She is an Adjunct Professor at Macquarie and Sydney University and is affiliated with the Australian Institute for Machine learning as well as the AWS Data Hero Program. Denis holds a Bachelor of Science from Germany, a PhD in Bioinformatics from the University of Queensland and graduated from the Australian Institute of Company Directors (GAICD) as well as holds a Certificate in Executive Management and Development from the University of New South Wales Business School.



Denis' research led to the discovery of novel disease genes for motor neuron disease and informed the COVID-19 vaccine development. She keynotes international 10,000-attendee IT, LifeScience and Medical conferences and has attracted more than \$50M in funding to further health research and digital health. She founded open-source bioinformatics software projects with commercial impact through cloud-deployment. She was recognised as Brilliant Woman in Digital Health 2021 and Women in AI 2022 and published a senior author paper in *Nature Biotechnology* in 2023.

Dr Michael Lawley

Group Leader, Health Data Semantics and Interoperability



Dr Michael Lawley leads the Health Data Semantics and Interoperability group with teams in health informatics and modelling, clinical terminology and interoperability, natural language processing and information retrieval, and software engineering. The group's focus is on improving healthcare delivery and outcomes through improvements in the quality and use of digital health data during collection, exchange, and analytics.

Michael has extensive expertise in clinical terminology, specifically large-scale ontologies such as SNOMED CT and is a leading contributor to HL7's FHIR Terminology Services standard. Work

developed by Michael and his team has produced technologies that have been licensed nationally and internationally by standards bodies, government organisations and SMEs. In 2018, he received the SNOMED International

Award for Excellence recognising his many contributions to the evolution of SNOMED CT.

Dr Jurgen Fripp

Group Leader, Biomedical Informatics

Dr Jurgen Fripp leads the Australian e-Health Research Centre's Biomedical Informatics group, with teams covering genomics, biostatistics, medical image analysis and clinical imaging. The group's focus is on using medical imaging biomarkers, machine learning and statistical techniques for precision health (prediction, staging, prevention and treatment), including when combined with various omics, neuropsychology, smart sensing and clinical phenotypes.



The group's techniques are deployed in hospitals and on the AEHRC's cloud informatics platform for use in a wide range of large observational and randomised control trials across the human lifespan (from conception to senescence) and disease spectrum (including osteoarthritis, cerebral palsy, cancer and dementia). Jurgen has deep expertise in medical imaging, including positron emission tomography (PET), magnetic resonance imaging (MRI), and computed tomography (CT).

Dr Marlien Varnfield

Group Leader, Digital Therapeutics and Care (DTaC) Group



Dr Marlien Varnfield leads the Digital Therapeutics and Care group, where she drives research focused on enhancing management strategies and improving health outcomes for at-risk populations, including pregnant women, infants, older adults, people with disabilities, and individuals living with chronic conditions.

Marlien's innovative research has led to tangible, real-world impacts. These include the commercialisation of a state-of-the-art cardiac rehabilitation platform that has transformed care delivery for cardiac patients, and the widespread rollout of the M♡THER digital health solution for managing gestational diabetes. In addition, she

contributed to the validation of our Smarter Safer Homes (SSH) platform, which supports older Australians to live independently in their own homes for longer. Marlien is also an Honorary Associate Professor in the School of Public Health at the University of Queensland.

Dr Rajiv Jayasena

Group Leader, Health System Analytics and Victorian Lead

Dr Rajiv Jayasena is the Group Leader for Health System Analytics and Victorian lead for the Australian e-Health Research Centre of CSIRO.

Rajiv has an Honours degree in immunology from Monash University and a PhD in Medicine from The University of Melbourne on early detection methodologies for Alzheimer's disease. Rajiv has also completed a Graduate Diploma in Business from RMIT, Certification in Operational Excellence (Lean Six Sigma Black Belt) and Safety, Quality, Informatics and Leadership Certificate Program (SQIL) from Harvard Medical School, Boston. He has held academic positions at both Monash University and The University of Melbourne and currently an Honorary Fellow at Centre for Digital Transformation of Health at The University of Melbourne.



Rajiv has established many collaborations with state and federal governments, hospitals, universities and industry, leading a portfolio of research and support programs for CSIRO. He continues his research leading the Health System Analytics group focussed on utilising health data to drive efficiency, productivity and decision-making for hospitals, patients and communities to support quality and safe patient care.

Dr Janet Fox (to March 2025)

Business Development Manager



Dr Janet Fox is the Digital Health Business Development Lead at CSIRO, driving innovation and strategic partnerships to amplify the impact of the Australian e-Health Research Centre. Collaborating closely with the CEO and Group Leads, Janet develops and implements growth and impact strategies, ensuring the continued success of AEHRC. With extensive expertise in business development and health research translation, Janet excels in building strong customer relationships, identifying opportunities, and crafting effective strategies to maximise their potential.

Annual e-Health Research Colloquium

Celebrating 21 years of digital health innovation

This year we celebrated a major milestone by hosting our 21st Annual Research Colloquium. The event brought together over 300 attendees—both in-person and online—to showcase the latest advancements in digital health research.

Key themes and highlights

1. Pandemic Preparedness and Pathogen Surveillance

Presentations showcased AEHRC's leadership in developing digital solutions for infectious disease control. Highlights included:

- HOTspots platform for mapping antimicrobial resistance in remote areas (Aminath Shausan)
- AI-based vaccine response analysis to improve immunisation strategies (Laurence Wilson)
- Wastewater surveillance technologies for early pathogen detection (Jatinder Sidhu)

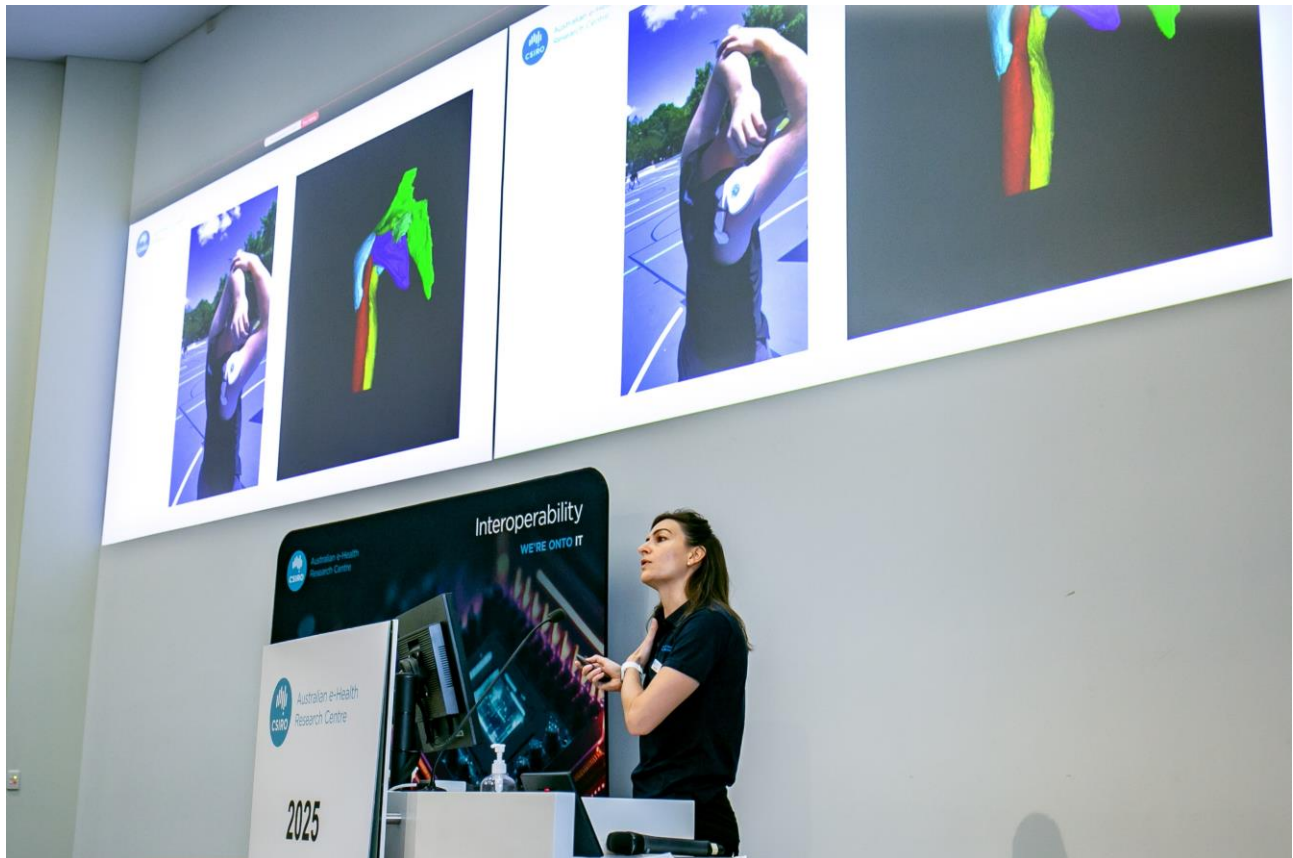


David Hansen, Research Director and CEO of AEHRC welcomes the audience

2. AI and machine learning in healthcare

Researchers demonstrated the application of AI/ML across a range of health technologies:

- Enhanced PET imaging for early Alzheimer's diagnosis (Pierrick Bourgeat)
- Wearable ultrasound for remote diagnostics, including applications in space health (Maria Antico, in partnership with QUT and the European Astronaut Centre)
- Using AI for better vaccine outcomes (Laurence Wilson)



Maria Antico explains how the wearable ultrasound works

3. Enabling interoperability in health data systems

Effective healthcare relies on data integration. Colloquium speakers presented:

- Findings from the Aged Care Data Landscape Report highlighting gaps in data interoperability (Liesel Higgins)
- Integration of cardiovascular risk assessment tools into GP systems (John Grimes)

4. Inclusive and culturally responsive healthcare

In partnership with the Child and Adolescent Health Service in WA, we developed Kara-Care, a digital yarnning tool to support Aboriginal health services in the Pilbara, reducing patient burden and improving data access at the point of care.

5. Implementation science and standards

AEHRC researchers emphasised the importance of translating innovation into impact. Presenters highlighted:

- Implementation science practices to ensure research adoption
- AEHRC's ISO 13485 certification and development of software as a medical device (SaMD) ensuring products meet international quality standards (Yan Chia and Jason Dowling)

The AEHRC Colloquium continues to be a leading national forum for shaping the future of digital health in Australia, showcasing CSIRO's commitment to scientific excellence, collaboration, and improved health outcomes for all Australians.

AEHRC in the news

In 2024–25, our communications efforts were headlined by the continued success and growing impact of the Sparked FHIR Accelerator — a flagship digital health project funded by DHDA and delivered in partnership with the Agency and HL7 Australia.

Now two years into delivery, Sparked is fulfilling its ambitious goals and attracting global recognition for its innovative, community-led approach to the development and implementation of FHIR standards in Australia. As community engagement leads, we've amplified the importance of this work for Australian healthcare through a strategic, multi-channel campaign.

Driving understanding and impact

To demystify FHIR and make the program accessible to all stakeholders, we released a suite of explainer videos tailored to patients, clinicians, and health system leaders. We also launched The Sparked Book — a comprehensive, visually engaging summary of Sparked's milestones, showcasing achievements across clinical and technical domains.

In addition to leading Clinical and Technical Design Group events and key leadership forums, we hosted our first Sparked Online Showcase, which attracted a global audience. With Brett Sutton, Director of Health and Biosecurity, as host we also launched Season 1 of the Sparked Podcast, which has since reached over 2000 downloads. Following its success, Season 2 is now live.



Media and thought leadership

This year saw strong media interest in our work, including:

- National coverage of our AI-based forensic skull identification research, featured in *The Sydney Morning Herald* and *ABC News*, with interviews by lead researcher Jason Dowling.
- Widespread attention for our Aged Care Digital Health Landscape report, which was covered across CSIRO News, radio, and print publications.



Australian e-Health
Research Centre



The Australian aged care data landscape

Gaps, opportunities and future directions

March 2025



We also launched new communications collateral at high-profile events including HIC 2024 and the Digital Health Festival, where Sparked attracted attention from across industry, government, and academia. Our own e-Health Research Colloquium celebrated its 21st year, marking over two decades of digital health innovation.

Expanding our digital presence

To increase visibility and accessibility of our work, we consolidated all CSIRO Health explainer and research videos under a dedicated YouTube playlist. This collection features content on everything from AI applications in disability support, to machine learning in precision health, and early detection of Alzheimer's disease.

Publications and recognition

In a major highlight, CEO and Research Director Dr David Hansen co-authored a book with CSIRO Board Chair Richard Royle, sharing insights on digital health and innovation. Their work was featured across multiple platforms, reinforcing CSIRO's leadership in the sector.

Recognition of our researchers also continued to grow. Notably, Dr Aaron Nicolson was named Australia's leading researcher in his field by *The Australian* — a testament to the calibre and impact of the scientific talent within our centre.

Awards

External Awards

- Children's Project 'Oscar' nominated for the 'Most Outstanding AI Collaboration or Partnership' in the Queensland AI Awards
- Lorraine Bell received the Sociologists in Action scholarship to attend The Australian Sociological Association's conference in Perth in November
- David Silvera and Moid Sandhu received Best Project Award at Autonomous Sensors FSP Conference 2024 in Wollongong, out of 20+ projects from 10 Research Units.
- Anna Roesler People's Choice Award for the best presentation at the Health in Preconception, Pregnancy and Postpartum Conference, Sydney
- Arvin and Bevan Koopman won Best Short Paper Award ("Rank-DistILLM: Closing the Effectiveness Gap Between Cross-Encoders and LLMs for Passage Re-ranking") and Honourable Full Paper Mention ("Set-Encoder: Permutation-Invariant Inter-Passage Attention for Listwise Passage Re-Ranking with Cross-Encoders") at the European Conference on Information Retrieval. This in collaboration with a German researcher who visited UQ for a sabbatical.
- Kerstin Pannek received Highly Commended Dr Stephen Morrison Best Clinical Research Award at the 2024 Herston Health Precinct Symposium
- Jessica Rahman received Highly Commended Early Career Research award at the 2024 Herston Health Precinct Symposium
- Kerstin Pannek received Emerging Leadership Award from the Organisation for Human Brain Mapping Australia
- Aida Brankovic received Springer Nature Editor of Distinction Award 2025 in the category Editorial Contribution Award
- Winner of the InterSystems International impact award for ADePT implementation at Austin health, judged by an independent panel from MIT.
- The Australian's 2025 Research magazine; Australia's top researcher in acoustics and sound, Aaron Nicolson
- 1st place; BioLaySumm Radiology Report Generation with Layman's Terms @ BioNLP ACL'25, Wenjun Zhang, Bevan Koopman, Jason Dowling, Aaron Nicolson

CSIRO recognition

- Highly Commended 2024: Aboriginal and Torres Strait Islander Engagement Impact Excellence Award: Ray Mahoney, Sophie Wright-Pedersen & Hannah Law
- Highly Commended for the H&B Science and Engineering Award 2024: Teresa Wozniak
- 2024 Health and Biosecurity Award for Digital Transformation: Janardhan Vignarajan, Maryam Mehdizadeh, David Conlan, Jane Li, Andrew Bayor, and Derek Ireland
- Health and Biosecurity Award for Support Excellence: Yan Chia, Jenny O'Connell, Katie Forestier, Rajiv Jayasena, Derek Ireland, Shaun Frost, Jason Dowling, and Sankalp Khanna
- H&B Trusted Advisor Award: Justin Boyle, Sankalp Khanna, Hamed Hassanzadeh, Jin Yoon, Vahid Riahi, Ibrahima Diouf, Bronwen Brotton, Katie Forestier, Naomi Stekelenburg, Antony Loizou, Johnathon Hall, Sandy Farnworth, Janet Fox, Ali Wood

AEHRC and Queensland Health

CSIRO and Queensland Health have enjoyed an enduring collaboration since the joint venture of the AEHRC was first established in 2003. With CSIRO and Queensland Health signing a new five-year agreement in 2022, AEHRC will continue to be an important contributor to the digital enhancement of Australia's health system into the future.

We work with Queensland Health across the program — in health data and text analytics, interoperability and connected care, mobile health and tele-health, genomics and medical imaging. Our scientists work with clinicians and service providers across the many parts of Queensland Health to ensure digital health innovation can translate to improved health care delivery, patient experience and outcomes.

Queensland Health continues to push boundaries to improve interoperability across the health system. The past year has seen eHealth Queensland a core contributor to Sparked, for which AEHRC leads community engagement - and we have very much appreciated their support. eHealth Queensland is also ramping up use of their Queensland Clinical Terminology Service which uses our Ontoserver technology. Queensland Health is the first health system in Australia to establish its very own clinical terminology services as an enterprise service used across Queensland Health, enabling users of clinical applications to easily browse, download and create terminology and terminology related content.

To ensure our workforce is ready for the implementation of FHIR, we have further developed opportunities to align activities with Queensland Health to increase training in and adoption of FHIR and interoperability. This includes providing workshops and connectathons in FHIR, developing secondment models to enable skills exchange and further develop digital health capabilities within our health ecosystem.

Working with eHealth Queensland, and key research partners including University of Queensland, Queensland University of Technology and Health Translation Queensland, we have developed a blueprint of the digital health research ecosystem in Queensland, which will include tools and resources for stakeholders navigating in the digital health research ecosystem in Queensland and support Queensland's health and medical research. These resources are designed to support health and medical researchers, and industry partners navigate Queensland's digital health landscape.

Answering the call to harness data and information for a sustainable health system, our scientists worked with University of Queensland, Queensland Health, Queensland Ambulance Service, clinicians from Gold Coast and Metro South Hospital and Health Services to better understand emergency department patient flows and bed demands across Queensland's hospitals. By integrating ambulance, emergency department and inpatient data, this program adopts a system-wide view of patient flow interactions to identify access issues and design solutions to improve patient flow at a system level.

With the recent mainstreaming of AI technologies, we have projects in various stages of implementation and development for the use of AI in healthcare with Queensland Health. These projects aim to ensure AI capabilities are effectively and responsibly harnessed to efficiency in the health system and improve patient outcomes. We have delivered several key projects using natural language processing techniques to enhance medical search and analytics. Among others, we have developed a precision medicine search platform at Children's Health Queensland to help clinicians identify potential treatments for children with cancers, support the notifications of cancer based on radiology reports, and use diagnostic test data to develop interoperable digital health antimicrobial stewardship applications for appropriate antibiotic prescription decisions.

Our teams continue to work with many areas across Queensland Health, including eHealth Queensland, Clinical Excellence Queensland, many Queensland Health and Hospital Services and Cancer Alliance Queensland. Recently, we developed several projects with these areas using data and analytics to better understand vulnerable patient groups presented to emergency departments, and improve care provided to both inpatient and outpatient cohorts connecting care to recovery. Our nationally validated M♡THER platform (developed to support women with gestational diabetes) has seen over 13,000 women and their treating physicians benefiting from the solution. We have also expanded our mobile health platform for other complex care conditions such as COPD, hypertension, colorectal cancer, stroke, peritoneal dialysis support and people with mental illness.



Queensland Health participants at the FHIR Developers training in Brisbane

Our imaging team has been working with the QIMR Berghofer Medical Research Institute, University of Queensland and Queensland Cyber Infrastructure Foundation to establish Queensland Alzheimer's disease cohort study. This study will combine patients currently enrolled in multiple studies such as the national Alzheimer's Disease Network (ADNet) and the Queensland Based PISA study to form a larger cohort study and be the basis for further grant funding. This consortium will be a critical infrastructure to support Alzheimer's and other aging research in Queensland.

With the re-establishment of our AEHRC Research and Investment Advisory Committee, with representatives from both AEHRC and Queensland Health, there will be more opportunities and conversations to ensure our digital health innovations can be translated to better care delivery and patient outcomes.

Many of the projects reported in the 2024/25 annual report highlight the way we work with Queensland Health and we continue to value their fabulous collaboration.

The Health Data Semantics and Interoperability group

About the group

Group leader: Michael Lawley



Our group is answering the call for high quality real-time clinical information to be shared between individual health practitioners, healthcare provider organisations and state and territory health departments to improve patient outcomes and health system performance.

We develop and apply innovative tools and techniques for evidence-based solutions and strategies to support improved health outcomes. As catalysts in developing the maturity of Australia's digital health ecosystem, we use, promote, and enhance health IT standards to improve the quality of, and unleash the value in, health data,

including electronic health records and administrative data sets. We translate this to impact through our role in operating the National Clinical Terminology Service (NCTS) and running Sparked, Australia's FHIR Accelerator programme.

We apply informatics, ML, NLP, and formal logic to problems involving decision support, systems modelling and integration, and reporting and analytics.

Health Data Semantics and Interoperability science and impact highlights for 2024/25

- Ontoserver accredited for use in the HL7 terminology server ecosystem and is registered for use by seven countries.
- Sparked delivered: Release 1 of Australian Core Data for Interoperability (AUCDI) and the AU Base v5.0.0 and AU Core v1.0.0 FHIR Implementation Guides. Release 2 of AUCDI with an expanded scope for Australian clinical data for interoperability imminent.
- A major new release of the Australian Medicines Terminology, AMT V4, went live along with powerful new tooling for maintaining it.
- Enhanced Medtex platform in collaboration with Cancer Alliance Queensland to meet new Queensland cancer notification legislation, expanding coverage to newly notifiable cancer types and improving automated extraction of reportable data from clinical text to support timely and accurate cancer registry reporting.
- Prototyped a digital health standards-based test result review application, developed in partnership with emergency departments, to enable future SMART-on-FHIR integration for microbiology and antimicrobial resistance data review. The prototypes are positioned for adaptation into clinical workflows and piloting using the integrated electronic medical record (ieMR) at the Queensland Children's Hospital.

- A precision dosing clinical decision support tool, developed in collaboration with the Herston Infectious Diseases Institute (HeIDI), is designed to assist antimicrobial dosing in critically ill patients using population pharmacokinetic models. The software is currently undergoing internal testing, being expanded to support more complex dosing models, and is in preparation for piloting in clinical settings.
- LLM-based clinical applications, including text summarisation, structured data extraction, and synthetic data generation demonstrated the potential of LLMs to enhance clinical decision support and improve data quality, laying the groundwork for future translational research and piloting.

Terminology Projects team

Team Leader: Kylynn Loi

Our team facilitates the use and implementation of standard terminologies such as SNOMED CT to improve health data quality and data interoperability. The team does this by working with national and international groups to develop terminology content, develop and apply data analytic techniques to coded data, and provide advice around implementation and use of terminology in Australia. This team also works together with the Sparked community to support the development of clinical artefacts including the AUCDI.



FHIR Terminology and Tooling team

Team leader: Dion McMurtrie

Our team comprises engineers specialising in the use of FHIR and clinical terminology to develop and integrate digital health systems. We create various tools to advance and facilitate the adoption of FHIR and related standards in building and integrating digital solutions within the health sector.



Data Semantics and Machine Learning team

Team leader: Dr Bevan Koopman

Our research is about helping people find relevant and reliable health information to make health related decisions. We do this with a focus on natural language processing, search and machine learning approaches.

We tackle problems where people need to find answers and make clinical decisions in the face of overwhelming amounts of typically unstructured data. This may occur in evidence-based medicine where, for instance, clinicians need to search through vast amounts of literature and clinical trials to find a targeted treatment for a specific cancer.



A solution might involve automating the processing of matching and recruiting patients to a clinical trial.

Our research is about:

- how to build models that search through, understand and generate natural language
- understanding the semantics of someone's query rather than just matching keywords
- how to inject medical domain knowledge into an AI model
- putting the human searcher in the loop so they can bring their domain knowledge to guide the model to relevant information.

Health Data and Text Analytics team

Team Leader: Dr Anthony Nguyen

We develop and apply advanced AI methods to unlock the full potential of electronic health record data. Our work enables complex, automated analyses that support clinical and public health decision-making. By collaborating closely with healthcare providers, we transform both structured and unstructured clinical narrative data into actionable insights. Our innovations improve:

- data quality
- patient outcomes
- the overall performance and productivity of the health system.



We specialise in natural language processing, machine learning, deep learning, including LLMs, and clinical terminologies. These technologies are central to achieving meaningful data interoperability and powering decision support, analytics, modelling and reporting across the healthcare landscape.

Health Data Semantics and Interoperability: Platform technologies

Poor data quality and consistency resulting in a lack of or inferior insights can compromise the quality and efficiency of care.

Our technologies enable interoperability, advanced and effective use of data captured in electronic medical records, through the development of products and services to support the use of clinical terminologies such as SNOMED CT and interoperability standards such as FHIR®.

Suite of FHIR native terminology tools

Widespread use of national terminologies by clinical systems provides considerable interoperability benefits and supports meaningful use of patient data for better health outcomes. However, rich and powerful clinical terminologies, such as SNOMED CT, are complex in nature.

This complexity makes implementation difficult and often costly, presenting a challenge to adoption. To address this challenge, we are developing new technologies that enable the advanced use of clinical terminologies such as SNOMED CT, LOINC and any FHIR-based CodeSystems.

Ontoserver

Ontoserver is the world-leading clinical terminology server implementing FHIR terminology services and supporting syndication-based content distribution.

Over the last year Ontoserver has continued to receive many new updates including:



- Only 3rd party terminology server to be validated for use with HL7 IG Publisher and Validation infrastructure
- Significant enhancements to code validation and translation support
- Further pre-adoption of FHIR R5 features where no backward compatibility issues exist
- Extended support for new SNOMED CT expression constraint language features
- FHIR R5 support

ontoserver.csiro.au

Ontocloak

Ontocloak is an authorisation server for managing access to Ontoserver and other related services.

Atomio

Atomio is a syndication service for managing content distribution. It addresses key challenges in governance and distribution of versioned terminology content.

Snapper

Snapper: Author is a web browser-based app for authoring FHIR terminology resources and publishing them to a FHIR terminology server.

Snapper: Map is a web browser-based app that enables authoring maps from legacy terminology to standards-based terminologies. Together, these tools support migration to and use of standard terminologies, and the adoption of the national approach to interoperable digital health information.

Snap2Snomed

Snap2Snomed is an open-source tool built and operated for SNOMED International to support collaborative mapping of term lists and local vocabularies to SNOMED CT. It builds on expertise developed with Snapper and leverages the automapping capabilities of Ontoserver to provide collaborative mapping to an international audience including SNOMED member countries and vendors such as Babylon Health.

An experimental extension of Snap2Snomed supports additional target code systems hosted by Ontoserver such as LOINC, RxNorm, and ICD 10. This version, Snapagogo, has been made available to the Australian research community through a collaboration with the Australian Research Data Commons (ARDC).

SnoMAP

SnoMAP is a suite of SNOMED CT to ICD10-AM mapping products that enables diagnoses to be recorded using SNOMED CT-AU and mapped to ICD10-AM codes. We have developed two products:

- **SnoMAP Starter:** a simple SNOMED CT-AU diagnosis to ICD-10AM Codes FHIR ConceptMap, to support the use and reuse of SNOMED CT for analytics and research activities.
- **SnoMAP ED:** a mapping service for emergency department non-admitted patient reporting purposes, thus supporting the use and re-use of the standard clinical terminology for ED funding activities. This has been revamped to support mapping directly to the IHACPA ICD10-AM shortlist.

Snorocket

Snorocket is our description logic reasoner, which for the first time enabled semi-real-time authoring of very-large-scale clinical ontologies like SNOMED CT. Snorocket is available under an Apache 2.0 opensource licence and as a Protégé plugin. It has also been licensed to SNOMED International and the Agency for their ongoing maintenance of SNOMED CT.

github.com/aeherc/snorocket

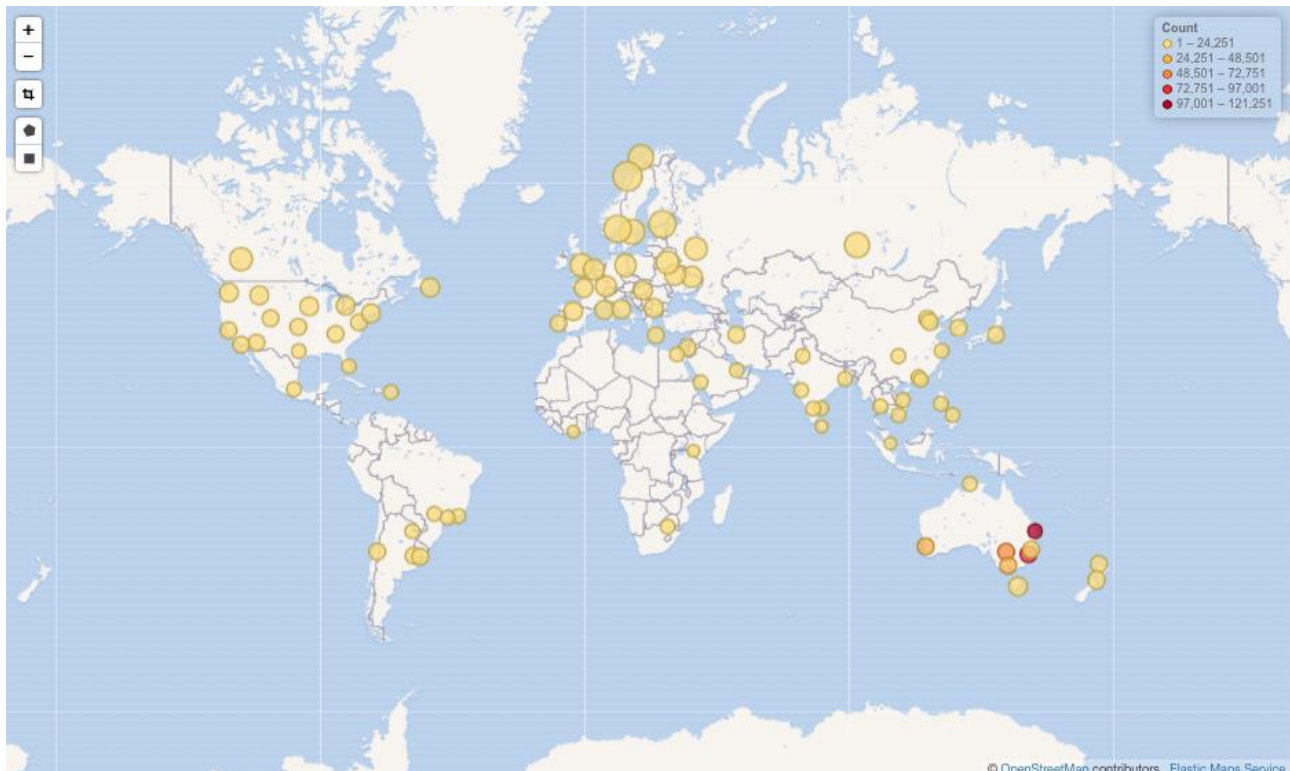
Shrimp

Shrimp is a widely used tool for browsing SNOMED CT, LOINC and other FHIR CodeSystems, powered by Ontoserver.



Supporting users around the world

Our clinical terminology and FHIR® enabled products are in use globally to support the advanced use of SNOMED CT, management of ValueSets and ConceptMaps and syndication of clinical terminologies. Shrimp and our public testbed are used worldwide. Ontoserver is also licensed commercially by users in Australia, New Zealand, Switzerland, Germany, England, Wales, Scotland, Estonia, Sweden, France, Belgium, Estonia, Indonesia, Canada, and the United States, with evaluation licences used across the United States, ASEAN region and South America. There are also several managed-service and embedded-use reseller licences in place with vendors in Nth American and Europe.



Supporting open-source technology

Pathling

Pathling simplifies the use of HL7® FHIR® and clinical terminology within data analytics. It is built on Apache Spark, and includes language libraries and a server implementation.



Pathling was designed to assist with these primary use cases:

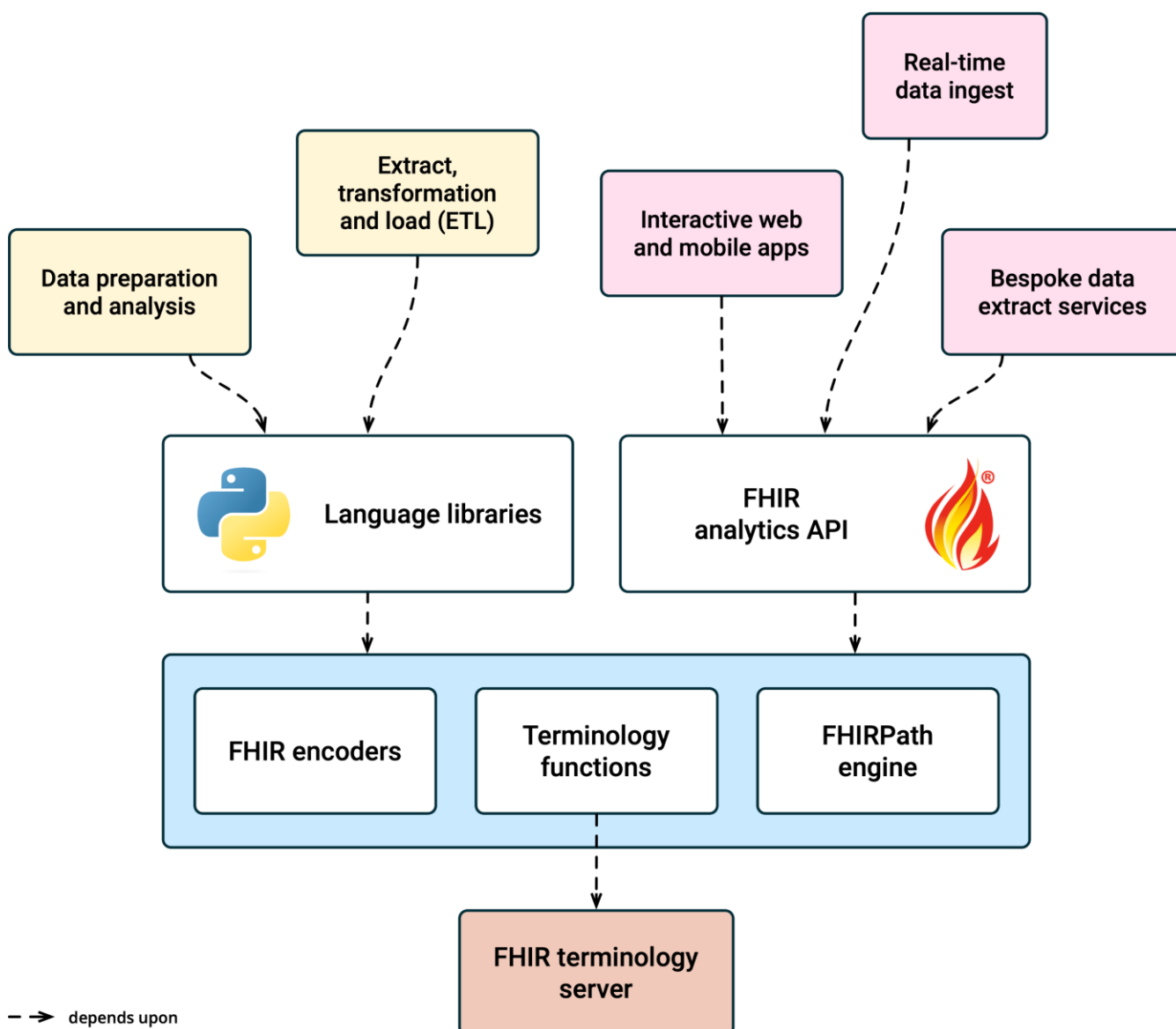
- Exploratory data analysis — Exploration of hypotheses, assessment of assumptions, and selection of appropriate statistical tools and techniques.
- Patient cohort selection — Selection and retrieval of patient records based on complex inclusion and exclusion criteria.
- Data preparation — Processing and re-shaping data in preparation for use with statistical and machine learning tools.

Pathling uses FHIRPath expressions for the aggregation and transformation of data, along with powerful and expressive search queries. This makes it easier to select and transform FHIR data as compared to a generalised query language such as SQL, and it also allows us to extend the functionality of the FHIR API to make it more capable for analytic use cases.

Pathling also integrates with the FHIR Terminology Services API to enable advanced terminology functionality within queries, at query time and at scale. This allows users to access terminological information and join it to clinical data in arbitrary ways, including advanced support for SNOMED CT and its expression constraint language.

Language libraries are available in the Python, Java and Scala, allowing for deep integration into existing applications and data science workflows. The server implementation provides a standard FHIR interface to analytic query operations and is suitable for the delivery of web and mobile applications.

You can learn more about Pathling at <https://pathling.csiro.au/>



Pathling: components and their corresponding use cases

Smart Forms

Smart Forms is an open-source web browser-based app for rendering FHIR Questionnaires. It supports clinical integration with healthcare systems for capturing standards-based health information.

Based on FHIR's Structured Data Capture specification, it notably provides these additional capabilities for forms:

- data pre-population — allows re-usability of data by pre-filling data existing in the healthcare system
- conditional rendering — rendering of questions based on user decisions or pre-filled data
- calculations – dynamic calculation of quantitative results based on answers existing in the form
- terminology support — allows use of standardised medical terminologies to represent medical concepts and data in forms.

Smart Forms provides an open-source library for its React-based rendering engine which is recently adopted by a few Australian and New Zealand-based organisations in the digital health space. Other supporting libraries for data pre-population and modular assembly of sub-questionnaires are also provided.

You can learn more about Smart Forms at <https://smartforms.csiro.au>.

The development of Smart Forms was funded by the DHDA.

Smart Forms: Rendering of the Aboriginal and Torres Strait Islander Health Check

Natural language processing

As the adoption of EMRs continues to grow, healthcare systems are increasingly shifting toward structured and standardised data formats. Yet, clinical documentation still relies heavily on narrative or free-text entries — rich in context, nuance, and clinical insights. These unstructured segments often contain critical information that supports diagnosis, treatment planning, and continuity of care.

Unlocking the full value of this data from free-text requires advanced techniques in NLP, which enables the querying, analysis, and interpretation of free-text content, transforming it into actionable insights. This remains both a challenge and opportunity in digital health innovation. AEHRC is addressing this through cutting-edge research and platform development in NLP, deep learning, and LLMs, helping to bridge the gap between unstructured clinical narratives and structured, computable health data.

Medtex

Medtex is our semantic medical text analysis platform, designed to extract structured insights from free-text clinical documents to support clinical decision making.

Medtex learns to identify clinically relevant statements and maps them to SNOMED CT, the internationally recognised clinical terminology, enabling consistent interpretation across diverse information sources. By incorporating domain knowledge, Medtex bridges the gap between natural language and formal clinical semantics, enabling automated inference and reasoning over medical text.

Medtex analysis engines have been developed to:

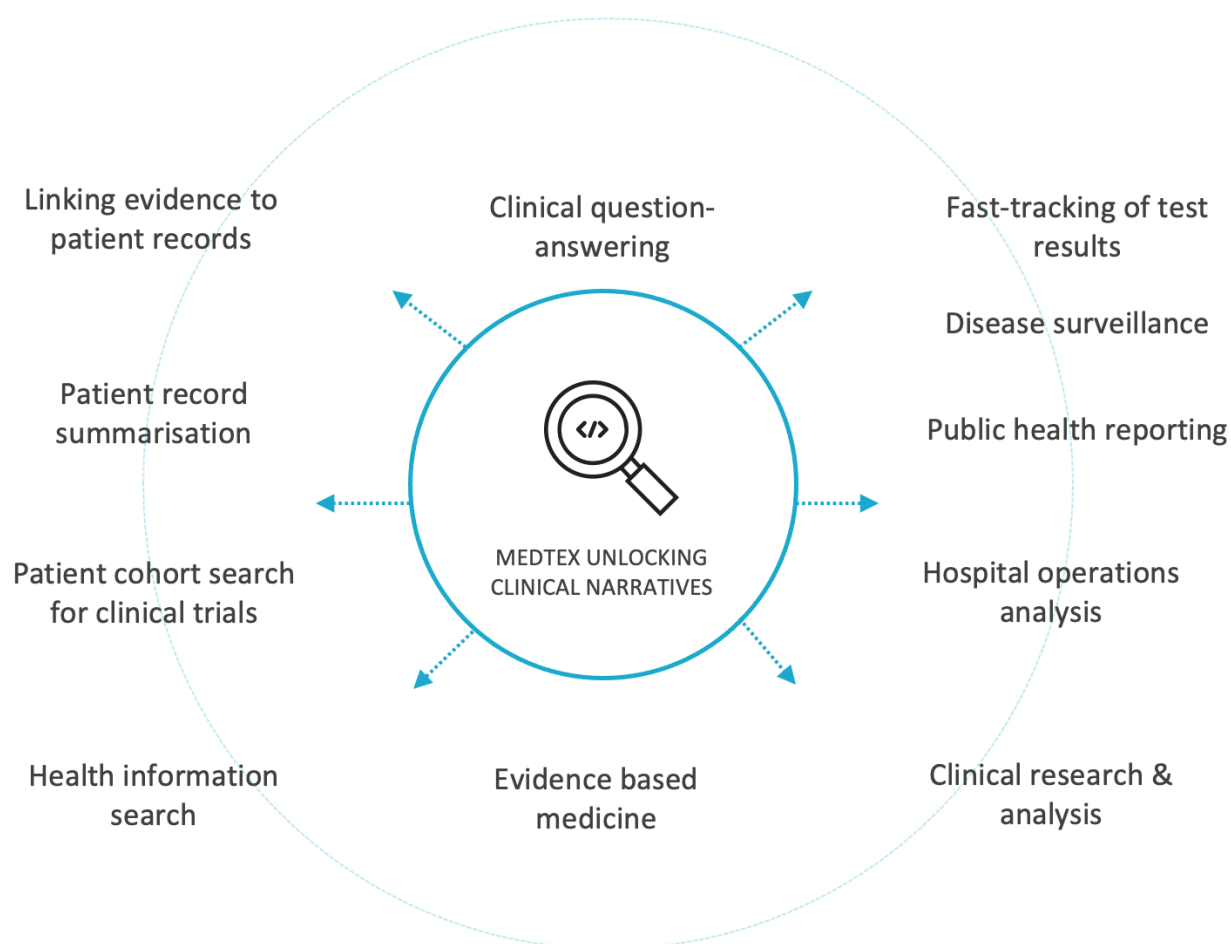
- standardise free text by identifying medical concepts, abbreviations and acronyms, shorthand terms, dimensions and relevant legacy codes
- contextualise and relate concepts using document structure and clinical context
- infer complex clinical notions through formal semantic reasoning tailored to specific health applications.

Medtex operates within a highly distributed computational framework, transforming unstructured narratives into structured data that can be queried, stored, or rendered across health systems.

Medtex has been utilised to deliver solutions to healthcare practitioners, including cancer registries and emergency departments. These solutions include:

- extracting cancer characteristics from pathology, radiology, and death certificate reports to support cancer incidence and mortality analysis
- streamlining pathology and radiology test result review workflows in emergency departments and identifying patients at risk of misdiagnosis or inappropriate antibiotic use.
- analysing triage assessments and progress notes to identify pain presentations and assess chest pain risk
- enabling advanced search and analytics across medical records.

Read more in [Health Data Semantics and Interoperability: Project Reports and Projects Updates](#).



Medtex: Unlocking clinical narratives

Search engines for health data

With a rapid increase in health data—in all its myriad forms—the need to effectively search this data rises. Simultaneously, much of this data is unstructured, making it difficult to search using methods tailored to structured data. Search engine technology was designed specifically for large amounts of unstructured data, making it well suited to the health domain.

We developed a suite of solutions for searching health data. Nowadays most of our work involves the training of AI models, specifically neural network models for ranking and natural language processing. These models are adept at understanding the meaning behind a user's query and the relevant information they are looking for, making them much better at finding that relevant information.

The development of our search technology is driven by the idea that people are looking for information to make important health decisions. As such, we develop solutions that support the decision making, empowering users with the information they need rather than ceding control to a black box system.

Key technologies we have developed include:

- Evidence-based search systems capable of ingesting all of PubMed and all current clinical trials and suggesting relevant evidence to support clinical decision making
- Automated the matching of patients to clinical trials (or visa-versa)
- Targeted cancer treatment recommendation for children with specific genetic findings
- Systematic analysis of human search behaviour in the health space to inform the development of better search engines

Chatbots for health

Chatbots bolster engagement in human-computer interaction. There are many examples in health care where chatbots can be used to support patients, carers and clinicians. A chatbot enables interactions between a knowledge base and a user in speech or text. Each chatbot is powered by a "brain" which needs to be developed and trained to support engaging dialogues. We've developed a range of chatbots for clinical and social settings. Recent examples include:

- The "What Matters 2 Kids" project uses a chatbot to engage with First Nation children that asks them to draw what matters to them. The chatbot then enquires about the drawing to capture the well-being of the child.
- "Dolores" a chatbot to discuss all things related to chronic pain with language suitable for the age of the user. Dolores has been piloted at pain clinics at the Royal Brisbane & Women's Hospital and Melbourne Children's Hospital.
- "Quin" a smoking cessation chatbot built from thematic analyses of Quitline counselling sessions. Quin is being designed for long-term use and support for a user wishing to cease smoking.
- "Aurora" a chatbot that administers a sleep-dependent memory test (developed at the University of Sydney) for people living with mild cognitive impairment. Aurora handles the testing within a critical time window and reschedules if the user misses the test.



Our chatbots can function on mobile devices without requiring internet access and have support for:

- Smart on FHIR
- Incorporate web LLMs or run entirely on a mobile device for privacy and security
- Custom user interface widgets
- Voice logging and processing
- Drawing widgets for interaction with children

Health Data Semantics and Interoperability: Project reports

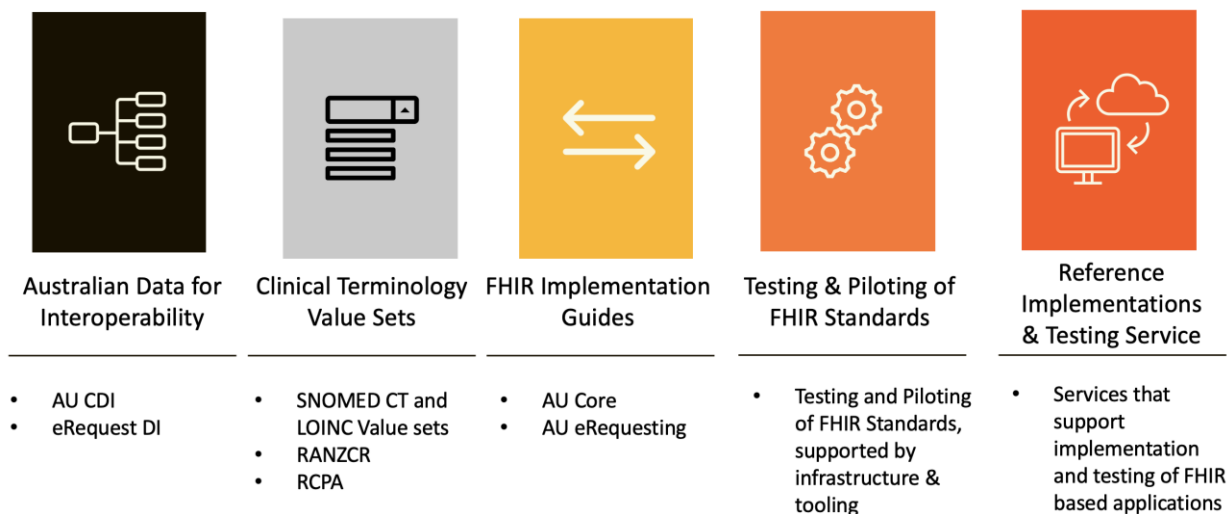
Sparked: Australia's National FHIR Accelerator

Collaborator: Commonwealth Department of Disability, Health and Ageing, The Australian Digital Health Agency, HL7 Australia

Sparked is Australia's first FHIR Accelerator, driven by a community-centric approach to accelerating the design and development of national data and FHIR standards that underpin standardised capture, storage and sharing of health information securely across Australia. The open, transparent, and consensus-driven community informing the development of these standards comprises government, technology providers and implementers, health provider organisations, peak bodies, practitioners, and domain experts.

Sparked is led by CSIRO's AEHRC in partnership with the DHDA, the Agency, and HL7 Australia.

The proposed specifications (Data for Interoperability and FHIR Implementation Guides) defined by the community have been published for public review and comments. These comments are being incorporated into the standard to ensure they are clinically and technically fit-for-purpose and scalable across Australia's implementer community. Through this process, we are conducting a scientific implementation evaluation of the approach to ensure a robust and repeatable approach is being taken based on international best practices.



Sparked has made significant progress in the last 12 months, with the Sparked community having grown to over 1200 members having delivered on multiple product artefacts, including the second release of the Australian Clinical Data for Interoperability (AUCDI) Release 2, AU Core FHIR Implementation Guide Release 1 balloted and the first draft of the eRequesting Data for Interoperability (eReqDI) ballot.

In parallel to these milestones, FHIR terminology value sets are being developed in collaboration with clinical colleges and peak bodies to implement consistent, clinically meaningful and computable language across systems. This year has focused on an Australian Patient Summary (aligned with the International Patient Summary standard), chronic disease management and

encounter record information. Further to the success so far, DHDA has committed further funding to support the planning of future work needing to be achieved by the accelerator.

Future projects will include supporting existing work to test the implementation of the above standards and continuing to support the standardisation of concepts for patient summaries, chronic disease management, and encounter record data.

The National Clinical Terminology Service

Collaborator: The Australian Digital Health Agency

The National Clinical Terminology Service (NCTS) is governed by the Agency and operated by us. The NCTS manages, develops, and distributes national clinical terminologies such as SNOMED CT-AU (including the Australian Medicines Terminology (AMT)), FHIR terminology resources, and related tools. We are also responsible for being the Australian National Release Centre for SNOMED CT on behalf of SNOMED International.

This year the AMT model has been aligned with the new drug model from SNOMED International. This major revision will deliver enhanced interoperability with other countries especially in conjunction with the International Patient Summary. To support this change, the authoring tool Lingo has been rebuilt, leveraging the international authoring tool and applying modern machine learning technology to assist in auto-generation of candidate labels for newly modelled content.

Entering the third year of a five-year service agreement with ADHA, the vision of the NCTS is to enhance healthcare delivery in Australia by streamlining the adoption and effective use of clinical terminology, enabling improved patient safety, data interoperability, and healthcare outcomes. To support and deliver on this, our focus is now on outreach and education through engagement with terminology users and implementers to support knowledge development in the community, promote adoption of standardised terminology, inform and communicate future enhancements, support implementation such as Ontoserver and extensions to the NCTS. This will be in conjunction with the ongoing delivery of the monthly NCTS releases.

Automating cancer data registries to enhance data quality and efficiency

Collaborator: Cancer Alliance Queensland (CAQ), Queensland Health

The Queensland Cancer Register (QCR), managed by Cancer Alliance Queensland (CAQ) at Queensland Health, is a population-based registry that plays a critical role in monitoring cancer incidence and outcomes across the state. In partnership with CAQ, we developed Medtex, an NLP platform that automates key cancer registry tasks to improve data quality and operational efficiency.

Medtex automatically identifies pathology and radiology reports that are notifiable to the QCR, reducing the manual burden on diagnostic imaging and pathology providers. Unlike studies and systems that focus on specific tumour types, Medtex extracts information across the full spectrum of cancers. It supports multiple reporting needs—including cancer notifications, staging and synoptic reporting - and integrates this data into the Queensland Oncology Repository (QOR). This enhances the clinical coding workflow and strengthens data capture within the QCR.

Read more about Medtex in Health Data Semantics and Interoperability: Platform Technologies.



Precision medicine search engine for paediatric oncology—"Oscar"

Collaborator: Queensland Children's Hospital

This project created 'Oscar': a search engine for finding targeted treatments for a specific child patient based on the genomic profile of their cancer.

Oscar allows clinicians to search over 300,000 clinical trials and 25 million medical articles. The specialised search capabilities of Oscar mean clinicians can find the right treatments for their patients with higher accuracy and less time/effort, ultimately leading to better patient outcomes for the most vulnerable patients — kids with cancer.

Our computer scientists, together with doctors from Queensland Children's Hospital developed AI algorithms to match a patient to relevant treatments. On top of this, software was developed to allow doctors to search, filter and explore treatments specific to their patients.

Oscar was rigorously evaluated in multiple ways. Using 136 real patient cases from Queensland Children's Hospital, Oscar was able to provide a relevant treatment in top two search results in 50% of cases. Oscar was then independently evaluated by Children's Cancer Institute, Sydney, where Oscar was able to find more relevant treatments and at a lower workload compared to current practice. In an overall survey of clinicians, seven out of eight indicated they would continue to use Oscar.

The technology underlying Oscar has been scientifically peer-reviewed, resulting in four international scientific publications.

Oscar was a runner up in the Queensland AI Award for the category "Outstanding AI Collaboration or Partnership".

Aus CVD Risk-i Calculator

Collaborator: National Heart Foundation of Australia

We partnered with the National Heart Foundation of Australia to create a new version of the Aus CVD risk cardiovascular risk calculator, designed to integrate more closely with general practice management systems. The new Aus CVD risk-i calculator uses the FHIR standard to automatically populate relevant information from the patient record and automatically write the final cardiovascular risk result back into the patient record to inform their ongoing care and management.

The application aims to:

- Improve workflow efficiencies for clinicians by reducing administrative burden of data entry.
- Provide a standardised pathway to integration to ensure data mapping is according to agreed standards. Previous integrations were done individually by CIS vendors, resulting in variable risk results.

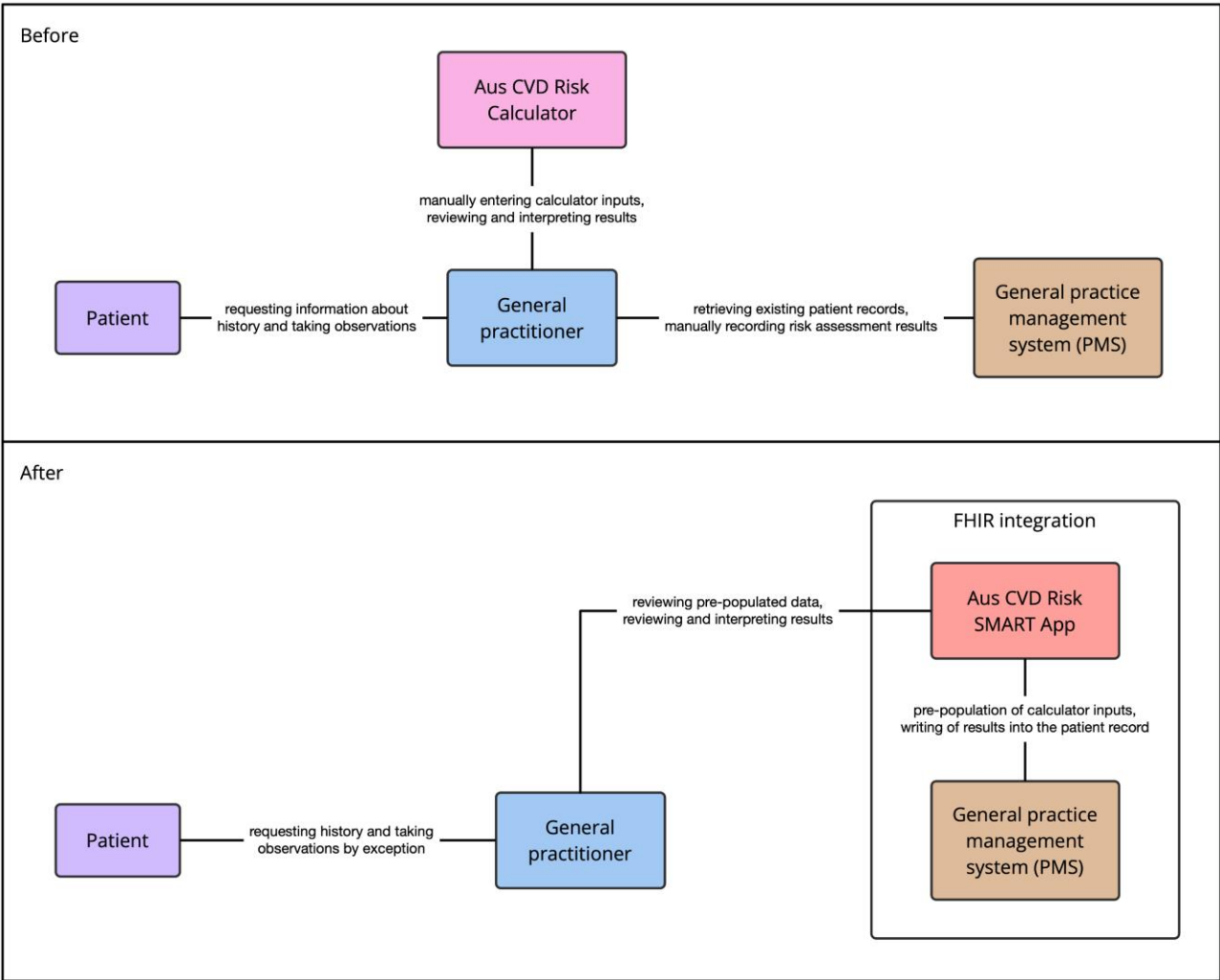
Aus CVD Risk-i leverages the FHIR AU Core profiles developed by the Sparked program and adopted by primary care software vendors. This allows the calculator to provide value without requiring significant additional integration work from vendors, demonstrating that FHIR interfaces are delivering reusability across a variety of different use cases.

The calculator was developed over a period of six months, split into three iterations. Stakeholders were given the opportunity to see and interact with working software throughout the process and contribute to the design and refinement of the tool. We also made the calculator available at multiple HL7 Australia connectathons, during which we were able to demonstrate it working with prototype FHIR interfaces from all the major general practice vendors.

We also participated in testing with primary care clinicians to evaluate the usability of the software, including general practitioners and nurse practitioners.

The calculator leverages technology from our popular open-source Smart Forms product, which helps to automate the creation of user interfaces based on the FHIR Structured Data Capture standard.

The Aus CVD Risk-i calculator was developed within our ISO 13485 compliant Quality Management System, assuring the quality of the implementation and producing a technical file that can be used for regulatory purposes to facilitate its rollout.



Changes to general practice workflow before and after the implementation of Aus CVD Risk-i

Health Data Semantics and Interoperability: Project updates

SNOMED CT in QLD digital hospital projects

Collaborator: Office of the Clinical Information Officer (OCCIO), Queensland Health

We have continued close collaboration with Queensland Health's Office of the Clinical Information Officer (OCCIO) to support the use of SNOMED CT in the Oracle iEMR product deployed in Queensland hospitals. This involves providing education and support to the team around the use of SNOMED CT in surgery, emergency departments and trauma, particularly during terminology updates, as well as support and maintenance of SNOMAP-ED.

SNOMAP-ED is a tool which takes the original SNOMED CT-encoded patient data recorded by emergency department clinicians and transforms it to qualify for activity-based funding. This is being used in Queensland digital hospitals to allow the SNOMED CT-encoded data to maintain its true value for clinical care delivery and to ensure it complies with, and qualifies for, activity-based funding. SNOMAP-ED has both SNOMED concepts and ICD-10-AM codes which are updated twice per month and Queensland digital hospitals can submit data for activity-based funding in near real time.

We are also working with Queensland Health to make this map available to Queensland Health sites through the Queensland Clinical Terminology Service as a FHIR concept map.

SNOVet with ACDP

Collaborator: Australia Centre for Disease Preparedness

SNOMED CT has a companion veterinary extension, SNOVet, which is currently managed outside of the SNOMED International. With the increase in focus on one health as the intersection of human, animal and environmental health, a terminology that allows for consistent data capture across these domains will be useful.

Together with CSIRO's ACDP, we are aiming to use SNOVet as the basis of data capture across the ACDP biosecurity STARS web service, which captures data about biological samples sent to ACDP for analysis. Through this real world use we are aiming to improve one health content coverage within the international terminologies (SCT and SNOVet) through identification of content gaps and addition of new concepts.

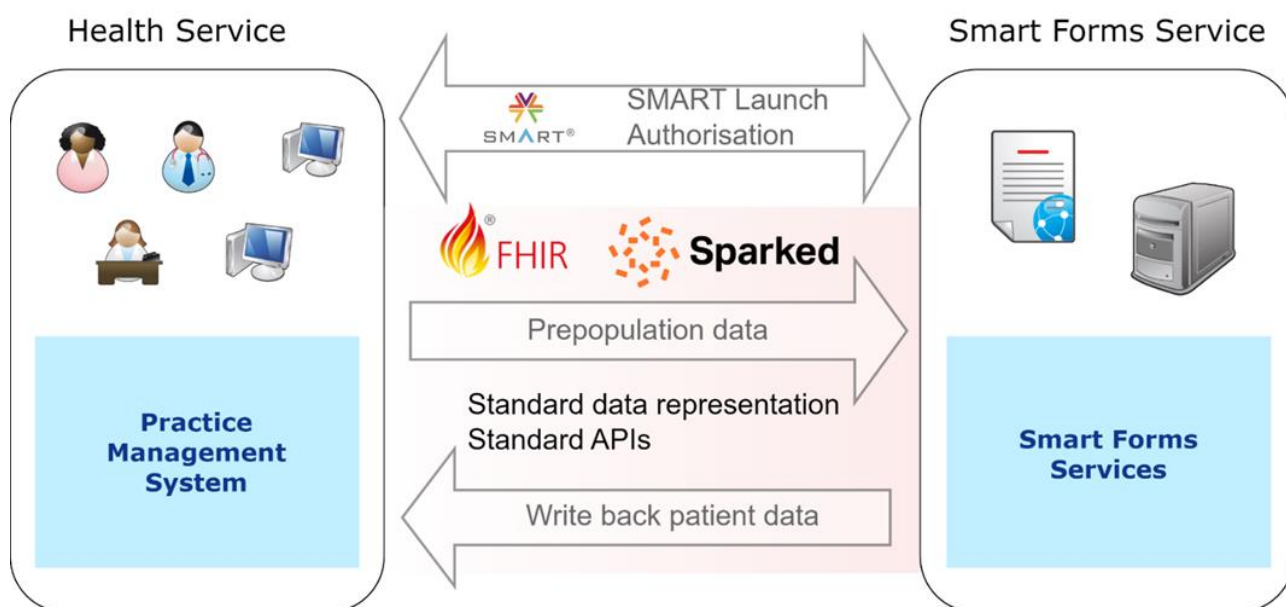
ACDP is now progressing to implementing new FHIR enabled codesets delivered to their systems through Ontoserver. We continue to deal with the lab's legacy data through mapping processes and this proving successful. We are also investigating alternative terminologies or taxonomies which may have greater suitability over SCT for their varying use cases.

Smart Health Checks

Collaborator: Commonwealth Department of Disability, Health and Ageing

With investment from the DHDA, we have developed open-source software and specifications to demonstrate how adopting foundational data standards can enhance patient information utility and improve the efficiency of the patient health assessment process. Building on the work to date, this project aims to extend the work with the First Nations Health Division to pilot the Smart Health Check—an enhanced tool for Medicare benefits schedule item 715 Health Checks, with a focus on software improvements and strengthening vendor capabilities to ensure effective support and delivery.

We're currently in the process of negotiating and executing contracts with participating GP desktop software vendors, to commence their product capability uplift from July. Software and specification development enhancements are also in progress and predominantly focused on write-back capability (to the patient record) and options for integration with the AU CVD Risk-i Calculator.



Digital health software project course with the University of Queensland

Collaborator: University of Queensland

We again partnered with the University of Queensland (UQ) to offer a health informatics on FHIR course to third- and fourth-year IT/software engineering students in the second semester of 2023. The course was led by Dr Chelsea Dobbins, lecturer at the UQ School of Information Technology and Electrical Engineering, and CSIRO Distinguished Visitor Professor Mark Braunstein. This year's cohort of students was significantly larger than previous years, up to 73 students.

The students worked with a group of clinical stakeholders including our researchers, with student groups building SMART-on-FHIR apps. Professor Braunstein's Health Informatics on FHIR online course was further expanded to include more videos and exercises covering the Australian digital health landscape.

Improving antimicrobial dosing in critically ill patients

Collaborator: Herston Infectious Disease Institute, Metro North Hospital and Health Service (MNHHS) and University of Queensland (UQ) Centre for Clinical Research

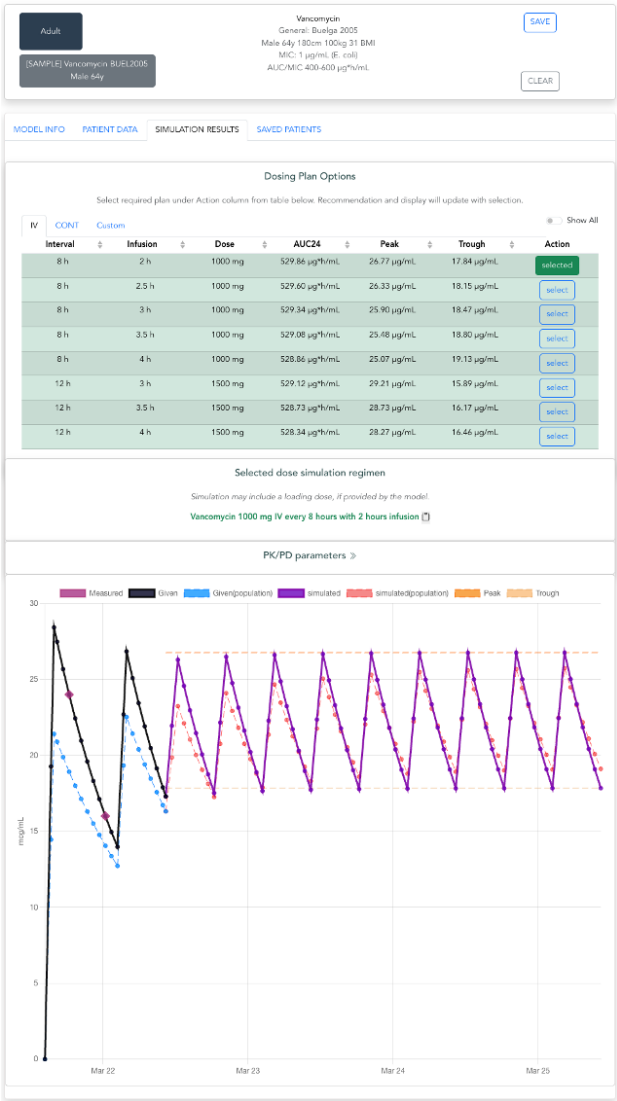
Difficult-to-treat infections, often caused by multi drug-resistant organisms, require prolonged antimicrobial therapy and are associated with high rates of morbidity and mortality. These infections are common across hospital settings and frequently affect critically ill patients who

require urgent, life-saving interventions. A key contributor to poor outcomes is suboptimal antimicrobial therapy, particularly ineffective or inappropriate dosing, which can also lead to the emergence of antimicrobial resistance.

Precision dosing offers a promising solution by tailoring antimicrobial therapy to individual patients based on available clinical data, including pathogen susceptibility and measured drug concentrations. However, existing precision dosing tools are limited in scope, supporting only a narrow range of drugs and pharmacokinetic models, and are typically not integrated with clinical information systems used in Australian healthcare.

In response, this project has developed a prototype web-based precision dosing platform, incorporating exemplar one- and two-compartment PK models. Future research will focus on piloting and validating the software in clinical settings, expanding its drug and model coverage, and enhancing its integration with hospital workflows.

HeIDI-CSIRO Precision Dosing Calculator: A prototype software solution



Optimising pain identification in emergency departments using transfer learning

Collaborator: Royal Brisbane and Women’s Hospital (RBWH) and Princess Alexandra Hospital EDs; Queensland University of Technology

Accurate identification of patients presenting with pain is essential for timely and effective care in EDs. However, pain is often under-documented in structured electronic health records, despite being commonly described in free-text triage assessments. This project used advanced NLP and transfer learning to improve pain identification in EDs with limited data and annotation capacity.

Two strategies were applied: (1) fine-tuning a language model trained on data from a well-resourced ED, using 2,000 samples from a resource-limited ED, and (2) continual pretraining using large volumes of unlabelled clinical text. “Resource-limited” refers to EDs with fewer annotated datasets and limited capacity for manual labelling.

The combined approach achieved an F1-score of 92%, comparable to models trained in well-resourced settings. This work supports the development of scalable NLP solutions that enhance clinical text classification and improve patient care across diverse healthcare environments.

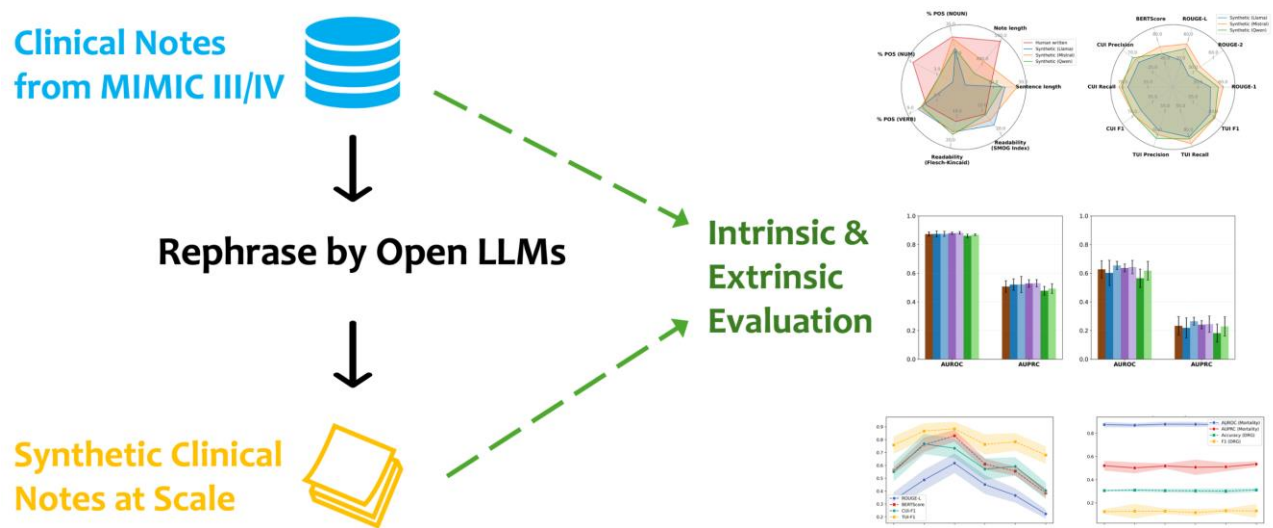
Evaluating synthetic clinical notes generated by large language models at scale

Collaborator: National Library of Medicine, NIH

Access to large-scale, high-quality clinical text is essential for training effective NLP models, yet privacy concerns and data scarcity remain major barriers. This project explored the use of LLMs to generate synthetic clinical text by rephrasing all notes from the MIMIC-III and MIMIC-IV databases, producing a 9.5-billion-word corpus—the largest of its kind.

The quality of the synthetic text was evaluated through intrinsic (linguistic and semantic fidelity) and extrinsic (predictive performance) assessments. Results showed that while LLMs altered the structure and language of original notes, they preserved core clinical meaning for most downstream predictive tasks. However, performance declined in detail-sensitive tasks such as ICD coding, indicating some loss of clinical specificity.

The findings support the use of synthetic clinical text for model development and data augmentation, offering a scalable and privacy-conscious resource for advancing clinical NLP in environments with limited access to real-world data.



Generating and evaluating synthetic clinical notes rephrased by LLMs at large scale

Enhancing clinical risk prediction from text using note-specific models

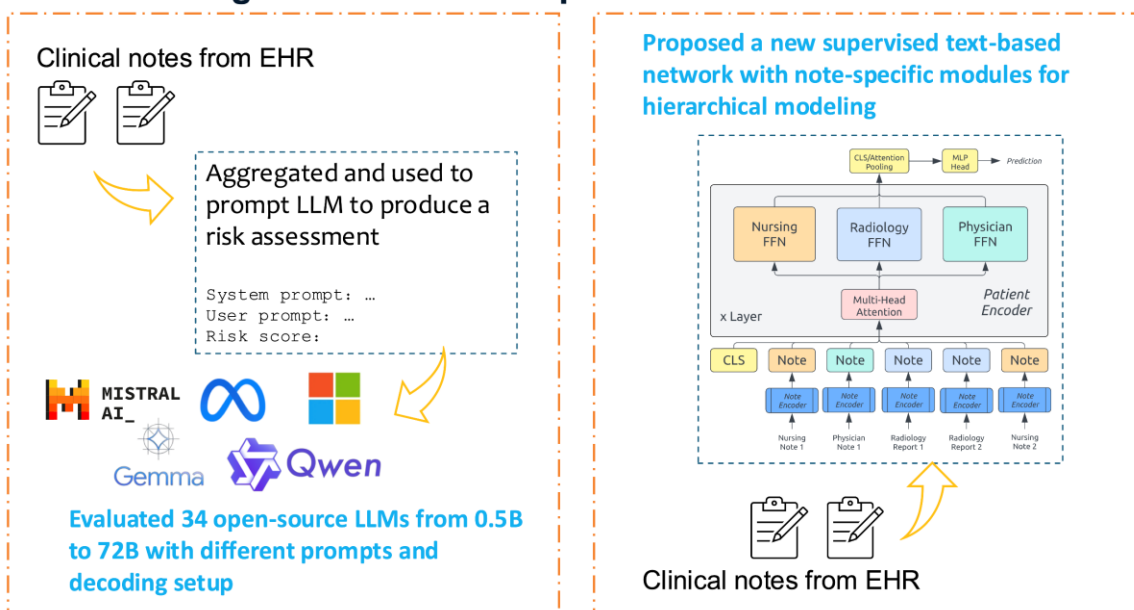
Collaborator: The University of Melbourne; RMIT University

Clinical risk prediction is a critical task in healthcare, with clinical notes offering a rich but under used source of information. These notes vary widely in structure and content depending on the author and purpose, posing challenges for NLP models. The effectiveness of instruction-following LLMs for risk prediction using real-world clinical notes also remains uncertain.

This study addressed both challenges in the context of in-hospital mortality prediction in critical care. A supervised hierarchical network with note-specific modules was developed to account for variations across different note types. The model was benchmarked against instruction-following LLMs using zero-shot, few-shot, and chain-of-thought prompting strategies.

Results showed that the note-specific model outperformed both measurement- and text-based supervised baselines. In contrast, LLMs consistently underperformed, highlighting limitations in their use for clinical risk assessment. The model also enabled identification of informative notes, supporting more efficient training of downstream models.

Benchmarking Text-based In-hospital Clinical Risk Prediction in ICU



Comparing NLP methods for clinical risk prediction: large language models and a note-specific hierarchical network

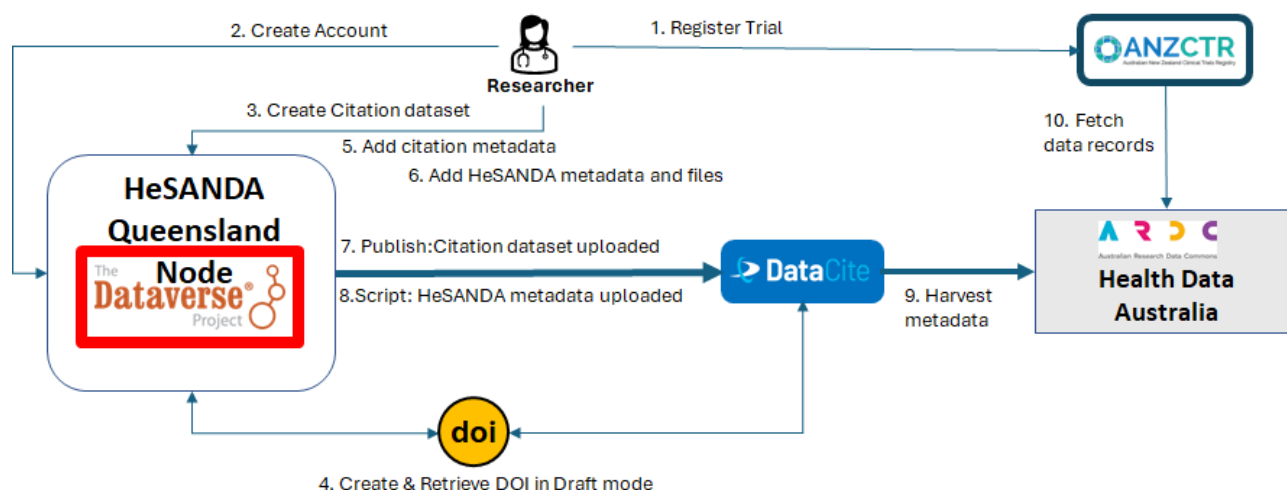
ARDC HeSANDA Project

Collaborator: Australian Research Data Commons, Health Translation Queensland, Queensland Cyber Infrastructure Foundation

The HeSANDA (Health Studies Australian National Data Asset) program is a strategic partnership with the Australian health research community to build a distributed national data asset from the outputs of health studies to support health data sharing and secondary use. HeSANDA will make health and medical research data easier to find, access, share and reuse, resulting in a reduction in research waste and improved researcher collaboration. It will increase Australia's return on health

and medical research investment by reusing existing data to inform new research questions, initiate new research collaborations and lead to improved health outcomes for patients.

With our partners we form one of nine nodes successfully awarded \$300k in funding to join this initiative in September 2021. The Queensland node implemented a Dataverse instance, as its operational platform, to facilitate the collection of the clinical trial metadata.



One of the outcomes of HeSANDA is the HDA platform, which launched in July 2023. Following the launch, a community connect project was initiated, in July 2023, to inform and educate the clinical trial community in Queensland about HeSANDA and the Queensland Node. This initiative has instigated a series of virtual and in-person workshops and the design of a suite of videos to better inform the clinical research community in Australia on four topics:

- Benefits of data sharing
- What is Health Data Australia
- How to setup your clinical trial up for sharing
- Why is metadata important for research

The community connect project culminated in the official launch of the HeSANDA Queensland Node in November 2023.

The Queensland node has been successfully awarded \$200k in funding in April 2024 to extend the activities of the HeSANDA project until May 2026.

Accordingly, in October 2024, the Queensland node initiated a survey to better understand the current practices of research data holders and requestors in relation to requests from other researchers for access to the data for use in another project. Furthermore, understanding of the enablers and barriers to research data sharing will inform the node's strategies to increase research data sharing, potentially accelerating scientific progress and improving public health. Results from this survey will be released in a journal publication soon.

In June 2025, the Queensland node has been successfully awarded an additional \$200k in funding, until May 2027, to expand the HeSANDA catalogue and activities to include cohort studies.

The 3,000 genomes project: using machine learning and artificial intelligence for robust culture-independent susceptibility testing

Collaborator: Pathology Queensland, University of Queensland, AMR Mission

Antimicrobial resistance is a growing threat with newly emerging resistance genes rapidly spreading in our hospital system.

However, while species level identification from genomic data is relatively straightforward, detection of the presence of antibiotic resistance genes is not always reliably predictive of phenotypic susceptibility. For rapid genomics-based diagnostics to be fully realised in clinical practice, we need predictive algorithms to robustly guide safe and effective antibiotic therapy. The prediction of resistance in bacteria is challenging because of complex underlying mechanisms and high rates of acquisition of resistance determinants via horizontal gene transfer.

In collaboration with Pathology Queensland and the University of Queensland, this project develops bespoke reliable machine learning analysis workflow to optimise rapid resistance prediction of antibiotic susceptibility from whole genome data for common bacterial pathogens. Two established machine-learning models were used to obtain the AMR contributory genotypic and k-mer frequency-based features. The features were individually evaluated for the classification performance with scores exceeding 90% observed on both the training and the validation datasets.

The 3,000 Genomes project concluded in January 2025 and demonstrated the value of machine learning (Random Forest and XGBoost) for predicting antibiotic susceptibility from genomic data alone. Future research should broaden the range of markers used, incorporating plasmids and other mobile genetic elements for more accurate and comprehensive resistance prediction.

MadeHER: Maternal and early life origins of menstrual disorders and pelvic pain

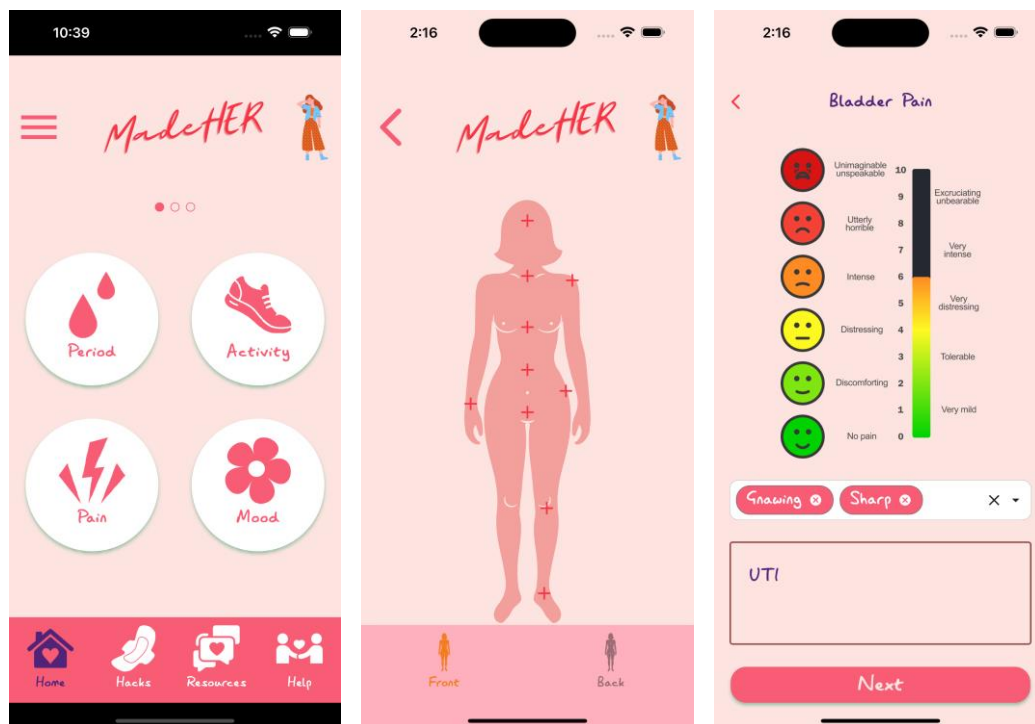
Collaborator: University of Queensland

Menstrual disorders—irregular, heavy, and/or painful periods and pelvic pain are common among adolescent girls. They can reduce quality of life and disrupt important life activities, such as school attendance, during this formative time. Persisting symptoms can indicate serious underlying pathologies, such as endometriosis or polycystic ovary syndrome.

In collaboration with Australian Women and Girls' Health Research Centre at the University of Queensland, who lead the MadeHER project, we developed a mobile digital diary to collect detailed prospective data on menstrual disorders and pelvic pain, and record linkage for prescriptions and health services.

The MadeHER mobile app features widgets for anatomy selection, pain scales, symptom description, and the volume of menstrual bleeding. Impacted social and schooling events and mood levels are also captured. The app provides PDF report generation suitable for GP visits. It also has gamification to encourage frequent data capture and selectable themes.

Adolescents (aged 11-19) and their mothers will be invited to participate in the MadeHER study. Both mothers and daughters will complete an online survey, and daughters will be invited to use the MadeHER app for 3-6 months. The target sample size will be 5000 mother-daughter pairs. The resulting evidence will identify factors involved in the development of menstrual disorders and pelvic pain during adolescence.



The MadeHer user interface

Generative AI discourse on the drawings of children living with chronic pain or who have experienced sexual abuse.

Collaborator: University of Queensland

This project examined the role AI might provide in interpreting drawings done by children living with chronic pain and those who have experienced sexual abuse. Children with chronic pain often lack the language and vocabulary levels to properly articulate their pain sensations and how pain affects their daily life. The drawings of children who have experienced sexual abuse frequently show subtle indications of abuse that have been discovered from decades of research in art therapy.

The AI system was able to correctly interpret some of these drawings and detect some of the red flags that can be relayed to a clinician. As such future work will be realising a multi-modal chat-bot providing natural language interactions, as well as drawing interpretation for more insightful interactions between children and computer interaction, ultimately striving for a technology that promotes better outcomes in the well-being of children.



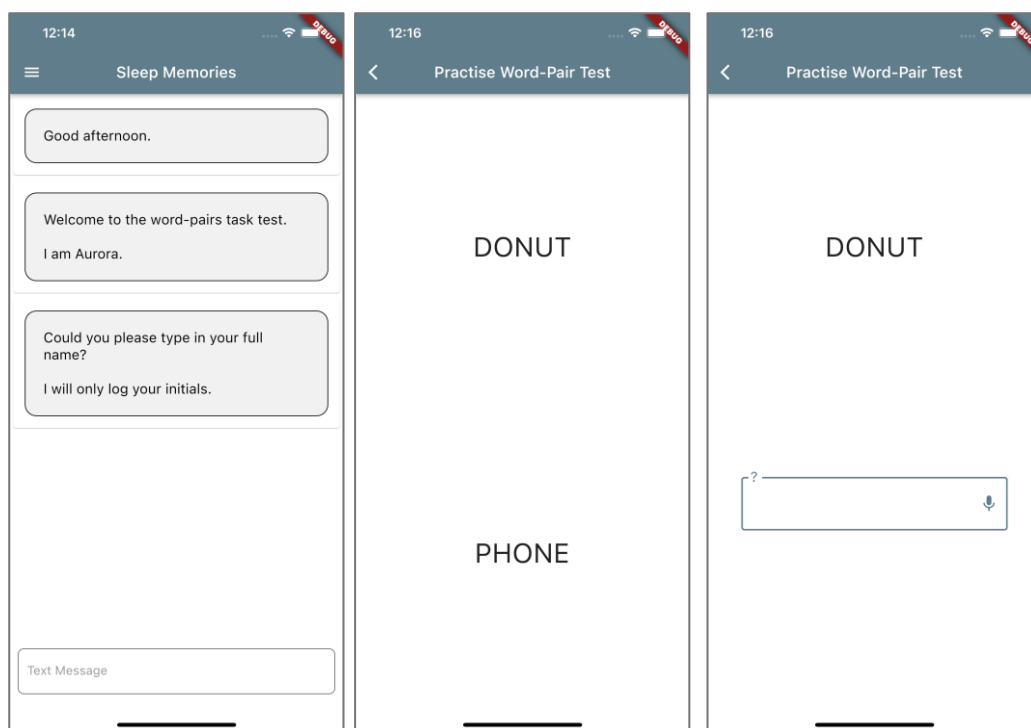
Two drawings of children living with chronic pain describing their pain sensations (volcano erupting and wave/flash sensations); and two drawings from two different children who have experienced sexual abuse that reveal known red flags (a figure with no arms /legs; house with a missing door)

Aurora: Sleep dependent memory chatbot

Collaborator: University of Sydney

A body of evidence supports the notion that sleep contributes to memory consolidation. Despite these findings, sleep-dependent memory is not routinely studied particularly in people living with mild cognitive impairment. Aurora is a chatbot that administers a sleep-dependent word-pair memory test developed at the University of Sydney for people living with mild cognitive impairment.

Aurora sets up a user profile, provides instructions to the user, and displays the word-pairs widget within the valid time window. It also coordinates scheduling of notifications and procedures when a missed appointment has occurred. Aurora is now being deployed in several pilot studies by the University of Sydney.



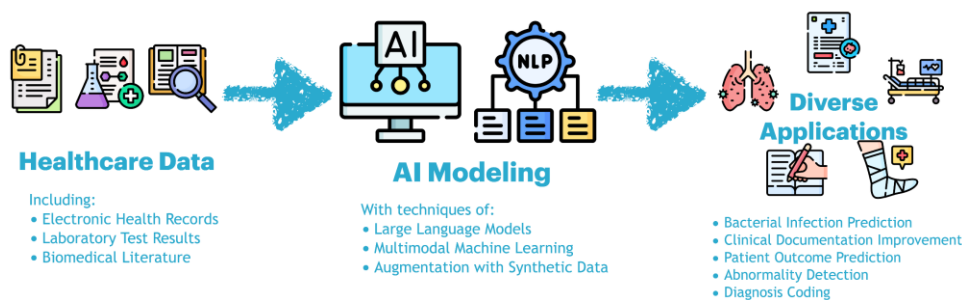
Screenshots of the Aurora chatbot introducing itself and example word pairs that the user is asked to memorise and recall before and after sleeping.

Health Data Semantics and Interoperability: Postdoc and student highlights

CSIRO 'Impossible Without You' Postdoctoral Fellowship: Jinghui Liu

Leveraging LLMs for clinical data and antimicrobial resistance (AMR) analysis

Jinghui Liu's research advances the use of NLP, LLMs, and MML to analyse complex clinical data for improved decision-making and workflow efficiency. His work on



the Minimising Antimicrobial Resistance (AMR) Mission has applied these techniques to enhance early prediction of bacterial infections in ICU patients, supporting more informed prescribing and reducing unnecessary antibiotic use. This research earned the Best Paper Award at the 21st Australasian Language Technology Association (ALTA) Workshop.

Jinghui also led the development of a top three ranked clinical NLP system in an international shared task organised by Stanford University, excelling in generating discharge summaries—particularly discharge instructions critical for patient safety. His broader contributions include a reviewer award at the AMIA Informatics Summit 2024 and an invitation to the Scientific Program Committee of the premier medical informatics conference, AMIA Annual Symposium 2024.

The Transformational Bioinformatics group

About the group

Group leader: Dr Denis Bauer

Our group enables scientists and industry partners to scale their research output using cloud-computing and ML. We deliver impact in two areas: human health and biosecurity.



Transformational Bioinformatics' science and impact highlights for 2024/25

Making precision health real: Working with Indonesia's Ministry of Health, we are building a cloud-based platform that empowers clinicians to diagnose rare genetic diseases and design personalised drug regimes based on a person's genome. The generated data can then be shared in a trusted research environment (TRE) with academics and industry to generate population-scale insights.

Creating global standards for genomics: We deepened our engagement with the Global Alliance for Genomics and Health (GA4GH) contributing to the design of sBeacon V3, the globally accepted standard for genomic data exchange. We also support the Cloud working group, and security group and Pathoplexus, in their thought leadership around guidelines for best practice. The group's achievements were highlighted in the GA4GH inaugural annual report.

Growing senior leaders in biotech: Natalie Twine graduated from the Australian Institute of Company Directors, joining Denis Bauer in readiness to shape Australia's cooperation by adopting an evidence-based governance structure.

Genome Insights

Team leader: Dr Natalie Twine

We generate knowledge into genome-trait relations by analysing population-scale 'omics (genomics, transcriptomics, proteomics) and integrating with observational data. Our aim is to discover the genetic origins of disease and ultimately improve and personalise diagnostics and identify new therapeutic targets. Our software solutions also facilitate the incorporation of genomic information into clinical practice via genetic risk score predictions or synthetic data generation.



Digital Genome Engineering

Team Leader: Dr Laurence Wilson

We develop analytics and web-services to improve genome technology applications in the health and biosecurity spaces. By computationally guiding editing machinery, such as CRISPR-Cas9, we improve accuracy and efficiency for precision therapy and biosecurity applications (such as genetic control of invasive and dangerous species). We also apply our technologies in the RNA therapeutics and vaccine space and advance our understanding of pathogen-host interactions.



Bioinformatics Products

Team Leader: Yatish Jain

We leverage cloud technologies and ML approaches to develop innovative bioinformatics platforms and novel algorithms in the health and biosecurity domain. Sustainable software development not only facilitates reproducible research but also expands commercialisation possibilities. The team builds sustainable bioinformatics solutions and distributes them using various delivery vehicles such as infrastructure as a code, web interfaces, cloud marketplaces and federated APIs to reach broader bioinformatics communities.



Transformational Bioinformatics: Platform technologies

VariantSpark

Collaborators: Seoul Clinical Laboratories (SCL), SAHMRI, UKBiobank, DNAnexus

Our genomes hold information that can substantially improve clinical care. However, finding the actionable information in the three billion letters of the human genome is challenging. While genome wide association studies (GWAS) have identified individual genetic contributors to diseases and traits (biomarkers), and polygenic risk scores (PRS) capture the overall genetic disease risk, there is no methodology able to identify the set of specific biomarkers that capture contributions from individual genes as well as the interaction between genes to predict overall disease risk. VariantSpark provides this capability, thereby improving clinical care while also increasing knowledge of the molecular mechanisms of disease.

VariantSpark is a ML approach implemented using distributed computing (Apache Spark) that is scalable to cohorts of 100,000+ whole genome sequences. Enhancing interpretability of results, we developed a novel statistical approach to control for false positives (*Computational and Structural Biotechnology Journal*, 2023). We demonstrated the power of VariantSpark by analysing Alzheimer's disease (SciRep, 2023) and COVID-19 viral data (*Computational and Structural Biotechnology Journal*, 2022), finding disease markers that were independently validated. An active community of developers and researchers is now involved in the VariantSpark project to improve the codebase and explain its application within health. VariantSpark is available for high-performance compute clusters (HPC), as well as for cloud computing, through services such as RONIN, AWS, Azure, and TerraBio.

Over the last 12 months, we analysed the world's largest genomic data repository (UKBiobank) using coronary artery disease (CAD) phenotypes, being the first to process the whole genome sequencing data of 500,000 individuals on the UKBiobank's cloud-based research analysis platform (*Scientific Reports*, 2025). We subsequently performed validation analysis using the NIH TopMed datasets (CAD) cohorts and AlphaFold to identify a novel CAD associated variant which mediates its effect through genetic and physical interaction. This work is currently under review at Nature Comms. Both our research into CAD and AD yielded the ground-breaking finding that VariantSpark captured more genetic variance in the UKBiobank and ADNI cohorts than is possible with traditional logistic regression methodology (PLINK).



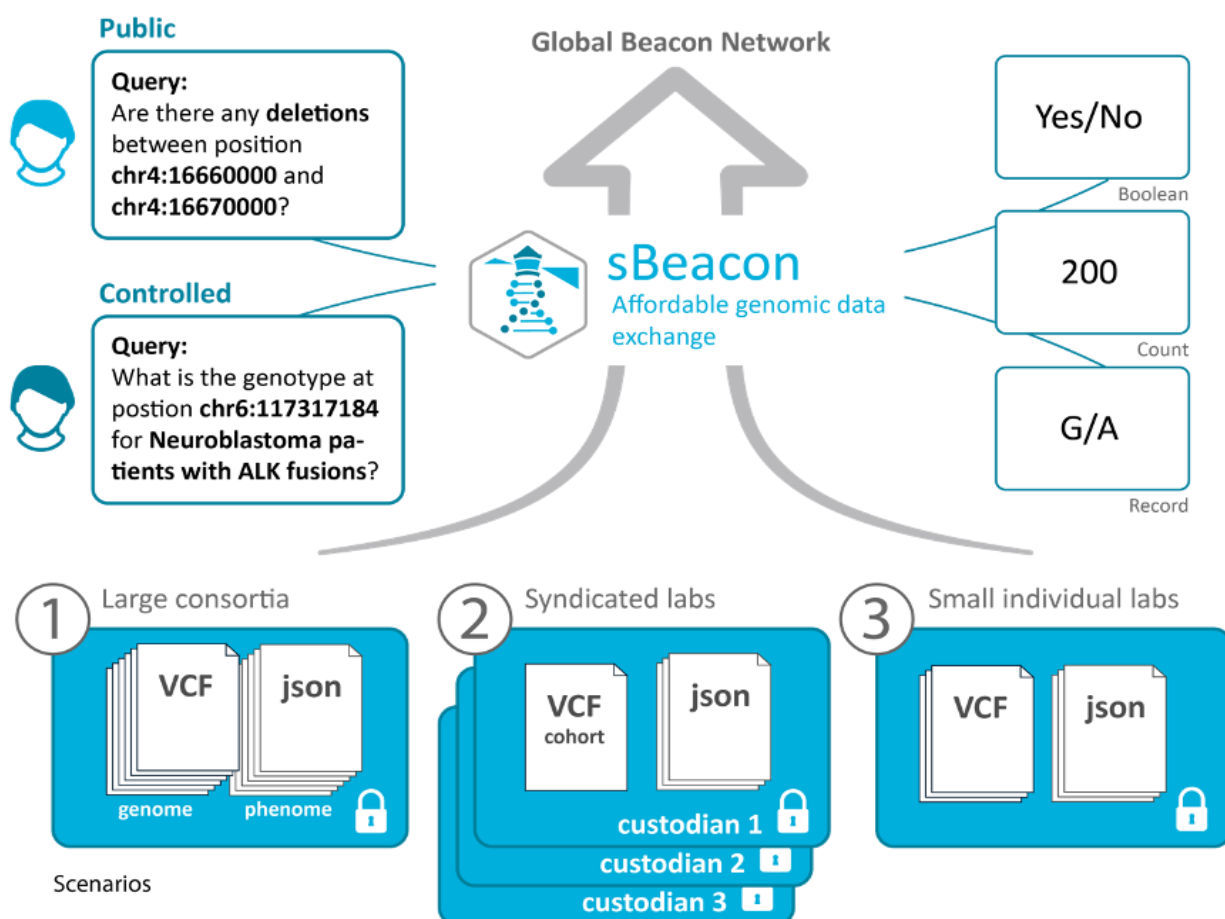
VariantSpark can process both big and 'wide' genomic data to drive biological insights.

We further developed an ecosystem of open-source software around VariantSpark, such as BitEpi (SciRep, 2021) which uncovers the interacting genes from the VariantSpark output and visualises them in their biological context, as well as PEPS (Medinfo 2023) to create realistic synthetic phenotypes datasets. Speaking to the application agnostic capability of VariantSpark, we have investigated applications for VariantSpark in the agriculture domain.

Beacon platform: sBeacon and PathsBeacon

Collaborators: Alliance for Genomics in Health (GA4GH), UMCCR, MGHA, DFAT, GSILab, Indonesia, Australian BioCommons, Pathoplexus

Data sharing in genomics is a crucial yet challenging task. The sheer volume of genomic data increases every day with application for researchers, clinicians, and pharmaceutical organisations, e.g. cohort studies, diagnostics, and drug discovery. sBeacon is a cloud-native federated data exchange platform published at *Nature Biotechnology* (impact factor 68). It implements Beacon v2 protocol by GA4GH, the internationally accepted standard for genomic querying. sBeacon also incorporates the international standard for clinical metadata handling, FHIR, through CSIRO's Ontoserver. This enables complex queries across genomic and phenotypic data.



Serverless Beacon allows fast and economical exchange of genomic and metadata while enabling data custodians to regulate data access

sBeacon is implemented on top of high performing AWS technologies such as AWS Lambda, DynamoDB, S3, and Athena, achieving real-time query time and scale to millions of samples. It caters to the vision for even small organisation to stand up a beacon and contribute the knowledge in their data to the world by eliminating idle time costs and automating infrastructure maintenance. The data storage architecture enables operation directly on the source data, which avoids data-duplications and supports direct control by participants through dynamic consent. We were also able to develop and publish ASKBeacon a platform for performing genomic data exchange and analytics with natural language.

This year, we further worked with GSIIlab, Indonesia's second-largest sequencing facility, to adapt sBeacon for the pathogen space achieve great scalability for continuous pathogen monitoring. We are currently extending sBeacon's pathogen domain into PathsBeacon, which enables the rapid detection and tracking of specific pathogen strains. In addition, we are working closely with GA4GH on the release of the Beacon V3 standard. We are also contributing to CSIRO's OneHealth initiative by standing up PathsBeacon for AAHL's avian influenza sequencing laboratories to allow researchers to query their sequenced genome and generate insights. PathsBeacon tool is being considered for GA4GH's Pathoplexus initiative as a GISAID alternative for sharing pathogen genomic data.

GT-Scan Suite

Collaborators: JCSMR, ANU, Gene Therapy Unit, CMRI, Westmead; Translational Vectorology Group, CMRI, Westmead

GT-scan is a platform solution that improves the accuracy of genome engineering applications (on-target scoring, SNP-aware off-target search) to enable novel high-precision applications in human health, biosecurity and precision medicine. Finding a suitable genome editing spot is like finding a specific grain of sand on the beach; it must have the right shape and colour (properties for CRISPR to bind) and be unique compared to all other grains on the beach (for CRISPR not to accidentally bind to another gene).

A key challenge with these technologies is in their application to diverse, heterogeneous populations. The natural genetic variation amongst individuals means that the applications (such as gene therapy) often need to be tailored to the individual, accounting for their unique risk profile. We have developed technologies which can account for this, analysing the genetic profile of an individual to tailor the gene editing approach. Our VARSCOT2.0 pipeline can go a step further to analyse the diversity across a population, designing strategies that are effective across all individuals, or even discriminatory between distinct populations. This is critical for the use of gene editing in agriculture use cases (such as targeting domestic vs wild populations of a given species).

Accounting for genetic diversity is critical for biosecurity applications. Gene editing to combat invasive species and pathogens is limited by the evolution of escape mutants, rendering the gene editing strategy ineffective. We develop AI models to predict how a given individual will evolve in response to a CRISPR-based method of biocontrol, allowing us to design evolution-resistant guides which function in a manner to limit the possibility of escape mutants, increasing their long-term effectiveness.

Genomator

Collaborators: Royal College of Pathologists of Australasia (RCPA), ANU phylogenomics lab

Data can be difficult to extract and transport due to data privacy and regulations. We are creating digital representations of the data which can protect privacy while preserving statistical relationships to enable analytics. However, current statistical and deep learning methods for creating synthetic data struggle with large data dimensionality and volumes, are prone to hallucinating scenarios incompatible with reality, and seldom quantify privacy meaningfully. We developed a patent-pending algorithm, Genomator, based on logic-solving approaches (SAT solving), which efficiently produces private and realistic representations of the original data.

We have demonstrated Genomator on genomic data—the most complex and private information. We generated synthetic data from a cohort of 1000 whole genome data and benchmarked it against GenAI approaches, showing better utility and higher privacy protection. Genomator is the only production-ready implementation scalable to whole genomes and capable of handling population-specific pharmacogenomic markers. It can be run in the data owner's trust environment (on-prem) with minimal compute resource needs. We also developed Reverse Genomator, which can controllably re-link synthetic data samples to their real-world counterparts, enabling discovery projects which requires re-identification upon discovering a patient-notifiable indication.

Transformational Bioinformatics: Project reports

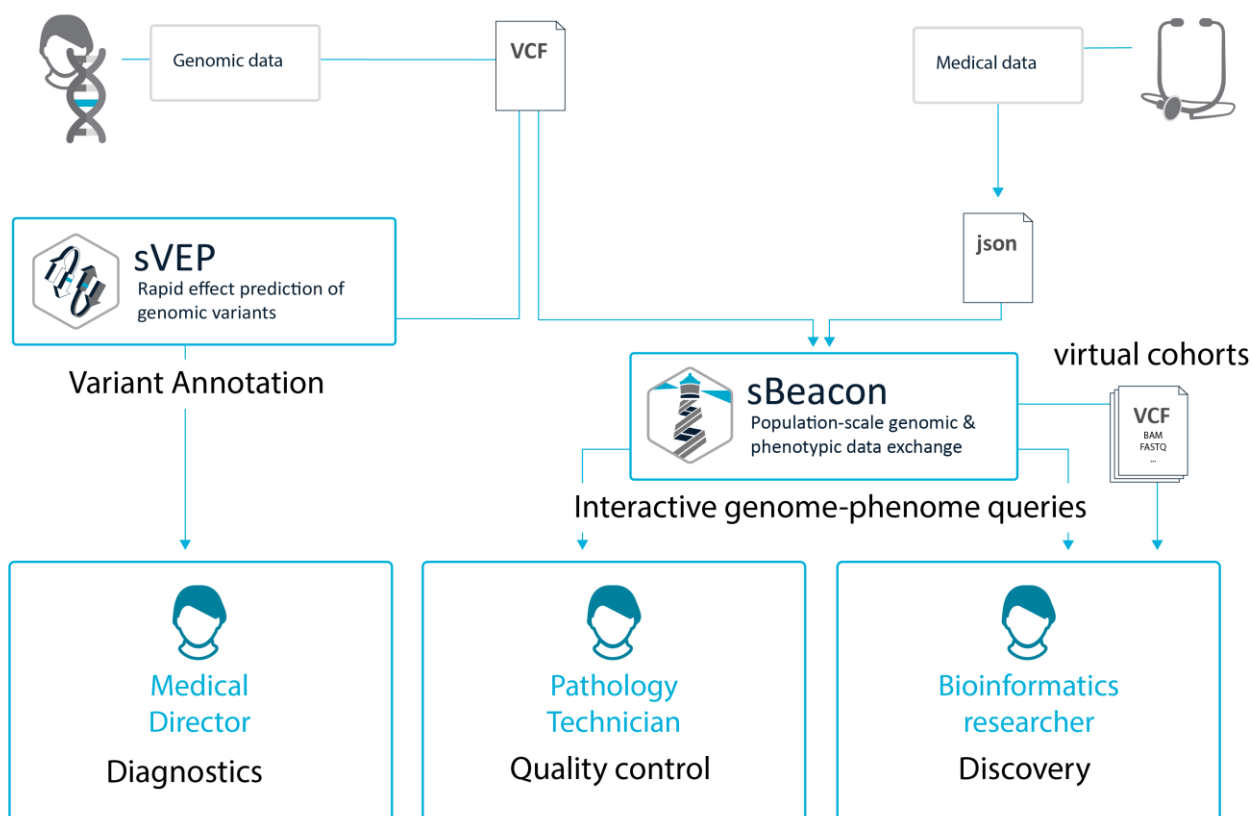
Risk Assessment for Genetic Biocontrol Strategies

Collaborators: Data61, FNIH, TargetMalaria

Genetic biocontrol strategies for invasive species and pathogens of interest use genetic technologies such as gene drives, CRISPR-Cas systems and synthetic incompatibility to control a target population through induction of specific phenotypes (such as male-sterility, reduced fitness etc). However, such strategies carry with them levels of risk, including their potential to spread to unintended populations through mechanisms such as horizontal gene transfer (HGT), which is the transfer of genetic material from one species to another in a manner that breaks traditional inheritance.

In collaboration with researchers from Data 61, FNIH and Target Malaria, we have undertaken a risk assessment of potential genetic biocontrol methods for the control of malaria-spreading mosquitoes. Through a bioinformatics analysis of the mosquito and human genome, we assessed the likelihood that genetic material could be transferred between the two genomes by investigating whether there was any historical evidence of it having occurred.

Analysis of the genomes revealed that while there were regions of conservation, these could be explained through conventional inheritance or expected sequence variation suggesting the chance of HGT between the genomes was very low. Such analysis and risk assessment will continue to grow in criticality as genetic biocontrol methods continue to be explored.



Indonesia Precision Health Initiative

Collaborators: Indonesia Ministry of Health, BGSi, UNDP

Indonesia is transforming its healthcare services to include the use of genomics data to support personalised treatments for patients. Correspondingly, there is accumulated unexplored data that poses promising resources for research representing Indonesia's affluent genomic characteristics. However, there are still impediments to implementing the approach, one of them being the capabilities to harness the wealth of genomics data. To rationalise this initiative, the Biomedical and Genome Science Initiative (BGSi) through the United Nations Development Programme (UNDP) commissioned the GSI-XTI consortium (GXC) to build a centralised platform with two key objectives: 1. Streamline and automate bioinformatics capabilities. 2. Enable a centralised and accessible data portal.

CSIRO has partnered with the GSI-XTI consortium (GXC) to deliver this centralised platform with sVEP and sBeacon being the key technologies underpinning the two objectives. The platform being built will include the standard and customisable features following BGSi's Hubs needs. To achieve this, the platform will customise the serverless Variant Effect Predictor (sVEP) to generate rapid annotations along with the capability to further enhance annotation with additional plugins. Similarly, building the data portal will foster collaborations within and/or between the clinical and research environments in Indonesia. For this, the platform will customise CSIRO's sBeacon platform for federated genomic and clinical metadata sharing.

Strengthening covid-19 animal models and regulatory science using a systems biology approach

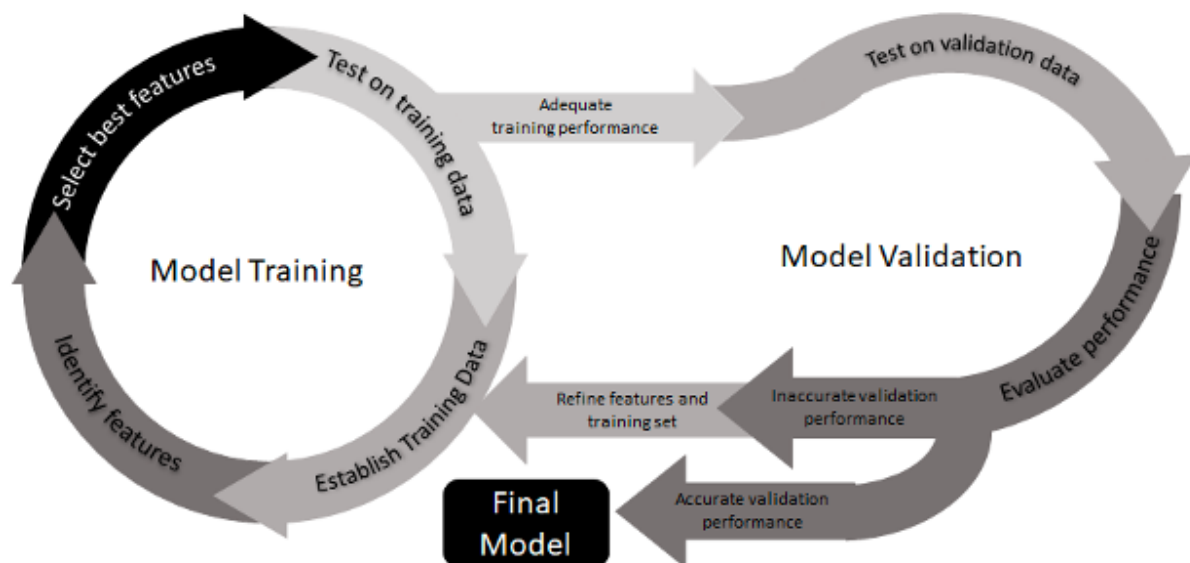
Collaborators: CSIRO's Australian Centre for Disease Preparedness; Manufacturing; Land & Water, Deakin University/Barwon Health, Coalition for Epidemic Preparedness Innovations (CEPI), James Cook University, The Peter Doherty Institution, University of Texas Medical Branch

We used a combination of ML and causal inference approaches to determine underlying links and pathways to an improved COVID-19 vaccination. From this, we identified a range of biological processes involved in antigen processing, signalling and cytokine related functions. Causal analysis also identified significant processes involved in cellular respiration and regulatory processes such as aerobic electronic transport important for maintaining normal cellular function.

These findings provide valuable insights into vaccine mechanisms and potential biomarkers for optimising future vaccine designs.

The project was extended to incorporate analysis of potential emerging influenza strains and influence on vaccine effectiveness. The outcomes of this project can be applied across different pathogens and improve the current processes for vaccine development.

This project is funded by the Australian Government's Medical Research Future Fund, Food & Drug Administration, and internal CSIRO funding.



ML method to identify treatment progression and efficacy

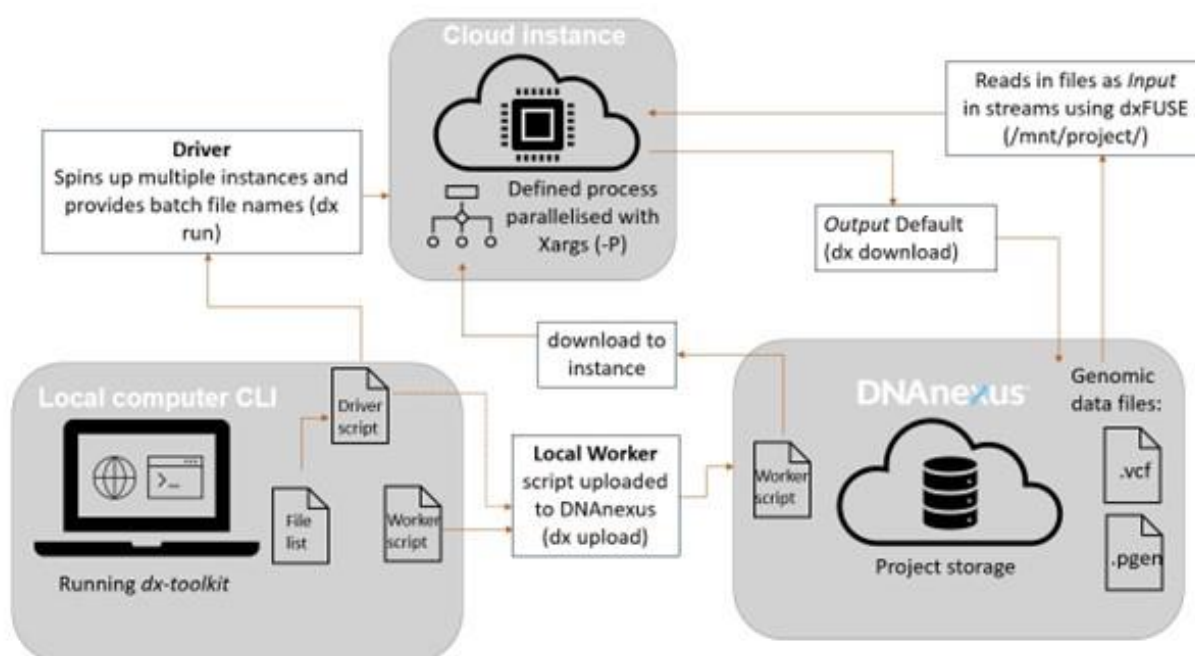
RAPpoet

Collaborators: DNAnexus, UK Biobank

The UK Biobank has released whole genome sequencing data from 500,000 participants through its cloud-based research analysis platform (RAP), a secure TRE enabled by DNAnexus and Amazon Web Services. Bringing researchers and tools to the data rather than the other way around marks a paradigm shift in genomic studies and poses challenges for those unfamiliar with cloud computing and bioinformatics.

To help bridge this gap, we developed RAPpoet (RAP parallel orchestration engine template), a tool that enables coordinated, large-scale analyses in parallel. In a coronary artery disease case study, RAPpoet cut analysis time by up to 94% and reduced costs by 44%.

As more mega-biobanks adopt TREs, tools like RAPpoet will be key to making powerful genomic research scalable, accessible, and cost-effective.

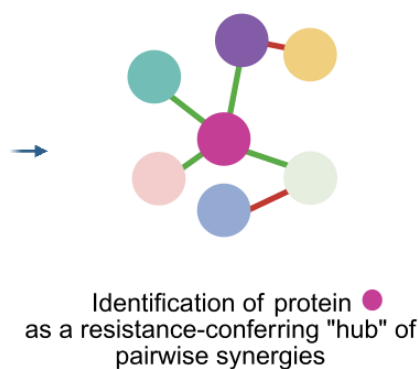
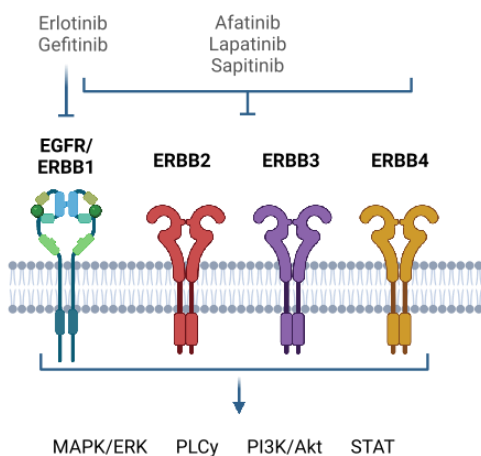


A driver-worker approach (RAPpoet) for managing the configuration of requested instances on UK Biobank RAP and for parallelising the processing of files on cloud instances.

SynerOmics

Together with our collaborators at ProCan (Children's Medical Research Institute), we developed a tool, synerOmics, which leverages the random forest algorithm to capture polygenic "synergies" impacting drug response.

In the last year, we have presented our approach at several scientific conferences and validated our approach on synthetic data and an independent dataset. Our analysis identified a novel resistance cluster of genes that show prognostic value in multiple tumour types and may predict resistance to tyrosine kinase inhibitors in breast cancer.



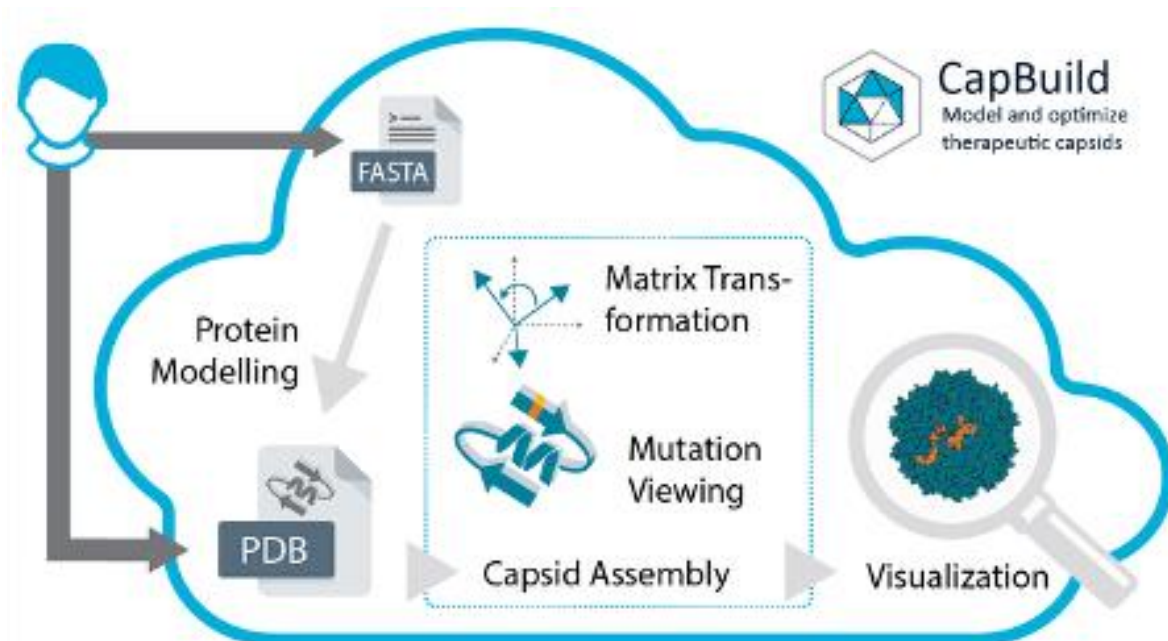
SynerOmics identifies a novel resistance cluster and hub protein correlating with tyrosine kinase inhibitor susceptibility in breast cancer.

CapBuild

Collaborators: Data61

CapBuild is a cloud-native web server developed to address the growing need for efficient AAV capsid engineering, a key aspect of gene therapy development. The complexity of designing viral vectors with the right structural properties has been a barrier for researchers due to the limitations of traditional methods and computational tools. CapBuild simplifies this process by offering a streamlined platform for AAV capsid prediction, assembly, and mutation modelling. Benchmarking shows high structural accuracy, with low RMSD values and high GDT scores across AAV serotypes. This platform empowers researchers to easily explore and visualise structural variants, making AAV capsid engineering more accessible and efficient. CapBuild is available at <https://capbuild.csiro.au/>

CapBuild has been accepted for publication in the webserver issue of *Nucleic Acids Research*.



Overview of CapBuild's PDB and modelling pipeline

Transformational Bioinformatics: Project updates

Malaysia workshop with Vaccine Institute

Collaborators: Malaysian Vaccine and Genome Institute, Ministry of Health of Malaysia

Since early 2020, Malaysia has uploaded over 41,000 SARS-CoV-2 genome sequences to GISAID as part of its genomic surveillance efforts. To enhance data analysis, the Malaysian Genomics and Vaccine Institute (MGVI) collaborated with CSIRO and AWS to explore tools like VariantSpark and BitEpi for identifying mutations and their interactions using ML in a cloud-based environment. A bioinformatics workshop introduced participants to these tools via the RONIN platform and included demonstrations of PathsBeacon for secure data sharing. The event also featured a seminar on preparing Malaysia's healthcare system for data-driven analytics, emphasising digital health technologies, AI-driven decision-making, and the importance of interoperability and regulatory standards. A second workshop prioritising skill building with AlphaFold and other vaccine development tools is due to take place in mid-2025, which will facilitate continued collaboration.

AskBeacon

Collaborators: Global Alliance for Genomics in Health, CSIRO Science Digital (Sigma8)

We initiated AskBeacon, the revolutionary enhancement to the Beacon UI that transforms the way users interact with complex biomedical data. AskBeacon adds a sophisticated layer of natural language abstraction to the traditional Beacon interface, seamlessly connecting with the robust sBeacon backend hosted on AWS serverless infrastructure.

The primary goal of AskBeacon is to improve accessibility by humanising the intricate world of ontology terms, complex query conditions, and the stringent Beacon V2 schema. By distilling these elements into a natural and conversational query experience, AskBeacon empowers users to interact with data effortlessly.

Genomic newborn screening

Collaborators: NSW Health, NSW Health Pathology, Sydney University

Targeted and whole genome sequencing can provide a universal platform for effective NBS at scale. Using genome sequencing for NBS would increase the number of diseases screened for by an order of magnitude. We are partners in a \$3 million MRFF grant with NSW Health, called TRAIL, to investigate the use of genome sequencing in NBS. Our team's contribution is to develop a digital consent platform, called GeneGuardian, for genomic consent management, which ensures the user has control over their genomic data. Furthermore, the grant also explores the use of an individual's genome sequencing in whole-of-life care.

The TRAIL project will use GeneGuardian to evaluate the feasibility and acceptability of a dynamic informed consent model for genomics-based NBS programs. GeneGuardian facilitates the consent process through a participant portal that includes consent education, consent capture, consent updates, and event notifications. It also captures user engagement data and educational needs

information to gather evidence around what education delivery model facilitates decision-making about participating in the genomic NBS programs.

We have leveraged AWS serverless infrastructure and infrastructure as code in developing the platform, ensuring both cost efficiency and portability. We have also strongly focused on the platform's security by performing security assessments through collaborations with AWS Cloud and NSW Health Pathology DevOps teams. User acceptability testing will be undertaken in June 2025 to gather feedback on the platform. This feedback will inform platform development and support the recruitment of 200 potential participants (pregnant women) in September 2025 to evaluate the model and the platform's utility in genomic NBS.

Vaccine design

Collaborators: Minimising Antimicrobial Resistance Mission, UTS

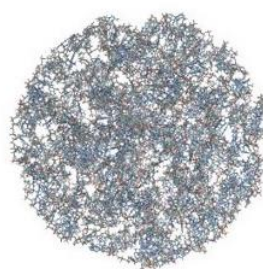
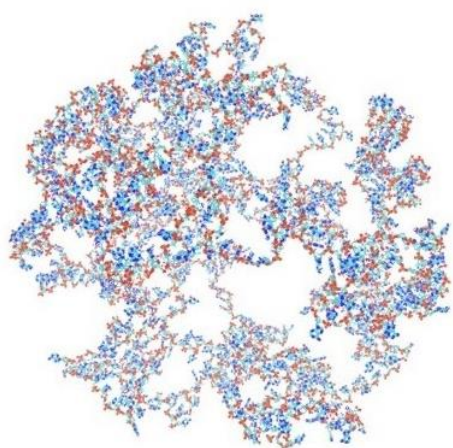
Designing new vaccines is a complex, time consuming and expensive process, typically taking 10-15 years from initiation to clinical application. We are working with collaborators within CSIRO and externally to develop new computational methods to streamline the process, helping researchers predict the best vaccine targets for effective intervention.

This project uses ML and protein structure modelling to simulate how pathogen antigens interact with the immune receptors and predict the antigen sequences most likely to elicit a strong immune response. We are working to apply these methods to assist in the development of new vaccines for biosecurity threats including African swine fever and drug-resistant bacteria.

Viral capsid modelling

Collaborators: The Translational Vectorology Group, Children's Medical Research Institute (CRMI), Westmead

Gene therapies are transformative technologies that enable treatment of previously untreatable diseases. Most approaches use viral capsids, protein shells derived from viruses such as adeno-associated virus (AAV), as delivery methods for the therapeutic DNA cargo. The size and volume of these capsids provide strict limits on what can be packaged inside them.



Modelling how a nucleotide sequence fits within a specific volume involves first modelling the three-dimensional structure of the molecule (left) and then compressing it to the desired volume to determine the stability of the final compacted structure

To improve packaging, we are exploring two complementary approaches: increasing the volume of the capsid through targeted mutations and reducing the effective volume of the DNA cargo through more efficient folding (Figure below). By using new developments in protein and molecular modelling, such as AlphaFold, we can model how the viral capsid and DNA interact in 3-dimensions and test how specific changes influence packaging effectiveness.

We have also developed an ML model to predict packaging efficiency. This model is currently undergoing laboratory testing to evaluate the accuracy and effectiveness of our predictions. We are collaborating with Associate Professor Leszek Lisowski, leader of the Translational Vectorology group at the CMRI, Westmead, world leaders in the design and manufacturing of gene therapy capsids.

Using genomics and ML to optimise the cattle breeding process

Collaborators: CSIRO Agriculture & Food

Using genomic approaches to selectively breed beef cattle positively impacts the sustainability of livestock production. Genomic estimated breeding values (GEBV) have been employed to predict traits including bull fertility, cattle immune competence and carcass characteristics. However, current accuracies of the GEBV models remain low at 28-62%. Our grant from the genomics cross-cutting capability allows us to engage with Toni-Reverter Gomez's team in CSIRO's Agriculture and Food to use our ML toolkit, VariantSpark-BitEpi, to improve on existing linear modelling approaches for GEBV.

We have demonstrated in human disease phenotypes that we can capture 10% more phenotypic variance by using genetic variants and interactions identified by VariantSpark-BitEpi than those identified by linear regression. Based on this, we hypothesise that we can improve GEBV accuracy for livestock. We will apply our approach on existing genetic datasets for bull fertility (n=8000), cattle immune competence (n=5500) and carcass characteristics/marbling(n=8316). Furthermore, VariantSpark's explainable ML will be able to identify QTLs, which, for example, can aid in pinpointing therapeutic and gene-editing targets for immune competence phenotypes, as well as contribute to our understanding of the molecular processes underlying marbling in cattle carcasses.

mRNA and small molecule therapeutics

Collaborators: ANU

We are working with collaborators at the ANU and in industry to design small-molecule therapeutics that target mRNA for the treatment of diverse diseases. Targeting of mRNA is a complex process, due in-part to the complex three-dimensional structures of the molecules which are often shifting and changing. By modelling the structures using our new algorithms, we can simulate which regions of the mRNA are the most stable and accessible. Combined with models of activity, toxicity and tropisms, this work will enable the design and validation of new therapeutics and reduce their time to clinic.

Indigenous genomics

Collaborators: ANU National Centre for Indigenous Genomics (NCIG), Australian Alliance for Indigenous Genomics (ALIGN)

Working with ALIGN and NCIG, we are designing genomic data exchange and management solutions in line with cultural and privacy requirements for Indigenous populations. The aim is to facilitate genomics insights without exposing an individual's or an Indigenous reference genome in the clear. Furthermore, we are looking at consent management that conforms with the decision-making practice of Indigenous community (elders, or consortia), while also being mindful of the need for digital solutions to record and transmit these solutions in remote areas of Australia that may not have internet connection.

Polygenic risk and UKBB

Collaborators: UQ, UCLA

A polygenic risk score (PRS) is an individual's genetic predisposition to a particular complex disease which, when integrated with other risk factors, can improve overall disease prediction, inform prevention strategies, and be used to develop personalised treatment plans. ML algorithms can improve current PRS prediction models but are hindered by their need for large-scale data and significant computational power. Leveraging our capability in cloud computing, ML, and population-scale genomics, we will develop and evaluate new advanced PRS tools. Additionally, we will harness AEHRC's expertise in privacy, federated learning, and ontology to ensure clinical applicability. We have engaged in collaborations with experts on admixed populations from UQ (A/Prof Loic Yengo) and UCLA (Prof Bogdan), to help address the Eurocentric bias in genomic datasets to ensure that clinical PRS benefits all Australians.

Genome biology epistasis review

Collaborators: Tilburg University, University of Sheffield, Bielefeld University, Stanford University, Lorentz Centre

Drs Letitia Sng and Natalie Twine co-led an international consortium to address the detection of epistasis, the interactions between genes and variants that influence the phenotype in complex ways. In July 2023, Natalie and Letitia co-organised a week-long interdisciplinary workshop at the Lorentz Centre in the Netherlands, bringing together 41 global experts to advance the field of epistasis detection. This included experts from the US, Prof Mike Snyder, UK, Dr Cooper-Knock, Netherlands, Dr Balvert and Germany, Dr Schoenhuth. The event culminated in a collaborative review paper published in *Genome Biology* (IF=10) in November 2024, highlighting current challenges, emerging solutions, and the need for new data resources. This work lays a crucial foundation for future studies.

Transformational Bioinformatics: Postdoc and student highlights

Postdoctoral highlight: Anubhav Kaphle

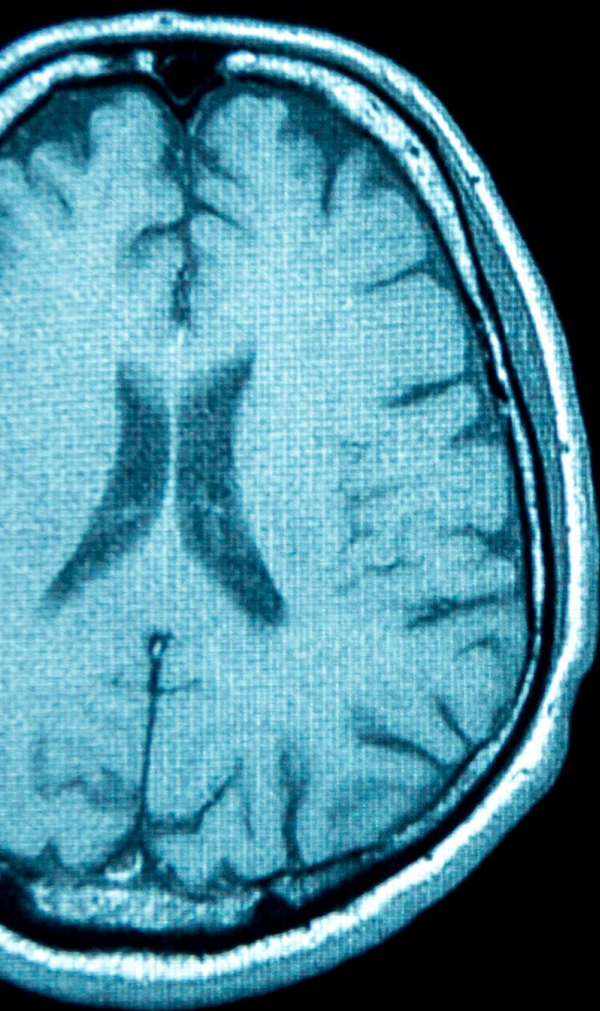
We are evaluating the feasibility/acceptability of a dynamic informed consent model for genomic newborn screening as part of a public health program, through an MRFF-funded research project with the TRAIL team at Sydney Children's Hospital. Our overarching goal is to enable consent-controlled secure data use with strong provenance, safeguards, traceability, and interoperability, to increase public trust in these systems and unlock sensitive genomic information for knowledge generation.

Engineering highlight: Nick Edwards

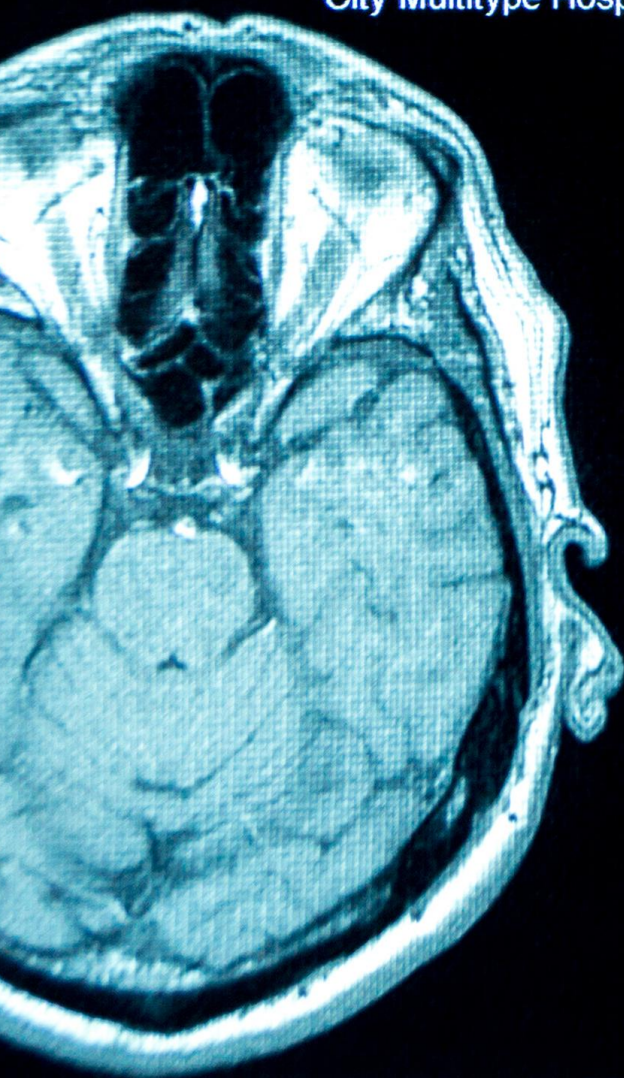
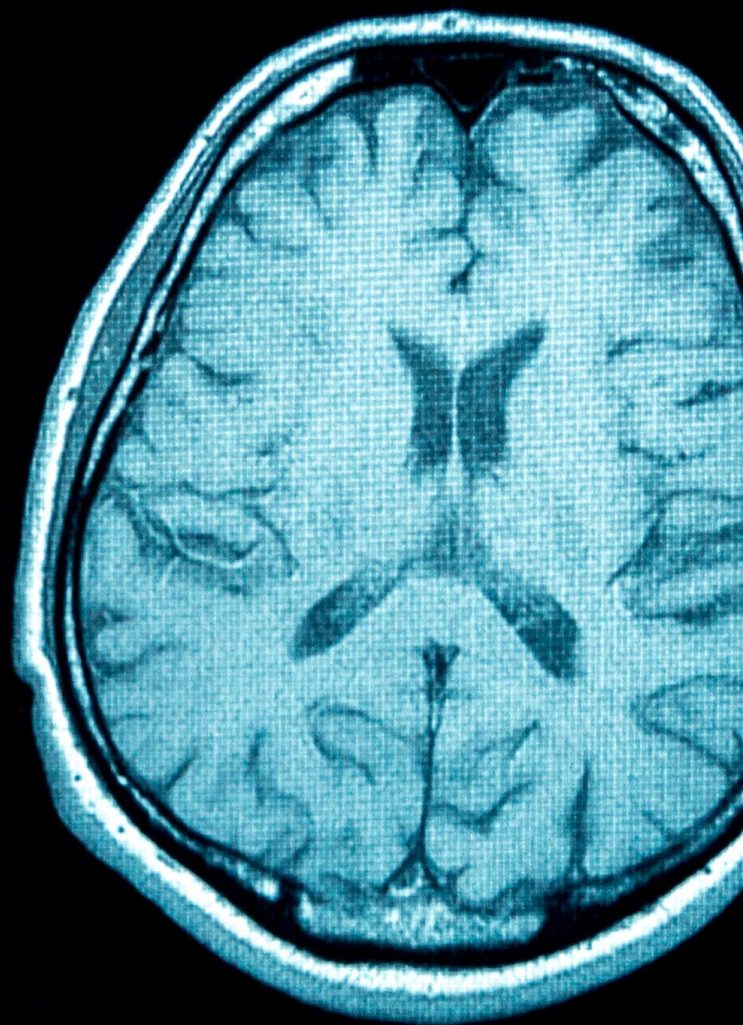
Indonesia is incorporating genomics data to support personalised treatments for patients. To enable this transformation, CSIRO—in collaboration with UNDP and BGSi—is integrating sBeacon for federated genomic data discovery and sVEP for genomic variant annotation. As part of this project, Nick is leading the development of pipelines for pharmacogenomic profiling, with a focus on drug metabolism and toxicity. This work supports safer, more personalised treatments and lays the foundation for a sustainable, genomics-enabled healthcare system in Indonesia.

Vacation student highlight: Florencia Stella

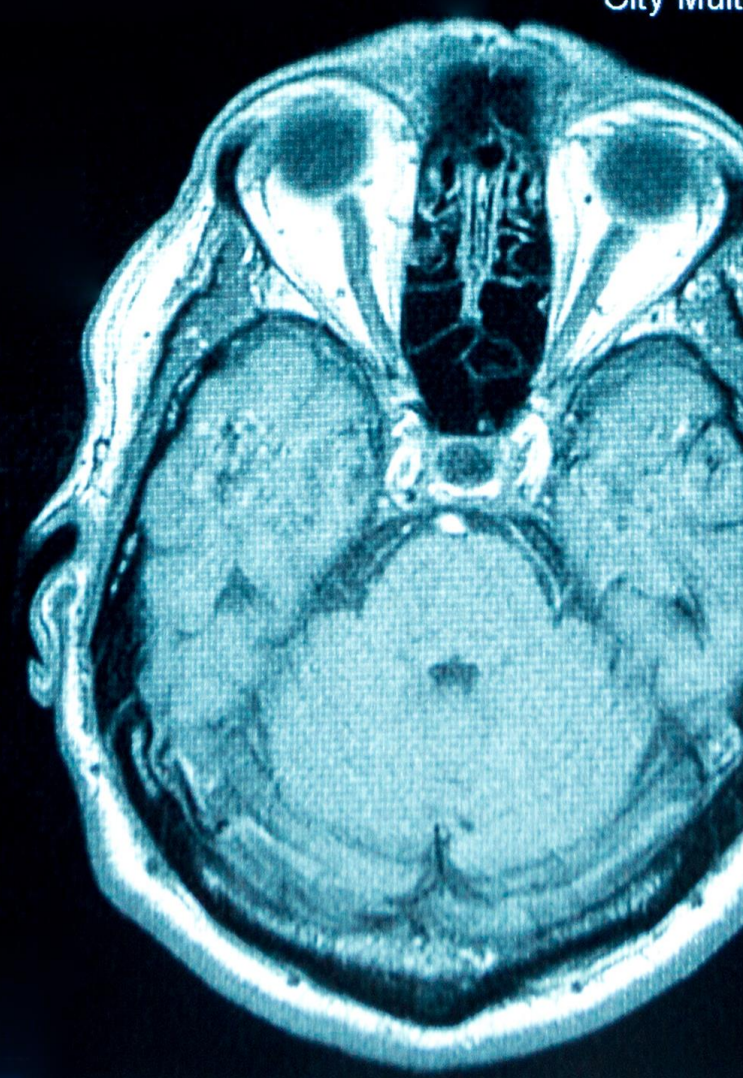
The rapid mutation rate of RNA viruses presents significant challenges for developing effective antiviral strategies in livestock. By applying deep learning approaches, we will model guide performance across large genomic datasets, optimising for both efficiency and specificity. Florencia contributed by refining the CNN model and developing an automated guide selection pipeline, forming a strong foundation for future advancements in antiviral guide design.



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The Biomedical Informatics group

About the group

Group Leader: Jurgen Fripp

The combination of precision medicine and AI will revolutionise healthcare. The Biomedical Informatics group works at this exciting interface, leveraging AI's ability to generate insights that empower clinical decisions (prediction, staging, prevention and treatment).

Our precision medicine focus is on discovery and validation of novel medical imaging biomarkers (from MRI, PET, CT, US, and X-ray), with AI guided insights integrating -omics, neuropsychology, smart sensing and clinical phenotypes.

The imaging, statistical and AI/ML techniques developed on our informatics platform enable both reproducible and scalable cloud and standalone software deployment. These are applied within in a wide range of (NHMRC, NIH funded) large observational and randomised control trials across the human lifespan and disease spectrum (including osteoarthritis, cerebral palsy, cancer and dementia). Where required we are developing our technology as SaMD.

The group is a key partner in many clinical trials and studies in Australia and internationally where we contribute to the collection and analysis of data and interventions with our clinical and research partners.

- Dementia is the second leading cause of death of Australians and is likely in future to become the leading cause as our society ages. The hallmarks of dementia can be characterised by a range of fluid and imaging biomarkers, including amyloid and tau PET. Our group is as a key partner in the Australia Dementia Network (15 institutions nationwide) and the Australian Imaging Biomarker Study of Aging (AIBL); providing advanced image analysis and biostatistical expertise. This is highlighted by our role in over 20 journal papers in the last 12 months.
- Each year in Australia, more than 20,000 infants are born premature and/or with low birthweight. This puts them at risk of neurodevelopmental conditions, such as cerebral palsy, where they potentially face a range of adverse cognitive, behavioural, educational and motor outcomes.
- In a large collaborative effort, including with the University of Queensland, Monash Health and the Cerebral Palsy Alliance, we are currently contributing to 11 projects which allow us to track brain development and investigate functional brain networks. These studies, conducted across the childhood period from preterm infancy to adolescence, provide insight into neuroplasticity following insult or intervention, and can be used to improve clinical reporting and to tailor the most effective therapy to enhance quality of life for the children and their families.



Biomedical Informatics' science and impact highlights for 2024/25

- Large number of high IF papers during the year including
- Aida received award Springer Nature Editor of Distinction Award 2025 in the category Editorial Contribution Award
- Vincent Dore won the de Leon's price, which recognises 'best papers' in the field of neuroimaging of neurodegenerative processes
- Hollie Min's work on image analysis for forensic skull biological sex classification featured across media channels including ABC News
- Aaron Nicolson featured in The Australian Magazine top researchers in the field

Medical Image Analysis

Team Leader: Jason Dowling

We focus on the development, validation, and translation of novel AI technology to obtain precision medical imaging (from MRI, PET, CT, US, and X-ray). This is achieved through close collaboration with clinicians, industry, and patients to understand needs and then develop, validate and translate precision imaging AI and machine learning technologies to improve disease diagnosis, treatment planning and treatment delivery.

This involves the development of AI and ML methods for the extraction, quantification, and modelling of information from 2D and 3D medical images and sensors; mapping data across imaging modalities and individuals/populations and performing image reconstruction and synthesis. Clinical applications include radiation oncology, cardiology, respiratory physiology, orthopaedic surgery and musculoskeletal image analysis.



Neurodevelopment and Plasticity

Team Leader: Dana Bradford

The focus of this team is to develop advanced neuroimaging technology (from MRI) to accurately localise and measure the extent of neuroplasticity for use in research and the development of precision medicine technologies. The outcome of this research is to provide earlier detection and improved diagnosis for childhood neurodevelopmental disorders and other brain trauma. Clinical applications include cerebral palsy and epilepsy.



Neuroimaging

Team Leader: Vincent Doré

Our team focus is on developing advanced neuroimaging technology and machine learning algorithms to extract clinically meaningful metrics from medical images, such as MRI and PET scans, for use in precision medicine applications. These metrics include diagnostic tools and disease staging applied to a range of clinical challenges.

In particular, we are developing a range of precision medicine software as a medical device (SaMD) applications related to Alzheimer's disease.

Our suite of precision medicine biomarkers encompasses metrics related to metabolism, amyloid, tau, neuroinflammation, cholinergic system to neurodegeneration.

These neuroimaging techniques are essential for discovering and validating fluid biomarkers, characterising at-risk group' for developing dementia groups and allow early interventions, such as lifestyle improvement.



Biostatistics

Team Leader: James Doecke

The Biostatistics team work on various projects with the aim to elucidate the complex relationships between fluid and imaging biomarkers, genes, lifestyle, environment, cognition and disease pathology. We have specialists in bioinformaticians and statisticians who apply their knowledge to biomedical data to identify disease-specific relationships. Our bioinformaticians develop software to process raw genomics data into usable summary information, while our biostatisticians develop online and publicly available statistical applications and provide reproducible reports for projects and collaborators. Our research partners rely on our specialist analytical expertise to move their research from the bench to the bedside, from collecting data through publishing results in high impact journals.

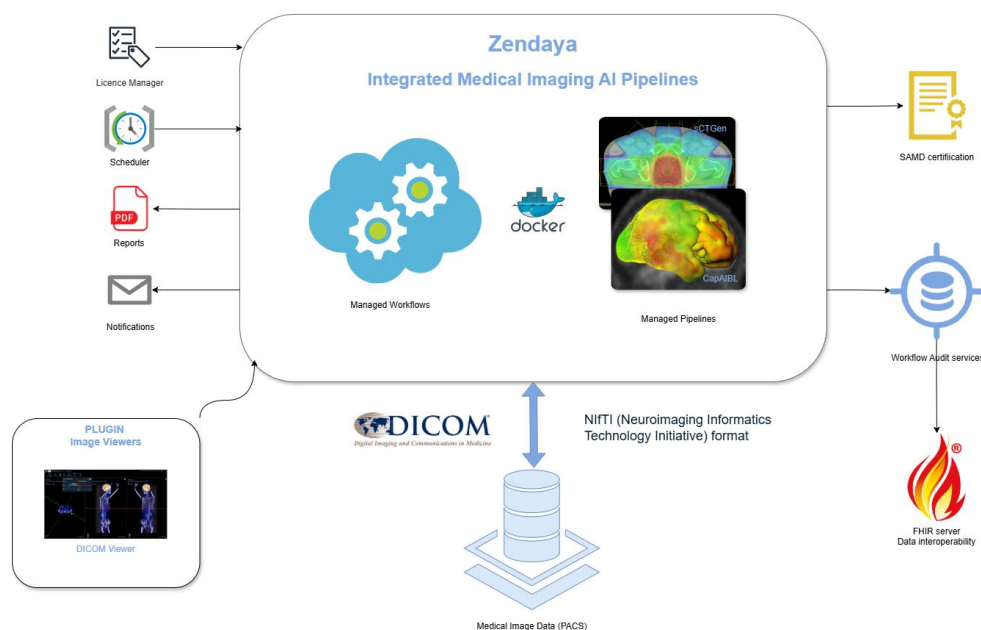


Biomedical Informatics: Platform technologies

Zendaya: Intelligent medical image analysis platform

Collaborators: Herston Imaging Research Facility (HIRF), UNSW, Austin Health

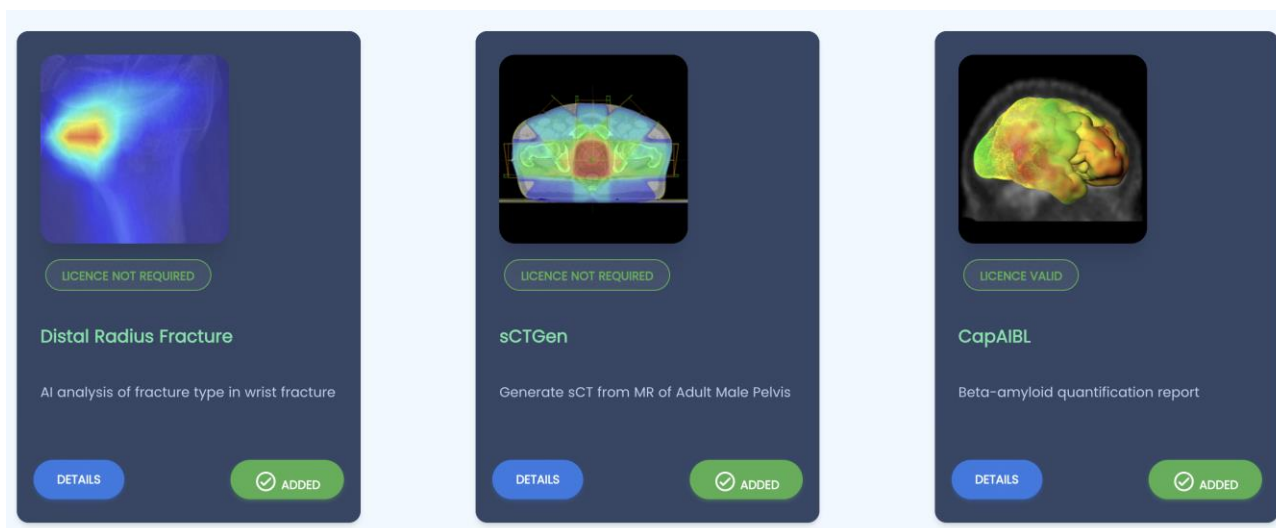
Zendaya is a next-generation platform developed by CSIRO to streamline the deployment, execution, and oversight of medical imaging AI workflows in clinical research. Designed with flexibility and future clinical integration in mind, Zendaya supports both cloud-based and on-premise (standalone) deployment, allowing seamless alignment with institutional IT and regulatory requirements. Zendaya enables the execution of containerised AI pipelines—such as SCTGen for synthetic CT generation and capAIBL for brain ageing biomarkers—using input medical images in DICOM or NIfTI formats. Access controls allow inputs to be accessed from PACS and research databases like XNAT, or uploaded manually by users. Some pipelines support multi-modal image inputs, expanding their clinical and research applicability. Each pipeline is governed by a licensing system, with commercial licenses available through the CSIRO Data Shop. Users can execute validated pipelines, explore MVP tools under development, or trial AI models undergoing regulatory evaluation. Pipelines in Zendaya may be linked to academic publications, ensuring transparent, reproducible science.



Overview of Zendaya platform components

Zendaya automates AI workflows, manages queuing of large-scale retrospective data runs, and supports event-triggered execution when new data becomes available. Upon workflow completion, users are automatically notified via email. The platform maintains audit trails, which can be exported as FHIR-compliant resources, supporting clinical traceability and integration into digital health ecosystems.

With a growing catalogue of AI tools—most developed using our ISO13485 Quality Management System—Zendaya offers a robust, scalable infrastructure for clinicians, researchers, and health service providers seeking to responsibly harness AI in healthcare.

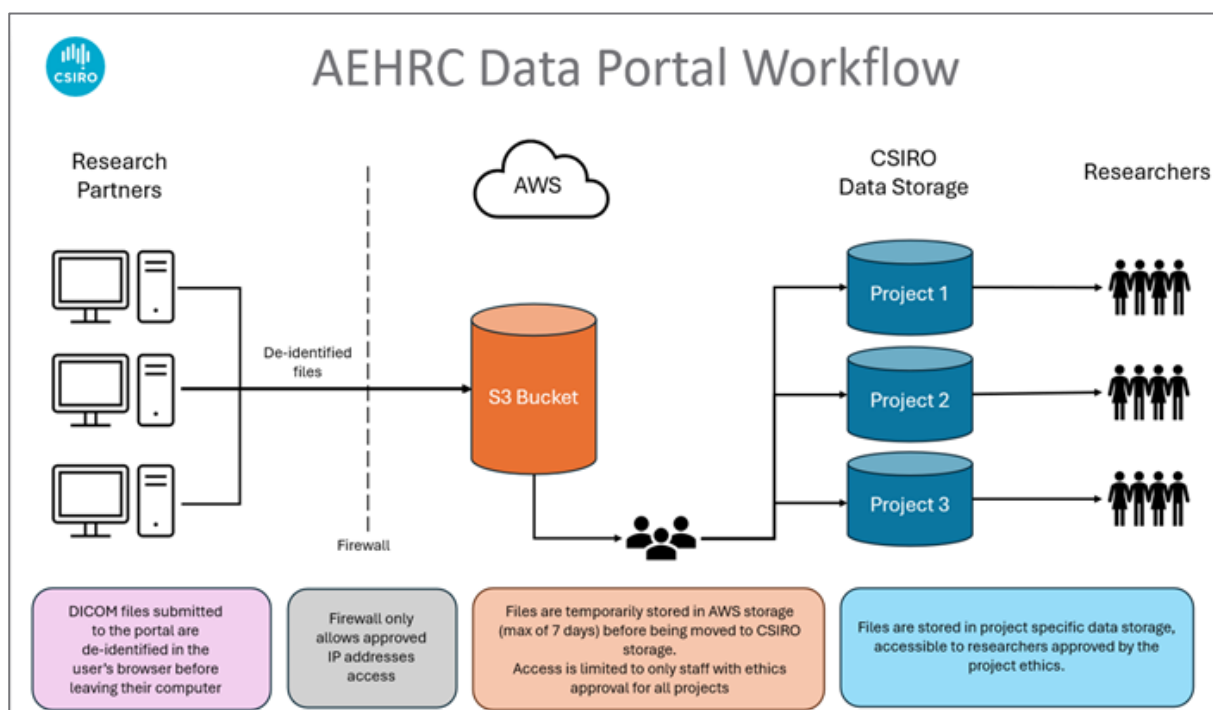


Zendaya enables execution the biomedical informatics suite of medical imaging pipelines, including CapAIBL and sCTGen

AEHRC data portal

Collaborators: University of Queensland, University of Melbourne

The AEHRC data upload portal is a user-friendly web portal designed for pseudo-anonymisation and secure one-way transfer of medical images and other files to CSIRO systems. On receipt, additional quality assurance, protocol checking and application of research pipelines (including defacing) are performed—with results stored and shared within project specific systems.



Overview of the AEHRC Data Upload Portal. Key features are: data is pseudo-anonymised on client-side, data can only be transferred one way, and our firewall restricts access to the portal to approved IP addresses

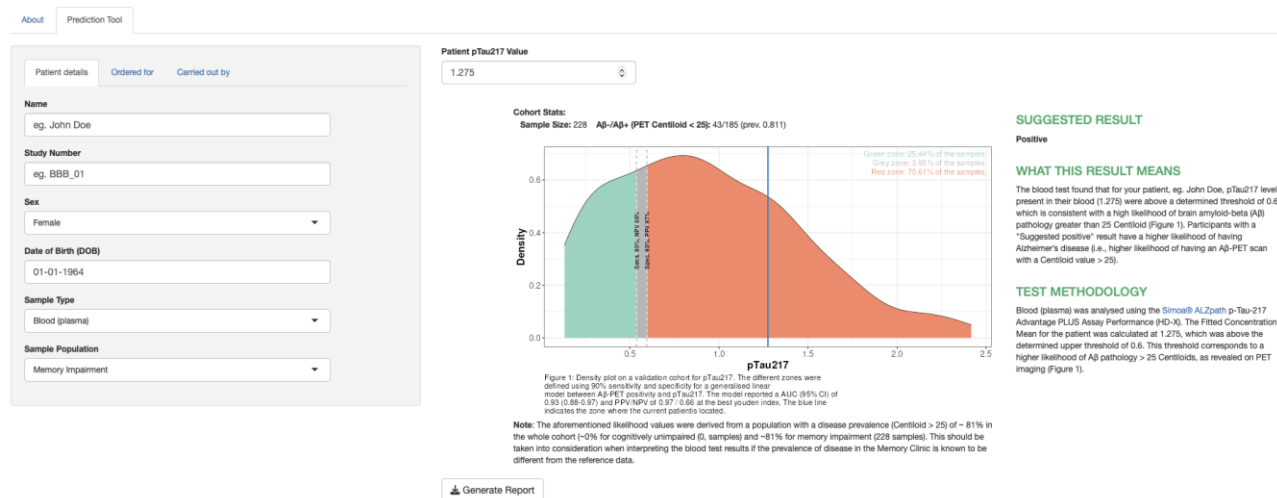
Amyloid-beta predictor app

Collaborators: The Florey Institute of Neuroscience and Mental Health, University of Melbourne

The amyloid-beta predictor application is an online tool which allows users to add a result from a blood-based biomarker test to determine the amyloid-beta status of a patient.

The application was developed using data from the Australian Imaging, Biomarkers and Lifestyle (AIBL) study of ageing, using a highly sensitive blood-based assay to support clinical decision making. Since the recent approval of the Eli Lilly disease modifying treatment (DMT) for AD (Kinsula) here in Australia, clinical specialists in memory clinics and general practitioners need to make decisions about whether a patient is suitable for treatment. One of the major components for eligibility is the patient must have an appreciable amount amyloid-beta in the brain. Currently the gold standard to determine this is a PET-imaging test, however this is very costly and currently not covered by the PBS. Given this requirement, cheap and non-invasive blood tests to predict the level of amyloid-beta in the brain have become available and have high accuracy (>90%) to detect the presence of amyloid-beta plaques in the brain. We have developed an easy-to-use online application, which can be used by clinical specialists and general practitioners to determine whether a result from this blood test provides supportive evidence for further consultation prior to DMT.

Amyloid Beta Predictor App



Amyloid-beta predictor app

Biomedical Informatics: Project reports

AIBL outcome

Collaborators: Florey, ECU, Austin Health, NARI

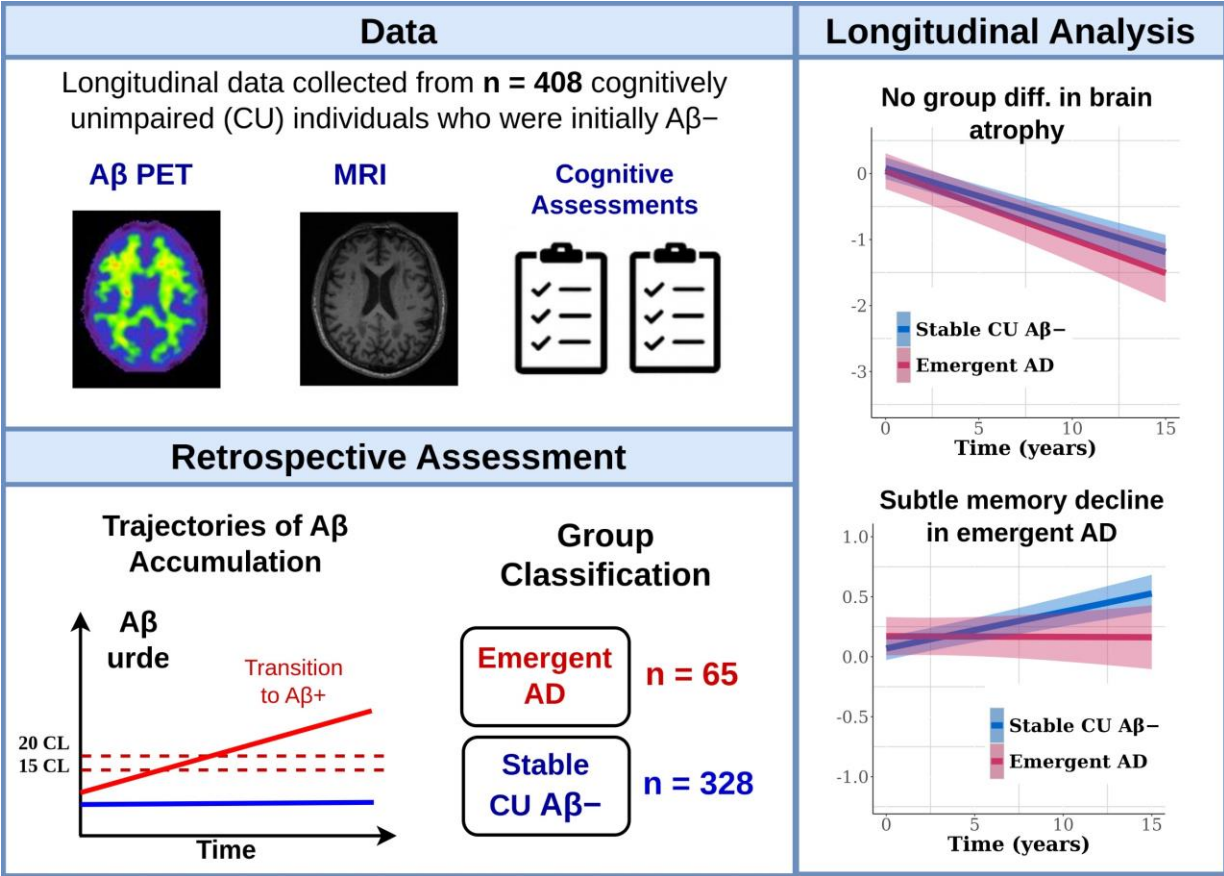
The AIBL Flagship Study of Ageing is an ongoing observational cohort study helping researchers unlock new insights into the onset and progression of AD, which is characterised by accumulation of amyloid plaques and tau in the brain. Since 2006, AIBL has collected study data every 18 months from over 3000 participants creating a large digital database and sample bank of highly characterised individuals enabling the characterising of clinical and biological changes in the early or preclinical stage of AD. Specifically, this study has aided the development and validation of a range of blood, CSF and imaging diagnostics.

Early brain and cognitive changes in emergent Alzheimer's disease

Collaborators: University of Melbourne, Monash University, University of Queensland

The ability of amyloid PET to detect preclinical AD, i.e., cognitively unimpaired (CU) older adults with abnormal levels of A β (A β +), has enabled secondary prevention clinical trials to assess whether anti-amyloid drugs limit further A β accumulation. However, it remains unclear whether, and to what extent, amyloid accumulation at subthreshold levels influences brain structure and cognition. To address this, we leveraged an emergent AD model with retrospective A β PET assessments to examine the relationships between A β accumulation, loss of brain volume (in the basal forebrain and hippocampus), and cognition in CU adults prior to meeting A β + classification criteria.

Using the longitudinal data from AIBL participants including comprehensive assessments spanning up to 15 years, we identified a relatively large sample of older adults who were initially A β - and later progressed to A β +, indicating emergent AD. Our results demonstrate that in the emergent stage of AD, amyloid accumulation occurs without measurable accelerated atrophy in the basal forebrain or hippocampus. However, we observed subtle memory decline in the emergent AD group compared to the stable CU A β - group. These findings suggest that substantial amyloid accumulation begins many years before the classification of A β +, with cognitive decline manifesting prior to detectable structural degeneration.



Study overview of emergent AD

Reactive astrogliosis as a forewarning of amyloid accumulation in the pre-preclinical stage of Alzheimer's disease

Collaborators: Austin Health

In a sub study of AIBL, we investigated, using a specific type of brain imaging scan called 18F-SMBT-1 PET the alterations in specialised brain support cells, the astrocytes, which are involved in the brain's inflammatory response. Astroglial cells become reactive, or enter reactive astrogliosis, when they detect injury or pathology in the brain. They respond by changing their shape, increasing production of certain proteins (like GFAP, MAO-B), and altering their behaviour. This response can be protective, but in chronic diseases like AD, over time their response may also become harmful. Our findings revealed that reactive astrogliosis varied across different brain regions and showed distinct patterns in healthy individuals who had already started accumulating a key Alzheimer's-related protein compared to those who had not. Most importantly, in cognitively healthy individuals who did not yet show signs of this abnormal protein buildup, elevated activity in these brain support cells significantly predicted the future accumulation of the Alzheimer's-related protein. This suggests that the 18F-SMBT-1 scan could serve as an important early indicator for Alzheimer's disease, and that targeting the function of these brain support cells might open new avenues for disease prevention and treatment.

AI-enhanced coronary calcium CT scan for improved cardiovascular risk prediction

Collaborators: Victor Chang Cardiac Research Institute, St Vincent's Hospital Sydney, University of New South Wales, The Lundquist Institute (Harbor-UCLA Medical Center, USA), Ingham Institute

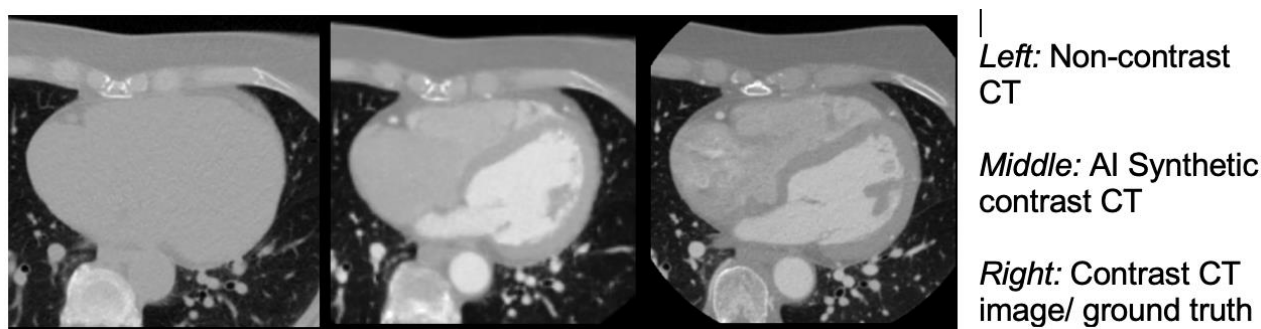
Cardiovascular disease (CVD) is a leading cause of death in Australia, with early detection and treatment of coronary atherosclerosis remaining sub-optimal. While the coronary calcium score is a reliable predictor of coronary events, it is underutilised for identifying significant non-coronary events (i.e. heart failure, arrhythmia, and stroke).

Although measuring cardiac chamber sizes and left ventricular (LV) mass have proven effective in predicting cardiovascular events, visualizing and assessing these structures on non-contrast CT scans remains a challenge. This study aimed to develop and validate a novel diffusion-based AI algorithm capable of transforming standard non-contrast, gated coronary calcium score cardiac CT scans into high-quality synthetic contrast-enhanced images.

Validation was performed using a dataset of 25 patients who underwent non-contrast CT, contrast-enhanced CT, and cardiac MRI. Volumetric measurements and anatomical segmentations from the synthetic images were evaluated against the gold-standard contrast-enhanced CT scans using Dice coefficients and Bland-Altman analysis.

The AI-generated synthetic contrast images showed excellent accuracy, achieving Dice coefficients greater than 0.90 for all cardiac chambers. Detailed anatomical structures, including coronary arteries, ventricular trabeculations, and papillary muscles, were clearly delineated, with no anatomical distortions (Figure 1). LV volume measurements derived from the synthetic images demonstrated strong correlation with those from contrast-enhanced CT ($r = 0.96$).

These results strongly indicate that this AI-driven approach could serve as a robust alternative to traditional contrast-enhanced imaging for certain applications, offering substantial potential to improve non-invasive cardiac assessment and risk stratification.



Comparison of AI-generated synthetic contrast CT with ground-truth contrast-enhanced CT

Wearable ultrasound

Collaborators: Queensland University of Technology, CSIRO Space Technology Future Science Platform, Australian Space Agency, European Space Agency, Ontogo Vascular

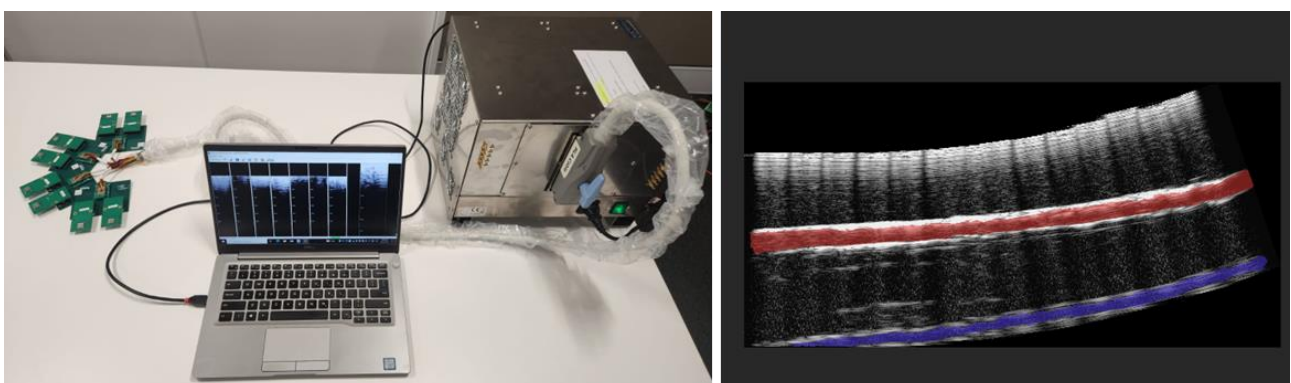
This project is developing a fully automated wearable ultrasound imaging system for internal anatomical assessment, in collaboration with the Queensland University of Technology (QUT). The system is designed for use in resource-constrained or extreme environments, such as space missions or remote clinical settings, where trained personnel may not be available.

The technology integrates multiple miniaturised ultrasound transducers into a flexible patch that can be positioned over the target anatomical region without requiring any clinical or anatomical expertise. Once in place, the system autonomously acquires and processes ultrasound data in real time. Custom AI algorithms are being developed to support image registration and interpretation, enabling reconstruction of a comprehensive anatomical view from the distributed probe data.

Over the past year, a fully functional hardware and software prototype has been developed. The current platform supports real-time image acquisition from up to eight ultrasound miniaturised probes simultaneously. AI-based automated image alignment and interpretation have been demonstrated at proof-of-concept level and are undergoing further integration and testing within the full system.

Two clinical applications are being pursued. The first is automated thrombus detection in the internal jugular vein for astronauts during long-duration spaceflight, in collaboration with the European Space Agency (ESA) and the Australian Space Agency, with support from the CSIRO Space Technology Future Science Platform. This included participation in the 2024 Australian delegation to the European Astronaut Centre and ESA in Cologne (Germany). The second application, developed in partnership with Ontogo Vascular, targets the automated detection of internal bleeding for trauma and emergency care.

This work advances the fields of wearable medical imaging, autonomous diagnostic platforms, and AI-enabled ultrasound interpretation, and positions the system for future clinical translation and deployment in challenging healthcare environments.



Left: Wearable ultrasound prototype with eight miniaturised probes. **Right:** Example anatomical reconstruction of two vascular structures obtained from multi-probe data using AI-based contouring. Data acquired using an ultrasound-compatible model for proof-of-concept validation.

cpThrive: a story of development

Collaborators: Cerebral Palsy Alliance, University of Sydney

Cerebral palsy (CP) is the most common physical disability and the fifth most common cause of death in childhood. There is no known cure for this lifelong condition that has complex variations in symptoms and severity. Families are faced with challenges in how to find new, safe and effective interventions—understanding what treatments are available, how effective those treatments are for different symptoms and sequelae of CP and how to choose treatments that align with their family priorities. Our goal was to leverage mobile health (mHealth) to translate research and clinical knowledge for families to facilitate better matches between individuals and treatments.



In an NHMRC-funded project, we worked with people with lived experience of CP, clinical experts and software developers through focus groups and workshops. We codesigned and developed an mHealth aide to streamline and filter treatments based on family priorities. The aide contains a step-by-step guide, a search function, treatment factsheets, and support resources to empower evidence-based personalised decision making. The mHealth app has been endorsed by research partners, and following robust trial across Australia, will be freely available in app stores worldwide.

Biomedical Informatics: Project updates

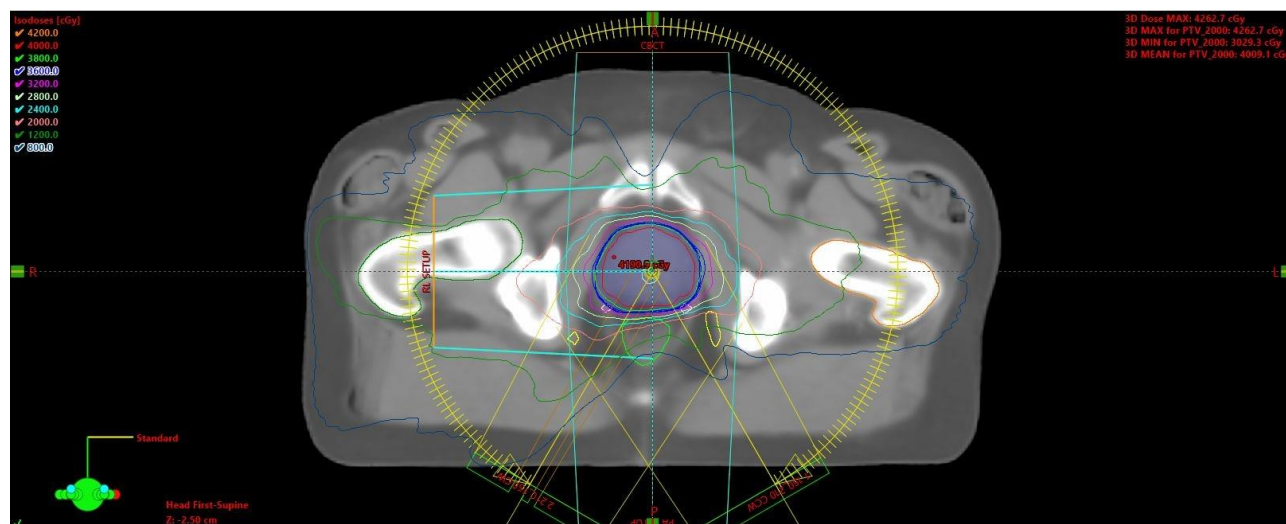
NINJA multi-centre clinical trial

Collaborators: Trans-Tasman Radiation Oncology Group, Ingham Institute, Liverpool Hospital, Calvary Newcastle Mater Hospital

The novel integration of new prostate radiation therapy schedules with adjuvant androgen deprivation (NINJA) clinical trial compares two emerging schedules of radiotherapy in the treatment of intermediate or high-risk prostate cancer. The trial is supported by funding from Cancer Australia (APP1158455). An important substudy includes validation of MRI-only radiation therapy treatment at eligible sites. This involves the generation of synthetic CT from patient MRI scans to enable dose delivery planning using CSIRO's sCTGen software. To date over 200 men at six

hospitals have been treated during this trial using the sCTGen software (TGA: CT-2020-CTN-03318-1; ACTRN12618001806257; Protocol: <https://bmjopen.bmj.com/content/9/8/e030731>).

This research has potential to improve the accuracy and quality of radiotherapy treatment in prostate cancer.



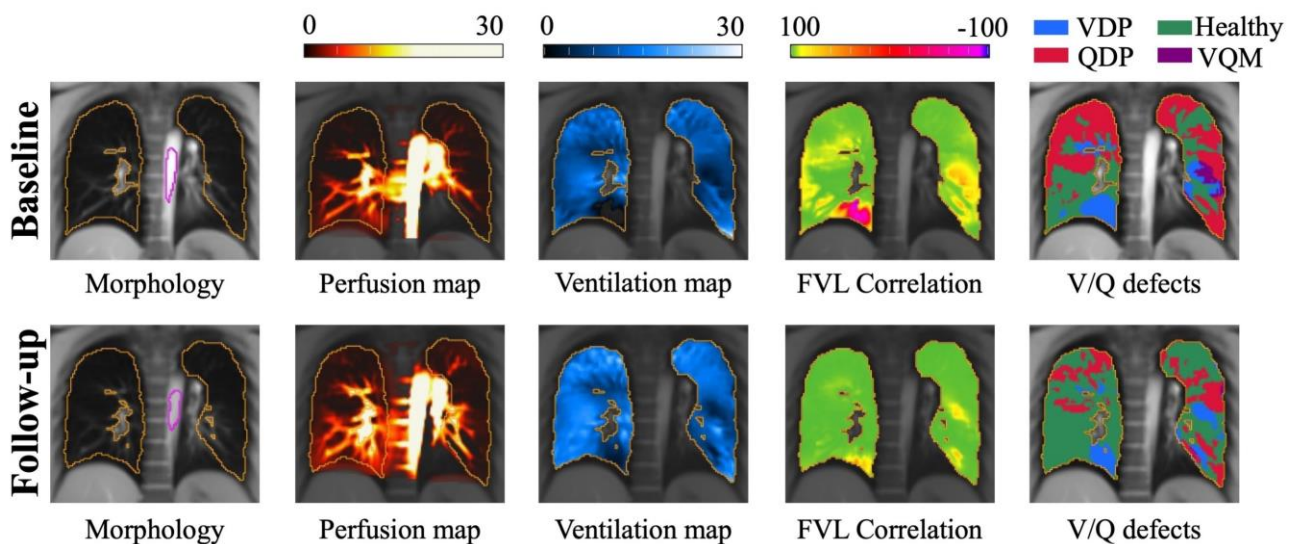
Sample external beam radiation therapy treatment planning screen. This figure shows the prescribed dose which will delivered to the patient's prostate. This plan requires electron density information (usually acquired from a CT scan). Only the axial image is shown here however the plan will be generated in 3D.

MRI-based paediatric lung structure and function assessment

Collaborators: Queensland Children's Hospital, Siemens Healthineers, Herston Imaging Research Facility

This project aims to improve health outcomes for children with cystic fibrosis and ataxia-telangiectasia (AT) by using MRI to provide information on lung status. Currently the most informative method for lung imaging in these children is computed tomography (CT) scanning which increases a child's cancer risk due to the radiation dose delivered. To address this issue, we are developing acquisition methods and software to extract quantitative information from MRI. This work is supported by external funding from the AT Children's Project, the US CF Foundation, and a 2020 NHMRC MRFF grant.

Over the past 12 months, our lung MRI functional biomarkers demonstrated the statistically improved patient outcomes in a drug trial for patients with AT, who previously could not have chest CT imaging due to radiation sensitivity. The findings were summarised in a high-impact Lancet journal—*eBioMedicine*. Additionally, we delivered an oral presentation in the top MRI conference ISMRM on our developed AI-assisted pixel-level lung imaging scoring software (Xin et al, <https://arxiv.org/abs/2506.23506>).



Exemplary results for improved lung perfusion and ventilation from a 33-year-old male patient with A-T. VQM denotes ventilation-perfusion match. (Lancet - eBioMedicine, accepted)

AI for trauma imaging

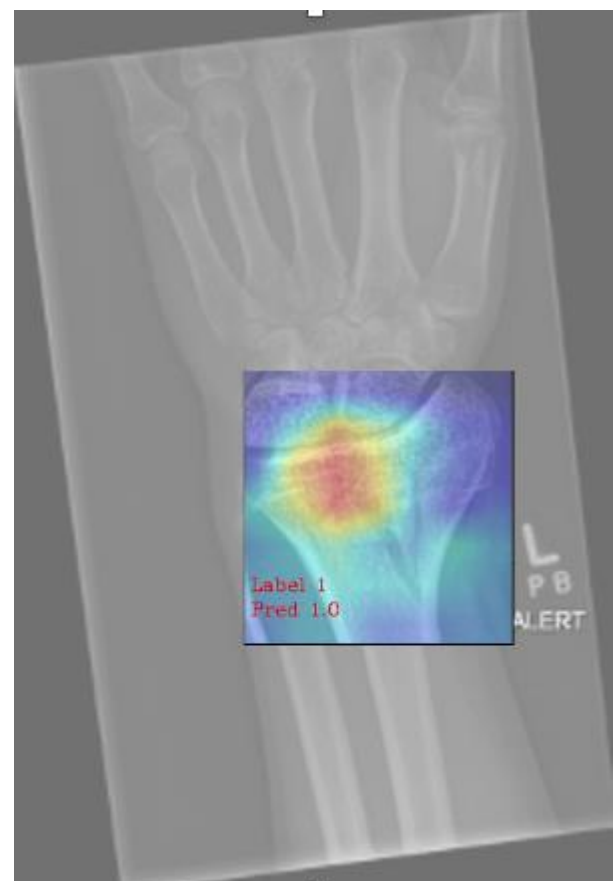
Collaborators: Jameson Trauma Institute, Queensland University of Technology

This project explores how AI and data analytics can improve trauma surveillance and treatment. The focus is on developing a screening tool to identify patients with distal radius fractures who require CT scans.

Over the past year, we developed and validated deep learning models that classify wrist fractures from single- and dual-view X-rays. The dual-view model achieved an accuracy of 0.87 and specificity of 0.86, indicating strong potential for clinical application.

Published results include Min et al., *Phys Eng Sci Med* (2023) and CARS 2023 proceedings.

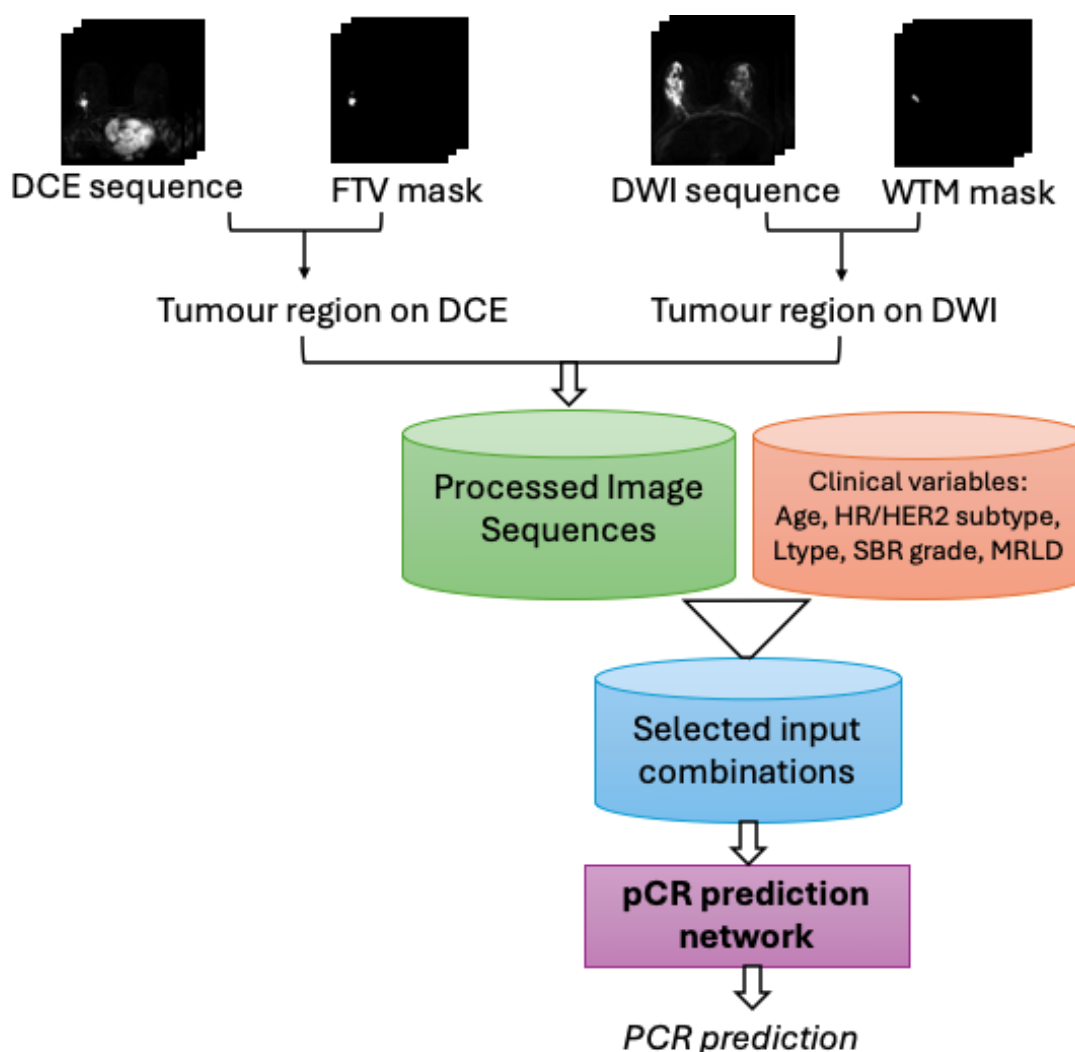
Automated detection and classification (Type A) of distal radius fractures from X-ray



MRI radiogenomics and breast cancer outcomes in a neo-adjuvant treatment setting

Collaborators: PA Hospital, University of Queensland and QIMR

This project is developing AI tools to help predict how breast cancer patients will respond to chemotherapy before surgery, using MRI scans and clinical data. Over the past year, we built two deep learning models that analyse pre-treatment MRI to forecast whether a patient will achieve a complete response. One model uses tumour regions marked by experts, while the other is fully automated. The semi-automatic model reached 81% accuracy; the fully automatic model, 78%. Including both contrast-enhanced and diffusion MRI, along with clinical details, improved performance. These tools may help personalise treatment plans, reduce unnecessary side effects, and improve outcomes by identifying patients who will benefit most from chemotherapy.

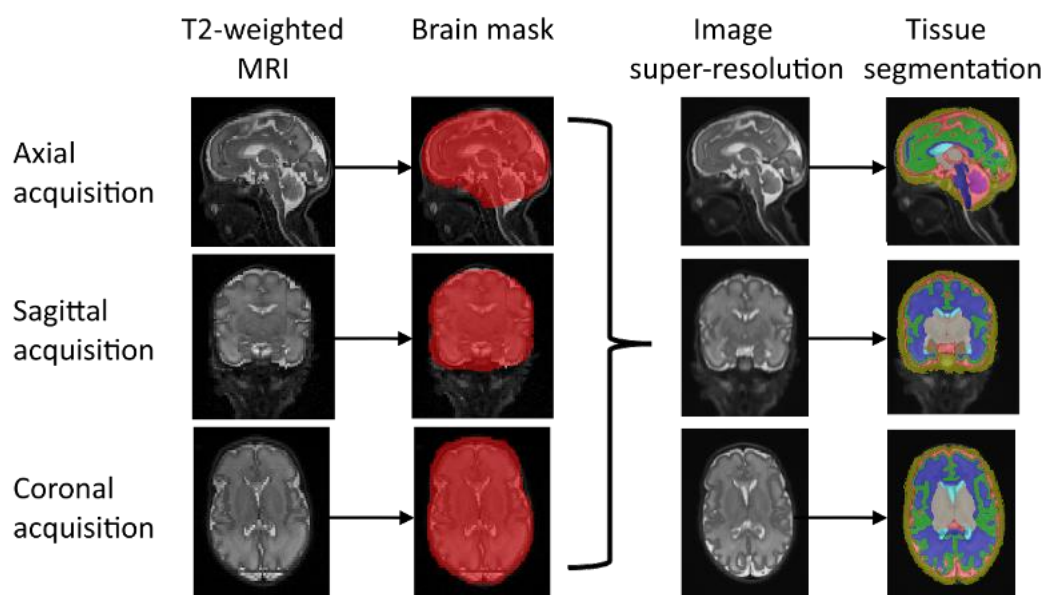


NAC pre-treatment pCR prediction using multiparametric MRI and clinical variables

Brain MRI before and at term equivalent age predicts motor and cognitive outcomes in very preterm infants

Collaborators: The University of Queensland, Monash University, Monash Children's Hospital

Brain MRI of high-risk neonates is increasingly used for the detection of brain injuries, and early prognosis of adverse outcomes such as cerebral palsy. While most imaging is performed around term equivalent age (TEA) for infants born preterm, this often requires families to return to hospital. We extracted structural biomarkers from MRI acquired before and at TEA in a cohort of very preterm infants to determine if either time-point, or both combined, are predictive of development at two years. We found statistically significant associations between brain structure and two-year outcomes on both early and TEA MRIs. Early MRI showed the best prognostic accuracy along with combining timepoints, indicating the potential clinical benefit of early MRI in predicting adverse outcomes.

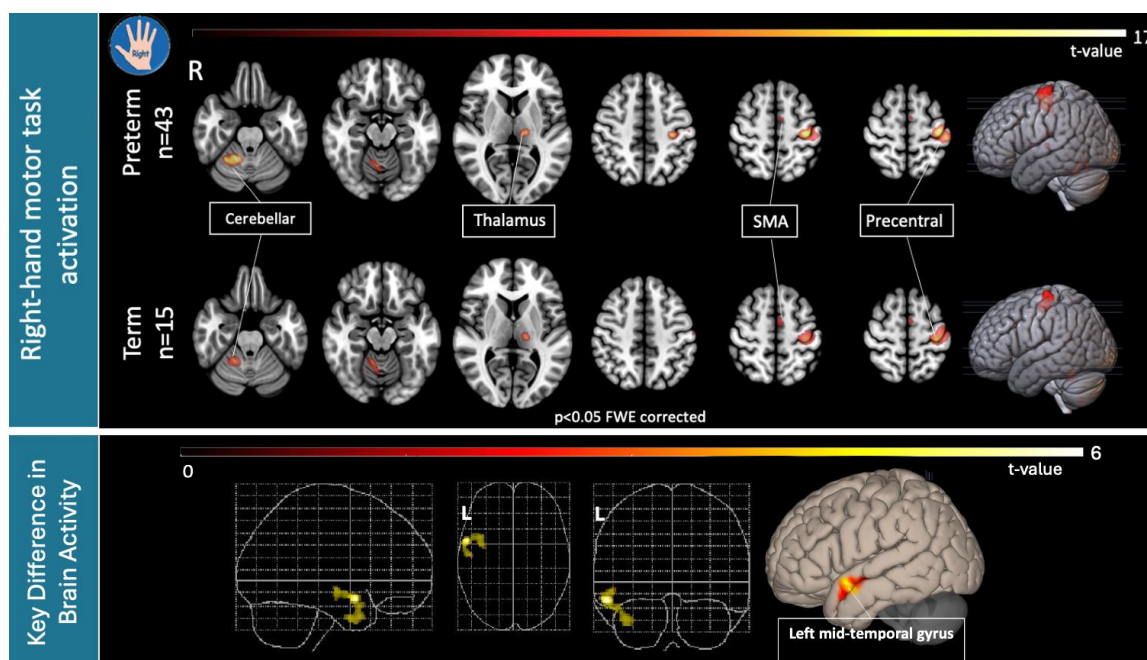


Three MRI acquisitions undergo brain masking and then get combined into a single high-resolution MRI (left), which is then segmented using the Developing Human Connectome Project pipeline.

Functional connectivity alterations in preterm children: motor task and resting-state findings at six years

Collaborators: The University of Queensland

Being born very prematurely can change how a child's brain works. We studied 6-year-olds, born very early and compared them with children born full-term using MRI scans as they tapped their right hand during the scan. The figure below shows their brain activity during the motor task: the upper panel shows areas activated in preterm children (top row), and full-term children (bottom row), both groups using typical motor regions. The lower panel directly compares them, highlighting a key difference: children born preterm had significantly increased activity in their left mid-temporal gyrus. This suggests their brains might use different pathways or work harder, adapting to their early start. Understanding these brain adaptations can facilitate better ways to support their learning and development.



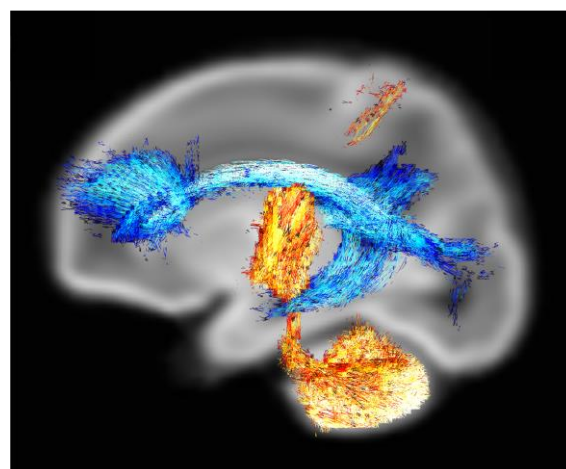
Brain activity during a right-hand motor task in six-year-old children. The top section of the figure shows the brain regions activated in very preterm children and full-term children. Both groups activated key motor areas like the cerebellum and precentral gyrus. The bottom figure highlights that children born preterm showed significantly greater brain activity in their left mid-temporal gyrus compared to full-term children while performing the same task.

Using advanced diffusion MRI to better understand brain development in preterm infants

Collaborators: The University of Queensland, Monash University, Monash Children's Hospital

Infants born preterm are at an increased risk of adverse neurodevelopmental outcomes. A greater understanding of normal and abnormal brain maturation is needed to enable earlier prediction of outcomes. We use advanced diffusion MRI to investigate microstructural and morphological brain maturation within the first few weeks of a preterm infant's life. We found that motor and cerebellar tracts undergo rapid development, while several tracts involved language, cognitive and executive function develop slower relative to total brain growth. The cortex showed microstructural development consistent with diminishing radial organisation. Future research will investigate whether preterm infants with adverse outcomes deviate from this developmental trajectory.

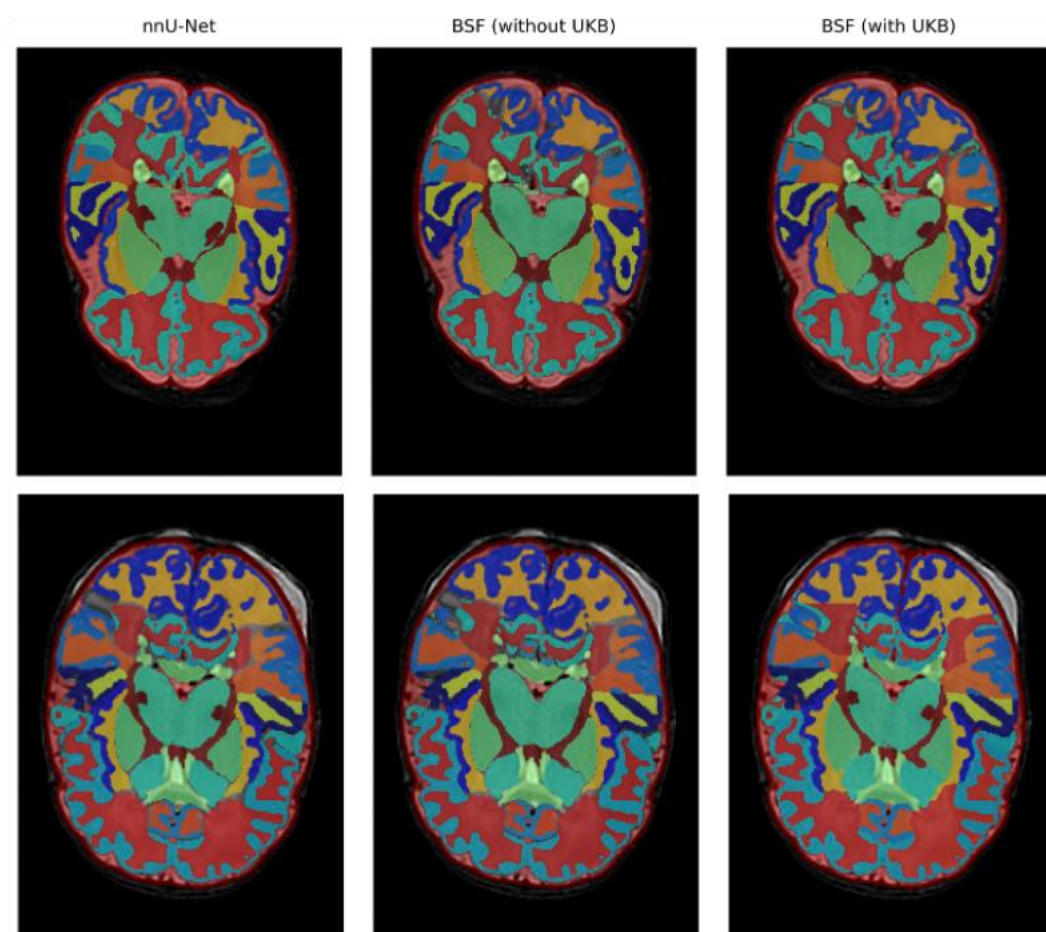
Sagittal brain MRI showing pathways with rapid development (red-yellow) and slow development (blue-light blue).



iASSESS: Automated neonatal T2w analysis pipeline

Collaborators: Cerebral Palsy Alliance, University of Sydney

The iASSESS pipeline encompasses image motion detection (and correction), image super-resolution, and brain tissue segmentation. All stages are currently under development, exploring machine learning approaches using our existing neonatal datasets. Crucially for downstream biomarker extraction, the brain tissue segmentation stage has involved testing several deep learning models. Compared to the established nnUnet benchmark (average Dice 0.89), a foundational model, characterized by its pre-training on a large, diverse corpus of brain MRI data rather than a specific segmentation task, achieved superior performance (Dice 0.91). This performance was further enhanced to an average Dice of 0.93 when utilising weights specifically derived from training on the UK Biobank dataset. These results underscore the potential of transfer learning, leveraging models pre-trained on extensive, diverse datasets (even those from adult populations), to significantly improve segmentation accuracy on the unique characteristics of neonatal data.

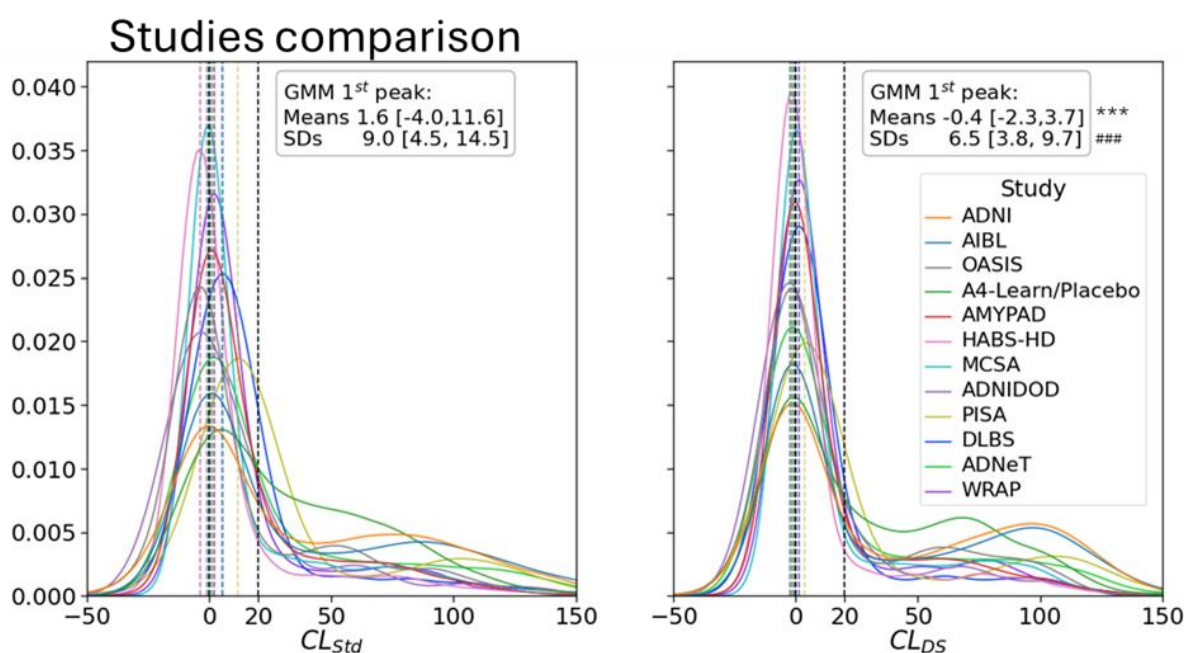


Obtained neonatal brain parcellation using nnU-Net (first column), BrainSeg foundational model (BSF) with random weights (second column), and BSF with weights derived from the UK Biobank (third column), demonstrated for two cases (top row, MRI acquired at 30 weeks gestational age; bottom row, MRI acquired at term equivalent age).

Using AI to improve amyloid PET quantification

Collaborator: AIBL, ADNeT, PISA, University of Melbourne, Austin Hospital, QUT, QIMR, University of Newcastle, Washington University, UCSF, Massachusetts General Hospital, University of Wisconsin-Madison, University of Texas, Amsterdam Neuroscience, University College London, GE HealthCare, University of California, University of Michigan, University of Pittsburgh

The centiloid scale is the standard for amyloid ($A\beta$) PET quantification, widely used in research, clinical settings, and trial stratification. However, variability between tracers and scanners remains a challenge. This project introduces DeepSUVR, a deep learning method to correct centiloid quantification, by penalising implausible longitudinal trajectories during training. The model was trained on two large studies, AIBL and ADNI, and validated on 10 international studies from Australia, USA and Europe, totalling over 25k scans. DeepSUVR significantly improves concordance with neuropathology, visual reads, and cognition as well as reducing longitudinal variability. More importantly, it also significantly reduces variability in the $A\beta$ -negatives scans. This will enable consistent decision making across hospitals, which is becoming increasingly important when qualifying patients for disease modifying treatment.

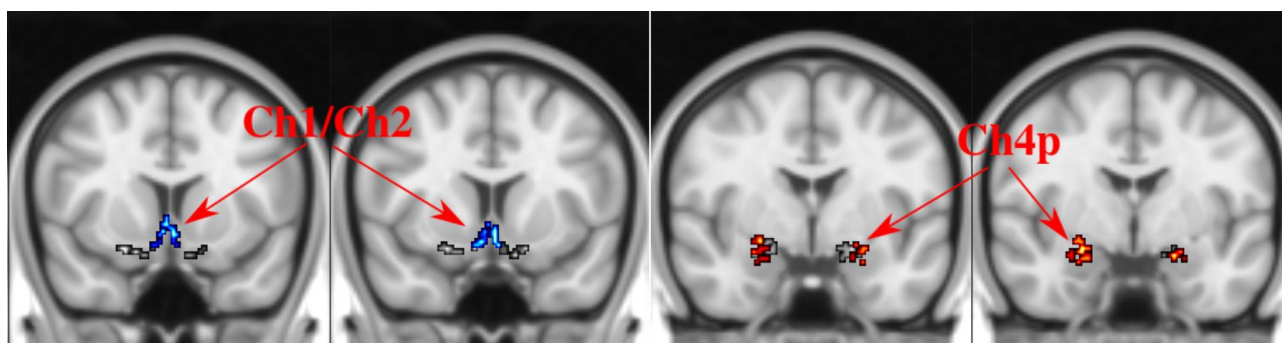


Histogram distribution of centiloid values across the 12 cohorts using the Standard and DeepSUVR centiloid quantification methods. For each approach, a Gaussian mixture is fitted to the distribution of centiloid values of each study, and the average mean [min,max] and average standard deviation [min,max] of the first peak across all studies is reported. The dashed lines mark the 0CL and 20CL (standard threshold for abnormality).

Longitudinal cholinergic degeneration in aging and Alzheimer's disease

Collaborator: AIBL, ADNeT, University of Queensland

Dysfunction of the cholinergic basal forebrain (BF) system begins during the preclinical stage of AD and persists throughout the disease's progression. This dysfunction interacts with other biological changes in AD, substantially contributing to cognitive impairment. This study characterises the nature of BF volume loss and the extent to which BF atrophy manifests as cognitive decline in early AD. Our findings indicate that individuals with abnormal levels of amyloid- β burden ($A\beta^+$) showed faster volume loss in BF and hippocampus, as well as faster decline in memory and attention. Notably, hippocampal atrophy primarily influenced memory decline, and atrophy in the predominantly cholinergic subregion of BF (Ch4p) affected attention decline.



Mask of the cholinergic basal forebrain subregions overlaid on a human brain template. (Red) Ch4p: the posterior subdivision of the nucleus basalis of Meynert, (Blue) Ch1/Ch2: the medial septal nucleus and vertical limb of the diagonal band of Broca.

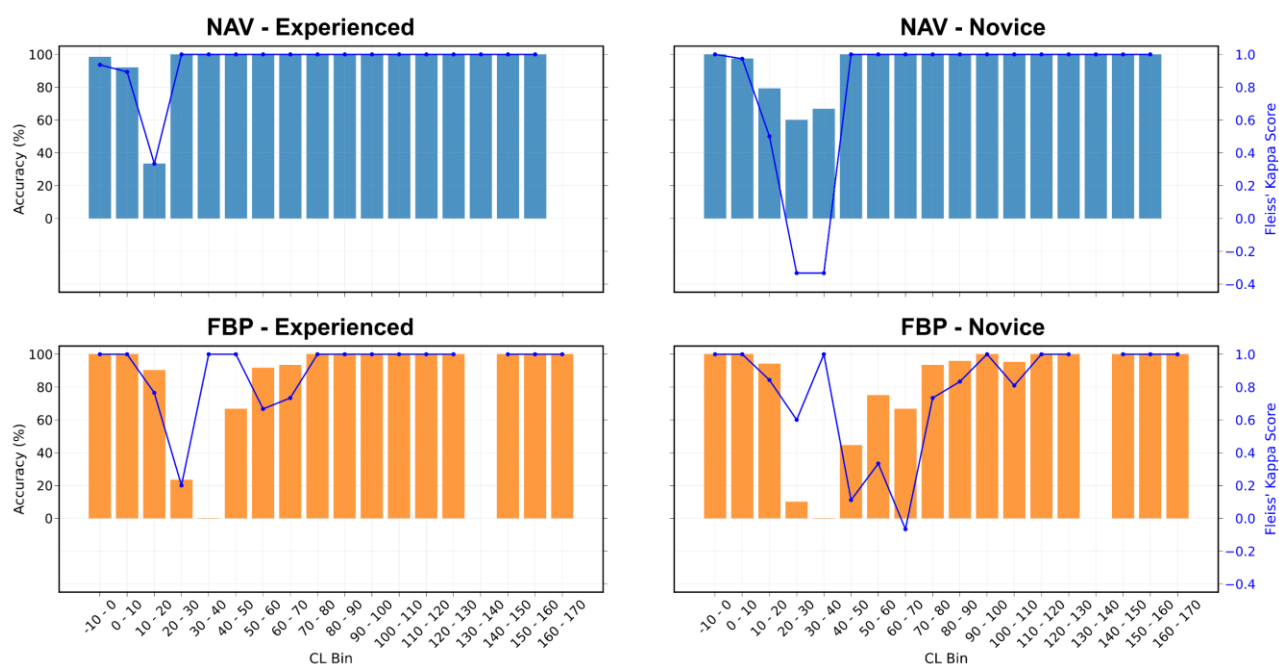
Visual read performance of 18F-Florbetapir and 18F-NAV4694 amyloid- β PET imaging in Alzheimer's disease

Collaborators: Austin Hospital, University of Pittsburgh, The Florey Institute of Neuroscience and Mental Health, Royal Melbourne Hospital, Mahidol University, Thailand, Chiang Mai University, Thailand, AIBL, ADNeT

Visual assessment of $A\beta$ PET scans remains standard clinical practice to rule out $A\beta$ pathology in AD. However, the accuracy and reliability of visual interpretation varies across different 18F-labeled $A\beta$ tracers and readers' experience. Compared against Centiloid (CL) reference standard, our study showed that visual read of 18F-NAV4694 (NAV) PET is more reliable and more consistent across readers than visual read of 18F-Florbetapir PET, particularly in individuals with low to moderate $A\beta$ loads. NAV PET appears advantageous for both experienced and novice readers to detect low levels of cerebral $A\beta$ with less reader variability, allowing the visual exclusion of $A\beta$ pathology more reliably. With the recent approval of disease-modifying treatments for early-stage AD, more accurate detection of low cerebral amyloid loads shown in 18F-NAV4694 $A\beta$ tracer has become increasingly important in clinical practice for monitoring the progress of anti- $A\beta$ therapy and determining when to stop the treatment.

We presented these results at the Society of Nuclear Medicine and Molecular Imaging (SNMMI) 2025 Annual Meeting in New Orleans, USA and 55th Annual Scientific Meeting of the Australian and New Zealand Society of Nuclear Medicine (ANZSNM) in Melbourne. A manuscript has been

drafted summarising these findings to be submitted to high-impact journal — *Journal of Nuclear Medicine*.

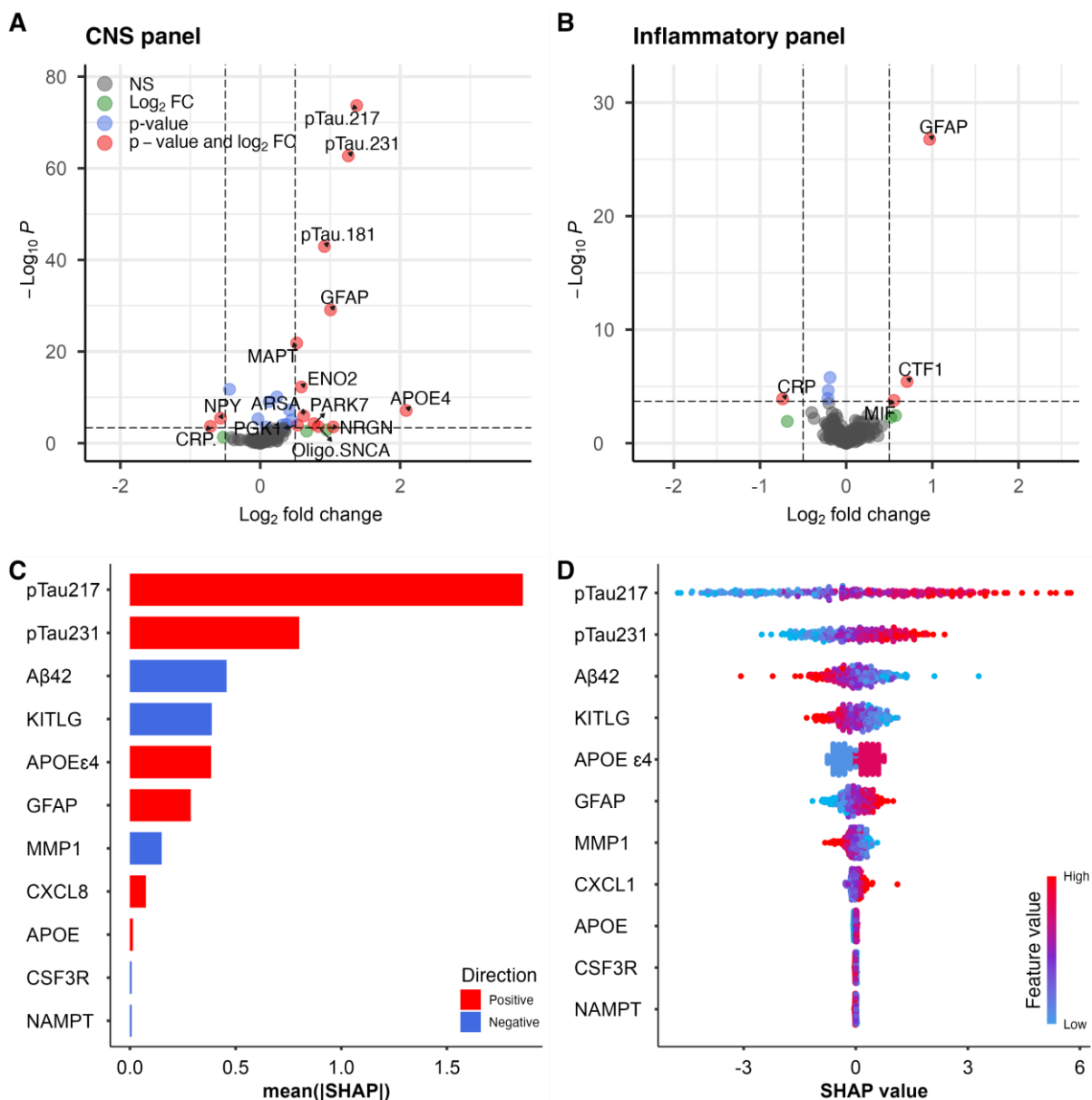


Mean accuracy of visual assessment (shown in bar charts) and inter-reader agreement in Fleiss' Kappa scores (shown in line plots) of experienced readers and novice readers for ^{18}F -NAV4694 and ^{18}F -Florbetapir in blue and orange, respectively. A Kappa score of 1 represents perfect agreement between readers whereas zero means no agreement beyond chance. Generally accepted threshold of 20CL (standard threshold for A β abnormality) was used for both tracers in the accuracy analysis

1.1.1 Blood based biomarkers for the detection of tau neuropathology

Collaborators: Australian Imaging, Biomarkers and Lifestyle Study, AbbVie

Alzheimer's disease is classically recognised from a neuropathological perspective as the aggregation of both amyloid-beta plaques within the brain, typically beginning ~20 years prior to symptom onset, and tau tangles, which form as the result of the degeneration of neurons. With substantial tau tangle development in the brain, cognitive function begins to decline, and the symptoms of clinical dementia slowly begin to surface. It is within this stage of tau tangle aggregation that, disease modifying treatments are currently approved for prescription. Current research shows that treatment appears to have greater success where there is lower tau tangle development (less neuronal loss), and as such it is vitally important that the different stages of tangle development in the brain are mapped out. While the most accurate way to do this is via PET-imaging, this is costly and time consuming. Projects with the Australian Imaging, Biomarkers and Lifestyle (AIBL) study of ageing, collaborating with the large pharmaceutical company AbbVie, focus on the identification of blood-based biomarkers which can allude to the proportion of tau tangles in the brain. The present research focussed upon identifying biomarkers from two large panels of biomarkers developed by Alamar Biosciences for just this hypothesis. Initial work was awarded an oral presentation at the world leading *Clinical Trials for Alzheimer's Disease* conference in Madrid (Oct 2024), with the project being submitted as a journal manuscript to *Alzheimer's and Dementia*.



Univariate and multi-variate approaches to identifying suitable biomarkers to detect the presence of tau pathology in a group of participants from AIBL. A & B) Volcano plots demonstrating the biomarkers which were found to be predictive of tau tangle pathology from two separate panels (CNS & Inflammatory) of biomarkers. C & D) Group average (C) and individual participant (D) effects per biomarker chosen via ML/AI methods.

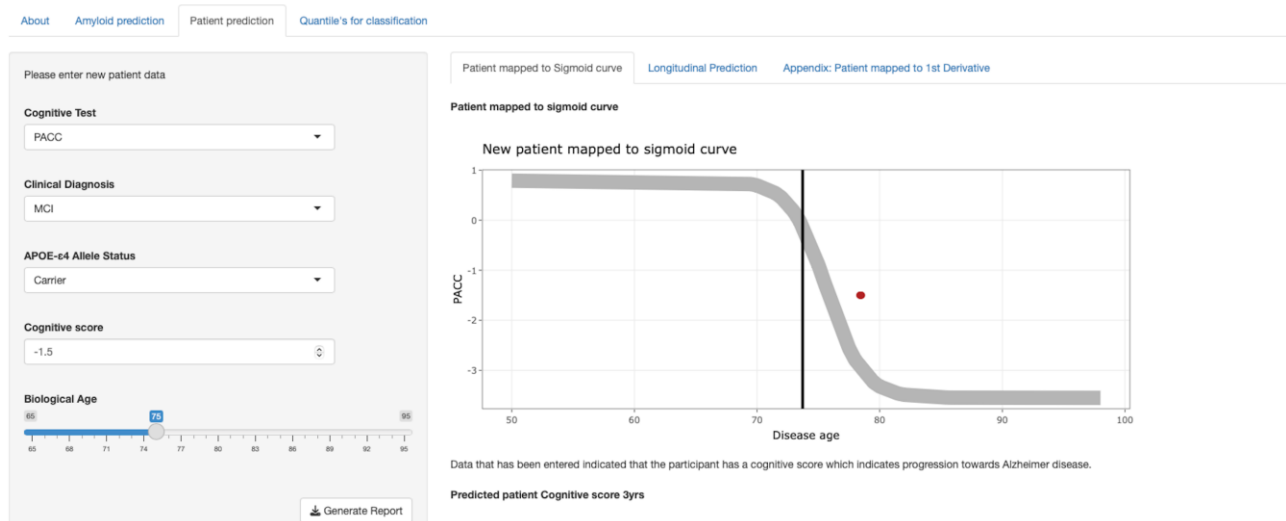
PADPT: Prediction of Alzheimer's disease progression tool

Collaborators: Australian Imaging, Biomarkers and Lifestyle Study, Biogen

The recent success of disease modifying treatments for Alzheimer's disease and the growing emphasis for such treatments to commence in the pre-clinical phase makes robust empirical models of clinical disease progression necessary for both a deeper understanding of findings from clinical trials, and for clinicians to evaluate effects of new drugs and select individuals for future trials. Such models have been developed from relatively small samples, with incomplete data or substantial loss of follow-up. We developed the prediction of Alzheimer's disease progression tool (PADPT), an online app to identify candidates with positive AD biomarkers likely to decline in cognition contingent on baseline information. We applied sigmoid models of disease progression (Cespedes et al.) to cognitive data from the Alzheimer's Dementia Onset and Progression in

International Cohorts (ADOPIC) consortium, the largest and complete AD natural history to date. Designed for amyloid positive individuals, the tool assesses the concurrence of amyloid positivity from four well known blood-based biomarkers: Ab40/Ab42, pTau181, NfL and GFAP. Secondly, in conjunction with baseline information from potential candidates, the PADPT estimates if an individual is likely to progress to cognitive decline or remain in stable cognition across four outcomes; MMSE, CDR-SB, language composite cognitive score, and pre-clinical Alzheimer's composite cognitive score (PACC). Further exploration compares potential cognition treatment related decline versus untreated decline over a range of user selected follow-up periods. PADPT's data driven sequential mathematical approach enables it to work as a standalone contingent on the ADOPIC consortium or enable performance driven by user supplied data. Our established methods can be applied to user supplied data to drive the PADPT for insights contingent on specific cohorts or for potential candidate as well as post-treatment comparisons.

ADOPIC Pre-clinical Alzheimer's Cognitive Composite: Patient prediction of cognitive decline



Patient prediction tab. User enters participant baseline information such as choice of cognitive outcome (PACC selected), clinical diagnosis (MCI selected), APOE e4 allele carrier status (carrier selected), cognitive outcome value and patient's biological age. Plot shows participant mapped onto disease curve (red dot) to the right of the inflection point (black vertical line) denoting this individual as a cognitive decliner. Tabulated summaries including estimated annual rate of decline are provided below plot. Cespedes, M., et. al., Doecke, J. D., (2023). Disease sub-groups from longitudinal patient trajectories. *Australian Statistical Conference*

Biomedical Informatics: postdoc and student highlight

CSIRO Early Research Career Fellow: Jessica Bugeja

Inspiring the next generation of researchers

As part of my postdoc, Jess participated in the WithSTEMYouCan Campaign, judged for the STEM convention, was interviewed for the 'With Stem you Can' campaign, spoke at the UQ STEM forward event and participated in CSIRO's 'Science as our superpower' group. She led and assisted 'It Takes a Spark' workshops and is now on the Spark conference organising committee. She volunteers as Resident Scientist at Dutton Park Primary School (CSIRO STEM Professionals in Schools).

The Digital Therapeutics and Care (DTaC) group

About the group

Group Leader: Marlien Varnfield

Our team of research scientists, engineers, and technicians in the Digital Therapeutics and Care group is committed to advancing care services for older adults, people with disabilities, and individuals managing chronic health conditions. Through sophisticated digital platforms, we deliver evidence-based interventions that are co-designed with end users to support better health outcomes.

We use state-of-the-art sensor systems, smart devices, and digital technologies to collect personalised physiological, behavioural, and social data from a variety of sources. This rich dataset enables us to track individual progress and detect emerging health concerns before they escalate.

By integrating technology into healthcare, we enhance the efficiency and effectiveness of care delivery, ultimately promoting the overall well-being of the populations we serve.



Digital Therapeutics and Care science and impact highlights for 2023/24

- A successful multisite pilot of the new digital diet diary within the award-winning M♡THER platform has driven meaningful change in the delivery of medical nutrition therapy for women with gestational diabetes mellitus (GDM) at Logan Hospital. Previously limited to women requiring insulin therapy, the platform is now offered to all women diagnosed with GDM at Logan Hospital, following high levels of patient and provider engagement with the new feature. Enhanced patient-provider communication and streamlined dietary management were key factors in this expansion. Building on this success, the feature is now being implemented across multiple additional hospital sites, supporting broader system-wide improvements in GDM care.
- Through the My Mate project, we demonstrated that clinically informed, AI-powered activity recognition using minimal sensors can enable real-time, low-intrusion monitoring to support independent living for older adults.
- The BEST CARE study demonstrates the potential of passive sensor systems to detect early behavioural indicators of fall risk in residential aged care, laying the groundwork for predictive, data-driven approaches to proactive falls management.

Artificial Intelligence in DTaC

Team Leader: Shaun Frost

Our team develops diagnostic and decision support systems for remote delivery of health services. The multi-disciplinary team combines expertise in clinical research, telemedicine systems and artificial intelligence for medical image and data analysis. The team works with key stakeholders and collaborators to develop and trial these solutions to demonstrate improved health outcomes and health service delivery.



Emerging Technologies in DTaC

Team Leader: David Silvera

Our team harnesses internet-connected sensors, robotics and smart devices to drive better outcomes across health, aged care, and disability services. By combining real-time data with advanced AI-based analytics and ML, we generate meaningful insights into health and lifestyle patterns. Our work empowers people to live independently in their homes for longer, while also enabling carers and service providers to deliver smarter more proactive support



DTaC Project Support

Team Leader: Liesel Higgins

We assist the DTaC group with project governance, research design, and the practical implementation of projects. The group consists of research technicians, research scientists, and project managers with clinical backgrounds. We use our multi-disciplinary knowledge and skills to support stakeholder liaison and management, interpretation of health and social care related research problems, and strategic development of research projects. Collectively we contribute to research design and development, project evaluation, research analysis, data management, application to ethics and privacy governing bodies, project timelines and accountability of project deliverables.



DTaC Indigenous Research

Team Leader: Janardhan Vignarajan

We address the health disparities between Indigenous and non-Indigenous people in Australia. We partner with Aboriginal and Torres Strait Islander community-controlled organisations to co-design and co-develop eHealth solutions to complement existing successful models of care for some of the most significant health issues in these communities.



DTaC Insights

Team Leader: Kaley Batten

We comprise of scientists and engineers with expertise in public health, clinical and health services, software engineering and machine learning. We work with key stakeholders and collaborators (clinical, commercial and academic) to develop, trial and validate new models of care in mobile health, tele-health and virtual care settings, to optimise accessibility and consistency of care in a range of health discipline areas.

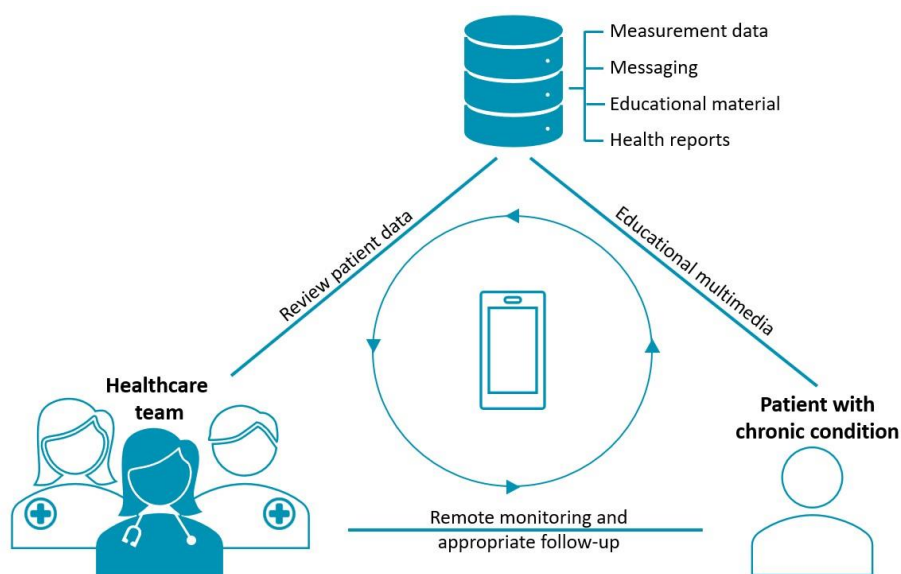


Digital Therapeutics and Care: Platform technologies

Mobile health platforms

Our mHealth platform, developed to support the management of chronic conditions such as cardiovascular disease, diabetes, kidney disease and mental illness, has recently been extended to the management of hypertension, heart failure and stroke as well as post colorectal cancer surgery follow up. The digital solution, which uses smartphone apps and sensors for monitoring of health and wellness measures, was re-engineered and improved to integrate new wearable technologies such as a variety of activity and sleep-tracking devices.

Applications of the mHealth platform for various medical conditions are being evaluated in collaboration with our health service and industry partners. In addition to using the platform for self-management of existing health conditions, we have also developed a preventive smartphone application risk profiling matrix for chronic diseases.



The mHealth care matrix

Components of the mHealth platform and data communication

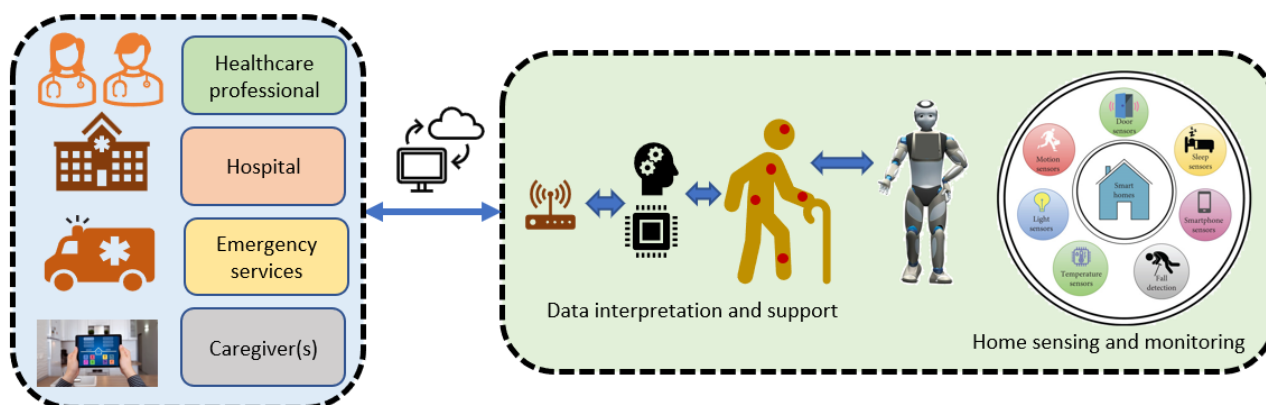
Our platform design has personally controlled health information and interoperability concepts at its core. The FHIR based architecture attempts to solve the issues around 3rd party FHIR server integration and correlation of existing patient identity while maintaining the patients' control over where their data goes, be it a primary care system, hospital system or other FHIR server like a Health Information Exchange.

Our first proof-of-concept has been deployed in a Victorian public hospital and will be used for monitoring people with gestational diabetes with a redesigned interface informed by clinician focus groups and the M♡THER trial. A simulated hospital information system is being used for the pilot and we have begun investigating integration into the hospital's electronic medical record system.

This gestational diabetes specific variant of the platform is being reworked within our ISO13485 certified Quality Management System for inclusion in the Therapeutic Goods Administrations, Australian Register of Therapeutic Goods (ARTG) so that Queensland hospitals can continue to benefit from it after the M♡THER trial concludes.

1.1.2 Smarter Safer Homes platform

The Smarter Safer Homes (SSH) platform is an advanced in-home health and activity monitoring solution designed to help older adults and people living with disabilities to live independently and safely in their own homes. Co-designed with consumers, clinicians and industry partners, SSH empowers users to self-manage their health and wellbeing while connecting seamlessly with both formal and informal care networks. The platform integrates sensor-based monitoring, AI powered data analysis, and user-facing interfaces, including a tablet app for end-users and a dedicated care provider portal.



The SSH platform supports people to live independently

In its latest evolution, SSH has progressed from passive monitoring to intelligent, responsive, and personalised interventions. This shift has driven a comprehensive redesign aimed at advancing sensing capabilities, analytics and user interaction. The platform now features a hybrid architecture that blends centralised cloud computing with AI-enabled edge processing, balancing performance across static (ambient sensors) and mobile (e.g. robotic) systems. This approach enhances user privacy, energy efficiency, latency, reliability, and scalability, while supporting real-time, distributed decision making across the smart home eco-system.

1.1.3 Kara-Care platform

The Kara-Care System is a digital health platform designed to bridge critical gaps in healthcare information accessibility across Western Australia. Developed through a collaboration between CSIRO, South Metropolitan Health Service (SMHS) and Department of Health, WA, the system aims to unify disparate health records between public hospitals and Aboriginal medical services (AMS). Built using interoperable standard—FHIR, Kara-Care consolidates patient data including allergies, prescriptions, discharge summaries, ECG reports, clinical images, and pathology reports. By enabling timely access to this data, Kara-Care supports culturally safe and informed care, addressing long-standing issues where hospital and community health records remain siloed and inaccessible across systems.

The platform was successfully deployed at two AMS sites—Puntukurnu Aboriginal Medical Service (PAMS) and Wirraka Maya Health Service Aboriginal Corporation (WMHSAC) as part of a proof-of-concept under the WA Minister’s “The Challenge” initiative. Currently, we are exploring opportunities with the department of health, WA and other stake holders towards sustainable rollout of the system across other Aboriginal health community sites.

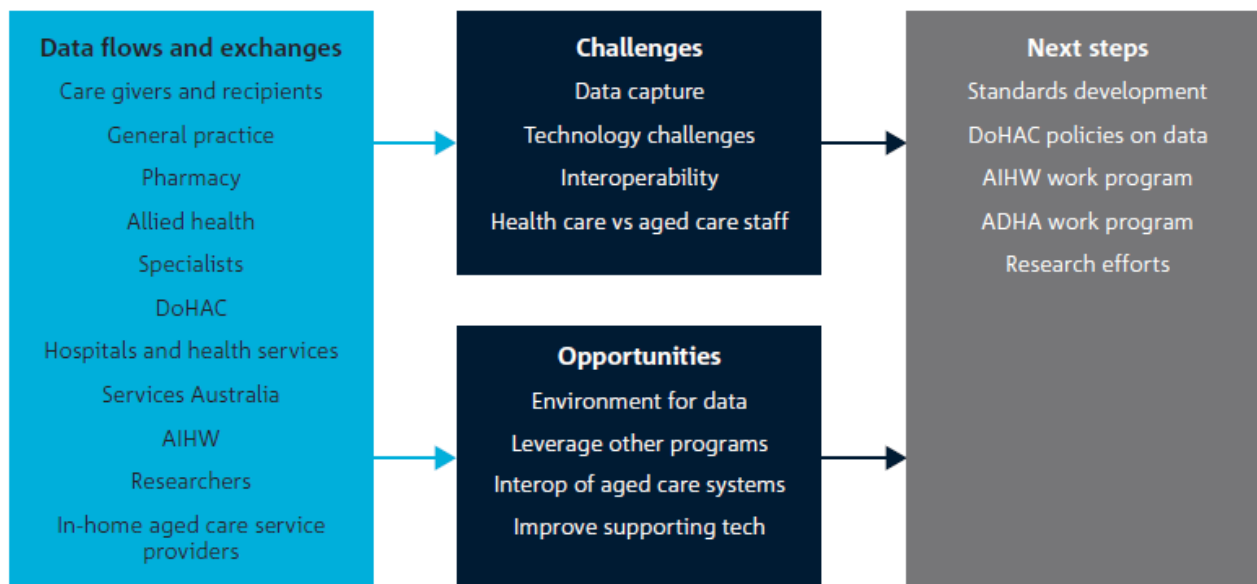


The Kara-Care System’s patient journey viewer displays a unified timeline of hospital visits, documents, and key clinical events, enabling clinicians to quickly understand a patient’s healthcare history across multiple services.

Digital Therapeutics and Care: Project reports

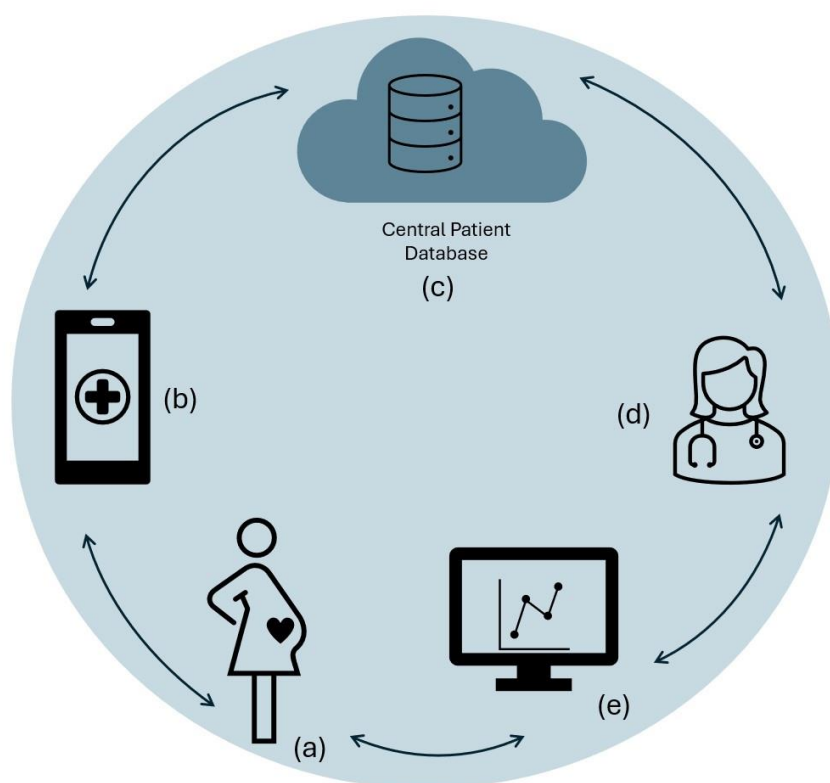
Aged Care Data Landscape Report

Collaborators: Digital Health CRC



The use of data in the Australian aged care environment is complex. Data is collected in a breadth of ways and formats, to provide care for older adults living at home or in residential aged care facilities. We collaborated with the Digital Health CRC to reflect and consider what recent sector wide work on data, technology and AI for the improvement of care provision looks like and what impact this work has had so far. For this project, information was gathered from desktop research that looked at the current literature and policy environment, along with research interviews with experts across the aged care sector (clinicians, managers, executive level professionals, researchers, federal departmental representatives, and technology vendors). The results showed that significant work has occurred in the implementation of numerous digital systems which have created both new opportunities and ongoing challenges. Challenges include data capture issues, general technology issues, restricted interoperability between current systems, and disparities between the aged care system and the health care system. Opportunities for ongoing work were identified as ongoing work to the digital environment in which data is being managed, the potential to leverage other programs to uplift aged care, the value of improving interoperability between aged care systems and the need to improve the supporting technologies. Overall, this project highlighted the importance of, and need to support development of at all levels, consistent and standardised data sharing as a vital capability to the provision of connected and coordinated care across the aged care sector in Australia.

1.1.4 M♡THER Studies



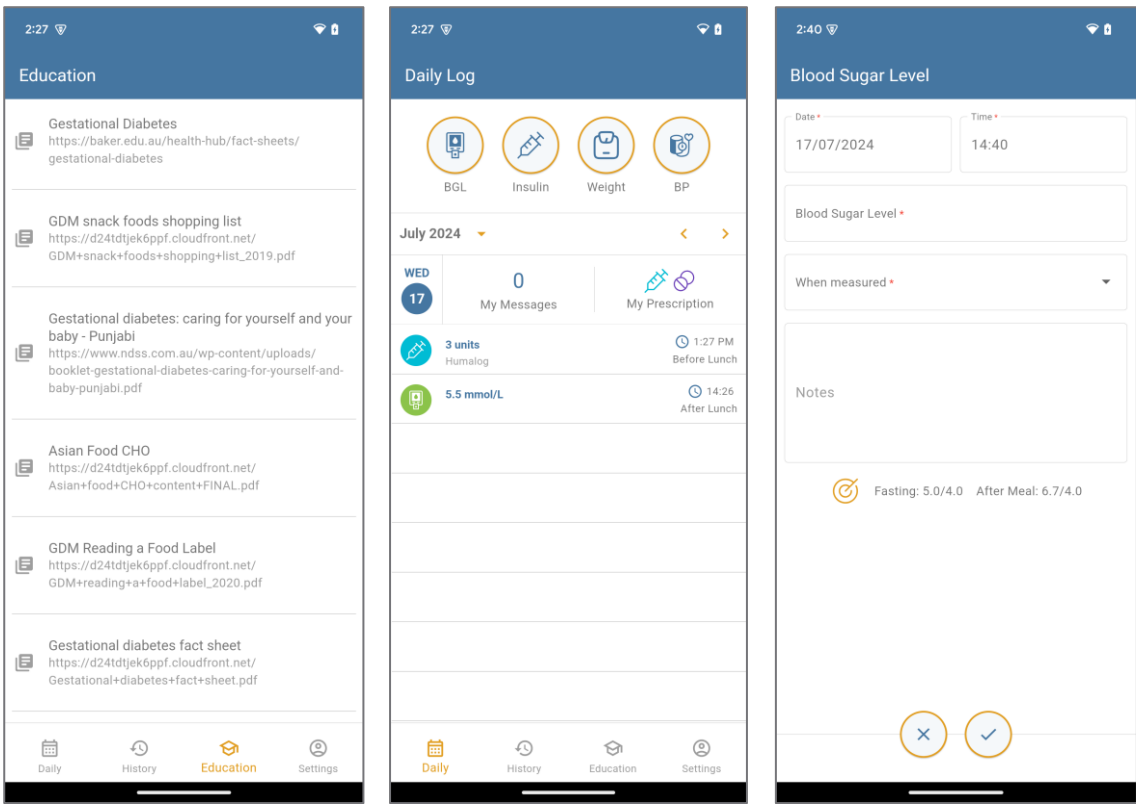
Schematic illustration of the M♡THER platform. A woman with GDM (a) installs the M♡THER app on their smartphone (b). The M♡THER app is used for data input such as blood glucose levels, weight, exercise and symptoms, and delivery of motivational prompts and educational media. Patient data is uploaded to a secure centralised patient database (c), that can be accessed by the GDM care team (d) via a clinician web portal (e). Data can be reviewed via the web portal by healthcare practitioners, aiding in discussions and management decisions.

M♡THER is a platform designed to help women and their clinicians manage gestational diabetes mellitus. The platform can support an individual to log and track their health data (blood glucose, blood pressure, steps, stress, sleep etc) and facilitate remote monitoring by the multidisciplinary team. The platform consists of a patient facing app and a web-based clinician platform. A successful feasibility study led to a multisite implementation study, buoyed by the demand for remote-monitoring during the COVID-19 pandemic.

Since mid-2020, M♡THER has supported over 12000 women and their health care team, with studies operating across Redland, Logan, Mater, Royal Brisbane and Women's Hospital and Ipswich Hospital. Additional feasibility studies have also been undertaken in regional and remote areas, including a past study at Mt Isa Base Hospital and an active study at Cairns Hinterland and Hospital Health Service (inclusive of Innisfail Hospital, Mareeba Hospital, and Mossman Hospital). A randomised control trial is commencing with a Melbourne health service to explore if and how the mHealth supported model of care for GDM can positively affect clinical outcomes.

Inspired by the opportunity to provide quality care remotely, easing the resource burden associated with frequent face to face appointments for hypertension in pregnancy, Southwestern Sydney Local Health District sought to augment the platform to manage hypertensive disorders in pregnancy. A randomised control trial has completed recruitment (n=265) across three hospitals in

Sydney. The preliminary feedback suggests the platform was well accepted by users, further analysis will provide insight into the safety, user-satisfaction, cost-effectiveness and impact on healthcare use.

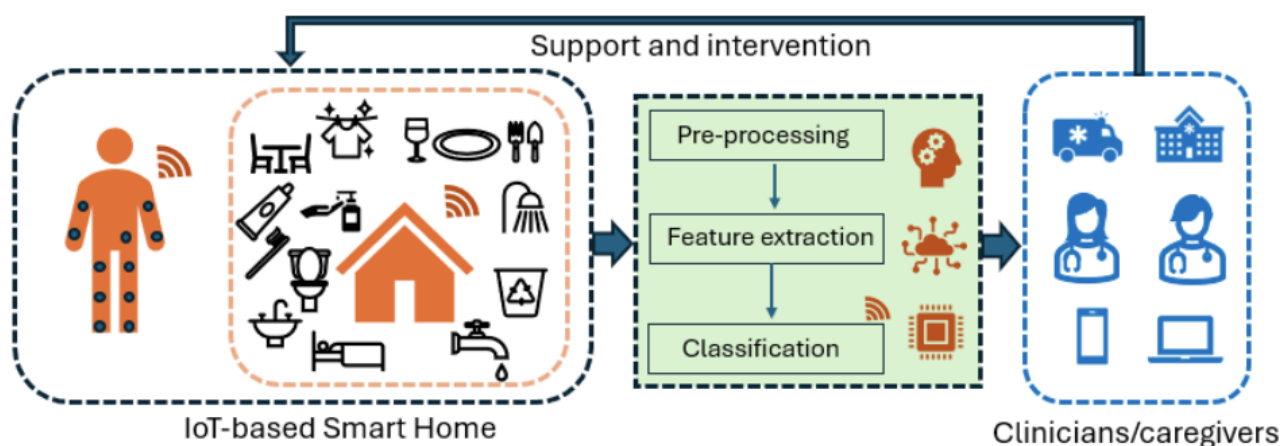


Patients can record blood glucose levels and other key readings in the MOTHER app

1.1.5 Smart home for independent living of older adults

Collaborators: Data61 CSIRO

With the global increase in the older population and a simultaneous shortage of aged care workers, there is an urgent need for innovative technologies that support independent living among older adults. This project addresses that need through a clinically grounded approach to human activity recognition in smart home environments. This project began by reviewing standard clinical assessment tools and conducting in-depth consultations with aged care clinicians to identify key daily activities relevant for assessing independent living capabilities. Guided by these insights, we deployed a combination of wearable and ambient motion sensors in a real home environment to collect activity data from 50 participants. This rich dataset enables the development of machine learning models capable of recognising daily activities in real time. Our results show that even a single wearable device can accurately detect a range of daily activities, highlighting the potential for practical, low-intrusion monitoring solutions. Reliable real-time activity recognition paves the way for timely, personalised interventions by clinicians and caregivers—support that can significantly improve the autonomy, well-being, and quality of life of older adults. These findings underscore the value of integrating AI-driven monitoring systems into both private homes and aged-care infrastructure.



Smart home solution designed to promote independence and well-being in older adults

HAPPI MIND

Collaborator: Monash University

In 2022, it was estimated that there were 401,300 Australians living with dementia. With an ageing and growing population, it is predicted that the number of Australians with dementia will more than double by 2058. While there is currently no cure for dementia, there is evidence that some health conditions and lifestyles may increase the risk of developing dementia.

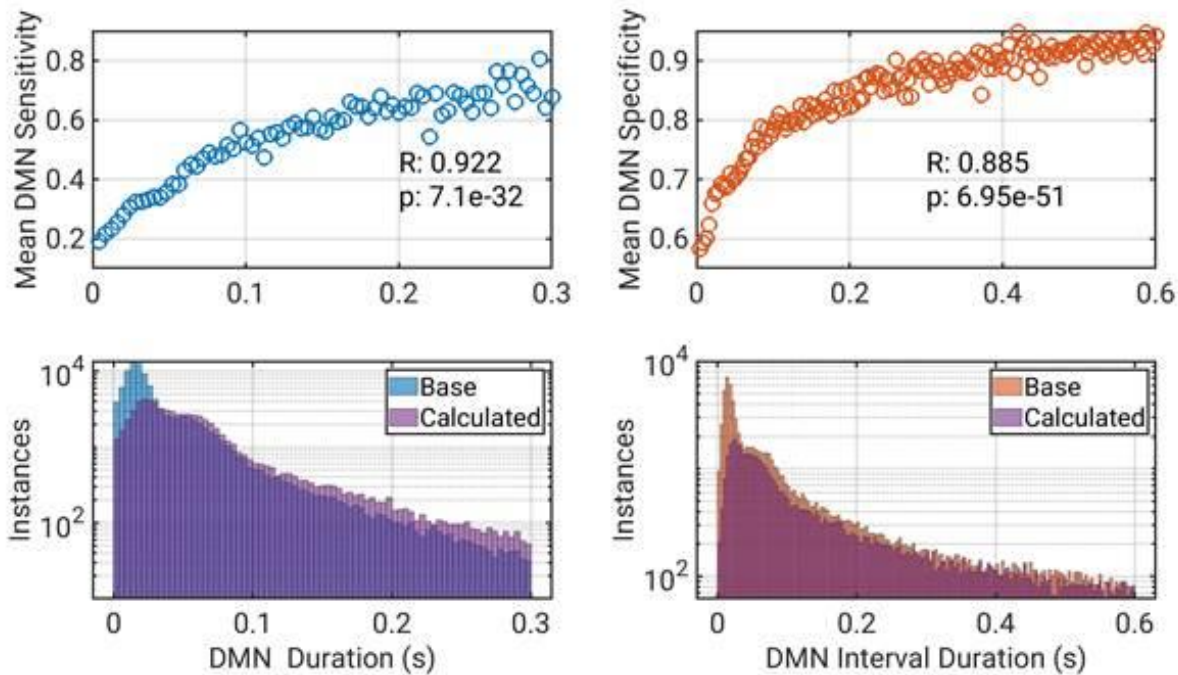
With our collaborators at Monash University, we are conducting a cluster randomised trial to evaluate a new approach for assessing and reducing dementia risk factors in middle-aged adults. By June 2023, 394 patients were recruited from primary care practices/clinics to participate in this multi-domain, primary care, nurse-led and smartphone assisted intervention. The primary outcome measure for the study is the Australian National University Alzheimer's Disease Risk Index (ANU-ADRI) score. To date, overall, n=330 have completed the primary outcome at 12 months.

Digital Therapeutics and Care: Project updates

Default mode network detection using EEG in real-time

Collaborators: Resonait

Recent studies have indicated that activity of the brain's default mode network (DMN) could prove insightful in monitoring patient recovery from depression and has been used as a therapeutic target itself. An opportunity exists to replicate recent therapeutic protocols targeting DMN connectivity via functional magnetic resonance imaging using the more economically scalable modality of electroencephalogram (EEG). The aim of this work was to validate the accuracy of real-time DMN detection methods applied to EEG data, using a publicly available dataset. Using a Hidden Markov Model to identify a 12-state resting-state network, this work achieved an overall DMN detection accuracy of 95%. Furthermore, the model was able to achieve a correlation of 0.617 between the baseline and calculated DMN fractional occupancy. These results demonstrate the ability of real-time analysis to effectively identify the DMN through EEG data providing an avenue for further applications that monitor and treat mental health disorders.



Real-time performance improves over state visits and intervals that are sustained over time. DMN sensitivity increases very robustly with state visit duration. Concurrently, DMN specificity increases very robustly with inter-state interval duration.

MoTER-HF heart failure platform

Collaborator: The Prince Charles Hospital

We have developed and evaluated the MoTER-HF platform to support patients with heart failure in managing their chronic condition. The feasibility study of the MoTER-HF platform was completed in March 2025. The study has demonstrated the platform's potential to support heart failure self-management, with meaningful participant engagement and perceived health benefits. A total of 23 patients were recruited from The Prince Charles Hospital. Participants expressed satisfaction with the app's integration into their routines and health management. Features such as easy navigation, Bluetooth-enabled automatic data capture, and historical data visualisations were noted by participants. Although no statistically significant improvement in health or behaviour was observed, positive trends emerged in the measures of self-care, quality of life, self-efficacy, anxiety and stress. Participants highlighted the benefits of improved self-monitoring of their condition, increased confidence from longitudinal data tracking, and reassurance from knowing clinical nurses were reviewing their data.

Overall, both patients and clinicians were positive about the usability and usefulness of the digital intervention, although some implementation challenges were also identified. This project has contributed to our ongoing research in mobile health and its feasibility and effectiveness in supporting the self-management of patients with chronic disease.

Wearable sensors for energy expenditure measurement in patients with burn injury

Collaborator: Royal Brisbane and Women's Hospital

Severe burns cause a profound pathophysiological stress response and a radical increase in metabolic rate. The gold standard method (indirect calorimetry) for determining energy expenditure (EE) in patients with burns has limitations in its application, only providing insight of resting EE on the day of measurement (not total EE) and is not practical to be used routinely. This project aims to identify the primary physiological indicators of EE and explore how they can be measured non-invasively using wearable devices. A review of the literature, market research, and consultation with relevant stakeholders was undertaken to identify promising wearable technologies capable of measuring physiological indicators of EE. The wearable devices selected for the feasibility trial (n=12) gather a range of physiological data, enabling the estimation of total EE through standard estimation equations and iterative algorithms, which will be compared against indirect calorimetry and predictive equations used in standard practice. Data collection for the feasibility is expected to be completed in June 25. This has been the first study to trial wearable devices to monitor EE and activity in hospitalised patients recovering from burn injury. This research will provide valuable data to improve our understanding of the potential use of wearable devices to monitor EE to guide nutrition decisions and inform future research exploring the validity of the devices.

AgeWell – Health insight into ageing Australians

Collaborators: Sax Institute, UNSW

The AgeWell project is advancing steadily and has entered a critical phase. Designed to explore how smart home technologies can support older adults in maintaining independence and well-being, the project involves deploying a purpose-built digital platform into ~100 participants' homes. This smart home system integrates a suite of ambient sensors and connected devices that unobtrusively monitor daily activities, health, and safety indicators. At this stage, the project is specifically focused on monitoring and identifying digital biomarkers related to mental health and social isolation—key factors that impact ageing Australians' quality of life. Over the past few months, we have achieved several milestones, including finalising the trial protocol, securing ethics and privacy approvals, and preparing for deployment. The smart home platform has been tested and refined to ensure both reliability and ease of use. Hardware has been successfully installed in initial test homes, and participant recruitment is now underway, marking an important step as we begin gathering real-world insights into the platform's potential effectiveness and impact.

A hybrid model for automated wrist fracture detection using X-ray imaging

Collaborator: South Metropolitan Health Service, Western Australia

This study presents a hybrid deep learning model for automated wrist fracture detection, which could assist clinicians by enhancing diagnostic accuracy, efficiency, and timeliness.

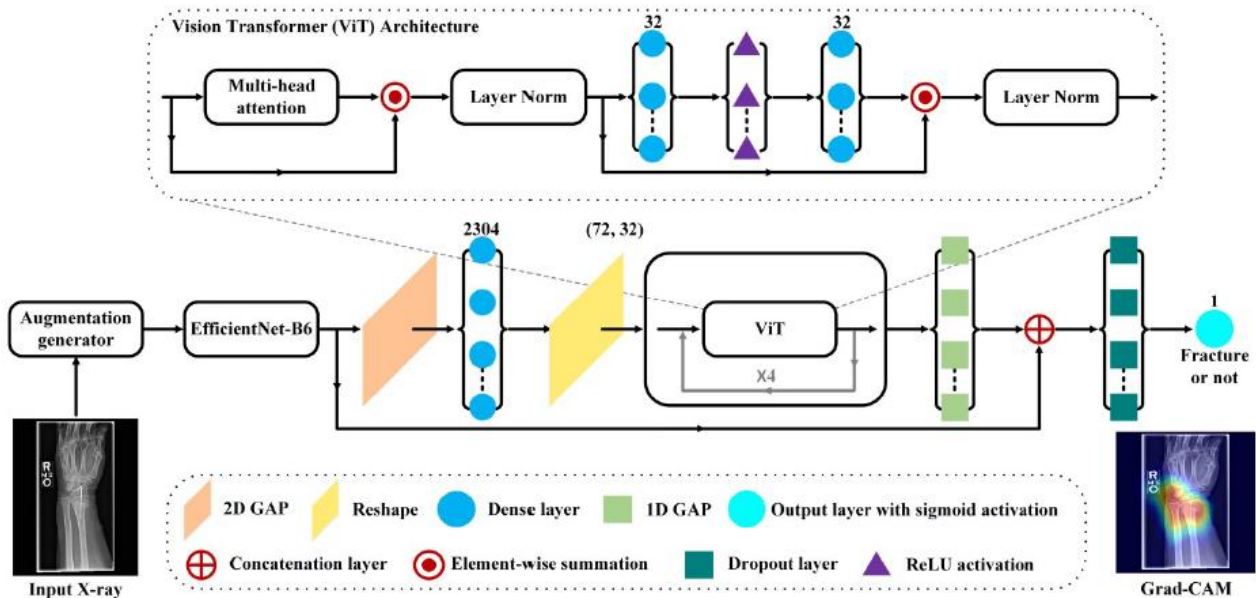


Illustration of the hybrid EffViT-B6 pipeline for WF detection, integrating EfficientNet-B6 with a Vision Transformer (ViT). The model analyses wrist radiographs to generate a binary classification, while Grad-CAM highlights the localised fracture region.

The proposed model automatically extracts and integrates both local and global feature representations in a single stage, achieving enhanced diagnostic performance and identifying fracture regions. Our results demonstrate that the model outperforms existing methods, achieving a classification accuracy improvement of 89.07 and an AUC of 93.21 on the publicly available baseline WF dataset (i.e., musculoskeletal radiographs), highlighting its superior classification performance.

A paper describing the model was accepted at EMBC 2025 (Annual International Conference of the IEEE Engineering in Medicine and Biology Society).



Examples of MURA wrist radiographs illustrate the disparities in dimensions, contrast, FOV, and the presence of artifacts.

Neurovascular coupling in Alzheimer's disease

Collaborators: AIBL, The University of Melbourne, Centre for Eye Research Australia

Healthy brain function needs responsive blood-flow to deliver oxygen and nutrients following brain activity (neurovascular response). Damage to this neurovascular response can occur in late-onset AD, making it a potential biomarker for predicting progression from mild cognitive impairment to dementia. Although the neurovascular response is technically difficult and expensive to measure in the brain, it is relatively easy to measure in the retina, which can be imaged non-invasively. This project developed a way to image a person's neurovascular response in the smallest blood vessels, finding that people with mild cognitive impairment have thinner neurovascular tissue and an impaired ability to mount a blood flow response following neuronal activation in comparison to their healthy counterparts.



Standard retinal image (colour) with overlaid image of blood flow in the smallest vessels, pink overlay indicates regions with increased blood flow following neural stimulation (neurovascular response)

Fall prevention in residential home via distributed sensors – BEST CARE project

Collaborator: Talius

This feasibility study explored the use of passive sensor technology in residential aged care homes (RACHs) to proactively manage fall risk by detecting behavioural changes such as reduced mobility and disrupted sleep. Drawing on prior research in community settings, the study analysed data collected from 24 residents, integrating ambient and wearable sensor data with clinical records and user feedback. The findings showed that sensor-based monitoring is technically viable and can reveal meaningful patterns in resident behaviour, with early predictive modelling suggesting potential for fall risk detection. Resident and staff feedback indicated general acceptance of the technology, though concerns were raised about privacy—especially in bathrooms—and the burden of false alerts. While some residents felt reassured by the system, most did not perceive a direct benefit unless they were frailer or cognitively impaired. Staff interviews highlighted the importance of thoughtful design and communication to ensure the system supports care without adding unnecessary workload. Overall, the study supports further development and scaling of sensor-based monitoring to enhance falls management in aged care.

Indigenous Health highlights

- Andrew Goodman completed his doctoral studies and was conferred by the University of Queensland in November 2024. His thesis is titled 'Can an integrated mHealth platform assist in the management of hypertension for Aboriginal and Torres Strait Islander people?'.
- Andrew Goodman was successful in securing an Indigenous Research Grant for project titled 'Exploring the relevance of Artificial Intelligence (AI) for Healthcare Applications in Australian Indigenous Communities: Scoping Project' (ISEP-ID 64).

Evaluation of the Remote Laundries Program

Collaborators: Aboriginal Investment Group

The Remote Laundries Project was launched in 2019 by the Aboriginal Investment Group (AIG) in response to community identified health issues associated with overcrowding and a lack of suitable washing facilities for large blankets and other linen in remote Aboriginal communities in the Northern Territory. The Remote Laundries program establishes secure, purpose-built, free laundromats in remote communities and are staffed by local community members. Scabies infestation affects 80% of Aboriginal babies in remote communities before their first birthday. The infection of scabies skin sores with *Streptococcus* bacterium leads to more complex diseases including the development of acute rheumatic fever and rheumatic heart disease. In partnership with AIG, CSIRO is evaluating the implementation and impact of the remote laundries on community health, social and economic outcomes, including towards preventing ARF and RHD.

CSIRO has co-designed a mixed-methods, three phases evaluation approach with AIG with Phase 1 data collection complete. Phase 1 focuses on assessing the implementation of the Remote Laundries program with the aim of showcasing key strengths of the program implementations, whilst also identifying key opportunities. Data has collected from in-field observations in remote Indigenous communities where laundries are located as well as interviews with AIG operations and laundry staff and external stakeholders who interact and influence the laundry operations to embed their perspectives. Data are currently being analysed to be reported back to AIG.



Skin Testing at the Point-of-care to Prevent Infections of Group A Strep and ARF: SToPPING ARF skin trial

Collaborators: Apunipima Cape York Health Council, Mulungu Aboriginal Corporation Primary Healthcare Service, Roche Diagnostics

The SToPPING ARF skin trial was designed in response to a community identified need for increased skin lesion diagnostic capacity. With the burden of GAS impetigo for Indigenous children living in remote northern Australia higher than anywhere else in the world, increasing primary prevention is a key to preventing acute rheumatic fever (ARF) and rheumatic heart disease (RHD).

There is currently no point-of-care test (PoCT) approved by Australia's Therapeutic Goods Administration for reliable and efficient molecular testing of skin lesions. Consequently, diagnostic testing in remote settings can take up to a week. Therefore, the current clinical guideline is to

treat suspected infections with a painful penicillin injection without diagnostic confirmation.

To increase the opportunity for diagnostic testing availability, we aim to determine the sensitivity and specificity of the Roche Diagnostic's Cobas Liat Strep A PoCT for diagnosis of GAS infections in skin lesions in a regional and remote setting, compared to a reference laboratory standard.

Phase one of this project involved the codesign of the research protocol with participating ATSICCHOs, incorporating initial feedback on the utility into the study clinical workflow to ensure culturally appropriate research design. Over the past year we codeveloped research and data governance and management procedures with each participating site and a human research ethics application was submitted for trial commencement in FY25/26.



Development of a best practice framework for eHealth with Aboriginal and Torres Strait Islander peoples: a Delphi study

There is increased evidence for the benefits of eHealth interventions with Aboriginal and Torres Strait Islander people, however there is currently no established framework that clearly guides culturally safe eHealth with Aboriginal and Torres Strait Islander people. This body of work aims to establish a best practice framework for the development and deployment of eHealth with Aboriginal and Torres Strait Islander people (Chelberg et al. 2022).

From January—March 2025, a modified Delphi study was conducted to form expert consensus on the factors most important to eHealth with Aboriginal and Torres Strait Islander people. Data collection and analysis is complete, and results from this Delphi have been drafted into a manuscript for publication.

A Best Practice Framework document is also being prepared, which will assist researchers and clinicians in translating findings from the Delphi study into practice.

Remote Indigenous housing: Measuring thermal comfort and energy security and intersections with health and wellbeing

Collaborator: Tangentyere Council

This project is contributing toward a broader climate change adaption and heat mitigation project in partnership with the Aboriginal Community Controlled Organisation Tangentyere Council in Alice Springs. In the Alice Springs region, poor housing suitability, energy insecurity and climate change exacerbating poor health outcomes were identified by the community as key issues for investigation. Access to empirical evidence (environmental, housing, and social factors) will facilitate Tangentyere Council to advocate for policy changes and decision making to improve housing suitability and other underlying determinants whilst also providing evidence to address Target 9b of the National Agreement on Closing the Gap. This project has been split into two phases with Phase 1, a feasibility study of environmental monitoring device implementation, complete. Phase 2 is utilising fit-for-purpose real-time sensors to monitor house temperature and humidity whilst also exploring via mixed methods the effects of thermal discomfort comfort and energy insecurity on residents' physical, cultural, social, and emotional wellbeing. Data collected will also be compared to external climactic conditions and energy consumption data.

An IoT network was established around Alice Springs and environmental monitoring devices were deployed into Town Camp residences across Alice Springs in December 2024 with data collection to cease December 2025. A combined survey and qualitative interviewing tool is currently being co-designed with Tangentyere researchers to collect lived experience and self-report data of residents' thermal discomfort, energy insecurity and the impacts on health and wellbeing.

The Powerful Pictures Study: A new model of care for tackling heart attacks with Indigenous Australians

Collaborators: Apunipima Cape York Health Council, Mulungu Aboriginal Corporation Primary Healthcare Service, Wuchopperen Health Service, Northern Aboriginal & Torres Strait Islander Health Alliance (NATSIHA), Queensland University of Technology, Metro North Hospital and Health Service, University of Sydney, Cairns and Hinterland Hospital and Health Service, Torres and Cape Hospital and Health Service, South Metropolitan Health Service (WA), and East Metropolitan Health Service (WA).



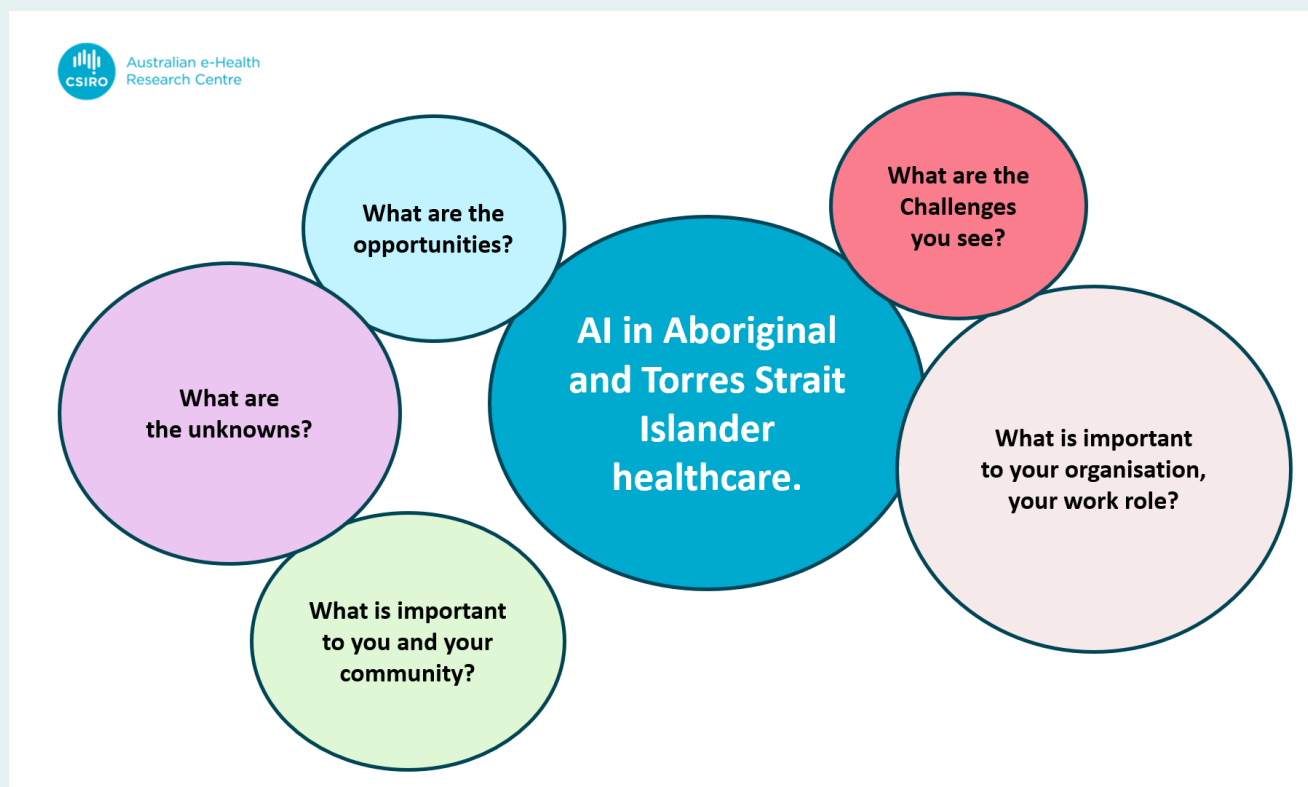
IMAGE (L-R): Laura Stephensen, Dr Andrew Goodman, Dr Andrea McKivett, Jeremy Rigney, Prof. Louise Cullen, Dr Gregory Starmer, Dr Sean Nguyen, Prof. Ray Mahoney, Dr Katrina Starmer, Prof. William Parsonage, Virginia Campbell.

The Powerful Pictures (PP) study is co-designing a new model of care (MoC) with Aboriginal and Torres Strait Islander Communities and Health Services to improve how heart disease is detected and managed using CT coronary angiography (CTCA).

To develop this model of care, we have embedded the guiding principle of ‘Two Eyed Seeing’ that sees strength of Indigenous and mainstream knowledges working together in partnership to create new solutions to complex challenges. Through our Two-Eyed Seeing co-design approach, a MoC for delivering culturally appropriate, patient-centred care to support detection and management of coronary artery disease with Aboriginal and Torres Strait Islander peoples was designed. The PP MoC has a foundational tenet of ‘trust’, that supports a quadrant of themes including partnerships, culturally responsive care, life course approach to heart health and connected processes.

Exploring the relevance of AI for Healthcare Applications in Australian Indigenous Communities: Scoping Project

Collaborators: Victorian Aboriginal Community Controlled Health Organisation Inc. (VACCHO), The Aboriginal and Torres Strait Islander Community Health Service (ATSICHS) Brisbane, Centre of Excellence for Aboriginal Digital in Health (CEADH), The Australian Indigenous HealthInfoNet.



Discussion prompts for consultation workshops

This project has implemented a consultation methodology approach through conducting independent workshops with key stakeholders to identify priorities and unanswered questions relevant to AI applications in Aboriginal and Torres Strait Islander healthcare. By building an evidence base, the project will clarify the relevance of AI to Aboriginal and Torres Strait Islander healthcare and identify any concerns and opportunities associated with its use and deployment in healthcare. Over four consultation workshops between November 2023 and May 2025, 53 participants, including executive leaders, service managers, researchers, administrators, clinicians and information technologists, shared their perspective on AI in Aboriginal and Torres Strait Islander healthcare.

Strong Communities, Strong Health: chronic disease prevention in the Torres Strait

The Strong Communities, Strong Health project is a three-year project being managed by the Healthy Ageing Research Team (HART) at James Cook University, Cairns. The project is a multi-methods project combining, lifestyle behaviour trends and desk-based asset mapping with qualitative data through yarning to comprehensively explore and report community specific strengths that can be harnessed for health promotion within the Torres Strait. The project culminates with co-design workshops between researchers, community members and relevant stakeholders, utilising this information to design strength-based health promotions strategies tailored for communities by communities. Over the last 12 months recruitment for the lifestyle tool validation has closed with 77 participants, community asset mapping of 167 asset types and preliminary analysis was completed for 10 communities across the region. Six yarning circles were held with >50 participants. The project is now in the final phase with 30% of co-design workshops delivered to date.

Integrated genetic healthcare

Collaborators: Central Queensland University, Metro North Hospital and Health Service (Genetic Health Queensland), North Metropolitan Health Service (Genetic Services of Western Australia), Western Australia Department of Health, Queensland Aboriginal and Islander Health Council, Aboriginal Health Council of Western Australia, University of New South Wales, Australian National University

The Integrated Genetic HealthCare project is a three-year MRRF project aiming to increase access to culturally appropriate, sensitive, and quality genetic healthcare for Aboriginal and Torres Strait Islander patients. The IGHC will deploy a suite of workforce development, coordinated care and health promotion strategies for ATSI CCHOs and genetic health services to strengthen pathways for a coordinated approach to equitably transform primary genomic health care for Aboriginal and Torres Strait Islander peoples. CSIRO is evaluating the implementation and impact of the Integrated Genetic HealthCare (IGHC) project.

CSIRO is leading the Evaluation Working Group and is currently co-designing the evaluation framework with research collaborators.

Digital Therapeutics and Care: Postdoc and student highlights

Postdoctoral fellow highlight: Anna Roesler

Anna led the co-design of a digital diet diary for the M♡Ther platform with three maternity services and their patients, transforming how gestational diabetes mellitus is managed. By replacing paper-based tracking with a digital tool, the diary improved access, efficiency, and user engagement in medical nutrition therapy. The pilot study showed strong uptake and identified future enhancements, including a more culturally inclusive food database. The feature is now actively used and evaluated across services.

Postdoctoral fellow highlight: Deepa Prabhu

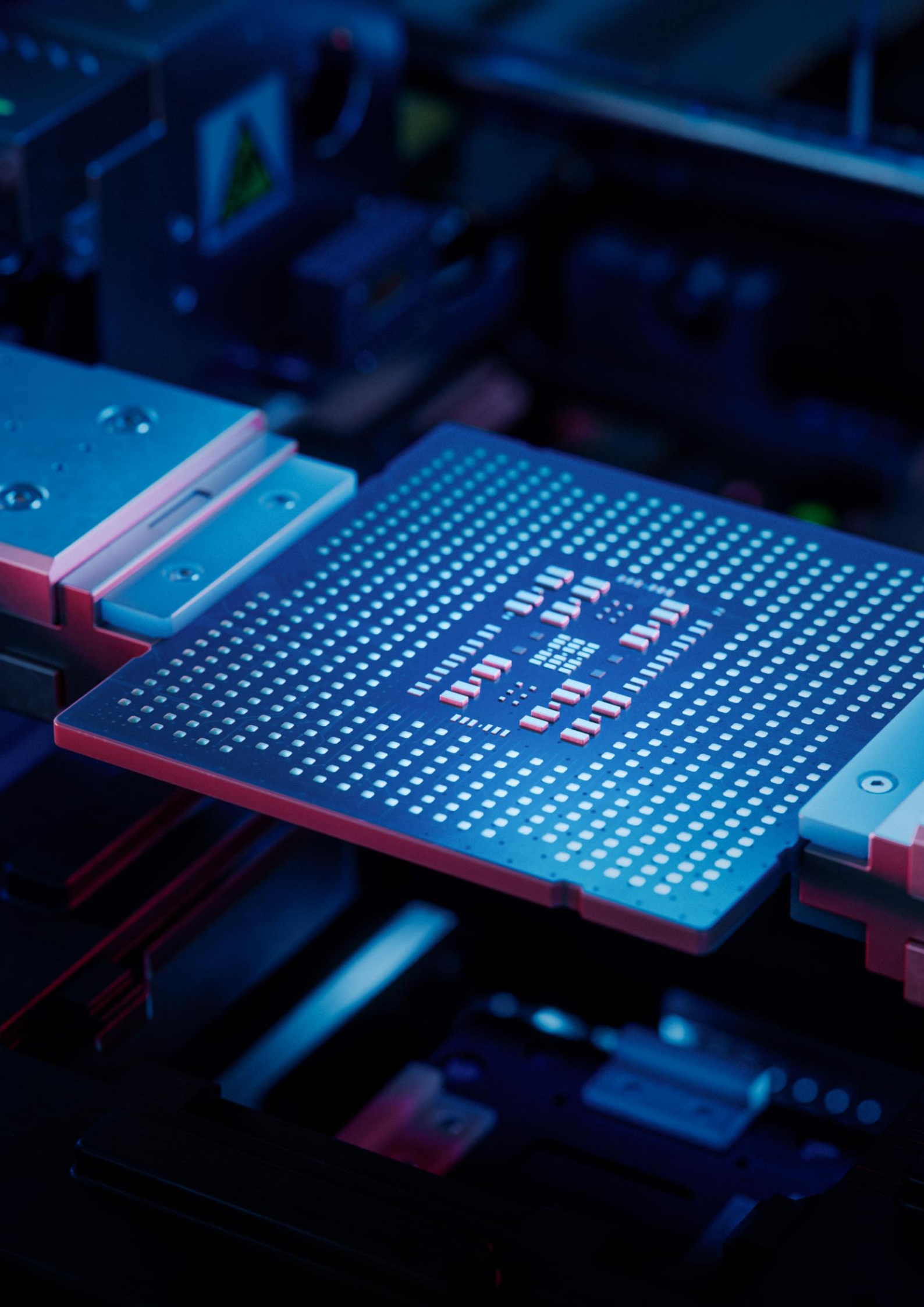
Deepa contributed to several key projects within the Emerging Technologies in DTaC team, using data from wearable and ambient sensors to investigate health behaviours, lifestyle patterns, and risks in older adults. She led statistical and machine learning analyses to explore correlations between in-home movement patterns and symptoms of depression among independently living older adults. Deepa worked on the ARIIA-funded BEST-Care project, focused on early identification of fall risk using ambient sensors in residential aged care settings. The AgeWell project, led by Deepa, explored the development of a longitudinal health data repository for older Australians. Deepa also contributed to a feasibility study using wearable sensors to measure energy expenditure in burn patients and provided research support to several other projects, including diabetic foot ulcer, and emotional dysregulation.

Student highlight: Erin Downs (Masters)

Erin's Masters research investigates the benefits of digital health technologies for persons with gastrointestinal cancer and gains insights from patients, caregivers, and healthcare professionals. Results from the study consolidates current insights on cancer apps, and compellingly advocates for real-time monitoring through apps, particularly in patients that experience high symptom burden, as these patients have more to gain and benefit from such an app. This unique perspective enriches existing knowledge and lays the groundwork for more effective digital health solutions tailored to these specific patient needs.

Student highlight: Liam Allan, Monash University (PhD Student)

Liam's work focusses on the feasibility, effectiveness, and potential delivery costs of mHealth programs for secondary prevention of stroke. Over the past two years, Liam has been involved in all aspects of the feasibility evaluation of the Care Assistant and support Program for people after Stroke or transient ischaemic attack (CAPS), including trial preparation, coordination, and quantitative and qualitative analysis. Preliminary findings of this work have been presented on international platforms, including at the Stroke 2023 conference, European Stroke Organisation Conference 2024, and European Society of Cardiology Congress 2024. As part of his PhD, he is also involved in evaluating an eHealth program for people after stroke which has recently completed a phase III RCT (2024) and will be involved in preparing the economic evaluation for cost-effectiveness.



The Health System Analytics group

About the group

Group Leader: Dr Rajiv Jayasena

Our group harnesses health data to drive efficiency, productivity and decision-making for hospitals, patients and communities to support quality and safe patient care. We develop safe and effective tools for generating insights, informing operational planning and policy making through modelling and simulation, surveillance systems and clinical decision support using artificial intelligence. These tools are developed using our quality management system (QMS) and deployed with the support of implementation science, resulting in scalable and commercial ready products that drive the uptake of sustainable health services.



Our research includes building analytics, prediction, optimisation, and operational and clinical decision support tools that can help hospitals and clinicians obtain a better understanding of where they can optimise delivery of health services. It also provides them with solutions that can help improve and streamline the delivery of care and improve patient outcomes.

We focus broadly on three areas of research—artificial intelligence, statistics and operations research to increase productivity and patient safety, implementation science informed evaluation of health service interventions and disease surveillance and response.

We also have two programs of activity supporting research at AEHRC, health data engineering and QMS. These two programs contribute by embedding industrial standards, interoperable software engineering and uplifting the regulatory compliance of AEHRC's software tools and solutions to be scalable-ready when we commercialise or offer products for routine use.

Health System Analytics science and impact highlights for 2024/25

- Technical report delivered to Australian Climate Services (ACS) on the air quality impacts from climate change on hospital demand to support the National Climate Risk Assessment (NCRA).
- Final report on the implementation-evaluation on the Rauland falls prevention workflows at Northern Health in Victoria and Maitland hospital in NSW.
- Successful in several MRFF and other grants (Chronic Respiratory Conditions Grant ENGAGEMENT, Multidisciplinary Models of Primary Care APRICOT, Digitising Information for Practice in Public Health (SMART-PH)).

- QMS certification received for “Design, development, manufacturing, installation and servicing of software-based medical devices”.
- Global AMR burden in *The Lancet*: “Global Burden of Disease Study”.
- ADePT demand forecasting scalable decision support project with InterSystems and Austin Health was awarded an international Impact Award at InterSystems READY 2025.
- Delivered a first in the Australian setting—a digital twin of the Queensland Patient Access Coordination Hub.
- The team working on the ADePT demand forecasting scalable decision support project with InterSystems and Austin Health was awarded an international Impact Award at InterSystems READY 2025.

Health Implementation Science

Team leader: Dr Alana Delaforce

We ‘make it real’ by moving innovation from the benchtop to bedside and beyond. We develop and promote the use of implementation science methods to ensure sustainable uptake of digital health solutions that enhance health outcomes at patient, provider, service and national levels. Research undertaken by the team focuses heavily on co-design and capacity building through implementation enhancement plans to drive the uptake of evidence into practice. The team also undertakes evaluations of health services to demonstrate effectiveness and/or efficacy of their services through hybrid-effectiveness trials.



Digital Solutions for Antimicrobial Resistance

Team leader: Teresa Wozniak

We are dedicated to mitigation, preparedness, and response to the threat of AMR. We have a diverse portfolio of external and CSIRO internal collaborators and is led by experts in the field of public health, system-level and statistical modelling, and social sciences. The team has implemented innovative disease surveillance programs which support efforts in reducing AMR in regional and remote Australia and is working closely with One Health partners to respond to current matters of local and national policy relevant to AMR.



Quality

Senior Quality Manager: Yan Chia

We support AEHRC's commitment to high-quality digital health research by embedding quality principles into research planning and execution. The team brings together expertise in software as a medical device (SaMD) regulatory frameworks, process optimisation, and translational science to strengthen research practices across the program. Through collaboration with program teams, we foster a culture of quality and supports the development of research outputs that are robust, scalable, and aligned with the expectations of our customers and partners.



Health Data Engineering

Team Leader: Derek Ireland

We are dedicated team of software engineers who work with scientists across the AEHRC translating our science into solutions for our customers and partners.



Health Intelligence

Team Leader: Dr Sankalp Khanna

The Health Intelligence team combines skills in artificial intelligence, statistics and operations research to further the science behind helping the health system increase productivity and safety through optimising patient, clinician and resource flows and providing intelligent decision support. Working closely with clinicians and health system administrators, we have delivered significant impact in the space of patient flow analytics and are well recognised as leaders in this research space. The team also has a strong track record of developing and implementing precision clinical decision support at point of care for patient management in acute care and primary care settings.

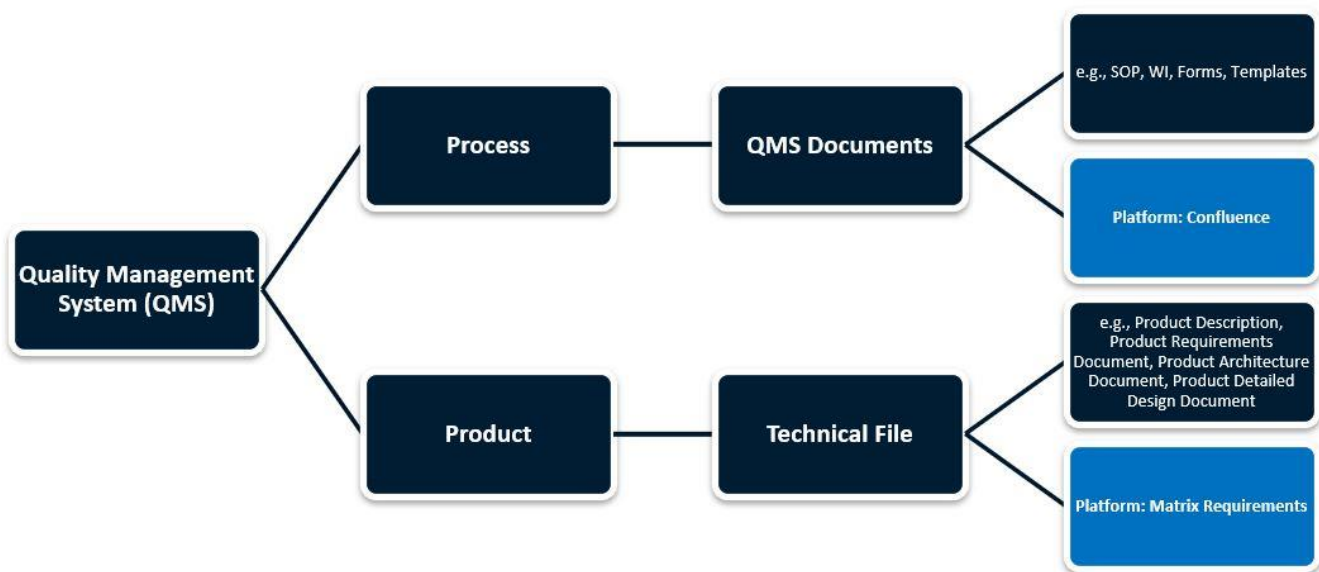


Health System Analytics: Platform technologies

The AEHRC quality management system (QMS)

We have implemented a QMS to support the design and development of SaMD across AEHRC. This strategic initiative strengthens the rigour, traceability, and compliance of our digital health research and development activities.

Aligned with internationally recognised medical device standards, the QMS provides a structured framework to ensure that AEHRC-developed software is safe, reliable, and fit for use in clinical environments. It facilitates the translation of research into high-quality, standards-aligned digital health solutions ready for adoption by the health system.



By embedding research outputs within a QMS framework, CSIRO is enhancing the impact of its digital health innovations, accelerating the readiness of these solutions for real-world use and increasing their value to healthcare systems, funders, and strategic partners.

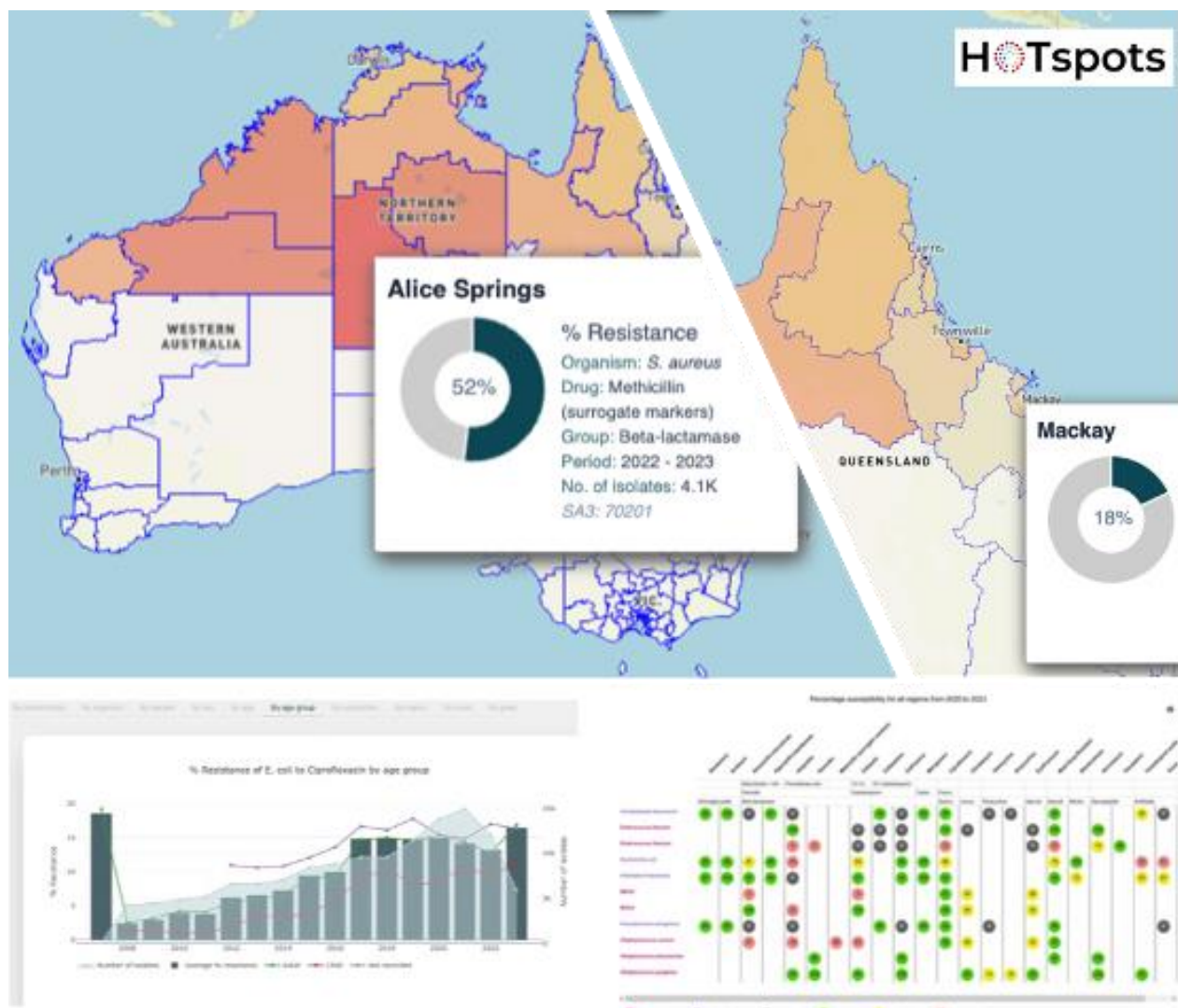
The implementation process engaged teams across AEHRC and included cross-program training, documentation improvements, software refinement, and internal audits. This work has enhanced organisational capability and embedded a stronger culture of quality across the centre.

HOTspots digital surveillance platform

The HOTspots digital surveillance platform facilitates access for healthcare providers, public health practitioners, and policy makers to up-to-date information on evolving AMR in hospitals and community clinics. This tool forms part of a suite of resources provided by the HOTspots surveillance and response program that supports antimicrobial stewardship activities, updating treatment guidelines and outreach capacity building in regional and remote settings of Northern Australia. From 2025, data for all Queensland and Western Australian clinical sites will be available and additional features of rates have been developed to provide the users with deeper insights on AMR.

Following the successful partnership with DHDA, the data from HOTspots now regularly contributes to national reporting on AMR epidemiology. In collaboration with local experts across Northern Australia, this platform continues to be used to support stewardship activities in hospitals and community clinics in Northern Australia. Currently HOTspots is available to clinicians through organisational intranet, Northern Territory Primary Health Network and integrated into general practice HealthPathways. HOTspots will continue to build partnerships with local data custodians and end-users to assist in the strategic direction for mitigating the treatment of AMR in regional and remote settings of Australia.

The expansion to One Health sectors, including collation of AMR data from wastewater surveillance programs is currently being co-developed.



Real-time Explainable Prediction Of Risk Tool (REPORT) clinical decision support algorithms

The availability of electronic health record data is transforming predictive patient risk stratification by enabling near-real-time identification of individuals at elevated risk for adverse health events. Leveraging a platform technology approach, we are developing the Real-time Explainable Prediction Of Risk Tool (REPORT) family of algorithms, a suite of high-performing, explainable ML models that operate on a shared data and analytics infrastructure. These models are designed to predict a range of critical outcomes, including preventable hospitalisations, clinical bloodstream infections, non-alcoholic fatty liver disease, and post-operative hypotension. By drawing from longitudinal and multimodal patient data—including demographics, vital signs, laboratory results, and clinical notes—these models provide risk scores and interpretable outputs to guide timely clinical intervention. The explainability of these algorithms ensures transparency and trust among clinicians, fostering adoption into routine decision-making.

This platform approach allows scalable deployment across diverse clinical settings, supports model retraining and validation, and facilitates integration into clinical workflows via dashboards or alert systems. Ultimately, ML-driven risk stratification enables proactive, personalised care, reduces avoidable harm, and improves system efficiency—supporting a shift from reactive to anticipatory healthcare.

Digital twins for operational and clinical decision support

Digital twins are emerging as a transformative platform technology in healthcare. We have developed an integrative framework that defines important elements and characteristics of digital twins to support operational and clinical decision making in healthcare. By integrating data from disparate sources across the healthcare continuum we are already building digital twins that employ this framework to support healthcare decision making. Our work with Queensland Health has recently delivered a digital twin of their statewide patient flow control room, the Queensland Patient Access Coordination Hub (QPACH). This adds a predictive outlook of capacity risk and the ability to run what-if scenario models to mitigate such risk. We have also commenced employing this framework to support AMR-related hospital decision-making and other public health-related decision-making.

Health System Analytics: Project reports

Improving Patient flow in Queensland's public hospitals

Collaborators: Queensland Ambulance Service, Queensland Department of Health – Healthcare Improvement Unit, Emergency Medicine Foundation, University of Queensland.

This study commissioned by the Emergency Medicine Foundation addressed the complex national challenge of access to hospital beds. Access block has been described by the Australasian College for Emergency Medicine as the single most serious issue facing health systems in Australia and New Zealand. The aim of the study was to establish an evidence base for factors leading to access block and help identify solutions that are most effective in improving emergency access.

The scale of this study made it unique, encompassing every ambulance record, ED presentation, inpatient episode of care and ward transfer over six years for the 25 largest hospitals in Queensland, from the busiest ED in the country to regional EDs. We used a multidisciplinary approach that incorporated the disciplines of mathematics, social science and emergency medicine delivering diverse insights for maximal impact. The study design incorporated qualitative and quantitative approaches to gain perspectives from patients and healthcare workers about what hinders flow and explores solutions to flow challenges.

The results provide independent, evidence-based recommendations in this contentious area, and are informing government policy about timely access to hospital care. For example, the study found that removing maintenance care patients from hospitals has tangible impacts on patient flow and this specific scenario was subsequently requested by HIU to incorporate within the team's development of a digital twin of the Queensland Patient Access Coordination Hub. Another study recommendation is to improve access to accommodation outside of hospital for vulnerable cohorts such as mental health, homeless and maintenance care patients, which is also informing follow on investigations.

The study also instigated a follow-up successful grant with EMF and our clinical collaborators focusing on delays to hospital discharge specifically for residential aged care patients. This is aligned with our study's primary recommendation which is to shift focus from the 'front door' of hospitals to the 'back door' in terms of system performance, clinical redesign and carriage of risk.

HeIDI – Infection Control Real-time Data Analysis and Outcome Simulation

Collaborators: Metro North Hospital and Health Service

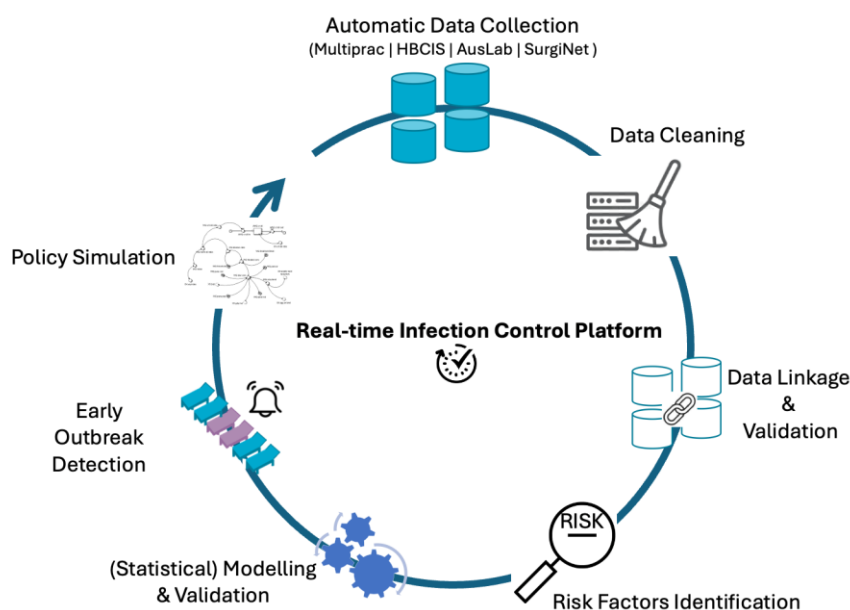
Time critical infection control is critical to the prevention and minimisation of infection related morbidity and mortality in community and hospital settings. Current data collection procedures are limited by fragmentation of information across multiple systems, duplication of collection, and largely manual processes to identify outbreaks. This delays timely identification and response.

This proof-of-concept investigation involved exploratory data analysis, survival analysis, modelling of risk factors contributing towards infections, and outbreak detection.

Linking patient administration and surgical information systems at RBWH with the electronic medical record and infection monitoring systems created a collection of data streams with the potential to enable real-time outbreak identification.

Focusing on healthcare associated gastrointestinal infections (CDiff), the team demonstrated how the linkage enabled important characteristics of infected patients to be identified along with factors contributing to their risk of infection. We applied several outbreak detection methods, including a novel entropy-based method, to identify clusters of unusually high cases in the study period. We also developed a web app that provides a framework for hosting detection algorithms, assessing patient-level infections and visualising prior hospitalisations.

These activities form a basis to support Queensland Health's efforts to improve infectious disease surveillance and intelligence, contributing to safer care for patients, informing strategies to improve practice and minimising preventable hospital acquired infections.



Real-time infection control platform

Rauland Australia fall protection project

Collaborator: Rauland Australia

A multi-hospital evaluation assessed Rauland Australia's digital fall prevention system, applying implementation science to examine the relationship between system use and patient outcomes. While no change in patient outcomes was detected, implementation was notably enhanced through a co-designed implementation enhancement plan that significantly increased system uptake and engagement. The project demonstrated the value of implementation science-driven methods. Key implementation barriers and enablers were identified, culminating in a recommended implementation approach now used by Rauland regularly when onboarding new hospitals, which is a direct impact from this project.

CFIR Construct (influencing factor)	Recommendation (R)
Patient needs and resources	R1: Introducing a standardised and comprehensive patient orientation to the Rauland Responder 5 system upon admission.
	R2: Collection of iterative patient feedback during implementation of the Rauland Responder 5 system.
	R3: Consideration of how patient's age, and cognitive, functional, and visual difficulties impact their use of the Rauland Responder 5 system.
Knowledge and beliefs about the intervention	R4: Efforts to bolster staff opinion of the intervention pre-implementation.
	R5: Provision of iterative staff education and training to improve staff knowledge and understanding of the Rauland Responder 5 system.
Design quality and packaging	R6: Improve innovation integration with nurse workflow.
	R7: Consultation and piloting during design and implementation of the Rauland Responder 5 system.
	R8: Improve formal processes in case the Rauland Responder 5 system is down.
	R9: Additional changes to the design of the Rauland Responder 5 system.

Air quality and communicable diseases

In 2024, Australian Climate Service commissioned CSIRO to undertake research on bushfire impacts on air quality and health system, and in the emergence and increased transmission of communicable diseases as part of the National Climate Risk Assessment (NCRA).

To quantify the impacts of bushfires on health system demand and mortality under different future climate scenarios, projections of climate to 2050 were generated by using 8 different global climate models. These indicated wide variation in estimates of air pollutants (undertaken by CSIRO Environment Research Unit). To determine the health impacts of a severe bushfire in 2050, we modelled a bushfire component (based on the 2019/20 bushfire period) and a climate change component, with each having an expected impact on future air quality and health. Health impacts were assessed for four outcomes: all-cause mortality, cardiovascular-related hospital admissions, respiratory-related hospital admissions, and asthma related ED presentations. These health demand impacts from climate change in 2050 were quantified and presented using the extreme 2019/20 bushfires example.

We also demonstrated that increasing maximum surface air temperatures could increase the emergence and transmission of established communicable diseases such as influenza and MRSA by 2050. Further modelling by CSIRO's Human Health Program demonstrated consistent patterns of increased potential zoonotic (animal to human transmission) virus density in the west, potential reductions in the east of Australia, and substantial changes in Tasmania by 2050. Finally modelling undertaken to explore potentially climate sensitive genomic changes showed that changes in maximum and minimum temperature and rainfall from climate change can potentially induce mutations in pathogens relevant to Australia including influenza and Japanese encephalitis virus.

QPACH digital twin

Collaborator: Healthcare Improvement Unit, Clinical Excellence Queensland, Queensland Health

The Queensland Patient Access Coordination Hub (Q-PACH) is a Queensland Health initiative designed to enhance operational performance and assist with patient flow, using real-time intelligence of ambulance and hospital operations across the major Southeast Queensland hospital and health services. We have worked closely with Queensland Health's Healthcare Improvement unit to develop a digital twin of the Q-PACH. While the existing dashboards within the Q-PACH provide real-time data on patient movement through emergency department and inpatient settings, and enable proactive decision-making to enhance overall efficiency of patient flow, the digital twin adds two new elements to support data-driven decision making:

- **Predictive Risk Outlook:** Using an advanced demand prediction algorithm, ADePT, we provide a 7-day outlook of expected ED and Inpatient arrivals and discharges allowing visibility into when and where pressure will mount, thus providing early warning for capacity strain.
- **Scenario-based risk mitigation:** Using simulation modelling, we allow for the testing of pre-selected intervention strategies, such as "What if we implement an early discharge sprint across 3 hospitals", to assess the impact of different decisions on mitigating the predicted capacity crisis.

Through introducing these two elements to provide early visibility of risk and scenario-based planning, the Q-PACH digital twin significantly enhances the health system's ability to manage demand, reduce pressure, and respond proactively.

Scalable decision support

Collaborators: InterSystems, Austin Health, WentWest

This project worked with industry and health service partners to develop standards-based scalable pathways for operational and clinical decision support.

Specifically, we worked with InterSystems and Austin Health to develop, validate and implement a novel demand prediction algorithm to inform capacity management as part of their access and capacity management practices. This implementation is being introduced for user testing at Austin Health, and other opportunities are also being explored. By integrating seamlessly with existing hospital IT systems through a standards-based, repeatable, and interoperable architecture, we will ensure smooth adaptation to diverse healthcare environments.

We also worked with Western Sydney PHN and data from across NSW PHNs to develop and validate a new algorithm to predict future unplanned hospitalisation risk for patients presenting in the primary care setting. The developed algorithm has been delivered to Western Sydney PHN who are working to implement it within Primary Sense, a PHN developed electronic clinical decision support tool that securely provides health data and insights to inform in-person interventions, improve population health and potentially prevent hospitalisations.

System dynamics modelling for antimicrobial resistance

Collaborators: NT Health

Antimicrobial resistance (AMR) disproportionately affects people living in regional and remote areas of Australia, where up to 50% of infections are resistant to treatment. Despite this significant impact, a system-wide strategy to reduce AMR risk is lacking, largely because the complexity and interrelationships of its drivers are not fully understood.

This project applies a systems thinking approach to explore feedback mechanisms driving AMR across all One Health domains. Through interviews and focus group discussions with 35 stakeholders across human, animal, and environmental health sectors, we co-developed a causal loop model capturing key interrelationships.

The analysis identified numerous reinforcing and balancing feedback loops, highlighting how clinical, social, environmental and structural factors interact (a snapshot of the model is shown below). These interrelationships form a dynamic hypothesis explaining the behaviour of AMR over time within the One Health context. This systems map underpins the development of a system dynamics simulation model that quantifies AMR trends using data from HOTspots and other sources. The model will support the co-design and evaluation of intervention scenarios with the greatest potential to reduce AMR.

By fostering shared understanding and collective actions across all One Health sectors, this approach supports the development of context-specific, evidence-informed AMR mitigation strategies.

Health System Analytics: Project updates

Following the Antibiotic Supply Chain Study

Collaborator: Animal Management in Rural and Remote Indigenous Communities (AMRRIC)

Access to antibiotics is important for maintaining human and animal health. However, this is not as simple as selecting the right antibiotic off the shelf when you need it. This project explores various contextual factors associated with antibiotic access across human and companion animal supply chains in urban and regional settings across Queensland. In-depth interviews have been conducted with 30 participants across the antibiotic supply chain including prescribers (GPs, vets), pharmacists, manufacturers, wholesalers and regulators. Findings reveal the role of political, economic, environmental and geographic systems on antibiotic access and use. Understanding these contextual factors helps identify avenues for change across these systems for improved antimicrobial stewardship.

Sparked evaluation

Numerous FHIR accelerators have been operationalised around the world to facilitate the development and uptake of agreed core data sets used to inform systems that communicate health information. The aim of these accelerators is to develop local standards that speed up the process by which technology is adapted and developed in a way that is interoperable. That is, health data applications that can easily and seamlessly share information regardless of vendor source.

There is very little evidence available in peer reviewed literature to explain what accelerators are and key factors in their success or otherwise.

We have nearly completed an evaluation of the implementation of the Sparked program and published our findings. As a result of the evaluation, to date, we have successfully:

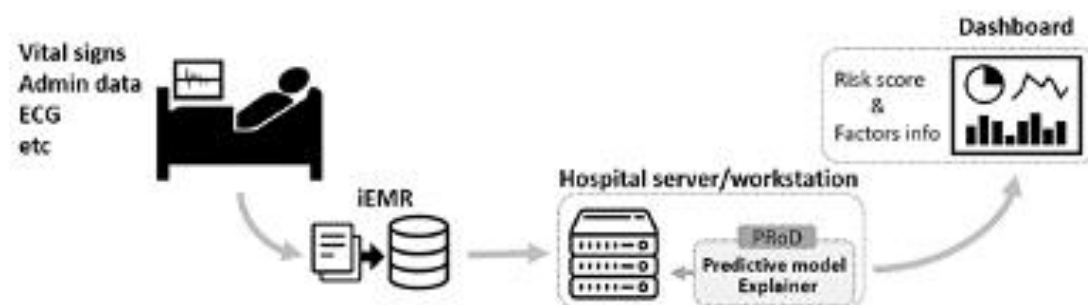
- defined the components of the Sparked FHIR accelerator program
- identified the key benefits, challenges and barriers encountered by participants.

Our final activity will be to triangulate our data sources with the results of a sentiment survey that was distributed at two time points.

Predicting patient deterioration

Collaborator: Queen Elizabeth II Hospital, Metro South Health Hospital and Health Service, Queensland Health

The EMR provides an opportunity to manage patient care efficiently and accurately. This includes the development of tools to aid in clinical decision-making at the bedside for the timely identification of adverse events or acute illnesses preceded by deterioration. We have developed a new algorithm to predict the risk of a patient triggering a multi-criteria clinical deterioration alert called Queensland Adult Deterioration Detection System. We have also just commenced a trial of this algorithm in a hospital setting, the Queen Elizabeth II hospital within the Metro South Health Hospital and Health Service. The eventual objective is to evaluate its use to improve detection and intervention prior to a patient's deterioration. The study will also explore how best to integrate this tool into the current hospital systems and understand how it affects clinical decision-making.



Patient risk of deterioration (PRoD) - algorithm pipeline

Virtual baby (VBaby): predictive physiological modelling of critically ill preterm newborns

Collaborator: Westmead Neonatal Intensive Care Unit (NICU), Cerebral Palsy Alliance, University of Sydney

Extremely preterm infants and very low birth weight (VLBW) babies have a higher risk of death and permanent disabilities. Providing early warning alerts several hours before clinical diagnosis can be crucial to prevent mortality and permanent injuries. Physiological markers such as heart rate variability provide crucial information relating to adverse outcomes.

This project will develop predictive models using high-fidelity physiological signals collected at Westmead NICU to predict adverse outcomes earlier than clinical diagnosis time. Previous work has focussed on a literature review on preprocessing techniques for premature infant physiological signal data, and the development of an ensemble-based approach for heart rate detection from neonatal ECG data. This year, we have extended our comparison of various heart rate detection techniques to include a technique developed by clinicians at Westmead and explored using ML on demographic data and ECG data of variable length to predict early onset sepsis. Current data samples have low incidence, limiting the types of models that can be deployed, and we are working with the clinicians at Westmead to explore other conditions of interest.

TRI liver disease

Collaborators: University of Queensland, Translational Research Institute, Queensland Institute of Medical Research

Non-alcoholic fatty liver disease is the most common chronic liver disorder in primary care, affecting one in four adults. In this study funded by the Translational Research Institute, we have developed explainable ML models to identify patients at risk of liver-disease-related death or decomposition to provide precision decision support at the point of care to support early intervention.

Early results on a longitudinal patient cohort offer promising results for predicting both death and decomposition, but our analysis also found significant gaps in the data that needed to be addressed before several clinically important variables could be included as predictors. It is proposed that the models will be finalised once this data is made available.

Colorectal cancer

Collaborator: Molecular Diagnostic Solutions, CSIRO Health & Biosecurity

Carcinoembryonic antigen (CEA) is the current clinically accepted blood-based protein marker to identify colorectal cancer (CRC) patients who are at risk of an adverse outcome after their initial cancer diagnosis. Using data across two independent studies, in this cross-research-program we identified two avenues for IP commercialisation pathways and have a manuscript in draft to be submitted to peer review journal *Cancers* (IF 5.2) describing survival analyses on early and late CRC patients. Regarding our IP work, first, we identified a panel of protein biomarkers that perform better than CEA at predicting patient incidence of metastasis or recurrence of cancer within five years. Secondly, we identified a different panel of biomarkers which are used to predict the

likelihood of tumour staging upon initial diagnosis. This valuable, interactive clinical decision support tool named ‘Dukes’ staging prediction tool’ is available via a web-browser.

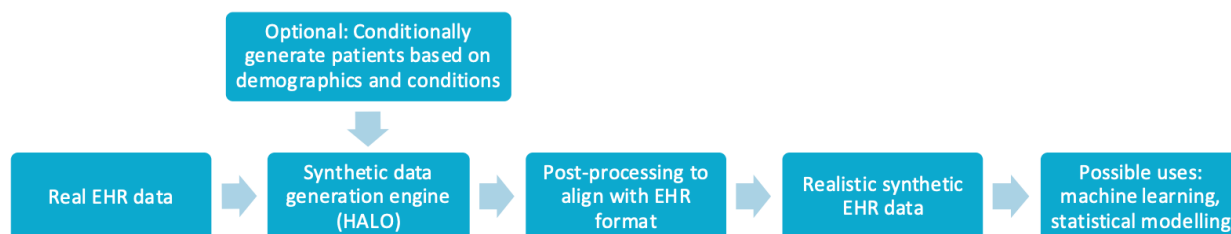
Smart public health

Collaborator: Flinders University, SA Health

Funded by the MRFF, this project aims to build Australia’s first AI-driven public health data platform to address emerging health priorities. A collaboration between Flinders University, South Australian Health, CSIRO and other partners, SMART-PH (DigiSing InforMAtion for PRacTice in Public Health) will create a Public Health ‘Data Lake’ (data repository), and then integrate the data with SA Health’s Digital Analytics Platform (DAP), an existing data infrastructure with real-time advanced data linkage capabilities to all clinical data such as electronic medical records. The first phase of the project has commenced, and we are working on a data audit, solution co-design, and a pilot on digital dashboards and automated reporting of public health information.

Generating synthetic electronic health record data

Structured tabular data such as electronic health records underpins much of public health and clinical research. Synthetic versions of these datasets can support data sharing, reduce bias, and enable modelling in underrepresented populations. We have developed a synthetic data generation pipeline (illustrated) and evaluated it across three diverse datasets. We evaluated the data to confirm its fidelity and suitability for tasks such as ML and statistical modelling. Through a literature review, we also identified key approaches for validating synthetic data, highlighted important but under-utilised metrics, and proposed novel ones to address existing gaps. Future work will focus on applying our pipeline to real-world public health scenarios.



Overview of the synthetic data generation pipeline.

Using machine learning to improve orthopaedic waiting list management

Collaborator: Gold Coast Hospital and Health Service

With growing demand on orthopaedic services, improving how patients are triaged and managed is increasingly important. This project explored whether or not ML can support better patient flow for orthopaedic foot and ankle referrals within a tertiary healthcare service. Using retrospective referral data, we developed and evaluated models to predict whether patients will require surgery, to support more efficient streaming of referrals to see surgeons or other clinics. While the dataset was relatively small, the results are encouraging and highlight key features for future model development.

Health System Analytics: Postdoc and student highlights

Aminath Shausan

As a postdoctoral fellow with a background in AI-driven disease modelling, Aminath has contributed to nationally significant projects forecasting antimicrobial resistance (AMR), climate-related health risks, and respiratory disease outbreaks. Aminath's work on AMR has applied statistical smoothing of AMR surveillance data in Northern Australia and forecasted AMR burden and hotspots. Similarly, her work on climate and communicable diseases have projected near-term and long-term future impact of climate on influenza and AMR in Australia. Aminath's work bridges data science, environmental health, and digital platforms to support evidence-based decision-making for national health responses and policy development. Her work has the potential to inform digital health infrastructure and strategic planning across government and research sectors.

Yen Pham

Yen's postdoctoral project applies system dynamics modelling to address AMR. She has identified key drivers of AMR by publishing a systematic review on the application of systems thinking approaches in AMR research and developed a causal loop model illustrating factors driving AMR across One Health domains in the Northern Territory. This model identifies critical leverage points to inform the development of strategy scenarios for mitigating AMR, which are being explored through a system dynamics simulation model. Yen is also leading a global review on the impact of changing climate conditions on AMR and supervising PhD students investigating the role of the environment as a reservoir of resistant genes.

Vacation student projects

Project: Neuroimaging in neonates: Automated mapping of brain development

Student: Nina Hadzivukovic, Queensland University of Technology

Supervisor: Jess Bugeja, Alex Pagnozzi, Rodrigo de Santa Cruz

Cortical surface reconstruction (CSR) using ML is a growing field. The cortical surface is an important biomarker that can provide an avenue for earlier diagnosis of neurodevelopmental impairments affecting children born preterm. Nina's project trained and extended an existing adult CSR ML method, CorticalFlow++, for the application to neonatal MRI data and to handle more complex cortical anatomies.

Project: Integrating usability engineering standards for enhanced SaMD development and regulatory alignment

Student: Judy Li, Monash University

Supervisor: Yan Chia, Jenny O'Connell

Judy's project focused on enhancing the integration of usability engineering within the development of software as a medical device (SaMD). To do so she evaluated CSIRO's existing quality management system against international requirements, including those set by the FDA and IEC, to identify opportunities for improved regulatory alignment. A tailored training package was also developed to support the adoption of usability engineering practices by embedding them into existing workflows, enabling the development of safer, more effective, and user-centred medical software solutions.

Project: Codesign on model of care for preventative healthcare using mobile health and devices

Student: Ava Regoli, The University of Sydney

Supervisor: Navin Cooray, David Silvera

CSIRO is currently developing an at-home, remote monitoring device for diabetes foot health called the Smart Footprint. Using infrared temperature sensors, the device measures foot temperature asymmetry to predict inflammation and potential complications associated with diabetes-related foot ulcers. Ava researched the value of developing a mobile health app to accompany the Smart Footprint device, writing a literature review, creating a prototype of the app, and conducting a user perspectives study to inform future research and development around mHealth and foot ulcer prevention.

Project: Communication for antimicrobial resistance

Student: Ella Koster, The University of Sydney

Supervisor: Naomi Stekelenburg, Majella Murphy

Ella created content for CSIRO's HOTspots website, which tracks antimicrobial resistance across northern Australia and helps educate local clinicians. Using various types of media, she developed explainer articles, press release content, infographics and other resources to try to communicate complex information effectively to a range of audiences.

Project: Integrative mapping of cholinergic white matter pathways using multi-modal brain imaging data

Student: Bailey Hart, The University of South Australia (UniSA)

Supervisor: Ying Xia, Kerstin Pannek

Cholinergic pathways are responsible for interconnecting different brain regions and facilitating neural signalling between different brain regions; these pathways change throughout the lifespan and are also implicated in various neurodegenerative diseases. Across the 12-week program, Bailey's project has focused on using multi-modal imaging data, particularly MRI and DTI, to create a map of the two primary cholinergic pathways in healthy older adult brains, allowing this template to be applied to future research and clinical populations to assess differences and changes in these pathways.

Project: Intelligent medical image analysis platform

Student: Harry Ngyuen, The University of Melbourne

Supervisor: Liz Cooper, Jason Dowling

Zendaya, AEHRC's intelligent medical image analysis platform, provides access to image analysis pipelines developed by our Medical Imaging team. As part of the platform, Harry developed an integrated DICOM viewer plugin to allow users to directly visualise and interact with DICOM 3D stack images in multiple planes.

Project: Utilising machine learning and natural language processing to support the management of gestational diabetes and maternal health

Student: Oluwatoyosi Adewale, The University of Queensland (UQ)

Supervisor: Kaley Butten

Toyosi worked on a study exploring the potential of ML and natural language processing to process women-supplied communications for managing gestational diabetes mellitus (GDM). The goal is to identify clinically relevant themes and support the development of an AI-driven chatbot to support GDM management.

Project: Health implementation science and text analytics

Student: Hannah Bansal

Supervisor: Alana Delaforce, Jessica Rahman, Pippa Niven, Jinghui Liu, Anthony Nguyen

Qualitative data analysis in health implementation science is the process of going through textual data and identifying information to facilitate the uptake of evidence-based practices in medicine. This is usually a very human intensive task. Hannah's project uses large language models and machine learning to evaluate whether this process can be semi-automated using prompting strategies.

Project: Neonatal brain MRI image viewer

Student: Ruvheneko Chatora, Curtin University

Supervisor: Kerstin Pannek, Liz Cooper

In her project, Ruvheneko developed a plugin web-based Image viewer that will be used for scoring brain growth and abnormality on newborn brain MRI.

Project: Website development for pathogen surveillance tool

Student: Swetha Ravichandran, The University of New South Wales (UNSW)

Supervisor: Nehleh Kargarfard, Carol Lee

Swetha's project involved developing a website for a pathogen surveillance tool that tracks mutations in pathogen genomic sequences. Users can use this tool to identify mutations that are increasing in frequency compared to the wild type based on the relevant metadata. This enables the stakeholders to monitor locally identified mutations of interest.

Project: Developing a predictive model for Cas13 efficiency: On and off-target model

Student: Florencia Stella, Monash University

Supervisor: Emiliana Weiss

This project aimed to develop a deep learning model to predict Cas13 knockdown efficiency, optimising on-target activity and minimising off-target effects. To achieve this, Florencia optimised a convolutional neural network model to predict the most effective guides based on the knockdown efficiency. Furthermore, she developed an automated pipeline to design and select optimal guides, integrating model predictions for both efficiency and specificity.

Project: EEG microstate analysis for disease prediction

Student: Holly Horswill, The University of Sydney

Supervisor: Javier Urriola, Aida Brankovic, Parnesh Raniga

EEG microstates describe the basic building blocks of human information processing. The temporal dynamics of EEG microstates can be used to understand brain network interactions and predict cognitive diseases. Holly's project extracted microstate temporal dynamics from EEG signals and then used this data as the input to a predictive machine learning model in Python. This pipeline offers an opportunity to use scalp-recorded EEG signals as a predictive tool, specifically for diseases such as epilepsy and Alzheimer's.

Project: Uncovering the connection between enlarged perivascular spaces and Alzheimer's progression

Student: Kaanchana Sekaran, The University of Melbourne

Supervisor: Ying Xia, Vincent Doré, Hollie Min

Kaanchana's project explored early biomarkers for Alzheimer's disease, with a focus on detecting enlarged perivascular spaces in MRI scans. Using deep learning techniques, she investigated the association between enlarged perivascular spaces and other pathological changes in the aging brain. By uncovering these critical connections, her project deepened understanding of how Alzheimer's affects older Australians and helped pave the way for earlier diagnosis and intervention.

Project: Advancing neonatal brain MRI analysis: AI-assisted tissue segmentation with foundation models

Student: Tisha Jhabak, The University of Sydney

Supervisor: Alex Pagnozzi, Bowen Xin, Jess Bugeja

Tisha's project investigates the feasibility of foundation models for brain tissue segmentation in our automated neonatal MRI analysis pipeline. She showcases the robustness and accuracy of this cutting-edge MRI segmentation approach, benchmarking its performance against established baselines like nnUNet.

Project: Investigating the use of random forests for genomic predictions and identification of variants for fertility in tropical bulls

Student: Aiden Jin, The University of Sydney

Supervisor: Mitchell O'Brien

Bull fertility is a key phenotype in the improvement of the beef production system. The identification of genetic variants that effect bull fertility traits and improvement in bull fertility trait prediction would assist in early in-life selection for bull fertility traits and thus improve productivity in beef production systems. Aiden has used a random forest model and compared it to traditional genome-wide association study models to investigate its ability to identify new variants and predict bull fertility traits.

Project: Information extraction from clinical text via LLMs

Student: Alex Duncan, The University of Queensland

Supervisor: Jinghui Liu, Anthony Nguyen

State-of-the-art generative LLMs were investigated to perform information extraction tasks on anonymised clinical notes. LLMs are gaining traction over traditional methods due to empirical evidence indicating their ability to generalise to domains that were not explicitly trained on. This is a crucial consideration in the context of clinical notes, as obtaining clinical data is challenging due to doctor-patient confidentiality and the substantial cost associated with annotation.

Project: The EnhANCing Breastfeeding and Diabetes sCreening In PostpArTum WomEn (ANTICIPATE) Study - Phase 1

Student: Vasavi Gowri Sankar, The University of Adelaide

Supervisor: Anna Roesler

M♡THER is an established digital tool supporting individuals in managing gestational diabetes mellitus (GDM) or an increased risk of GDM during pregnancy. Despite the increased risk of recurrence in subsequent pregnancies and developing type 2 diabetes, limited tools exist to support individuals postpartum. This research focused on preparing the initial stages of the M♡THER platform extension for postpartum self-management, including preparing an ethics application and wireframes, and conducting preliminary research to identify key topics for app sections.

NHMRC and MRFF grants

Our scientists are chief and associate investigators on many grants from Australia's foremost medical research grant bodies, such as the NHMRC and the MRFF.

Updates on these projects are given in the group sections, but here we give a short description of the aim of each of these projects.

Medical Research Future Fund (MRFF)

MRFF Genomics Health Futures Mission: A national large scale automated reanalysis program to increase rare disease diagnosis

Years Funded: 2021-2025

Chief Investigators: Professor Zornita Stark, Murdoch Children's Research Institute

AEHRC Investigators: Dr Denis Bauer, Dr Natalie Twine

The project will develop and evaluate a national program for automated, systematic reanalysis of genomic data to deliver improved diagnostic outcomes in large cohorts of rare disease patients. They will harness continuously updated knowledgebases of disease-associated variants and genes, improvements in genomic data analysis and interpretation, and use of cloud-based distributed systems with machine learning approaches to scale up analysis nationally. CSIRO will supplement the bioinformatics activity for the project through expertise in cloud architecture and machine learning to improve platform efficiency and scalability.

MRFF Targeting Treatable Traits in COPD to Prevent Hospitalisations TERRACOTTA

Years Funded: 2021-2025

Chief Investigators: Dr Johnson George Monash University

AEHRC Investigators: Dr Rajiv Jayasena

This project aims to evaluate the efficacy of a practice nurse-coordinated intervention - Targeting Treatable Traits in COPD to Prevent Hospitalisations (TERRACOTTA) in the Australian primary care. The specific objectives are to: a) test the efficacy of the interdisciplinary intervention at improving QoL; b) test the efficacy of the interdisciplinary intervention at preventing hospital/ED visits; c) optimise the diagnosis and management of obstructive airway diseases in primary care; and d) improve self-management using action plans and mobile health support.

MRFF School readiness child outcomes of early neuroprotection/early neurorehabilitation for infants at high risk of cerebral palsy—in the first 2000 days

Years funded: 2022-2026

Chief Investigator: Professor Ros Boyd, University of Queensland

AEHRC Investigators: Dr Kerstin Pannek

Early intervention trials for infants at high risk of cerebral palsy so far have assessed outcomes up to 2 years age. In this study, we will follow-up children who participated in RCTs of early neurorehabilitation/neuroprotection (recruited at <6 months age) at 4-5 years old to determine school readiness and longer-term effectiveness of interventions. CSIRO will contribute image analyses of newborn brain MRI, to determine whether children with specific brain injuries are more responsive to certain interventions.

MRFF Dementia, Ageing and Aged Care Mission: Blood testing to predict and discriminate dementias

Years funded: 2021-2026

Chief Investigator: Professor Ashley Bush, University of Melbourne

AEHRC Investigators: Dr Jurgen Fripp, Dr James Doecke

A predictive blood test for Alzheimer's disease (AD) is urgently needed. Our project will bring together Australia's leading dementia researchers and the largest dementia-related research cohort ever assembled in this country to accelerate the use of blood tests in clinical settings (e.g., hospitals, memory clinics) that can help to diagnose, and predict the onset of, AD. We will also examine the impact of having a diagnostic blood test for AD on health and management outcomes.

MRFF Digital Infrastructure for Improving First Nations Maternal & Children's Health DIFFERENCE

Years funded: 2022-2026

Chief Investigator: Professor Clair Sullivan, University of Queensland

AEHRC Investigators: Dr Michael Lawley

The DIFFERENCE project will deliver the largest connected First Nations data infrastructure to ensure the best possible start to life for First Nations Australians. Building on strong partnerships prioritizing First Nations data sovereignty and governance, it will develop a data linkage platform with a nationally agreed health data set for First Nations child and maternal health outcomes, and interoperability standards—all with one aim—to support closing the gap in maternal and perinatal health disparities between First Nations and non-First Nations mums and infants. This project will also generate sophisticated ML analytics to foster iterative quality improvement and will adopt international standards to support scalability.

MRFF NEWBORN GEN SEQ TRIAL: NEWBORN GENomicSEQuencing in screening — TherapyReadyAndInformationforLife

Years funded: 2022-2026

Chief Investigator: Professor Bruce Bennetts, University of Sydney

AEHRC Investigators: Dr Denis Bauer, Dr Natalie Twine

Newborn screening (NBS) enables early diagnosis and management of serious health conditions leading to better health outcomes and the number of diseases that would benefit from the inclusion in NBS continues to grow. This trial will demonstrate the use of next generation sequencing as a universal platform for genomic testing in NBS and ultimately will ensure individuals with genetic disorders can benefit from rapid diagnosis and access to life-changing novel therapies.

MRFF Cardiovascular Health Mission: Picture This — A new model of care for tackling heart attacks with First Nations Australians (The Powerful Pictures Study)

Years funded: 2023-2026

Chief Investigator: Professor Louise Cullen, Queensland University of Technology

AEHRC Investigators: Dr Andrew Goodman

This high-quality interdisciplinary research into a new model of care will lead to improved diagnosis and treatment of coronary artery disease in First Nations Australians. The Powerful Pictures Study will develop and evaluate Clinical Pathways for Implementing Optimised Evidence-Based Diagnosis and Treatment. The study aligns with the 'Closing the Gap' priority to reduce First Nations disadvantage due to reduced life expectancy and with national standards for cardiovascular disease in First Nations Australians, specifically the 'Early Recognition' standard specific to primary prevention for patients with new chest pain requiring referral for additional testing.

MRFF Clinical Trials Activity: Targeted, adaptive genomics for ethical, evidence-based expansion of newborn screening—a type II hybrid effectiveness implementation trial

Years funded: 2022-2027

Chief Investigator: Professor Alex Brown, The Australian National University

AEHRC Investigators: Dr Denis Bauer

We have purposefully assembled the nation's leading individual, institutional and organisational proponents of genomics, bioethics, data science, and precision medicine, in partnership with Indigenous research and health care providers, community and consumers, to establish a national network that will articulate and prosecute a transformative approach to the development of responsible, culturally appropriate, nationally consistent and internationally relevant Indigenous genomics efforts. The network will be led by Centres of Excellence (or nodes) based in Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Western Australia.

Each will support national priority programs in Indigenous governance; policy; capability development and data systems as well as leading flagship programs to maximise the realisation of benefit to Indigenous people from genomics.

MRFF Clinical Trials Activity: Targeted, adaptive genomics for ethical, evidence-based expansion of newborn screening—a type II hybrid effectiveness implementation trial

Years funded: 2023-2027

Chief Investigator: Associate Professor Natalie Taylor, The University of New South Wales

AEHRC Investigators: Dr Denis Bauer

Newborn bloodspot screening of pre-symptomatic infants is a highly effective universal public health measure to prevent death and disability from treatable genetic conditions. NBS in Australia predominantly involves biochemical testing for approximately 25 conditions. A lack of a suitable test is one major contributing factor as to why many treatable genetic conditions are not routinely screened for. Our team has developed and validated a novel genomic screening test to expand NBS.

MRFF Australian Brain Cancer Research Infrastructure: Supporting Australian brain cancer research with an integrated network of platforms

Years funded: 2023-2028

Chief Investigator: Professor Rosalind Jeffree, The University of Sydney

AEHRC Investigators: Dr David Hansen, Dr Anthony Nguyen

Brain Cancer Biobanking Australia (BCBA) is a national consortium of adult and paediatric brain cancer specialists, researchers, biobankers and consumers founded in 2015 under the aegis of the Cooperative Trials Group for Neuro-Oncology. BCBA will establish three interlinked national platforms: a clinical quality registry, registry trials, and biobanking and organoids platforms.

MRFF Preventive and Public Health Research Initiative: Targeting out-of-pocket healthcare expenditure through citizen sciences with Aboriginal communities

Years funded: 2024-2027

Chief Investigator: Associate Professor Courtney Ryder, Flinders University

AEHRC Investigator: Professor Ray Mahoney

Having a life expectancy 10 years less than other Australians, a risk of hospitalisation 2-10 times greater for your injury or chronic and complex disease, and the constant barriers and delays trying to access affordable and equitable healthcare caused by out-of-pocket healthcare expenditure (OOPHE) is the lived reality for many Aboriginal and Torres Strait Islander families, one of the most marginalised communities impacted by the significant OOPHE burden. This project aims to build and implement a social prescribing digital platform for OOPHE, underpinned by citizen science approaches to harness the wealth of knowledge amongst consumers in Aboriginal and Torres Strait Islander communities with lived experience and passion for creating and determining solutions. Citizen science aims to increase community understanding and involvement in research that addresses their community's health and wellbeing. Through our proposed social prescribing

platform, Aboriginal and Torres Strait Islander families will benefit from the links to OOPHE information and services across the government, community or voluntary sector, identified by and with citizens, and delivered through a co-designed web application.

MRFF Genomics Health Futures Mission: Integrated genetic healthcare—improving access to quality genetic services for Aboriginal and Torres Strait Islander patients

Years funded: 2023-2026

Chief Investigator: Mr Gregory Pratt, Julie-Anne Rogers, Central Queensland University

AEHRC Investigator: Dr Ray Mahoney

Integrated Genetic HealthCare is a 3-year project that aims to provide a culturally safe pathway for Aboriginal and Torres Strait Islander patients to access quality genetic health services. This is done by improving coordination between primary and specialist services. Through community engagement in Queensland and Western Australia, we will identify principles, key messages, barriers, and recommendations to support improved access to genetic health services. Health Promotion, Coordinated Health Care and Workforce Development are the key principles of IGHC. This model has been developed by and for Aboriginal and Torres Strait Islander people; in partnership with experts from the community, universities, community-controlled, and public hospital and health services.

MRFF Research Data Infrastructure Grant: National integrated stroke data — advancing learning health systems

Years funded: 2023-2027

Chief Investigator A: Professor Dominique Cadilhac, The University of Melbourne

AEHRC Investigator: Dr Michael Lawley, Dr Anthony Nguyen

Our innovative project will harness and integrate data from hospitals, registries, and government administrative data to achieve an advanced Learning Health System in Australia for stroke. In partnership with key stakeholders, we will: 1) develop digital solutions for the automated transfer of hospital data into a national registry; 2) provide data tools to support evidence-based decision making; 3) create a novel National Stroke Research Data Asset by linking registry and government data to enable population-level stroke research. Our transformative data interoperability solutions promise to revolutionise stroke care and drive significant health and economic benefits.

MRFF Chronic Respiratory Conditions: Enhancing adherence and self-management in the treatment of respiratory conditions—ENGAGEMENT

Years funded: 2024-2029

Chief Investigator: Assoc Prof Johnson George, Monash University

AEHRC Chief Investigators: Dr Rajiv Jayasena, Dr Alana Delaforce, Dr Marlien Varnfield, Mr Norm Good

One in three Australians has a chronic respiratory condition, contributing to 7.5% of the total burden of disease in Australia. Evidence shows that people who engage with self-management interventions have enhanced health outcomes.

This project aims to co-design, pilot test, trial and evaluate a digitally supported model of care. Over five years, we will test the efficacy and cost-effectiveness of a nurse-supported, technology-enabled, action plan-guided self-management program for asthma and chronic obstructive pulmonary disease.

MRFF Chronic Respiratory Conditions: Using wearable oximetry and a virtual ward to improve outcomes of infants with bronchopulmonary dysplasia (BPD)

Years funded: 2023-2026

Chief Investigator: Associate Professor Ju Lee Oei, University of Sydney

AEHRC Investigator: Dr Sankalp Khanna

Every year, more than 1000 Australian infants are diagnosed with bronchopulmonary dysplasia (BPD), the most common and debilitating complication of prematurity. They are at risk of hypoxemia for months. Hypoxemic spells cause serious organ injury, even death and are mostly clinically undetectable until a crisis occurs. In the NICU, oxygenation is monitored and treated vigilantly based on 24-hour pulse oximetry, but this is not possible at home. Current Australian guidance cannot recommend oximetry for infants at risk of hypoxia at home because there is no data to inform on best use.

This grant will conduct a four-year randomised clinical trial with wearable oximetry embedded in a digital care pathway that was extensively used in the COVID pandemic for adults, to improve oxygen management and health in BPD.

MRFF Multidisciplinary Models of Primary Care: Australian primary care initiative for medicine use optimisation and safety—(APRICOT)

Years funded: 2024-2029

Chief Investigator: Dr Johnson George, Monash University

AEHRC Investigators: Dr Alana Delaforce, Dr Marlien Varnfield, Dr Rajiv Jayasena, Mr Norm Good

Improving the quality of medicine use by prescribers and consumers to reduce/avoid medication-related problems will be the focus of the APRICOT study.

Quality prescribing indicators will be developed in consultation with relevant stakeholders (including policy makers, prescribers and consumers). This will be followed by an active education program using knowledge brokers to improve prescribing in primary care. Self-management interventions with the help of an app will also be delivered to consumers by the multidisciplinary team to improve medicine adherence and safety. Outcomes at practice level will be assessed at six and 12 months in a cluster randomised controlled trial.

MRFF Research Data Infrastructure Grant: NINA: National infrastructure for federated learning in Digital health

Years funded: 2023-2028

Chief Investigator: Mr Clair Sullivan, University of Queensland

AEHRC Investigator: Dr Michael Lawley, Dr Anthony Nguyen

The NINA project focuses on delivering better health outcomes to Australians affected by chronic disease by drawing together an interdisciplinary team of digital health, clinical informatics, data science and AI researchers and clinicians to tackle Australia's data problem using cancer, diabetes, osteoarthritis and RA and autoimmune diseases as four use cases. Australia cannot wait for cultural change that encourages data sharing and an overhaul of our legislative policies across jurisdictions. NINA transcends these justifiable legislative and privacy barriers by utilising cutting edge FL technology and clinical informatics to deliver better outcomes for chronic disease patients.

MRFF National Critical Infrastructure Grant: Scaling and piloting a genomic platform for population newborn screening

Years funded: 2024-2027

Chief Investigator: A/Prof Natalie Taylor, UNSW

AEHRC Investigator: Professor Denis Bauer

This project aims to establish the world's first genomic newborn screening digital platform capable of screening for hundreds of life-threatening genetic illnesses at birth. The research infrastructure will enable a 12-month real-time trial of an expanded NSW panel in 60,000 newborns in Queensland, involving researchers from New South Wales, Queensland, and South Australia. The primary objectives are to assess the accuracy, cost-effectiveness, and acceptability of this revolutionary technology.

MRFF National Critical Infrastructure Grant: National platform for therapeutic mRNA development

Years funded: 2024-2027

Chief Investigator: Professor Thomas Preiss, Australian National University

AEHRC Investigator: Professor Denis Bauer

Australia's mRNA R&D ecosystem presently lacks internationally competitive capability in the optimisation and systematic testing of mRNA candidates for safe and effective therapy. To fill this critical gap, the project aims to build an open-access sovereign platform, delivering accessible prototyping and optimisation capability to a broad range of users. The NTRP will address critical areas of unmet needs in research capability and diseases with global medical impact.

MRFF National Critical Infrastructure Grant: PrecisionGO – Advancing precision medicine and enhancing patient outcomes

Years funded: 2024-2028

Chief Investigator: Professor Philip O'Connell, Westmead Institute for Medical Research

AEHRC Investigator: Professor Denis Bauer

PrecisionGO will address unmet medical needs for patients with severe disease or inadequate treatment responses. This precision medicine (PM) pipeline targets earlier disease detection, improved treatment efficacy, to reduced healthcare costs. The developed interoperable data workflows for key Australian data sources represent a critical infrastructure outcome to enhance national PM approaches. Included in setting up the nation's first PM facility, it will provide national stakeholder and consumer training, influencing clinical best practices and healthcare provision.

MRFF National Critical Research Infrastructure: SMART-PH – Digitising information for practice in public health

Years funded: 2024-2029

Chief Investigator: A/Prof Courtney Ryder, Flinders University

AEHRC Investigator: Dr Sankalp Khanna

Currently, the health system is heavily siloed and lacks critical digital infrastructure to facilitate multi-sector collaborations. Accessing high-quality data from inter-governmental agencies is made challenging by outdated or incomplete data, making public health processes inefficient. Development and evaluation of targeted, evidence-based public health programs/initiatives utilising innovative AI tools will be facilitated once these gaps are addressed.

MRFF Improving First Nations Cancer Outcomes Partnerships for Cancer Research: Empowering Indigenous communities: Strengthening agency, equity, and connections in cancer care and prevention

Years funded: 2025-2027

Chief Investigator: Professor Gail Garvey

AEHRC Investigator: Dr Andrew Goodman

Achieving equity in cancer care for First Nations Peoples requires a multifaceted approach to address the cultural, historical, racism, and systemic barriers to healthcare. To achieve long-term improvements in cancer efforts requires strengths-based approaches developed with and driven by First Nations leadership and communities. Our diverse and multidisciplinary team will establish a First Nations-led, community-driven, and culturally informed research program in partnership with First-Nation's organisations in Queensland. Our goal is to develop a 'Whole-of-Community Approach' to optimise cancer prevention and cancer care for First Nations Peoples.

MRFF Consumer Led Research: Preventative and Public Health Research Initiative: ConnectUp: Citizen science informed online platform to increase social connection, physical health, and mental wellbeing in people with disability and their carers

Years funded: 2024-2028

Chief Investigator: Dr Dominika Kwasnicka, University of Melbourne

AEHRC Investigator: Dr Marlien Varnfield

Digital technologies can empower people with disability and carers to build and take part in an accessible community-driven initiative that will increase social connection and physical activity, leading to improved physical and mental health. Led by people with disability and carers, we have co-developed 'ConnectUp', an online platform that safely helps people form and sustain social connections and engage in physical activities in their local area.

MRFF Chronic Musculoskeletal Conditions in Children and Adolescents: Australian cerebral palsy musculoskeletal health network

Years funded: 2023-2027

Chief Investigator: Professor Craig Munns, University of Queensland

AEHRC Investigator: Dr Alex Pagnozzi

Early detection of musculoskeletal complications in children with cerebral palsy (CP), coupled with evidence based preventative interventions, will reduce the impact of spine, hip and skeletal fragility disorders in children, adolescents and adults with CP. This will enable children, adolescents and adults with CP to have the best possible musculoskeletal health, physical function and quality of life, leading to a reduction in healthcare related and societal costs.

National Health and Medical Research Council (NHMRC)

NHMRC Early diagnosis and early intervention for infants with cerebral palsy: implementation of international evidence-based guidelines into practice

Years funded: 2022-2025

Chief Investigator: Associate Professor Alicia Spittle, University of Melbourne

AEHRC Investigators: Dr Dana Bradford, Dr Kerstin Pannek, Dr Alex Pagnozzi

Brain MRI forms an important part of the diagnostic workup of cerebral palsy. In this project, we will develop automated approaches to quantitatively evaluate clinical brain MRI of newborns and toddlers with cerebral palsy. These automated tools will support clinicians by making information in MRI more easily accessible and less time consuming.

NHMRC Dementia Research ADNeT

Years funded: 2018-2025

Chief Investigator: Professor Chris Rowe

AEHRC Investigators: Dr Jurgen Fripp, Dr Vincent Dore, Dr Pierrick Bourgeat, Dr Parnesh Raniga, Dr James Doecke

The project (The Australian Dementia Network, ADNeT) will continue development one of the world's largest longitudinal studies into Alzheimer's disease (Australian Imaging, Biomarker & Lifestyle Flagship Study of Ageing, AIBL). By recruiting a large population-based cohort of participants, the study will provide a registry for worldwide clinical trials, and an Australian network of leading clinicians to research the progression of the disease.

NHMRC Boosting Dementia Research Grant: Holistic approach in primary care for preventing memory impairment and dementia (HAPPI MIND)

Years funded: 2019-2025

Chief Investigator: Dr Johnson George, Monash University, Melbourne

AEHRC Investigators: Dr Rajiv Jayasena, Dr Marlien Varnfield

To evaluate the efficacy and cost-effectiveness of the Holistic Approach in primary care for Preventing Memory Impairment and Dementia (HAPPI MIND) program in reducing the risk of dementia among middle-aged people attending Australian general practices.

NHMRC PROTECTMe Assessing antenatal maternal melatonin supplementation in fetal growth restriction to improve neurodevelopmental outcomes

Years funded: 2020-2025

Chief Investigator: Dr Kirsten Palmer, Monash University

AEHRC Investigators: Dr Kerstin Pannek, Dr Alex Pagnozzi, Dr Javier Urriola Yaksic

Foetal growth restriction is a risk factor for adverse neurodevelopmental outcome. This randomised clinical trial investigates whether maternal melatonin supplementation during pregnancy can improve outcomes. We will determine whether there are any observable

differences in brain structure and microstructure between newborns in the treatment group compared to placebo group and investigate whether these brain changes lead to differences in outcomes at two years age.

NHMRC-EU Collaborative Research Grant: Clinical validation of artificial intelligence for providing a personalised motor clinical profile assessment and rehabilitation of upper limb in children with unilateral Cerebral Palsy

Years funded: 2022-2027

Chief Investigator: Professor Roslyn Boyd, University of Queensland

AEHRC Investigators: Dr Alex Pagnozzi, Dr Jurgen Fripp

The broad aim of the AINCP program will be to identify, collect and combine multiple clinical and digital biomarkers clinical multiaxial assessments, brain structure and function, upper limb daily movement to stratify distinct functional subgroups in children with unilateral cerebral palsy, and create the first diagnostic decision support tool. This will inform the decision-making process for providing an accurate prognosis and individualised rehabilitation.

NHMRC Synergy Grant: Cerebral palsy SYNERGY network to protect, repair and improve outcomes

Years funded: 2022-2027

Chief Investigator: Professor Roslyn Boyd, University of Queensland

AEHRC Investigators: Dr Jurgen Fripp

Cerebral palsy (CP) is a life-long disability with immense burden (0.14% GDP, \$1.47b p.a.). Recently, the incidence of CP has reduced by 30% to 1 in 700 children as a result of international multidisciplinary research on prevention, neuroprotection and improved maternal and neonatal care. Our diverse CP Synergy network will accelerate this reduction in the rate and severity of CP by developing novel early biomarkers (neuroimaging, EEG, genomics, liquid biopsy) to improve foetal and neonatal diagnosis, prognosis, prediction to inform precision medicine clinical trials of neuroprotectants (melatonin, cell therapies) and intensive neurorehabilitation to improve motor, cognitive, psychological and health outcomes for children with CP and their families. Our main aim is to prevent CP and/or ameliorate the early brain injury by developing and testing new interventions then translate effective interventions rapidly into clinical practice. We have engaged consumers at every step in the research process to ensure relevance to persons with CP. Involvement of the Australian CP Register will enable testing of longer-term network outcomes at 5 years of age. Our translation objective is to ensure effective treatments are implemented earlier into clinical practice by determining costs, consequences and effectiveness to inform the NDIS.

NHMRC Ideas Grant: Imaging, fluid and genetic markers of Alzheimer's disease

Years funded: 2021-2026

Chief Investigator: Associate Professor Simon Laws, Edith Cowen University

AEHRC Investigators: Dr Pierrick Bourgeat

Markers of pathology and inflammation are useful tools for the diagnosis and staging of neurodegenerative conditions such as Alzheimer's disease. This approach will deepen our basic understanding of this disease, improving early detection and prediction of cognitive impairment. This work will make possible more accurate diagnosis, and improved monitoring of therapeutic interventions.

NHMRC Ideas Grant: Optimising the therapeutic value of cholinesterase inhibitors in Alzheimer's disease

Years funded: 2023-2027

Chief Investigator: Dr Ying Xia CSIRO

AEHRC Investigator: Dr Jurgen Fripp

This project will build upon the ongoing Australian Dementia Network (ADNeT) screening and trials initiative, with detailed PET biomarkers for A β and tau and cognitive evaluations and will utilise advanced cholinergic imaging techniques for better understanding cholinergic dysfunction at various biomarker-defined stages of early AD in a cohort of cognitively unimpaired individuals and patients with mild cognitive impairment. The project aims are to 1. Characterise early cholinergic alterations in preclinical AD and their direct link to the functional vulnerability of the cholinergic system, as simulated in the SCT model; 2. Determine the time-course of cholinergic dysfunction in relation to A β , tau, neurodegeneration, and cognition at early stages of AD, and 3. Investigate and discover new cholinergic markers based on advanced MRI, genetics, and cognition, focused on i) assessment of cholinergic function and ii) longitudinal changes.

NHMRC Clinical Trials and Cohort Studies Grant: Development of menstrual diary app for MadeHER

Years funded: 2021-2025

Chief Investigator: Professor Gira Mishra Naismith, The University of Queensland

AEHRC Investigator: Dr David Ireland

Menstrual disorders and pelvic pain, irregular, heavy, and/or painful periods are common among adolescent girls and disrupt life activities, such as attendance at school, during this formative time. If the conditions persist, it may indicate the presence of underlying pathologies, such as endometriosis and polycystic ovary syndrome. This study will examine the relationship of maternal factors, and in utero, early life, and childhood exposures, with menstrual disorders and pelvic pain in adolescence. It addresses both the current inadequacies of evidence and the limitations, in terms of scale, scope, and duration, of previous studies in this field. A multidisciplinary team of epidemiologists, public health and computer science researchers are examining the relationship of maternal factors with menstrual disorders and pelvic pain in adolescence. A specialised mobile

app is being developed to track menstrual flow, pain and subsequent loss of social and daily activities such as education and work.

NHMRC Synergy Grant: Synergise, integrate and enhance sleep research to transform brain ageing (SIESTA)

Years funded: 2024-2029

Chief Investigator A: Professor Sharon Naismith, The University of Sydney

AEHRC Investigator: Dr Pierrick Bourgeat

SIESTA's innovative program encapsulates three multidisciplinary and integrated streams of research in older adults 'at-risk' for dementia

STREAM 1: Discover in large deeply phenotyped samples, the pathophysiological mechanisms linking SD with longitudinal cognitive trajectories, and determine how and when this occurs. We will develop new measures of glymphatic clearance in humans and determine the factors driving suboptimal waste removal. We will also elucidate the role of the brain's locus coeruleus in sleep disturbance

STREAM 2: Extend existing trials and develop novel therapeutics for SD utilising our strengths in sleep disorder management, data analysis, neuropsychology and biomarkers

STREAM 3: Improve screening, monitoring and management of SD in clinic and community settings by testing, validating, and implementing new digital health technologies.

NHMRC Centre for Research Excellence: DRIVE CP

Years funded: 2023-2027

Chief Investigator: Professor Iona Novak, University of Sydney

AEHRC Investigators: Dr Dana Bradford, Dr Alex Pagnozzi, Dr Wei Lu

The DRIVE Directing Research Very Early in Cerebral Palsy Health Network CRE will achieve a continuing reduction in the rate and severity of cerebral palsy (CP) towards full participation in society, through knowledge creation, translation, capacity building, and collaboration. In our previous CRE, we collaboratively achieved a 30% reduction in CP incidence, resulting in Australia having the lowest rate of CP worldwide. Now, children at high risk of CP will be detected in the first three months of life (using our early diagnosis guideline, paired with new universal screening) and fast tracked to receive early evidence-based rehabilitation in multi-centre clinical trials, underpinned by enhanced value-based care. Our previous clinical trial findings will be implemented into practice and policy through our clinical practice guidelines, mobile health aide and partnership with the NDIS. Improvement in outcomes and enhanced healthcare will be measured on our population Australian Cerebral Palsy Register.

Australian Research Council

ARC Training Centre for Next-Gen Technologies in Biomedical Analysis

Years funded: 2022-2026

Chief Investigator: Prof Killugudi Swaminatha Iyer, Western Australia University

AEHRC Investigators: Dr Denis Bauer

The ARC Training Centre for Next-Gen Technologies in Biomedical Analysis, led by UWA, will deliver a workforce trained in the development of transformative technologies that will rapidly expand the Australian pharmaceutical, diagnostic and defence sector.

ARC Industrial Transformation Research Hub for Advanced Manufacture of Targeted Radiopharmaceuticals

Years funded: 2023-2028

Chief Investigator: Prof Kris Thurrecht, University of Queensland

AEHRC Investigators: Dr Jason Dowling

Radiopharmaceuticals are emerging as next generation medical technologies for addressing complex health challenges, and their manufacture offers significant economic benefit to Australia. The ARC Research Hub for Advanced Manufacture of Targeted Radiopharmaceuticals (AMTAR) aims to establish a manufacturing platform for new medical technologies combining innovations in biotechnology and pharmaceutical science. The program addresses industry-led challenges for translation of biologics as molecular radiopharmaceuticals, building capacity in biomanufacturing, radiobiology and radiochemistry. The program establishes a dedicated manufacturing pipeline, future-proofing production and securing supply chain of next generation medical technologies.

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Publications

Journals

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