ANNUAL REPORT 2024

Image X Institute

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IMAGE X INSTITUTE | THE UNIVERSITY OF SYDNEY

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OUR MISSION

"To improve lives by inventing and advancing new ways to image and treat disease"

SNAPSHOT 2024

30 papers published

18 USYD-sponsored **clinical studies**

$6.3M **funding** commenced

20 **invited talks**

59 **conference presentations**

Director's Message

As the Director of the Image X Institute, I am proud to reflect on a year of achievements and advancements in our mission to improve the lives of people with cancer worldwide. This report will highlight many of those milestones and highlights. We are fortunate that our research spans the length of the translational spectrum from basic scientific discovery through to clinical studies and clinically used products to improve patient outcomes. Our work requires people and funding. These people are the Image X professional and academic staff and students, consumer advisors, the many areas of university support, our industry partners, our collaborators and particularly our clinical trial partners. So much time, effort and goodwill from health professionals goes into clinical trials to maximise the short and long term patient outcomes and treatment experience. It is humbling, inspiring and comforting to have this support and to know the virtues of the people caring for patients in our communities.

Coming by money is never easy, and medical research funding is no exception. We acknowledge our funding sources, and the extensive network of people and reviewers behind them, who have chosen to support our research. These funders include the NHMRC, Cancer Institute NSW, Cancer Australia, Cancer Council NSW, MRFF, Tour de Cure, the Department of Industry, Science and Resources, and the University of Sydney amongst others.
As we look to the future, we remain committed to driving the next generation of cancer breakthroughs and making a global real-world impact on the lives of cancer patients.

Sincerely

Professor Paul Keall

Director, Image X Institute
Faculty of Medicine and Health
University of Sydney

RESEARCH THEMES 2024

MEDICAL IMAGING

Patient Connected Imaging
Using physiological signals to adapt acquisition for clearer CT and CBCT images and more accurate treatment planning

Functional Imaging
Visualising and measuring biological processes

MRI
Developing nanoparticle reagents and imaging biomarkers to better image and treat brain cancer

PET Imaging
Imaging metabolic processes to improve treatment plans and response predictions

CTVI
Identify and spare healthy lung tissue from radiation using CT imaging

Interventional Imaging
Harnessing the full flexibility of robotic imaging systems to increase surgical accuracy and possibilities

Imaging with Carbon Nanotube sources
Enabling rapid 3D imaging during radiation therapy treatment

REAL-TIME IMAGE GUIDED RADIATION THERAPY

X-ray Guidance
Tracking targets and healthy tissues using imagers on standard treatment systems

MR Guidance
Enabling real-time tumour tracking on images acquired during MRI-linac treatments

Surface Guidance
Combining internal and external motion monitoring for more accurate radiation therapy treatment

NOVEL SYSTEMS AND APPLICATIONS

3D-Printing
Delivering novel 3D-printed solutions for oncology and orthopaedic treatments.

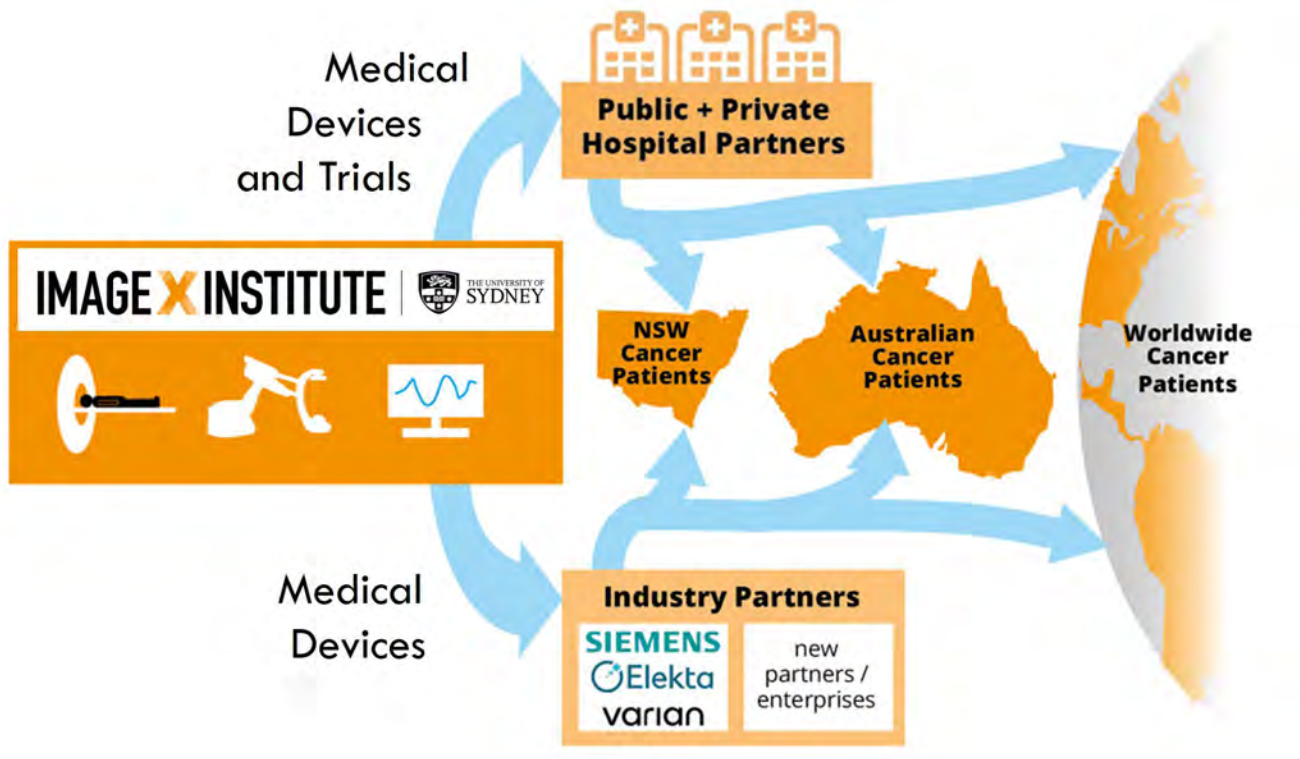
Nano-X
Accessible radiation therapy through novel system design and engineering

MILESTONES AND HIGHLIGHTS

Completion of the Cancer Institute NSW Cancer Council NSW Translational Program Grant

In 2019 we commenced our $4M program to advance imaging and radiation therapy innovations from the discovery phase into clinical trials and beyond. The five-year grant brought together academic, clinical and industry partners to create a large and successful program in applying cancer imaging and targeted radiotherapy inventions to improve health. Amongst major achievements the team advanced medical devices on the translational pathway from development to 12 world-first clinical trials – reaching people impacted by cancer.

It also helped to drive the next generation of cancer breakthroughs by supporting 18 early career researchers, nine PhD completions and allowing 22 students to work alongside investigators as part of a Summer Scholarship program. An article from the Cancer Institute NSW further summarises our Translational Program Grant achievements and future plans.

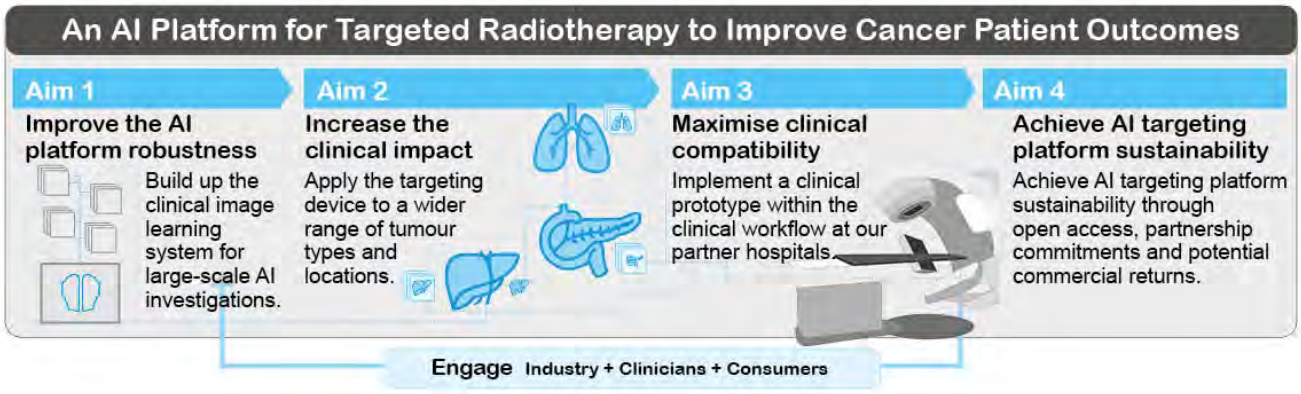


Picture: Translational pipeline for medical device development

MRFF National Critical Research Infrastructure 5-year program funding

"*An AI Platform for Targeted Radiotherapy to Improve Cancer Patient Outcomes*" was funded for $3M over five years as part of the Medical Research Future Fund National Critical Research Infrastructure initiative. The technology harnesses AI for cancer imaging during radiation therapy. When the AI Platform is installed on a standard radiotherapy system, it will unlock the ability to provide targeted, personalised radiotherapy that has until now only been achievable on top-tier radiotherapy systems accessible to just 5% of cancer patients. With high-end treatment systems proven to halve the incidence of treatment-related toxicity, the AI platform has the potential to bring the same incredible clinical benefit to the tens of thousands of Australians receiving radiotherapy on standard systems every year. Led by the Image X Institute, the chief investigators include Prof Paul Keall, Dr David Waddington, Dr Emily Hewson, and Dr Chandrima Sengupta. The team includes clinical partners from New South Wales, Victoria and Queensland, consumer representatives and SeeTreat, an industry partner and Image-X spin-off company.

> "These important research projects will help build the infrastructure that will underpin our use of AI in the healthcare system, improving the lives of Australians everywhere."
>
> The Hon Mark Butler MP, Minister for Health and Aged Care



Picture: Development of an AI platform for targeted radiotherapy

Clinical Study Life-Cycle

Clinical studies are critical for translating discoveries into clinical practice. This report we celebrate several important milestones in the clinical study life-cycle, from protocol approval, to recruitment of the first and last patients on a study, and making data publicly available. Successful completion of studies relies on the efforts of our researchers, clinical partners, patients and the guidance of our Clinical Trials Lead, Shona Silvester.

Picture: Status of our clinical studies

Real-time Image Guided Radiation Therapy Master Clinical Trial protocol approved

A master trial assessing the technical feasibility of first-in-human real-time image guided radiation therapy methods (Real-time IGRT) received approval from a Human Research Ethics Committee (HREC). Real-time IGRT is our first master clinical trial. It will enable us to seamlessly develop, implement, and clinically trial technology that can halve treatment side effects for patients for multiple different cancer types. We have the ambitious goal to halve treatment side effects for 10% of Australian patients by 2030 and 90% of the world's patients by 2040.

First patient recruited to the Magnetic Resonance Imaging of Hypoxia for Radiation Treatment Guidance in Glioblastoma Multiforme (MANGO) clinical imaging study

After much work led by Dr Caterina Brighi, supported throughout by Shona Silvester, David Waddington, neuroradiologist Jamie Drummond and a team of others, the MANGO imaging study recruited its first patient. The goal of the study is to use novel functional imaging methods to detect regions of resistant (hypoxic) tumour and to evaluate the role of these functional imaging methods to selectively deliver targeted radiotherapy to regions of aggressive disease.

Last patient treated on the LARK trial

Clinical trials are a long journey. From conception, engagement, development, protocol, agreements, recruitment, data collection and analysis, trials represent years of work by teams of people. The final treatment in the Cancer Australia-funded TROG 17.03 Liver Ablative Radiotherapy with KIM (LARK) clinical trial has been completed. Dr Chandrima Sengupta has been leading the trial and Shona Silvester played an important role in trial development and commencement. The first in human LARK publication is published in the Radiotherapy and Oncology journal and data for the primary trial analysis are currently being collated for a future publication.

SMART clinical study patient recruitment is complete

The Surface Monitoring technology to Remove The mask – SMART – clinical study reached full recruitment of 30 patients. Outside of their treatment, the patients had two sessions with some of our Remove the Mask technology, surface imaging. As opposed to existing commercial systems, the technology is cost effective (and open source) and is also closer to the patient to improve monitoring accuracy. The patients were also questioned about their experience contrasting the mask and the no mask approach to treatment. Dr Youssef Ben Bouchta led technology development and trial recruitment was led by Dr Puma Sundaresan and the Blacktown hospital team.

BRAVEHeart clinical trial data made publicly available

Following the publication of the outcomes of the BRAVEHeart (Breast Radiotherapy Audio Visual Enhancement for sparing the Heart) clinical trial, the data were made publicly available at: https://doi.org/10.25910/7by0-vf89. Making trial data available is important for many reasons.

> **“Sharing of clinical trial data has great potential to accelerate scientific progress and ultimately improve public health by generating better evidence on the safety and effectiveness of therapies for patients.”**
>
> USA National Institutes of Health website

Recognition

Dr Hilary Byrne was appointed as the chair of the American Association of Physicists in Medicine (AAPM) Working Group on Lung Functional Imaging in Radiation Therapy.

Dr Emily Hewson was selected as one of eight Associates of the American Association of Physicists in Medicine (AAPM) Science Council Associates Mentorship Program (SCAMP).

Dr Emily Hewson was appointed to the Physics in Medicine and Biology journal Editorial Board, as recognition of her growing international profile.

Professor Paul Keall was awarded Honorary Membership of the European Society of Radiation Oncology at the annual meeting in Glasgow in May. This award is in “recognition of outstanding scientific contributions in the field of Radiation Oncology”.

Dr Tess Reynolds was selected to attend the 2024 Emerging Leaders of Academic Medical Physics Symposium at the University of Wisconsin-Madison. She was also selected for the AAPM’s Global Rising Stars program.

Dr David Waddington was awarded the Research Excellence and Inclusion Brown Prize from the University of Sydney. He also received an FMH Makers and Shapers Award for his research leadership and dedication to staff and students.

Picture: Prof Paul Keall receiving Honorary Membership of the European Society of Radiation Oncology, presented by Prof Anna Kirby

Engagement

Image X Institute strives to connect with a diverse and dynamic community. This includes undergraduates and postgraduates, researchers within the Faculty of Medicine and Health, healthcare professionals, cancer survivors, consumer advocates, and the general public. In 2024 our researchers shared their work and their personal career journeys through a range of platforms, from intimate panel discussions to mainstream national media.

In the Media

David Waddington was featured in a major Australian masthead, The Daily Telegraph: *"Sydney cancer researchers harness artificial intelligence for 'cutting edge' treatment."* His interview appeared online and in print. Read the article here: https://www.dailytelegraph.com.au/news/nsw/sydney-cancer-researchers-harness-artificial-intelligence-for-cutting-edge-treatment

In addition to this, David was an invited panelist on the University of Sydney Researcher Development Unit's career conversation series, sharing his experiences in creating balance as an ECR with life in general and all that brings – health challenges, caring responsibilities, self care and strategies.

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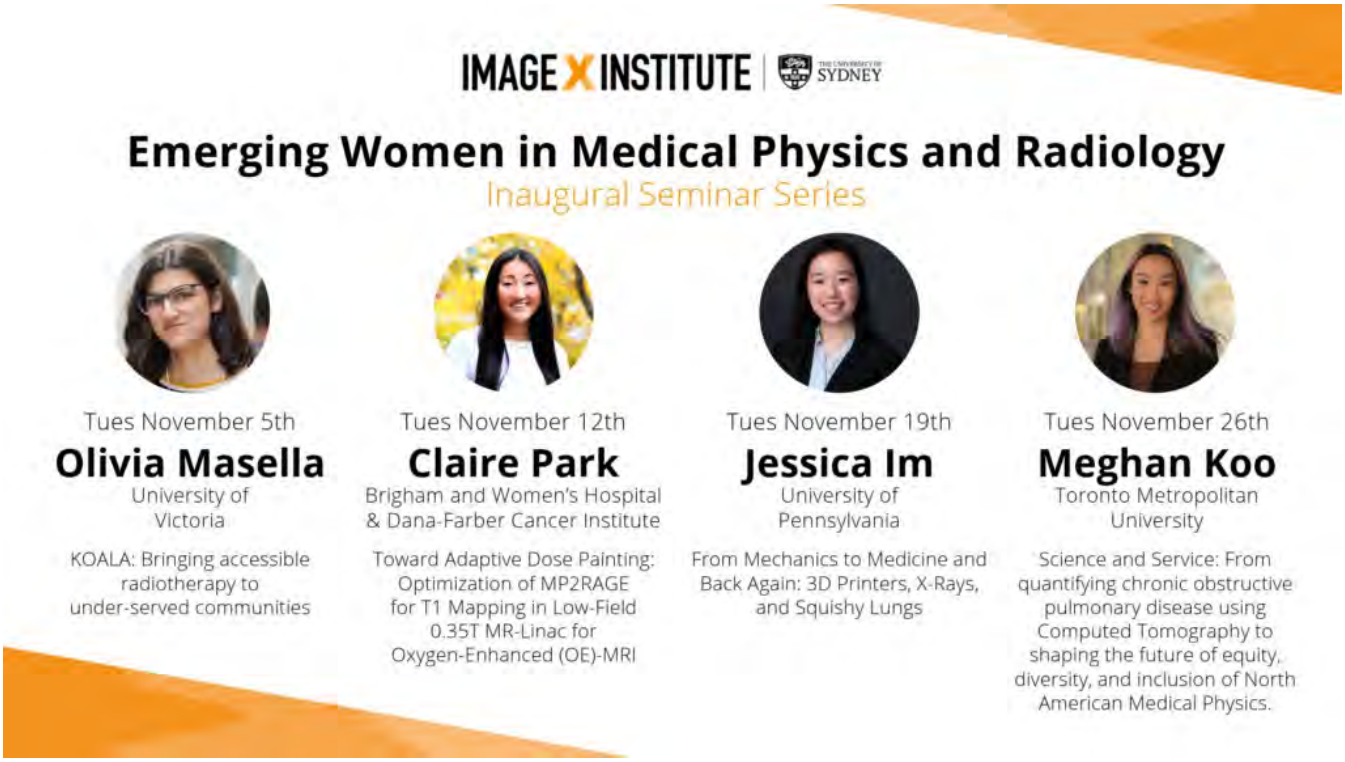
Welcome to Sydney's AI revolution

City life set for 'profound' change

'Cutting-edge' tech targeting tumours

Picture: David Waddington's full page feature in the Daily Telegraph

Inaugural Emerging Women in Medical Physics and Radiology Seminar Series



In November the institute held its first inaugural Emerging Women in Medical Physics and Radiology Seminar Series, initiated and curated by Tess Reynolds. The series was publicly accessible online, with the goal of providing a platform to share the amazing work being done by emerging researchers across a range of f areas, with a post-talk Q&A with each speaker.

PhD students Alicja Kaczynska and Chen Cheng recently organised the **'Connecting Women in STEM* Research'** panel with the support of the Office of Student Life. This event gave the students an opportunity to ask the panel members questions about research careers after some short presentations. which was followed with catered informal networking. Panel members Dr Tess Reynolds from Image X, Dr Sirisha Tadimalla from the Institute of Medical Physics, Dr Tonima Ali from the Brain and Mind Centre, and Dr Theresa Fruth from Astroparticle Physics all gave insight into their work, careers, and journeys.

RESEARCH ACTIVITY

Research Funding

Commenced in 2024 (Image X researcher)

- Prof Paul Keall, Dr Doan Trang Nguyen, Prof Ricky O'Brien, Prof Thomas Eade, A/Prof Jeremy Booth, A/Prof Shankar Siva, A/Prof Nicholas Hardcastle, A/Prof Sashendra Senthi, A/Prof David Pryor. A New Device for Targeted Radiation Therapy to Improve Cancer Patient Outcomes. NHMRC Development Grant $668,892.80
- Prof Paul Keall, Dr David Waddington, Dr Doan Trang Nguyen, Prof Ricky O'Brien, Prof Thomas Eade, A/Prof Jeremy Booth, A/Prof Shankar Siva, A/Prof Nicholas Hardcastle, A/Prof Sashendra Senthi, A/Prof David Pryor, Dr Emily Hewson, Dr Chandrima Sengupta, Ms Lee Hunt. An Artificial Intelligence Platform for Targeted Radiation Therapy to Improve Cancer Patient Outcomes. MRFF National Critical Research Infrastructure Grant Stream 2, $2,984,230
- Dr Owen Dillon, A/Prof Magdalena Bazalova-Carter, Dr Saree Alnaghy, Mr Anthony Skeats Creating the Next Generation in Radiotherapy Imaging with Carbon Nanotube Sources and Photon Counting Detectors. CCNSW Project Grant. $436,665
- Dr Owen Dillon, Anthony Skeats, Dr Michael Jackson, Prof Ricky O'Brien, Dr Saree Alnaghy. Quantum CT for Cancer Diagnosis in All Australian Clinics. Critical Technologies Challenge Program Round 1 - Stage 1 Feasibility. $289,388
- Dr Nicholas Hindley, Dr Chun-Chien Shieh. From relativity to respiration: How ideas from Einstein's general theory enable adaptative radiation therapy for lung cancer patients. Cancer Australia Category A ECR PdCCRS grant $100,000
- Dr Hilary Byrne, Dr Dasantha Jayamanne, Dr Sarah Bergamin, Dr Owen Dillon, Dr John Kipritidis. How are you breathing today? Embedding functional imaging throughout radiation therapy to improve lung cancer patient outcomes. Cancer Australia ECR PdCCRS grant $173,016
- James Grover Developing, deploying, and assessing deep learning techniques to advance real-time adaptive magnetic resonance imaging guided radiation therapy. Tour de Cure PhD Student Grant. $10,000
- Dr David Waddington Harnessing artificial intelligence to improve MRI-guided radiotherapy for liver cancer patients. Tour de Cure Early Career Researcher Grant. $100,000
- Dr Kevin London, A/Prof Peter Kench, Dr Hunor Kertesz. 68Ga-FAPI PET CT in Paediatric Solid Tumours. 2024 ANSTO/ANZSNM Research Grant Application. $19,200
- Dr Saree Alnaghy, Dr Michael Jackson, Dist Prof Anatoly Rozenfeld, Prof Susanna Guatelli, Prof Paul Keall, Dr Owen Dillon, Dr Matthew Newall, Dist Prof Peter Metcalfe, Prof Nicholas Hardcastle.

Sharper Targeting, Brighter Future: Advanced Imaging in Cancer Radiotherapy. Critical Technologies Challenge Program Round 1 - Stage 1 Feasibility. $350,203

- Dr David Waddington, Dr Sheryl Foster, A/Prof Roger Bourne, A/Prof Peter Kench. A portable MRI scanner for low-field imaging research and teaching. University of Sydney Provost's Capital Equipment (CAPEX) and Contingency Fund $849,296
- Dr David Waddington. Research Excellence and Inclusion Brown Prize $50,000
- Dr David Waddington. FMH Rewarding Research Success, $90,000
- Prof Paul Keall. FMH Rewarding Research Success, $90,000
- Prof Paul Keall. University of Sydney 2024 - Strategic Research Fund, $63,500
- Dr David Waddington. University of Sydney 2024 - Strategic Research Fund, $16,000
- Dr Tess Reynolds. University of Sydney 2024 - Strategic Research Fund, $6500
- Dr Owen Dillon. University of Sydney 2024 - Strategic Research Fund, $6500
- Dr Emily Hewson. University of Sydney 2024 - Strategic Research Fund, $6500
- James Grover. University of Sydney 2024 - Strategic Research Fund, $1500

Publications

Assigned an issue or published online in 2024

- Abdel-Wahab M, Coleman CN, Eriksen JG, Lee P, Kraus R, Harsdorf E, Lee B, Dicker A, Hahn E, Agarwal JP, Prasanna PGS, MacManus M, Keall P, Mayr NA, Jereczek-Fossa BA, Giammarile F, Kim IA, Aggarwal A, Lewison G, Lu JJ, Guedes de Castro D, Kong FS, Afifi H, Sharp H, Vanderpuye V, Olasinde T, Atrash F, Goethals L and Corn BW (2024). "Addressing challenges in low-income and middle-income countries through novel radiotherapy research opportunities." Lancet Oncol **25**(6): e270-e280. DOI: 10.1016/s1470-2045(24)00038-x.
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- Byrne HL, Steiner E, Booth J, Lamoury G, Morgia M, Carroll S, Richardson K, Ambrose L, Makhija K, Stanton C, Zwan B, Carr M, Stewart M, Bromley R, Atyeo J, Silvester S, Plant N and Keall P (2024). "Prospective Randomized Trial Comparing 2 Devices for Deep Inspiration Breath Hold Management in Breast Radiation Therapy: Results of the BRAVEHeart Trial." Adv Radiat Oncol **9**(9): 101572. DOI: 10.1016/j.adro.2024.101572.
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- Choi S, Brighi C and Long S (2024). "Dynamic contrast enhanced high field magnetic resonance imaging for canine primary intracranial neoplasia." Front Vet Sci **11**: 1468831. DOI: 10.3389/fvets.2024.1468831.
- Ferrara D, Shiyam Sundar LK, Chalampalakis Z, Geist BK, Gompelmann D, Gutschmayer S, Hacker M, Kertész H, Kluge K, Idzko M, Langsteger W, Yu J, Rausch I, and Beyer T (2024) "Low-dose and standard-dose whole-body [18F] FDG-PET/CT imaging: implications for healthy controls and lung cancer patients." Frontiers in Physics, 10.3389/fphy.2024.1378521
- Gardner M, Dillon O, Byrne H, Keall P and O'Brien R (2024). "Data-driven rapid 4D cone-beam CT reconstruction for new generation linacs." Phys Med Biol **69**(18). DOI: 10.1088/1361-6560/ad780a.
- Gardner M, Finnegan RN, Dillon O, Chin V, Reynolds T and Keall PJ (2024). "Investigation of cardiac substructure automatic segmentation methods on synthetically generated 4D cone-beam CT images." Med Phys. DOI: 10.1002/mp.17596.
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- Hewson EA, Dillon O, Poulsen PR, Booth JT and Keall PJ (2025). "Six-degrees-of-freedom pelvic bone monitoring on 2D kV intrafraction images to enable multi-target tracking for locally advanced prostate cancer." Med Phys **52**(1): 77-87. DOI: 10.1002/mp.17465.
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Intellectual Property and Industry Engagement

Dr Tess Reynolds extended her industry partnership with Siemens Healthcare to maintain unique access to the control system of a robotic C-arm imager and include her international collaborators in the agreement.
Image X spin-off, SeeTreat, was founded by Prof Paul Keall and Dr Trang Nguyen to develop medical software to approve the experience of clinicians and patients. See Treat is an industry partner on an NHMRC Development Grant and MRFF National Critical Research Infrastructure grant.

- Emily Hewson, Owen Dillon, Jeremy Booth, Paul Keall. Motion monitoring using projection imaging with rotating views. Patent filed
- Mark Gardner, Owen Dillon, Hilary Byrne, Paul Keall. Data-driven rapid cone-beam CT for new generation linacs. Provisional application

Invited Talks and other professional activities

- Dr Vicky Chin chaired the first Australasian/Asia-Pacific interest group for Stereotactic Arrhythmia Radioablation (STAR). As several centres in Australia/NZ/Singapore have commenced or about to commence treating arrhythmia patients with stereotactic radiotherapy, this is a forum for the sharing of multidisciplinary knowledge and experience, and to help harmonise management for these patients.
- Dr Emily Hewson gave two presentations at the University of Utrecht and Inselspital, Bern University Hospital titled *Real-time adaptive radiation therapy on standard linear accelerators.*

- Dr Emily Hewson presented at the Cancer Research UK Manchester Centre on *Real-time targeted radiation therapy using MLC tracking*.
- Dr Emily Hewson presented at the Danish Centre for Particle Therapy, Aarhus University Hospital on *Next generation MLC tracking and motion management.*
- Dr Emily Hewson, Prof Paul Keall and RNSH collaborator Dr Jeremy Booth presented at the Institute of Cancer Research, UK on *Who needs an MRI-Linac? X-ray-guided adaptive and real-time targeted radiation therapy.*
- Dr Nicholas Hindley gave a seminar at the Centre for Medical Radiation Physics, University of Wollongong on *Real-time tumour and organ-at-risk tracking during lung cancer radiation therapy*.
- Prof Paul Keall gave a presentation at the University of Munich on *Building and clinically translating new technology in radiation therapy.*
- Prof Paul Keall gave a presentation at Brigham and Women's Hospital, Dana-Farber Cancer Institute on *MRI-guided Radiation Therapy*.
- Prof Paul Keall presented at the Northern Beaches Prostate Cancer Support Group on *Real-time radiotherapy: Targeting prostate cancer.*
- Prof Paul Keall presented on *An AI Platform for Targeted Radiotherapy to Improve Cancer Patient Outcomes* at an ACPSEM NSW/ACT Branch Imaging Workshop
- Dr Hunor Kertesz and Jeremy Lim organised and moderated a workshop for the American Association of Physicists in Medicine (AAPM) Functional Lung Imaging Working Group. There were 12 presentations, including one from Prof Paul Keall on the VITaL trial, and over 50 people from many time zones joining.
- Jeremy Lim presented at the Cancer Research UK Manchester Centre and at POLARIS, the University of Sheffield on *3D-printed lung phantoms for CT ventilation imaging quality assurance*.
- Dr Tess Reynolds gave a presentation at RMIT, Melbourne, on *The Future of the Hybrid T heater: Imaging Innovation and Biofabrication.*
- Dr Tess Reynolds shared her grant funding experiences in a webinar for the American Association of Physicists in Medicine's Global Research and Scientific Innovation Committee (GRSIC) and the Global Early Career Research Subcommittee (GECRSC).
- Dr Tess Reynolds gave a seminar at Massachusetts General Hospital, Boston, on *Expanding the capabilities of robotic CBCT imaging systems.*
- Dr Tess Reynolds was elected chair of the 2025 Sydney Clinical Imaging Network (SCIN) Summit and tasked with delivering a full-day program to celebrate the achievements of the SCIN members, foster interdisciplinary relationships and spark new collaborations.
- Dr Tess Reynolds presented on *The Future of the Hybrid Theatre: Imaging Innovation and 3D-Printing* at the Emerging Leaders of Academic Medical Physics Symposium and Workshop. She also received the best poster prize at this symposium.

- Dr Tess Reynolds was a panelist for a *Connecting Women in STEM Research* event at the University of Sydney. Our PhD students Chen Cheng and Alicja Kaczynska were part of the student team organising the event.
- As part of her new leadership role with the BreastScreen Reader Assessment Strategy (BREAST), Dr Tess Reynolds attended the Royal Australian and New Zealand College of Radiologists (RANZCR) conference to help facilitate 16 workshops that enabled over 90 registrars and radiologists to complete digital mammogram and digital breast tomosynthesis test sets.
- Dr Chandrima Sengupta presented at the *Growing Ideas & Growing Careers* event hosted by Sydney Cancer Partners.
- Dr David Waddington organised the 2024 Junior Fellows Symposium at the International Society for Magnetic Resonance in Medicine meeting, entitled “Innovations & Future Perspectives in MRI Technology,” which will delved into groundbreaking MRI methods and techniques poised to revolutionise the field. He also moderated a session ‘Technology Covering Global MRI Access’.
- Dr David Waddington was a panel member in a new University of Sydney initiative to help early career researchers navigate work-life balance challenges.
- Dr David Waddington presented to the Institute of Medical Physics, University of Sydney on *Expanding Global MRI Access.*
- Dr David Waddington was an invited speaker at MRI Together, a global online event on open, reproducible, and inclusive MRI research. His presentation was on *Real-time deployment of open source tools for image reconstruction.*

Conference Presentations

American Association of Physicists in Medicine Annual Meeting 2024 (Los Angeles, CA, USA)

- P Keall*. *Delivering cardiac radioblation and managing motion, in the session Cardiac radioablation for ventricular tachycardia patients: opportunities and pitfalls*. Invited Talk/ Panel member
- N Hindley*, P Keall. V*oxelmap: An Open-Source Deep Learning Framework for 3D Intrafraction Motion Monitoring and Volumetric Imaging during Image-Guided Radiation Therapy.* Oral presentation
- H Kertész*, H Byrne, I Rausch, F Schmidt, V Panin, M Conti, T Beyer, R O’Brien. *Achieving High Resolution Total-Body PET/CT Using Positron Range Correction.* Oral presentation
- B Lau*, C Lin, L Roshkovan, H Sagreiya, W Hsu, F Jamal, D Farouk, S Katz, A Kamona, J Stayman, G Gang. *Simulating pulmonary nodules in healthy lung CT with diffusion networks.* Oral presentation
- H Byrne, H Kertész *, J Lim, J Kipritidis, R O'Brien, P Keall. *3D-Printed Patient-Derived Inhale and Exhale Lung Phantom for CT Ventilation Imaging Quality Assurance*. SNAP Oral presentation

- C Cheng*, M Gardner, O Dillon, Y Ben Bouchta, P Sundaresan, P Keall. *Real-Time Volumetric Imaging of the Head and Neck on a Standard Linac Using a Kalman Filter*. SNAP Oral presentation
- E Hewson*, L Mejnertsen, J Booth, P Keall. *Real-Time Dose-Optimized Multileaf Collimator Tracking for 3D Deformations of Anatomy: Investigating Multiple Lung Cancer Targets*. SNAP Oral presentation
- A Kaczynska*, M Stewart, E Hewson, A Martin, Y Ben Bouchta, D Nguyen, J Booth, N Hardcastle, J Johnson, P Keall, C Sengupta. *First Experimental Investigation of a Real-Time 6 Degrees-of-Freedom Tumor Motion Monitoring Device for Thoracic and Abdominal Cancer Sites.* SNAP Oral presentation
- Y Ben Bouchta*, M Gardner, D Truant, P Keall. *Feasibility and Safety of Surface-Based Gating for Mask Free Head and Neck Radiotherapy.* Poster
- Dillon*, B Lau, H Kertesz, P Keall. *Dvgardener: An Open-Source Toolbox for Manipulation, Quantification, Generation and Compression of Deformation Vector Fields.* Poster
- C Duncan*, A Kanawati, T Reynolds. *Developing the low-cost 3Dpritned synthetic spines for surgical training and simulation.* Blue Ribbon Poster
- M Gardner*, R Finnegan, V Chin, O Dillon, T Reynolds, P Keall, R O'Brien. *Methods for Automatic Segmentation of Cardiac Substructures in 4D Cone-Beam CT Images for Accurate Cardiac Radioablation Treatments*. Poster
- J Hindmarsh*, S Crowe, J Johnson, C Sengupta, J Booth, S Dieterich, P Keall. *Dosimetric Evaluation of Real-Time Adaptive Radiotherapy on the Radixact Synchrony: An Update to an International Challenge*. Poster
- T Reynolds*, O Dillon, N Hindley, Y Ma, J Stayman, M Bazalova-Carter. *4D respiratory cone-beam CT imaging for thoracic interventions on robotic c-arm systems.* Poster
- K Klucznik*, T Ravkilde, S Skouboe, P Keall, L Happersett, H Pham, B Leong, P Zhang, G Tang, P Poulsen. *First Clinical Online Real-Time Motion-Including Prostate and Bladder Dose Reconstruction during Prostate Radiotherapy Delivery.* Oral presentation
- A Ahmed*, L Madden, M Stewart, B Chow, A Mylonas, R Brown, G Metz, M Shepherd, C Coronel, S Mangan, L Ambrose, A Turk, M Crispin, A Kneebone, G Hruby, P Keall, J Booth. Real-Time Markerless Tracking of the Pancreas for Pancreatic Cancer SABR. Poster

AusMRinRT 2024 (Mooloolaba, QLD)

- C Brighi, D Waddington*, P Keall, J Booth, K O'Brien, S Silvester, J Parkinson, M Mueller, J Yim, D Bailey, M Back, J Drummond. *Validating MRI biomarkers of hypoxia for improved diagnosis, biology-guided radiation treatment and response assessment in glioblastoma*. Oral presentation
- J Grover*, S Shan, P Keall, D Waddington. *Towards real-time high spatiotemporal resolution multi-slice MRI for adaptive MRI-guided radiotherapy using deep learning*. Oral presentation

- P Janowicz*, C Brighi, D Waddington. *Towards detecting infiltrative brain tumours using novel superparamagnetic iron oxide nanoparticles and MRI*. Oral presentation

Australasian Neuroscience Society 42nd Annual Scientific Meeting (Perth, WA)

- P Janowicz*, C Brighi, Z Kuncic, D Waddington. *Positive Contrast Magnetic Resonance Imaging of Iron Oxide Nanoparticles in Patient-Derived Orthotopic Glioblastoma*. Poster

Australian and New Zealand Society of Nuclear Medicine 54th Annual Scientific Meeting (Christchurch, NZ)

- H Kertész*, H Byrne, I Rausch, F Schmidt, V Panin, M Conti, S Zuehlsdorff, T Beyer, R O'Brien. *Positron Range Correction for the Total-Body PET/CT using Ga-68.* Oral presentation

Biologically guided Radiation Therapy (BgRT) Symposium (Sydney, NSW)

- D Waddington*. *Preclinical brain cancer imaging with nanoparticles*. Invited talk
- P Keall*. *VITaL: A randomised controlled trial investigating ventilation imaging to improve the quality of life for patients with lung cancer*. Invited talk

European Society of Radiation Oncology 2024 meeting (Glasgow, UK)

- P Keall*. *Image guidance of moving targets in radiotherapy* in the pre-meeting course on Clinical Translation of CT Innovations in Radiotherapy. Invited talk
- P Keall*. *Hypofractionation: What are the implications with regard to image guidance and accuracy?* Invited Talk
- E Hewson*, L Mejnertsen, J Booth, P Keall. Real-time adaptive radiation therapy for multiple lung targets: a proof-of-concept study. Oral presentation
- A Mylonas*, DT Nguyen, V Seshadri, P Ramachandran, J Lye, R Khor, M Gardner, C Sengupta, P Keall. *Deep learning-based contrast agent segmentation for liver cancer targeting during radiation therapy.* Oral presentation
- C Sengupta*, DT Nguyen, T Moodie, B Zwan, SF Liu , D Mason, T Causer, N Hardcastle, L Inskip, R Cone, B Tacon, E Brown, J Luo, M Stewart, S Arumugam, T Wang, S Tang, YY Lee, K van Gysen, J Chu, Y Li, P Greer, J Booth, R O'Brien, P Keall. *The first clinical implementation of real-time 6 DoF liver tumour tracking for SABR in the TROG LARK clinical trial.* Oral presentation
- C Brighi*, G Parrella, L Morelli, S Molinelli, g Magro, E Orlandi, C Paganelli, M Ciocca, D Waddington, P Keall, A Iannalfi, R Giulia, S Imparato. *Evaluating image-guided dose painting for skull-based chordoma patients treated with proton therapy.* Poster presentation
- J Lim*, J Kipritidis, P Keall, M van Herk, H Byrne. *Correlating lung dose and function overall survival using 4-dimensional computed tomography-based ventilation imaging.* Poster presentation

- C Sengupta*, DT Nguyen, Y Ge, M Grace, C Hall, B Whelan, M Jameson, P Mc Loone, A Kaczynska, P Liu, P Keall. *Comparing a software-enabled and an add-on hardware-based motion monitoring system for prostate SABR.* Poster presentation

European Society for Radiation Oncology (ESTRO) meets Asia (Kuala Lumpur, Malaysia)

- E Hewson*. At the symposium *Advanced monitoring and management of treatment uncertainties.* Invited talk

Engineering and Physical Sciences in Medicine conference 2024 (Melbourne VIC)

- Y Ben Bouchta*, M Gardner, J Sykes, D Truant, P Sundaresan, P Keall. *Surface imaging to remove the mask – Preliminary results from the SMART1 clinical trial*. Oral presentation
- M Gardner*, A Mylonas, M Mueller, Y Ben Bouchta, J Sykes, P Sundaresan, P Keall, D T Nguyen. *Towards Removing the Mask: A real-time method for accurate segmentation of head and neck tumours in kV images.* Oral presentation
- M Gardner*, O Dillon, H Byrne, T Reynolds, J Kipritidis, M Gargett, P Keall, R O'Brien. *Rapid 4D Cone-Beam CT for new generation linacs.* Oral presentation
- A Kaczynska*, N Hardcastle, J Booth, P Keall, C Sengupta and LARK trial team. *Accuracy of external surface markers for intra-treatment motion monitoring in breath-hold liver SBRT.* Oral presentation
- C Kuban*, A Zahir, W Nixon, Z Gao, A Yan, A Kaczynska, F Jin, M Stewart, D Mason, R Brown, J Hindmarsh, J Johnson, P Keall, C Sengupta. *An open-source internal and external motion actuation system to advance real-time image-guided radiotherapy*. Oral presentation
- C Sengupta*, Y Liang, P Keall. *An open-source clinical image learning system for targeted radiation therapy applications*. Oral presentation
- A Yan*, C Sengupta, E Mathias, C Kuban, J Johnson, P Keall. *An Open-Source Hardware and Software Couch Tracking System that Enables Real-time Adaptive Radiation Therapy*. Oral presentation
- J Barber*, P Balaji, T Murray, A Hickey, T Barry, E Hau, C Sengupta, M Gardner, S Tadimalla, P Qian. *Development of imaging and treatment protocols for large animal cardiac SBRT.* Oral presentation
- D Chrystall*, M De Oliveira, M Stewart, C Sengupta, F Jin, A Kejda, P Keall, J Booth. *The implementation and commissioning of a 3D beam's-eye-view real-time IGRT system for prostate SBRT.* Oral presentation

2024 FMH Networks EMCR Symposium (University of Sydney)

- N Hindley*. *Real-time tumour and organ tracking for adaptive radiotherapy.* Oral presentation
- P Janowicz*, C Brighi, D Waddington. *Detection of infiltrative glioblastoma angiogenesis using novel superparamagnetic iron oxide nanoparticles*. Oral presentation

- D Waddington*. *Accelerated Imaging at Ultralow Magnetic Fields: A comparative study of traditional and neural-network-based reconstruction approaches.* Oral presentation

Gordon Research Conference- In Vivo Magnetic Resonance (New Hampshire, USA)

- P Keall*. *MRI-guided radiation therapy*. Invited Speaker

International Society for Magnetic Resonance in Medicine & European Society for Magnetic Resonance in Medicine and Biology 2024 Annual Meeting (Singapore)

- D Waddington*. *Presentation in the session What Can I Do Next? Careers Inside & Outside Academia?* Invited talk
- J Grover*, S Shan, P Keall, D Waddington. *Transformer residual cross (T-Rex) networks for volumetric super-resolution.* Digital Poster

MedPhys2024 (Sydney, NSW)

- J Hindmarsh*. *Prospective hazard analysis in radiation therapy - A systematic review*. Oral presentation
- A Kaczynska*. *Combining light and x-rays to enable real-time cancer targeting*. Oral presentation

2024 Postgraduate Student Cancer Research Symposium (Sydney, NSW)

- J Lim*, H Byrne, J Kipritidis, P Keall, M van Herk. *Correlating lung dose and CT ventilation imaging-measured function with lung cancer patient survival.* Oral presentation

Radiological Society of North America 110th Scientific Assembly and Annual Meeting (Chicago, Il, USA)

- D Waddington*, E Shimron, S Shan, J Grover, T Boele, N Koonjoo, S Shen, J Kirsch, A Sorby-Adams, M Rosen. *Accelerated MRI at low magnetic fields. Can fast imaging approaches from clinical field strengths be translated to the low-field regime?* Oral presentation (Cutting-edge research submission)

Royal Australian and New Zealand College of Radiologists Annual Scientific Meeting (Perth, WA)

- V Chin*. *Understanding cardiac risk in thoracic cancer radiotherapy.* Oral presentation
  Received the Elekta award for advances in the use of technology

36th TROG Cancer Research Annual Scientific Meeting (Newcastle, NSW)

- P Keall*. *Hypofractionation - a win for patients and the health system. But what are the implications with regard to image guidance and accuracy?* Invited talk

- C Sengupta* *TROG 17.03 LARK: Liver Ablative Radiotherapy utilising Kilovoltage Intrafraction Monitoring (KIM).* Invited talk
- Y Ben Bouchta*, M Gardner, D Truant, P Sundaresan, H Dhillon, P Keall. *Multidisciplinary, patient informed and patient centred research: Using technology to "Remove the mask*". Oral presentation
- C Sengupta*, Y Liang, I Ghosh, DT Nguyen, R O'Brien, B Whelan, P Keall. *An open-source project for managing clinical trial data: Making data accessible, usable, interoperable, and secure*. Oral presentation

Westmead Research and Innovation Conference and EMCR Symposium (Sydney, NSW)

- T Reynolds*, C Duncan, P Lorentzos, A Kanawati. *Low-cost 3D-printed synthetic vertebra with realistic insertion torque for surgical training and simulation of pedicle screw fixation: comparison between resin and PLA filament models.* Poster

Winter Institute of Medical Physics 2024 meeting (Breckenridge, CO, USA)

- E Hewson*. *Next generation MLC tracking: real-time dose optimization for 3D deforming anatomy*. Oral presentation
- T Reynolds*. *Innovation in interventional Cone Beam CT Imaging*. Oral presentation

GOVERNANCE AND OPERATIONS

Image X Institute Staff and Students

Academic Staff

Professor Paul Keall, Director, NHMRC Leadership Fellow

D Tess Reynolds, Deputy Director, Cancer Institute NSW and Robinson Fellow

Dr Youssef Ben Bouchta, Research Fellow

Dr Thomas Boele, Research Associate

Dr Caterina Brighi, Research Fellow

Dr Hilary Byrne, Senior Research Fellow

Dr Vicky Chin, Research Associate

Dr Owen Dillon, Research Fellow

Dr Mark Gardner, Research Fellow

Dr Emily Hewson, Cancer Institute NSW Early Career Fellow

Dr Nicholas Hindley, Research Associate

Dr Phillip Janowicz, Research Associate

Dr Hunor Kertész, Research Associate

Yifan Li, Research Associate

Jeremy Lim, Research Associate

Dr Chandrima Sengupta, Research Fellow

Dr David Waddington, NHMRC Emerging Leadership Fellow

Dr Brendan Whelan, Senior Research Fellow

Ann Yan, Research Associate

Professional Staff

Dr Helen Ball, Operations Manager

Chloe Duncan, Research Assistant

Jonathan Hindmarsh, Clinical Medical Physicist

Freeman Jin, Software Engineer

Julia Johnson, Design & Communications Officer

Sam Liang, Software Engineer

Shona Silvester, Clinical Trials Lead

Students

Chen Cheng, Doctor of Philosophy
James Grover, Doctor of Philosophy
Jonathan Hindmarsh, Doctor of Philosophy
Alicja Kaczynska, Doctor of Philosophy
Benjamin Lau, Doctor of Philosophy
Adam Mylonas, Doctor of Philosophy
Dr Yuvnik Trada, Doctor of Philosophy

Mohammed Alzaabi, Masters of Medical Physics research project
Laura Buettgen, Visiting PhD scholar, University of Hamburg
Frances Kan, Dalyell individual research project
Chris Kuban, Masters of Imaging Medical and Surgical Robotics, Télécom Physique Strasbourg (internship)
Jiaming Li. Declan Langreiter, Win Lyn, Anna Purvis, Sophie Russell, Yuhao Shen; Bachelor of Biomedical Engineering Honours projects
Zhihe Tian, research project for study abroad program
Abbas Zahir and Chloe Duncan, Bachelor of Biomedical Engineering internship

Governance Committee

Our Governance Committee oversees the governance and progress of the Institute and provides direction and support in helping us to achieve our goals through the removal of barriers. The Image X Institute sits within the Clinical Imaging node of the Sydney School of Health Sciences and Faculty of Medicine, and the committee has representation from the institute, school and faculty levels as well as Research Operations and Finance.
Professor Antoine van Oijen (Chair), Associate Dean (Research Performance), Faculty of Medicine and Health
Professor Paul Keall, Image X Institute Director
Dr Helen Ball, Image X Institute Operations Manager
Ishan Pratap Kakkar, Finance Manager, Sydney School of Health Sciences
Mark Kay, Director Post Award, Research Portfolio
Dr Tess Reynolds, Image X Institute Deputy Director
Dr David Waddington, Image X Institute Early Career Fellow
Professor Martin Ugander, Head of Clinical Imaging, Sydney School of Health Sciences

Executive Committee

Our Executive committee provides direction on key issues and operations of the institute. Its membership includes senior/early career research academic, student and professional staff representation; Paul Keall, Helen Ball, Tess Reynolds, Emily Hewson, Hilary Byrne, David Waddington and Jonathon Hindmarsh.

Picture: Image X researchers at the 2024 Research Planning retreat.