Optimising Disease Prediction, Diagnosis and Intervention: Case Study

Engineering and Physical Sciences Research Council

Making medical imaging smarter

A new breed of more affordable and impactful medical imaging technologies, a new generation of experts with the skills to develop, deliver and harness them – doctoral training supported by EPSRC is driving forward advances that will save lives and cut healthcare costs.

Meeting the Grand Challenge:

Hosted jointly by King's College London and Imperial College London, the EPSRC Centre for Doctoral Training (CDT) in Smart Medical Imaging is targeting a field of technology pivotal to continued progress in diagnosing and treating disease. With industry involvement at its heart, the CDT will deliver vital expertise and valuable breakthroughs that help realise a remarkable new era for medical imaging.

Vision and Value:

Firmly established as a core component of healthcare, imaging technologies are one of science's fastest-growing fields. But the human eye can only gather a fraction of the insights that MRI or CT scans[1], for instance, could actually provide. Moreover, as medical imaging techniques become increasingly expensive and sophisticated, the time and cost involved in developing and using them has become a significant constraint on optimising their value to health.

Against such a backdrop the CDT is training the next generation of researchers in this field, with a vision of leveraging the full potential of medical imaging for healthcare. This involves integrating artificial intelligence (AI), targeted, responsive, safer imaging probes and cutting-edge emerging and affordable imaging solutions in a unique multidisciplinary environment. This environment encompasses imaging scientists, engineers, clinicians and the healthcare industry.

Key Components:

With £6 million of EPSRC funding, the CDT opened its doors in 2019 and will run until 2028. Combining world-class research and teaching capability at King's and Imperial – a partnership that previously delivered the successful EPSRC CDT in Medical Imaging – it has attracted input, support and co-funding from a host of industrial partners including Siemens, GSK, GE, Philips and many UK small and medium-sized enterprises.[2]

Its four-year training programme provides students with a range of learning experiences. After a one-year Masters of Research in Healthcare Technologies, students spend three years on a PhD relating to one of four themes: AI-enabled imaging, smart imaging probes, emerging imaging and affordable imaging. With industrial placements and mentoring a key element, students also become part of a world-leading group of over a hundred scientists and clinicians focused on rapid translation of cutting-edge research into real-world settings, including Guy's and St Thomas' NHS Foundation Trust hospitals. Entrepreneurship and public engagement are important components of the training programme.

Image credit: King's College London

[1] MRI: magnetic resonance imaging; CT: computed tomography. [2] www.imagingcdt.com/partnerships. Grant number: EP/S022104/1

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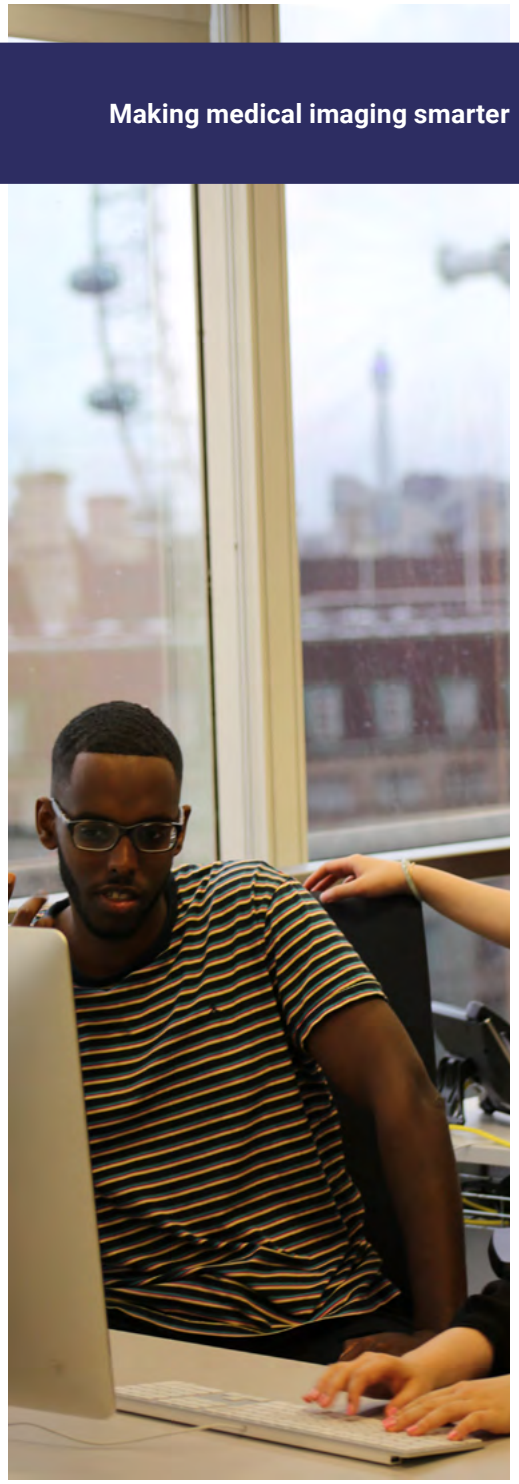

Image credit: King's College London

Outputs and Outcomes:

- 14 students were enrolled into the CDT in 2019 and 17 in 2020, while 45 students from the previous CDT are also currently on the programme.
- Every student aims to emulate the success of the students who secured their doctorates in the predecessor CDT in Medical Imaging, such as:
  - Sophie Morse, who won multiple prestigious awards for her work on microbubbles and how they can open blood vessels to agents or drugs by oscillating under application of ultrasound, enabling non-invasive investigation of brain tissue
  - Cian Scannell, who spent a year as an enrichment student at the Alan Turing Institute where he learnt about cutting-edge data science and pattern recognition techniques; he then applied them to his work on automated detection and characterisation of coronary artery disease from cardiac MRI examinations.
- The new CDT's intake includes:
  - Aidan Michaels, who has launched a 'RadioNuclear' podcast to engage with the public on molecular imaging and nuclear medicine
  - Marica Mufoletto and Ioannis Valasakis, who have become engineering editors of Computer Vision News magazine, reporting on subjects such as deep learning in healthcare imaging.

Impacts and Benefits:

- **Building a talent pipeline.** The CDT is producing experts comfortable working at the intersection of fields such as AI, engineering, data science, imaging chemistry, chemical biology, photonics and physiology, where the development of new, smart medical imaging technologies needs to focus.
- **Delivering technological breakthroughs.** Students will be equipped to contribute to important breakthroughs during their careers and their research at the CDT itself will also deliver valuable advances in medical imaging.
- **Better technology take-up.** The CDT's focus on affordability will translate into wider take-up of smart medical imaging technologies in the years and decades ahead.
- **UK growth and jobs.** For UK medical imaging companies, access to a pool of skilled experts and novel, affordable technology solutions are prerequisites to establishing a leading position in this fast-growing global market.

Next Steps:

King's and Imperial will focus on increasingly integrating their medical imaging expertise with clinical services. Working with local NHS Trusts will enable advances achieved through PhD projects to be rolled out at scale, maximising impact on healthcare outcomes.

Behind the Project:

Alistair Young, Professor of Cardiovascular Data Analytics and AI at King's, is Director of the CDT, having just taken over from Professor Julia Schnabel. Key colleagues include inorganic chemistry specialist Professor Nick Long (Deputy Director), imaging sciences specialist Professor Claudia Prieto (Associate Director for Research Training) and Dr Valeria De Marco (CDT Manager). "The coronavirus pandemic has accelerated a lot of pre-existing trends in healthcare," Alistair says. "The need for and scope to harness technologies such as AI is an excellent example. This new CDT is establishing the skills pipeline essential to making possible an exciting new chapter in medical imaging."

76:

the number of students currently on the CDT's programme

Relevant EPSRC Research Areas:

- Medical Imaging
- Artificial Intelligence Technologies
- Image and Vision Computing
- Imaging Chemistry
- Chemical Biology
- Photonics