

SCOPE

**SPECIAL
ISSUE:
CELEBRATING
WOMEN
IN MPCE**



UNHEARD VOICES

*What is being done to tackle
gender bias in medicine and
amplify the voices of women?*

BIG DEBATE

A discussion around
discrimination and
diversity in the sector

ULTRASOUND

Better tools, evidence
and equity for
pregnancy ultrasound

RADIOTHERAPY

Investigating upright
radiotherapy of
the breast

NEONATAL X-RAYS

Creating a 3D printed
baby phantom for full-
body neonatal X-rays

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Rebecca Wallis, Northern
Center for Cancer Care -
Newcastle

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Nicky Whilde, Southend
University Hospital



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Celebrating women in MPCE

Helen Chamberlain outlines the content in this special issue guest edited by IPEM President Anna Barnes.



impact of intersectionality and championing diverse experiences when considering equity in health.

Several articles this month also touch on the importance of investigating under-researched populations – from pushing for improvement in ultrasound in pregnancy, to better understanding the radiation risks to fetuses and babies, women are leading the way in advancing clinical practice for many populations.

In radiotherapy, we hear from Shelley Taylor, who offers a fascinating overview of her innovative work for the North West Radiotherapy Specialised Services Clinical Network. We then hear from

Isabel Ho, who makes a convincing

argument as to why radiotherapy safety should adopt a systems thinking approach,

while Tracy Underwood outlines her work in upright radiotherapy and challenges a long-held belief about how radiotherapy should be delivered. Finally, there is an excellent overview from Polly

Darby of the huge range of topics

discussed at ESTRO 2025, looking at some of the major developments taking place in radiotherapy practice.

We hope you enjoy this issue. **o**

Helen Chamberlain, Scope EAB Commissioning Editor.

With contributions by Clara Ferreira, Scope EAB Commissioning Editor.

This issue is focused firmly on the excellence shown by the diverse range of women in MPCE

W

elcome to the Autumn issue of *Scope*. And what a special issue it is – firmly focused on the excellence demonstrated

by the diverse range of women working in medical physics and clinical engineering. Alongside thanking all the wonderful contributors, we'd also particularly like to thank Anna Barnes, for championing this special issue and for being such a wonderful IPEM President. We wish her all the best in her future professional and personal endeavours.

Our cover story, "Unheard voices: gender bias in medicine" explores the risks to women accessing healthcare when gender differences are ignored, or deliberately dismissed, in clinical research and treatment – a pattern that has persisted for decades. The diverse range of experts featured in

the article gives reason for hope that future generations will experience better healthcare treatment and outcomes, but also highlights the need to challenge often deeply embedded ideas and practices.

Our big debate article brings in the perspectives of a range of professionals at different stages in their careers, offering valuable insights into the evolving landscape of our profession.

The member profile shines a spotlight on the career of Nana Odoms. We learn about her work leading a large clinical engineering department and some of the challenges she has faced as a Black woman in the field, illustrating the importance of recognising the

SEEKING EQUITY

Championing ideas and viewpoints

This issue highlights how innovation is accelerated when a diverse range of people are represented in the workforce – bringing varied viewpoints and championing different ideas. The difference between

achieving equity and equality is recognising that treating everyone the same is simply not sufficient to achieve the same outcomes; we need to offer personalised support to meet individual needs. This applies equally to both

people that require our services – there is much to be done to ensure different groups have equally good outcomes and experiences of healthcare – and also applies to how we support and uplift our colleagues. As you read



this issue, we hope you feel inspired to consider where you can make a difference.

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Institute of Physics and
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GO

THE BIG DEBATE

16/ OPPORTUNITIES AND OBSTACLES FOR WOMEN WORKING IN MPCE

In this issue's Big Debate we
hear six voices – three from the
early 1990s and two fresh
out of the starting blocks.
Our participants compare the
opportunities and obstacles
for women in the sector
between 1990 and 2025. Areas
covered include looking at
instances of discrimination,
practical advice for others and
what professional bodies can
do to improve the situation.



**Have I ever felt disadvantaged because I am a female?
I didn't until I reached more senior levels and then I noticed the
canonical experiences, such as being "mansplained" at.**

Anna Barnes
IPEM President **page 16**

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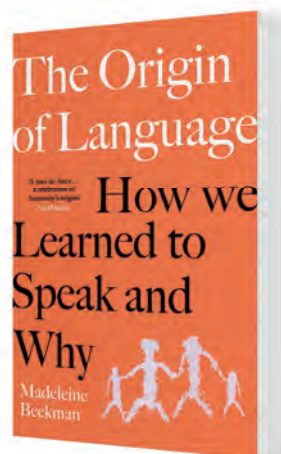
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When I was handed the presidential baton at IPEM, my first thought was “well, this is going to be exhausting”. Spoiler alert – it wasn’t. In fact, it turned out to be... dare I say... fun.

That’s partly because I never saw the role as “being in charge” in the presidential, striding-about-with-a-sceptre sense. Instead, I thought of myself as the temporary captain of a very steady ship, steering for a couple of years before handing over to the next navigator. My 30+ years in medical physics and engineering gave me enough nautical nous to keep things afloat – and I could sail confidently knowing that the engine room was crewed by absurdly competent staff, with the CEO as our indefatigable operations manager. The real joy came from working alongside them, hearing their war stories, and sharing a few of my own.

Over 30 years

Other presidents have said the same. But here’s the nagging question: if it was so enjoyable, why am I still the only woman to have captained



Scope Guest Editor **Anna Barnes** looks back over her tenure as the first female President of IPEM since 1990.

REFLECTIONS OF A RELUCTANT TRAILBLAZER

My time as IPEM President

MY 30+ YEARS IN MEDICAL PHYSICS AND ENGINEERING GAVE ME ENOUGH NAUTICAL NOUS TO KEEP THINGS AFLOAT

this ship in over 30 years?

Not so long ago, a visit to IPEM HQ in York would greet you with a wall of solemn portraits – the “line-up of past presidents” – an unbroken row of distinguished gentlemen. The exhibit has now been taken down (perhaps in the interests of diversity... or maybe just redecorating), but the point remains.

When I first joined IPEM in 1993, the place felt very different. My debut trustees’ meeting as membership registrar in 2001 began inauspiciously: I was asked to “leave the coffees outside the door” while the council got settled. Apparently, I looked more like “the help” than “the help running the membership”. And around that Arthurian-style round table of 30+ members, there was just one other woman.

STYLES OF FEMALE LEADERSHIP

Female leaders are often celebrated for their transformational leadership style. A focus on collaboration, mentorship and empowerment characterises this approach. Women in leadership roles tend to prioritise communication and emotional intelligence, fostering an inclusive environment that values each team member’s contributions. By leveraging empathy and interpersonal skills, female leaders can effectively navigate complex organizational social dynamics. The article “Exploring Female Leadership Styles: A Comparative Look at Gender in Leadership” looks at these issues.

🔗 b.link/krqbecs2

Fast forward to my final trustees’ meeting in York last month, and things are certainly better – the room now reflects something closer to our 35%/65% female-to-male membership split. But there’s still work to do before it becomes completely normal to see women chairing the Professional Standards Committee, STERIC, or, indeed, wearing the presidential medal.

Shine a light

One of my lingering regrets is not digging deeper into why more women haven’t stepped into these senior volunteer leadership roles.

Should we be bolder, perhaps even mandating a female president every third term? Some universities already require both male and female nominees for certain funding calls. Or maybe the answer is less stick, more carrot: targeted invitations, active allyship, strong mentorship networks and creating an environment where women simply expect to lead.

As a small step in that direction, I commandeered this edition of *Scope* to shine a light on women’s under-representation – not just in leadership, but in research itself. In these pages, you’ll find:

- **The Big Debate** – Five voices, three from the early 1990s and two fresh out of the starting blocks, comparing the opportunities (and obstacles) for women in our field between 1990 and 2025.
- **Research matters** – Why the lack of women participants in studies has real-world consequences for women’s health.
- **Spotlight features** – Showcasing women-led research and policy work driving innovation in

DR ANNA BARNES BIOGRAPHY

Dr Anna Barnes is an HCPC-registered Clinical Scientist, Director of the King’s Technology Evaluation Centre at King’s College London, Joint Head of Medical Physics and Clinical Engineering at Guy’s and St Thomas’ NHS Foundation Trust and the President of IPEM.

She has been involved with IPEM throughout her career. Dr Barnes was one of the first two IPEM trainees in Scotland in 1993, specialising in biomedical engineering and equipment management. She graduated with a PhD in 1999 from the University of Glasgow followed by two Fellowships at New York University and Columbia University, focusing on neuroimaging and statistical analysis.

Dr Barnes then pursued a research fellowship at the University of Cambridge Brain Mapping Unit before joining University College London Hospital nuclear medicine department as the Lead Clinical Scientist for the newly installed Siemens mMR Biograph PET MRI scanner. During this time, she was awarded two NIHR research fellowships to validate, evaluate and deploy imaging biomarkers in oncology and was appointed Chief Healthcare Scientist for the South-East for NHS England.

Her volunteer roles at IPEM have included Vice President External, Vice President Academic and President Elect, before becoming President.

women’s health technologies. My hope? That when some future *Scope* Editor digs out this piece, it won’t be as an archival curiosity about “the only woman to do it in decades”, but as one of many, many presidential reflections from women who took the helm.

And if that happens, I’ll consider my watch at the wheel a job well done. ○

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UPFRONT

UTERINE CANCER

Significant gaps in testing for genetic cancer risk

Patients with womb cancer are not being tested for a genetic condition that increases their chance of developing further cancers, a study has found.

Despite NHS guidance, less than half of those eligible received a blood test for Lynch syndrome – an inherited condition that leaves individuals more susceptible to womb and bowel cancer.

Diagnosis of Lynch syndrome is important as it enables patients to take action to reduce their cancer risk, improving outcomes and reducing NHS costs, experts say.

Lynch syndrome affects one in 300 people, but as little as 5% are aware that they have it.

The condition is caused by genetic variants similar to the BRCA genetic variants that increase breast cancer risk. Those with Lynch syndrome have a 50% chance of developing womb cancer in their lifetime, compared to a general population risk of 3%.

The National Institute for Health and Care Excellence (NICE) recommends that all patients diagnosed with womb or bowel cancer have tumours tested for markers of Lynch syndrome. If identified, they should be referred for genetic counselling to access support and advice and a simple blood test to confirm the diagnosis.

A University of Edinburgh-led

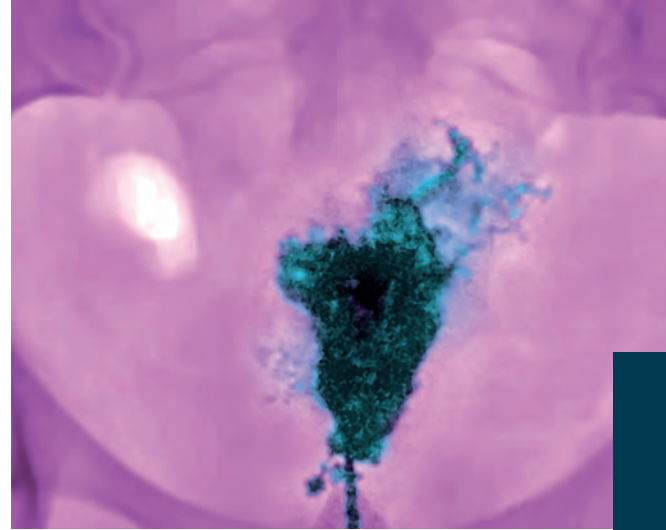
study looked at more than 2500 womb cancer cases across the UK and Ireland between 2022 and 2023.

While 91% of tumours were tested for markers of Lynch syndrome, test results were not routinely communicated to the wider clinical team, meaning follow-up genetic counselling and blood tests were not arranged.

Two-thirds of the patients eligible for genetic counselling were referred for appointments. Those who were referred faced long waiting lists, resulting in high drop-out rates. Only 48% of womb cancer patients who should have had further testing ultimately received a blood test.

Gaps in testing mean that many womb cancer patients with Lynch syndrome go undetected, leaving them at risk of developing bowel cancer. Family members are also left vulnerable to cancer risk, unaware they may have the condition.

Dr Neil Ryan, Clinical Lecturer at the



University of Edinburgh's Centre for Reproductive Health, said: "Despite clear guidance and excellent rates of tumour testing, too many women with Lynch syndrome are still being missed because they're not referred for definitive blood testing in a timely way.

"This not only denies them the chance to reduce their future cancer risk but also prevents their relatives from being tested and protected."

Early detection would allow the use of preventative measures to reduce the risk of future cancers, such as taking aspirin and having regular colonoscopies to prevent bowel cancer, or hysterectomies to prevent womb cancer, according to experts.

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FAST FACTS**2500**

The study looked at more than 2500 womb cancer cases across the UK and Ireland

**91%**

In 91% of cases, tumours were tested for markers of Lynch syndrome

**48%**

However, less than half of womb cancer patients ultimately received a blood test

10 YEAR PLAN

“MPCE workforce needs to be central”

IPEM has welcomed the publication of the Government’s 10 Year Plan for the NHS and emphasised how vital medical physicists and clinical engineers are to its successful delivery.

However, it also warned that sustained investment – and reform – in workforce, capital equipment and infrastructure would be needed, alongside a clear and ambitious action plan in order to achieve successful implementation.

IPEM Chief Executive, Gill Collinson, said: “IPEM submitted evidence as part of the development of the 10 Year Plan and we are delighted to see that the importance of new and emerging technologies has been

strongly recognised. The 10 Year Plan will fundamentally alter the NHS, but it cannot succeed unless medical physicists, clinical engineers and other health scientists are at the heart of its implementation.

“IPEM, through our members’ expertise and leadership, is uniquely positioned to support and shape the successful delivery of this 10-year plan to ensure that it realises its ambitions. The detailed action plan for these reforms will be critical to its success or failure.

With our strong networks, IPEM can bring partners together to work with the government and the wider NHS to deliver for patients.”

🔗 b.link/3lmbml4l



SPENDING REVIEW

IPEM WELCOMES CHANCELLOR'S ANNOUNCEMENT

Following the Chancellor’s announcement of increased investment in the NHS, IPEM Chief Executive Gill Collinson said: “In our submission ahead of the Spending Review, IPEM asked the government to invest in the medical physics and clinical engineering workforce, in more modern equipment like scanners and in AI and new technology.

“I am pleased therefore, that the Chancellor specifically included £10 billion for the NHS Technology Fund and £2 billion to be spent on an AI Action Plan in her statement. IPEM and its members look forward to contributing to how that investment will be spent.

“We also welcome the significant increase in the NHS budget. We previously supported the government’s investment in replacing old scanners, but this will merely eliminate the backlog and sustainable funding needs to be put in place to ensure that the NHS is not reliant on scanners that are operating past the recommended end of their life.”

NEWS IN BRIEF

Premature menopause

Premature menopause, medically known as premature or primary ovarian insufficiency (POI), has been linked to an elevated lifetime risk for depression and anxiety. A recent meta-analysis revealed an odds ratio of 3.3 for depression and 4.9 for anxiety in women with POI compared with those without the condition. Researchers gathered data from nearly 350 women with POI to try to identify the specific variables that contribute to the likelihood of depressive symptoms. Nearly one-third (29.9%) of the women with POI suffered from depressive symptoms

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Predicting lung motion

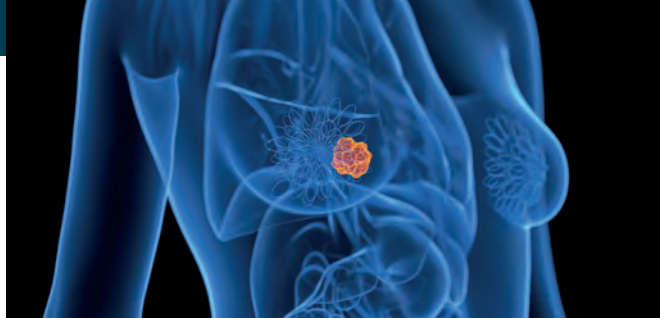
A research team led by Professor LI Hai from the Chinese Academy of Sciences, has developed a model that can accurately predict lung motion caused by breathing, offering safer and more precise options for lung biopsies and radiotherapy. The team introduced a novel model that blends general breathing patterns from large datasets with personalised patient information. The model only needs two standard CT scans. In validation tests, PCWS achieved a mean prediction error of 0.20 mm, demonstrating high accuracy.

🔗 b.link/t3avluiu

Preventive mastectomies

More women at higher risk of breast cancer should be offered a risk-reducing mastectomy (RRM), according to researchers at Queen Mary and London School of Hygiene and Tropical Medicine. An analysis has found that it reduced the likelihood of developing breast cancer compared with breast screening and medication. Offering RRM to this cohort could prevent 6500 cases of breast cancer per year in the UK.

🔗 b.link/2kup766u



BIOLOGICAL PREDISPOSED

African ancestry and aggressive breast cancers

While the incidence of breast cancer is highest for white women, Black women are more likely to have early-onset or more aggressive breast cancer, such as triple-negative breast cancer.

Among women under 50, the disparity is even greater: young Black women have double the mortality rate of young white women.

Now research from the University of Notre Dame is shedding light on biological factors that may play a role in this disparity.

A new study found that a population of cells in breast tissues, dubbed PZP cells, send cues that prompt behavioural changes that could promote breast cancer growth.

The researchers focused on PZP cells as previous studies have shown that they are significantly higher in healthy breast tissues of women of African ancestry than in healthy breast tissues of women of European ancestry.

While PZP cell levels are known to be elevated in

breast cancer patients, their higher numbers in healthy, African ancestry tissues could hold clues as to why early-onset or aggressive breast cancers are more likely to occur in Black women.

Crislyn D'Souza-Schorey, study lead said: "While socioeconomic factors and delayed diagnosis may be contributing, substantial emerging evidence suggests that biological and genetic differences between racial groups can also play a role."

🔗 b.link/ifsqgo8o



CAREERS GUIDE

FINDING THE NEXT WORKFORCE GENERATION

The launch of IPeM's new careers guide provides an exciting resource for anyone considering a role in medical physics and clinical engineering.

Produced for IPeM by IoP Publications, this free, online publication provides information on the careers available, entry and training requirements and case studies across a wide range of professions.

To support this, IPeM has also brought out a series of careers videos, with frontline IPeM member professionals explaining their roles in an easily accessible way.

Both the careers guide and videos can be found on IPeM's website and are available for anyone free of charge.

IPeM would like to thank all of the volunteers and IPeM staff who contributed to the guide and video for their valuable contributions and commitment to promoting the profession.

🔗 b.link/5t3vqpy0

MRC PARTNERSHIP GRANT

EXPAND INNOVATIVE HYPERPOLARISED MAGNETIC RESONANCE IMAGING

Researchers have been awarded a Medical Research Council grant to form a UK and European partnership focused on helping advance the field of hyperpolarised magnetic resonance imaging (HMRI).

HMRI is an emerging clinical medical imaging technology that has the potential to revolutionise our ability to detect and monitor treatment, much earlier than is currently possible, across several conditions that affect the body, such as cancers and diabetes.

The research team is drawn from the Universities of Oxford, Cambridge, and Nottingham, as well as IPeM and the Institute of Physics.

The partnership has two aims. The first is to work to develop an endorsed course in hyperpolarised magnetic resonance

imaging, providing a baseline of knowledge and skills for industry and academic based staff and students in the field.

The second aim is to begin a multi-centre study to assess the repeatability and reproducibility of the technology when used to probe metabolism in the healthy human brain.

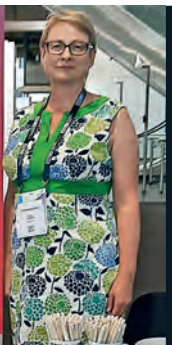
Dr Jemimah Eve, IPeM Director of Policy and Impact, said: "We are delighted to be part of this cutting-edge partnership. HMRI has the potential to offer significant benefits for patients, but it essential to train the skilled professionals of the future in its use."



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IPEM AT ESTRO

TRANSFORMATIVE INNOVATION THROUGH PARTNERSHIP

IPEM was in attendance at the ESTRO Conference in Vienna, Austria, earlier this year.

The conference and exhibition were brought together by experts from around the world to discuss the congress theme “transformative innovation through partnership”.

Those in attendance also explored the latest clinical research, joined forces to enhance multidisciplinary cancer care and networked and reconnected with peers.

The five-day event in May saw around 6000 delegates descend on the city, over 100 exhibitors attended, 20 organisations had stands in the Communities Pavilion and five start-up companies showcased their innovations.

Among the IPEM community in attendance was President Anna Barnes who presented results from a multi-centre, multi-vendor real-world evaluation of AI auto-contouring tools.

NATIONAL CANCER PLAN

IPEM call for increased investment

IPEM has submitted evidence to the National Cancer Plan, calling for increased investment in staff, more localised services and the better use of big data to improve screening programmes and tackle inequalities.

IPEM said: “It is essential that we address the workforce challenges among diagnostic staff, especially among medical physics and clinical engineering, in order to expand capacity. These professionals are essential, for example, in maintaining, calibrating, checking and operating complex imaging equipment to diagnose cancer. AI is now enabling the NHS to provide more targeted screening for certain cancers. Genomics, developed by healthcare scientists, has

been key to this. This technology however, requires a sufficient number of medical physicists and clinical engineers to develop, evaluate and implement new technology safely, effectively and efficiently.”

It also called for more localised services, making it easier for people to access the diagnostics and treatment. For example, IPEM supports the aspiration for everyone to be within 45 minutes of a radiotherapy centre, saying that the government should “address the huge variation in radiotherapy access across the UK by supporting the safe and robust establishment of new Linac provision in areas currently distant from radiotherapy services”.

b.link/quuvil5a



DIARY DATES

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RWA and RPA Updates 2025

9-10 Sept: Newcastle

The annual Radiation Waste Advisor (RWA) Update will focus on ensuring up-to-date regulatory compliance and best practice. The Radiation Protection Advisor (RPA) Update is IPEM’s principal meeting for those working in radiation protection in healthcare.

b.link/j69q88hq

Clinical Risk Foundation Course

25 Sept: Online

This introductory course covers clinical risk around health IT systems with DCB0129

and DCB0160.

b.link/ot3xfe4o

MR Safety Update

15 Oct: Manchester

The meeting will cover topics including changes in legislation, advances in technology and developments in research. It will also provide a forum to share best practice.

b.link/3lzcxdyv

AI in Imaging and Treatment Planning

17 Nov: Online

A training day that will provide an overview of AI approaches and applications. It will include an AI primer, a session on AI

in radiotherapy from theory to practice, a panel discussion and Q&A.

b.link/op93thek

How to Get Professional Registrations: EngTech, IEng, CEng

26 Nov: Online

An overview of professional registration. You will hear from those with experience of the process and have an opportunity to look at the requirements in detail.

b.link/mn2vxmrl

How to Write a Business Case

2 Dec: Online

The business case training is tailored for small value

schemes and will offer a step-by-step approach to developing a business case and key tips and recommendations for content and layout.

It will give an insight into how to craft a compelling case.

b.link/mlwgoudi

Science Technology and Engineering Forum

12-13 Oct 2026:

Manchester
IPEM’s Science, Technology and Engineering Forum (STEF) is the must-attend event for MPCE. Keep an eye on the IPEM newsletter and social media channels for more information.

b.link/fdzdn6f

IMAGE: ALAMY, SHUTTERSTOCK

MOLECULAR IMAGING

SEX DIFFERENCES AFFECT EFFICACY OF OPIOID OVERDOSE TREATMENT

Naloxone, a drug to treat narcotic overdoses, has greater binding to opioid receptors in women's brains than in men's brains, according to new research.

The first-in-human whole-body PET study suggests men and women may respond differently to opioid use disorder treatments and offers new insights to advance neuropharmacology.

The μ -opioid receptor (MOR) is the target of opioid drugs including fentanyl and heroin, as well as well as naloxone, an opioid antagonist used to treat opioid use disorder. MORs are widely expressed in the central nervous system, peripheral



organs, and immune system, making them especially useful for assessing functional changes in people with opioid use disorder.

In the study, six female and seven male healthy subjects underwent two IIC-carfentanil whole-body PET imaging sessions – one at baseline and one immediately after pretreatment with the MOR antagonist naloxone.

IIC-carfentanil brain distribution volume ratios were determined using the occipital cortex and the visual cortex within it as reference regions. Peripheral organ distribution volume ratios were also measured using the descending aorta and biceps/triceps as reference regions.

On the whole, naloxone reduced MOR availability by 40–50% in brain regions known to express high levels of MORs; a greater reduction was seen in women compared to men. For peripheral MOR distribution, the descending aorta reference region showed less variance than the extremity muscle, but both showed blocking effects of naloxone.

Jacob Dubroff, Associate Professor of Radiology at the University of Pennsylvania, said: "This research is significant because it suggests that there may be sex-based differences in how men and women respond to opioid overdose treatments."

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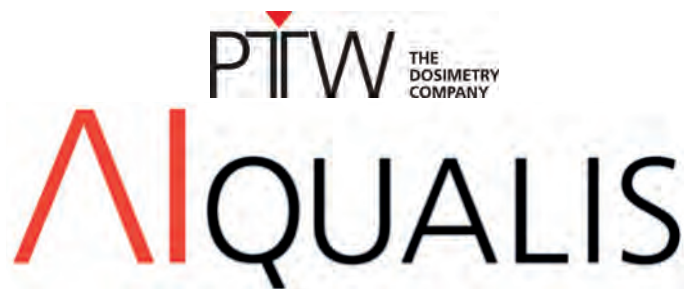
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Supporting adherence
to the RCR Guidance



The software to monitor your AI contouring
quality in clinical practice

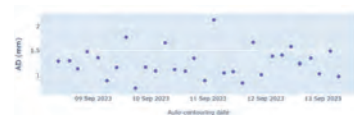
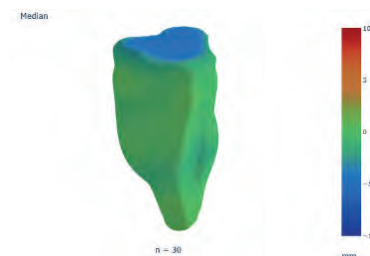
The RCR Guidance on auto-contouring in radiotherapy states “post-implementation monitoring of auto-contouring technology after clinical implementation must be undertaken.”

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Member profile:

Nana Odoms

I'm the Head of Clinical Engineering at the Cleveland Clinic in London. I oversee strategic and operational management of medical devices and health information systems. My role involves setting departmental vision and goals, business planning, budgeting and capital planning.



Tell us about a typical workday?

My day typically starts with reviewing overnight reports and incident logs, addressing and authorising urgent repair requests and attending team and leadership huddles. I analyse equipment performance reports to inform future planning. On any day, I could be meeting with the clinical leadership to assess upcoming service changes, or new initiatives requiring technological support, or evaluating proposals for equipment acquisitions or upgrades.

Which elements of your job do you like the most?

I find immense value in visiting clinical

areas (Gemba) to observe processes, speak with frontline caregivers and patients and find improvement opportunities. These visits offer practical insights, find hidden patient safety risks, best practises and support a culture of continuous improvement.

What are the biggest challenges you see – either for yourself or the sector?

As a first-generation migrant in the UK, a Black woman in healthcare engineering, a mother and a community leader, I have experienced disproportionate burdens, gender bias and systemic discrimination. As an engineer, I have faced biases that questioned my capabilities and

challenged my authority. Women's contributions are frequently undervalued, and such systemic discrimination stifles innovation by excluding diverse voices. These are deeply ingrained issues that require collective action to address and I am looking to add my voice.

What skillsets do you think are required to be successful in your role?

As a leader in this field, curiosity is fundamental to my success. It drives innovation and continuous improvement, especially when combined with collaboration, persistence and positive disruption. Curiosity leads me to explore innovative ideas, challenge assumptions and seek solutions in our rapidly evolving field. It motivates me to stay updated on emerging trends in digital health by researching articles, attending conferences and engaging with industry experts.

What accomplishment have you been most proud of in your career?

I led the activation of a 184-bed hospital and two outpatient projects by overseeing medical device and systems integration.

What do you do in your free time?

As a mother of three, I spend quality time with my children through cultural outings and travel. I also chair a Ghanaian community network and regularly speak in schools and colleges, offering career advice and serving as a visible role model.

Why did you join IPEM?

I joined IPEM because I saw the professional network as gateway to opportunities, knowledge and relationships that are often inaccessible through traditional channels.

Through joining IPEM I have been able to access experienced professionals who provided mentorship that helped me navigate challenges and accelerate my development. Being part of IPEM and the Head of Departments Network allows me access to industry-specific and relevant learning and networking opportunities. Having received help from relationships through the IPEM network in the past, I hope to join the mentor community and give back. ○

PART ONE: ANSWERS FROM SENIOR NHS LEADERS

Q *Have you ever faced adversity or have witnessed adversity being a female in STEM?*

ANNA

Have I ever felt disadvantaged because I am a female? I didn't until I reached more senior levels (director and head of department level) and then I noticed the canonical experiences such as being "mansplained" at, spoken over and not listened to, but then a man would repeat my ideas and they would be accepted.

FIA

My experience in UK has been very positive overall as I was lucky to work with very supportive managers and teams. Yet there were funny episodes with new collaborators addressing some of the men in my team, rather than me, as they assumed they were in charge.

The years I found trickier were the first ones as a mother. My husband and I had no family around to support us, I was developing as a leader and he had a critical role himself as an MRI safety lead. So I had to "climb the ladder" in slightly different ways than some of my male peers at the time. I travelled less, I worked reduced hours on site to start with... that meant not being in post-work socials or networking opportunities as much. I had to be strategic and very selective about meetings, conferences and training courses. My

husband and I had to have synchronised work diaries to not be away or have key meetings at the same time.

The beginning of my life in STEM, growing up in Southern Italy five decades ago, was a different, more intense story... I was sort of treated as "the odd one" by peers, wider family and society... I was mocked as a weirdo or sort of feared as a genius... I was fortunate though to have supportive parents and teachers. My mum was a leader herself, but one from a previous generation, who by the time she was my age had been resigned to let less experienced male colleagues have the leading position, whilst she did all the work behind the scenes. My early life story is probably one of the reasons moving to UK was so attractive. Initial language barriers aside, I felt more understood at work than I ever had in Italy.

HEATHER

I have always felt that a career in physics as a woman was considered a counter-cultural choice. That said, I didn't feel that out of place at university and even less so as a trainee medical physicist, not least as the NHS has a workforce that is predominantly female and there is good gender balance at STP level – pretty remarkable when you consider about 25% of physics graduates are women. I did become more aware of the barriers to progression when my children were young and I worked part-time, my ability to do that was very much at my manager's discretion and my competence and commitment to my work was sometimes openly questioned by others.

IMAGES: ISTOCK

THE BIG DEBATE

Gender: opportunities and obstacles

Three senior women in the sector and a radiographer and researcher earlier on in their careers pose each other questions about how gender has affected their working life and the contemporary issues faced by women in medical physics and clinical engineering.



MEET THE PANEL



DR ANNA BARNES

Director of the King's Technology Evaluation Centre at King's College London, Joint Head of Medical Physics and Clinical Engineering at Guy's and St Thomas' NHS Foundation Trust, President of IPeM



DR FIA FEDELE

Consultant Clinical Scientist, Head of Clinical Physics, Barts Health NHS Trust, Director of IPeM Science, Technology and Engineering Research and Innovation Council (STERIC), Honorary Senior Lecturer, King's College London



DR HEATHER WILLIAMS

Consultant Medical Physicist, Clinical Director, Medical Physics and Engineering, Interim Nuclear Medicine Group Leader, The Christie



KATY AKTEMEL

Specialist Radiographer, Nuclear Medicine & PET/CT, Gartnavel General Hospital/ WoS PET Centre



MAISIE KEOGH

Doctoral Researcher, University of Strathclyde, Department of Biomedical Engineering, Churchill Fellow 2024

As I've taken up more senior roles I've found it interesting how the dynamics in some rooms change depending on the diversity of the attendees and, sadly, there are still some poor behaviours that are tolerated amongst white men who are considered assertive/charismatic/strong/valuable leaders, which I doubt would be so readily accepted if a woman or person of colour behaved in the same way. I certainly think very hard about how I present myself professionally that creates work which you don't have to worry about if you are assumed to be the authority figure.

Q

What advice would you give to women who may face adversity in STEM?

ANNA

Go on as many leadership courses as you can. Define your own success based on what you learn about yourself during these courses. Don't be scared to ask questions when you don't understand the arguments or points being made. The chances are they aren't explaining it very well.

FIA

I found leadership and unconscious bias courses very useful, as they help you understand why often others do not intentionally mean to be a blocker or upset you. Most importantly I found the support of peer networks helpful. I consider my bank of close female colleagues across UK one of my most precious life gifts. I would also suggest finding mentors. In my case, a couple of them have been women, but most men actually, and it has helped me put more matters into perspective.

HEATHER

There is so much career advice and guidance available that it can be quite overwhelming. I've listened to some helpful talks and completed some really useful courses, but I've also come across some absolute dross pitched at women, that just repackages gender stereotypes and fails to address systemic bias and real-world barriers to career progression. It is really important to critique any career advice, regardless of where it is coming from, and not allow someone else's perception of excellence to push you out of shape.

Be true to yourself. Work hard on building a professional reputation founded on deep subject knowledge and personal integrity – if you know your stuff and can be relied on to make the right call when the chips are down, that makes you a valuable asset. I'm very grateful to those who saw my abilities and potential and encouraged me to push harder and go further; and yes, the vast majority of those people were men.

Q *What specific changes could professional bodies or journals make to help women progress into leadership positions and how can we measure the impact of those efforts?*

ANNA

I very much believe in role modelling and making the effort to make sure that the message gets out that it's not OK to have a presentation programme that is all men or only has one or two women included. Our membership is 35/65 so there's no excuse not to make sure the programme is representative of membership. When you see it call it out. IPEM have become a lot better at doing this now thanks to the work of Eva McLean, our EDI Manager, and allyship from previous presidents.

FIA

We have to keep talking openly about this and other EDI matters. Not to be dramatising them, but not to hide different experiences, challenges and needs. For me, it is key to try and support each other at work during difficult life transitions, such as new unions, childbirths/adoptions, separations, deaths or even a house move. We have to normalise that a person has a life outside of their professional one and embrace and support all of them.

HEATHER

I think hearing a diversity of voices and perspectives is so important, and ensuring the representation of women within IPEM is reflected in who gets to speak, present and chair is a key part of that.

I've had a lot of conversations with the IPEM team about the composition of the workforce in different roles and at different stages in career progression. It's clear IPEM needs better data to characterise any trends and help identify ways of better supporting all members of the workforce, and undermining systems and processes that disadvantage some more than others. IPEM members can really help with this endeavour by providing detailed demographic information.

Q *How do we ensure diversity and inclusion efforts go beyond tokenism and translate into lasting cultural and structural change across our organisations?*

ANNA

I think that is already happening. Men are much more likely to ask for paternity leave now, or flexible working, in order to share with the parenting responsibilities. However, I think there does need to be more positive action in encouraging women to take up leadership roles – mentoring and leadership programmes aimed at women and sponsored by the work place.

FIA

By talking about it and demystifying it; and practical support and changes, not just words. With leadership roles, we need to focus on people's skills and their abilities rather than their working patterns. It is not a case that more women have approached leadership roles since flexible working. For example, I only recently went back to full-time work since having my son 16 years ago, and I hear in some workplaces that leadership positions can only be taken by full-time staff. When recruiting my own collaborators I never worried about their sex, or them having to work full-time, only on their potential and wish to grow and work together. We also need to make it possible for everyone to develop without losing their own individuality and heritage – embrace richness in diversity. If we were all the same and thought the same, how could we serve diverse communities?

HEATHER

While we have seen a lot of progress, I think we're in quite a dangerous cultural moment in that sexism and gender bias, and "women in science" in particular, is considered a solved problem. I have friends who have been working on women in STEM initiatives for decades and now cannot access funding for support networks, speaking programmes or outreach programmes in schools. Yet, we still have under-representation of women in physics and engineering in general, and

even in medical physics and engineering, we still see women massively under-represented at a senior level. This is down to a wide variety of factors outside and inside of the workplace. For example, inside the NHS, there is still bias and sexism (even though it is now often subtle, even seeming benevolent), and the workforce still reports shocking levels of sexual harassment which require hospitals to have sexual safety charters and active bystander training. We all need to remain vigilant, keep challenging our own preconceptions and prejudices, and keep pushing for change. Misogyny remains depressingly prevalent in wider UK culture and we all need to be explicit about what we do and do not accept in our own teams.

Q *Where do you see the biggest opportunities for women to lead innovation over the next decade, and how can we equip the next generation to seize them?*

ANNA

Everywhere and anywhere... Much later in my career I've discovered that I really enjoy studying how we as humans adapt and adopt our ways of working with new technology. Successfully introducing new technology into the complex healthcare provider workplace requires a systems approach to implementation. Often left to non-scientists to carry out it can be a paradigm shift when an engineer or a scientist takes a lead in these projects.

FIA

The NHS 10 Year Plan is all about moving closer to communities, technologies and more integration. Women often tend to have more of an "outward" view to the world and other professions, so I feel we can be the catalyst elements in co-development and in adoption of technology. We owe it to the next generation to be out there and keep paving the way for them. The little girls in primary and secondary schools need to see us, know that we are growing in numbers and that they can have success in STEM careers. I am a big advocate – to the point I'd say of being a little obsessed – about reach out activities. One of the highlights of my time as a STEM parent was to bring a spectroradiometer to kids in year 3, and see their excitement. Guess who came out with most of the questions? The girls and kids from the more disadvantage backgrounds.

HEATHER

I have a hoodie at home I bought during the backlash against Jodie Whittaker playing Dr Who (because heaven forbid that a shape-shifting alien timelord

should take female form!) that says "A woman's place is anywhere in time and space". Women should be where they want to be, including as people of substance at the leading edge of absolutely everything. Personally, I'm still as fascinated by positron emission tomography now as I was when I did my PhD in the subject 25 years ago, and am wildly excited about establishing the new total body PET-CT facility at The Christie in Manchester. In terms of equipping the next generation, I think tailoring professional development to the individual and actively supporting opportunities for all is so important.

Q *In your experience, what's the most effective way to build networks of sponsorship for women, and how can we embed that formally within organisations?*

ANNA

I refer you to my previous answer about attending leadership courses. Oh and a, as William Butler Yeats once said, "there are no strangers, only friends you haven't met yet" approach to networking. Remain curious about other people, stop worrying about what the world thinks of you, and the rest will just follow.

FIA

Be open, be out there and not worried to approach other professionals for advice and support. Also, I'd say to learn to keep the imposter syndrome, which still tends to be more vocal in women than men, in check. It will never go away, but one can learn to manage it.

HEATHER

I still do not find networking easy. I'll turn up to a meeting or conference and see everyone already hanging around with people they know, and there's a big part of me that just wants to sit in a corner with a cup of tea, learn the things, and go home. Fortunately, I've been working in medical physics in the UK for long enough that I usually know someone else in any given room, so I'll normally talk to them and be introduced to others through them. If you see me on my own at a conference, please do come and say "hello" and put me out of my misery – I endeavour to be both interested and interesting.

Once I've connected with someone, I'm pretty good at remembering them and reconnecting in the future if a project or opportunity that may be of mutual interest comes up; I like staying in touch and joining the dots. I guess that can end up being sponsorship, born of creativity, stubbornness and a reasonably good memory.

PART TWO: ANSWERS FROM EARLY CAREER PARTICIPANTS

Q

Why and how did you choose a career in healthcare science?

KATY

The field that I currently work in is nuclear medicine, which has a significant impact on patient care as it enables earlier and more accurate diagnoses, guiding treatment decisions, and ultimately improving outcomes and quality of life. During my undergraduate studies as a radiographer, I learned about the field of nuclear medicine. I knew this was the specialism I wanted to pursue, as out of all the radiology specialisms, this one most heavily involves science. Furthermore, as a Radiographer, I am very much in a people-facing role. Only three months after I graduated, I specialised in nuclear medicine and have enjoyed working in the field every day since.

MAISIE

I've always been fascinated by the intersection of engineering and human health - how technology can restore independence, dignity and quality of life. My background in chemistry and biofluid mechanics evolved into rehabilitation engineering when I realised I could combine analytical problem-solving with meaningful, people-focused impact. Working in stroke rehabilitation, I've seen first-hand how even incremental advances in technology can transform recovery. That sense of purpose is what drew me in, and it's what keeps me here.

Q

Is there any up and coming technology that you think will make it easier or improve the way you do your job?

KATY

Within my field of work, nuclear medicine, there are many technological developments and advancements. From a scanning point of view, the introduction of total-body PET/CT and the development of cadmium zinc telluride (CZT) SPECT cameras have brought significant benefits, not just for patients, but also for operators like me. Both of these scanners have improved image quality,

meaning we spend less time on image correction or repeating scans. This has increased our confidence in the results and reduced our workload.

In addition to improved image quality, these newer scanners allow more patients to be scanned per shift, as image acquisition is quicker and the operation of the cameras is easier. This has improved patient throughput without adding extra stress to radiographers and clinical technologists.

In Scotland, where I work, these types of scanners are still rare in clinical use. In the future, I look forward to working with them, as colleagues across the country have praised the way these cameras enhance both patient care and the operating experience.

MAISIE

Advances in wearable motion capture and AI-driven data analysis are especially exciting. Low-cost, portable systems - some using markerless tracking - are making it possible to monitor patient progress in real-world environments, rather than just in a lab. Combined with machine learning, we can detect subtle changes in movement patterns earlier, allowing for more personalised interventions. This technology has the potential to make stroke rehabilitation more accessible, scalable and equitable.

Q

What barriers or challenges do you see to being successful in your career because of your gender?

KATY

From my experience working within radiology, and from what I have observed across the UK, women in radiography are well-represented at entry-level positions. However, they are often underrepresented in more senior roles, such as management, research, and academic leadership. In recent years, with growing awareness around feminism and the barriers and challenges faced by women in STEM, there has been a noticeable increase in opportunities. I've started to see far more women in leadership positions, especially here in my own city, Glasgow.

Compared to the experiences shared by women who have been in STEM for many years, I feel that for those of us in the early stages of our careers,



the barriers to progression seem less restrictive, which is a positive shift. That said, there is still progress to be made across the country, as these challenges have not been completely removed.

MAISIE

The barriers are often less about overt discrimination and more about the cumulative effect of being underestimated, overlooked, or held to a higher standard. In male-dominated spaces, women can find themselves in a constant cycle of having to prove credibility – particularly in leadership or technical decision-making. There's also the challenge of navigating networks and opportunities that are still, in many cases, informally closed. These dynamics can slow career progression unless actively addressed.

Q *How do we ensure diversity and inclusion efforts go beyond tokenism and translate into lasting cultural and structural change across our organisations?*

KATY

We need to shift our focus from representation alone to embedded, systemic change. In my opinion, making this change real and lasting means that professional bodies and organisations must address the root causes. Too often, we focus on the number of women hired or promoted, but we should be looking deeper. There needs to be a focus on analysing the pay gaps that still exist within STEM, the rate at which women are promoted, and whether there are mentorship and sponsorship opportunities to help women advance into senior roles.

In addition, it is essential to listen to those directly impacted, which can be done through anonymous surveys, focus groups run by professional bodies, and even exit interviews that can uncover challenges or barriers women face that lead them to leave their roles. These might include feeling isolated in male-dominated teams, feeling “invisible,” or experiencing microaggressions. Recognising these challenges and barriers that women face in STEM is the first step, but the real progress comes from actively dismantling them by creating workplaces where women can not only enter the field but thrive, lead, and shape its future.

MAISIE

It starts with accountability and measurable outcomes. Diversity can't just be a line in a strategy document – it needs to be tied to recruitment, promotion and retention metrics, with leaders held responsible for progress. We also need to embed

inclusive practices in everyday workflows – who gets invited to key meetings, whose ideas are heard, and who gets credit for their contributions. Lasting change happens when inclusion stops being a project and starts being the culture.

Q *What specific changes could professional bodies or journals make to help women progress into leadership positions and how can we measure the impact of those efforts?*

KATY

There are many changes that professional bodies or journals can do to actively support women in STEM. Firstly, they can ensure gender-balanced visibility and authority within editorial boards and committees. Likewise, when organising keynote speakers or panels, these should be diverse and gender-balanced. Tracking trends in authorship of published work and actively encouraging and seeking contributions from underrepresented women is also important.

Professional bodies and journals can use their platforms to shape the conversation around the barriers and challenges women face in STEM, for example, by publishing policy and opinion pieces, such as this article. They can also celebrate the achievements of women in STEM without stereotyping, focusing instead on their expertise and the impact of their work. Finally, they should embrace intersectional storytelling, providing a platform for women of colour, women with disabilities, LGBTQ+ and others who face additional barriers in STEM, ensuring their voices are heard and their contributions recognised as vital to driving meaningful change.

MAISIE

Professional bodies and journals have enormous influence in shaping the narrative of who belongs in STEM. They can:

- proactively commission and publish work by women in leadership, not only on diversity topics but on core technical advances.
- offer structured mentorship and sponsorship programmes that connect early- and mid-career women with senior leaders.
- ensure conference and editorial boards have balanced representation – and be transparent about those numbers.
- highlight data on gender progression year-on-year to track whether interventions are working.

The real measure of success isn't just how many women enter the field – it's how many thrive, lead and shape the future of it. ●

UNHEARD VOICES

Gender bias in medicine

Decades of treating white males as the norm in clinical research have entrenched health inequalities for women. AI could help or hinder this. What is being done to amplify the voice of women and make their health a priority?

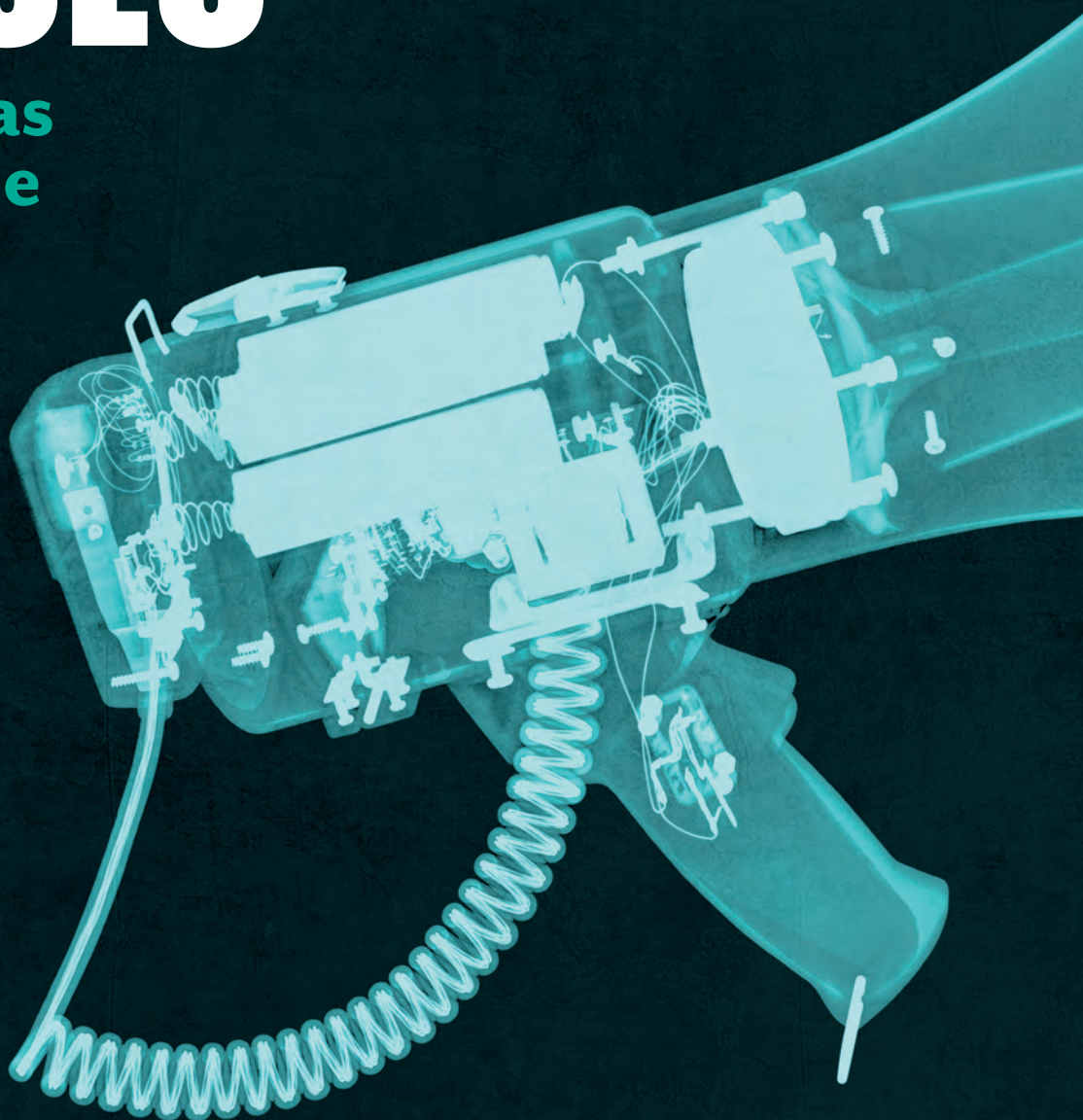




IMAGE: GETTY IMAGE

WOMEN ARE MORE OFTEN MISDIAGNOSED, DISMISSED, GASLIGHTED OR UNDER-TREATED

Prior to the thalidomide tragedy in the 1960s, women had been excluded from medical research for several reasons. Research data was collected from white men because they were considered representative of humans, and was then generalised to females. Researchers were typically male and demonstrated bias. There were concerns about hormonal fluctuations and the impacts of research on fertility or pregnancy.

Following the 1960s' realisation that thalidomide resulted in severe birth defects for thousands of children, the US Food and Drug Administration recommended excluding women of childbearing potential from phase I and early phase II drug trials.

By the mid 1980s, the US National Institutes of Health (NIH) had begun recommending long-term research into how biology affects women's health and including women in research, and in 1989 stated that researchers should include a rationale in proposals for not including women. In 1993, US Congress passed the NIH Revitalization Act, which mandated the inclusion of women and minorities in NIH-funded clinical research.

A damaging legacy

"But by then the medical system was already calibrated to male physiology," says Maryam Akhtarini, Clinical Physicist and Founder of Interwoven Clinical Science. "The consequences have been profound. Women are nearly twice as likely to suffer adverse drug reactions. They are more often misdiagnosed, dismissed, gaslighted or under-treated across many areas of medicine. From heart

disease and autoimmune conditions to pain management, neurodiversity, mental health and gynaecology, to experiencing later diagnoses."

This legacy persists in radiotherapy because physicists still rely on pooled, male-dominated oncology trial data, tumour control probability (TCP) and normal tissue complication probability (NTCP) models. These are dose-response curves used to estimate tumour control and normal tissue side effects from radiation dose. Sex-averaged organ tissue weighting factors used in effective dose models are designed for population-level radiation protection, not personalised treatment.

Even when sex is recorded, it's rarely analysed as a biological variable, Maryam explains. "Organ tissue weighting factors used in effective dose calculation are still population-based and sex-averaged. And radiogenomic tools inherit the same bias, because they have been trained on pooled, sex-agnostic datasets.

"All of which ignore sex as a biological variable, meaning data remains male-centric or sex-neutral, and misses the vital insights that come from sex-disaggregated data analysis," Maryam says. "[This leads] to maintaining the one-size fits all, status-quo."

The result is that women and girls – who are generally more radiosensitive and may achieve better tumour control – experience greater long-term toxicity and higher risks of secondary cancers. "In addition, factors such as hormonal status that affect DNA repair dynamics, metabolism and immune modulation, are rarely considered. These glaring realities and critical biological differences are not reflected in treatment planning systems or prediction models," Maryam says.

It's not just sex that is poorly represented in data sets, but also race and ethnicity. "Many diagnostic tools and clinical algorithms perform less accurately for minoritised groups because they were trained on homogeneous populations," Maryam says. "For example, in pulmonary function tests, pulse oximeters systematically overestimate oxygen levels in patients with darker skin, leading to missed hypoxia.

"These blind spots compound

biological misrepresentation and structural healthcare bias,” she adds.

Discrimination

Even for treatments primarily aimed at women, this one-size-fits-all approach has big implications. “Breast cancer screening for women is obsolete,” says Virginia Marin Anaya, Clinical Physicist at University College London Hospital NHS Foundation Trust and STEM ambassador. “It really discriminates against younger women, Black and ethnic minority women.”

As an NIHR Innovation Fellow, Virginia was awarded funding to study AI auto-contouring in radiotherapy, embedding patient and public involvement, including breast cancer patients, Black and ethnic minority women. But even getting to this stage was a challenge. “I needed to ask permission of my manager and at first they thought I shouldn’t as ‘it’s not something physicists do’.

“This work highlighted that some commercial AI solutions did not include the ovaries as organs at risk in their pelvis model. They did include, however, the prostate, seminal vesicles, and penile bulb, illustrating the unconscious bias” says Virginia.

Her research points to the fact that the breast screening process which started in 1988 hasn’t really changed since. “The NHS sends out letters to women over the age of 50. But cancer doesn’t distinguish the fiftieth birthday. Some transgender people might need screening but they don’t get the letter because it depends how they are registered with their GP.”

Mammograms may also be less effective for women with dense breasts. Women who carry the BRCA1 or BRCA2 gene are more likely to develop breast cancer at a younger age. “They would benefit from an MRI scan or ultrasound combined with elastography,” Virginia adds. “We need a risk stratification model that looks at the risk different people face.”

Knowledge gaps

The exclusion of pregnant women from clinical trials and imaging studies stems



DATA REMAINS MALE-CENTRIC OR SEX-NEUTRAL, AND MISSES THE VITAL INSIGHTS THAT COME FROM SEX-DISAGGREGATED DATA ANALYSIS

from well-founded concerns about foetal radiation exposure and ethical considerations, says Dr Beverley F Holman, Principal Diagnostic Nuclear Medicine, PET/CT and Research Physicist at Royal Free London NHS Foundation Trust. “They have also created substantial knowledge gaps,” she says.

“When a pregnant patient requires advanced imaging to guide life-saving treatment, clinicians and physicists are often left without evidence to inform risk-benefit decisions,” she says. Recently her team encountered “precisely this challenge” (see box, right).

“Our experience illustrates the broader issue: pregnant women are frequently left out of research and data collection,” she adds. “In nuclear medicine, these biases manifest in an absence of dosimetry, biodistribution and safety data for pregnancy, creating uncertainty when



real-world clinical need arises.”

Beverley says that systematic efforts – including registries, case series and carefully designed studies – are needed to fill these gaps. “In the meantime, when clinicians must make decisions with limited precedent, sharing experiences transparently is a crucial step towards safer, more equitable care.”

Personalised medicine

Another looming challenge to prioritising women’s healthcare is AI. “With AI, the bias is not in the model, but in the data you use to train the models, and unfortunately the data is biased,” says Dr Beatriz Costa Gomes, Research Programme Manager at Microsoft AI and science communicator.

Beatriz points to the fact that the body temperature considered to be a fever is based on middle-aged white men, and that women’s body temperature is objectively lower. “But how do you counter this? Even with humans you cannot counter a doctor who has been trained that a fever is above 37.5 degrees,” she says. “These

values, these averages, these numbers were defined ages ago and embedded into regulations. Unfortunately, from the large amount of data that we have, it’s always going to be stacked against women. But what we do have is the ability with AI to counter this bias – to try and weed it out and take the glasses off.”

AI can also help via personalised medicine, because it is making decisions based on an individual’s data. “There’s so much power that can be had in having your own personal agent of AI because it will know your values and not be biased by general values or round numbers,” Beatriz says. “If you remove the human biases, you have an agent that focuses on you, on your normal, and realises what is normal for you.”

Microsoft AI reports in a study that its AI-based medical programme, the Microsoft AI Diagnostic Orchestrator (MAI_Dx0) was four times better at correctly diagnosing cases described in the *New England Journal of Medicine* than a team of human doctors. “I’m not saying we should

GROWING THE EVIDENCE BASE

A pregnant woman presented with severe hypercalcaemia caused by suspected parathyroid adenoma to Dr Beverley F Holman and her colleague Tamar Willson, Senior Nuclear Medicine Physicist at Royal Free London NHS Foundation Trust.

“Exploratory surgery had failed to locate the lesion, and further intervention was urgently required to stabilise her condition and prevent harm to both mother and foetus,” Tamar says. “Accurate localisation of the lesion was critical to avoid repeated unsuccessful surgery.”

F-fluorocholine PET/CT offered the highest likelihood of identifying the lesion, but to the team’s knowledge, there was

no published experience that describes F-fluorocholine PET/CT in pregnancy. “Given that choline is an essential nutrient for the foetus and is known to cross the placenta, there was the potential for non-negligible foetal uptake,” Tamar says.

Following multidisciplinary discussion, the team planned to administer 0.2 MBq/kg F-fluorocholine to the patient to balance the need to minimise radiation exposure, whilst maintaining the likelihood of a diagnostic study. They also counselled the patient about the relatively large uncertainty in foetal radiation exposure with this radiopharmaceutical and the known clinical risks of hypercalcaemia.

She was injected with

17 MBq and was scanned for 30 minutes with a long axial field-of-view (LAFOV) PET/CT scanner. CT was performed of the same region and a separate 10-minute PET scan was acquired from vertex to pelvis to assess foetal uptake.

“The PET/CT study successfully demonstrated intense choline uptake in a nodule inside the thyroid gland that was subsequently surgically removed and confirmed to be an intrathyroid parathyroid adenoma,” Tamar says. “Following the surgery the patient’s parathyroid hormone levels and calcium levels dropped.” The PET-only image demonstrated minimal F-fluorocholine uptake in the foetus, and preliminary

calculations estimate the foetal dose at 0.5 mSv from PET and 0.1 mGy from CT.

Although not a formal research study, the approach and outcome are documented in a report in the *European Journal of Nuclear Medicine and Molecular Imaging*. “We are now working to model foetal dosimetry more precisely in this setting. Our aim is to contribute to an evidence base that allows informed consent and optimised protocols whenever pregnant patients require PET imaging,” Tamar adds. “Excluding pregnant women from all research and reporting may appear protective, but in reality, it leaves clinicians with little guidance and patients with fewer options.”

RADIO THERAPY CAN LEAD THE WAY, NOT JUST BY AIMING PRECISELY, BUT BY LEARNING TO SEE AND THINK DIFFERENTLY

just have AI doctors, but having AI doctors in tandem with human doctors is what's needed," Beatriz says. AI is dangerous if people pretend there is no bias. "This is a data and a human problem, and AI won't solve problems while we still have intrinsic systemic misogyny and racism," she adds.

Designing for difference

In radiotherapy, AI is now widely used for automated contouring, toxicity prediction (often using clinical trial data and NTCP-based models) and emerging dose personalisation via treatment decision algorithms. "To prevent AI from reinforcing sex-based and biological biases, we need a new standard in AI development," Maryam says.

This includes using sex-disaggregated training datasets instead of pooled averages, key biological variables not just demographic tags, bias audits at every stage – from model training to clinical deployment, fairness metrics that access who benefits not just overall accuracy, and oversight by interdisciplinary teams, including clinical scientists, gender, medicine, data ethics and health equity.

"Emerging strategies, such as federated learning, intersectional

evaluation frameworks, re-weighted models, and algorithmic auditing show real promise. But these must become standard practice, not optional extras," Maryam says. "Used wisely, AI can help surface disparities, personalise treatment, and support the shift towards biologically intelligent systems."

Visibility of women in physics and engineering medicine will also go some way to addressing disparities in women's health, because it will have a ripple effect on what is researched and how. Virginia

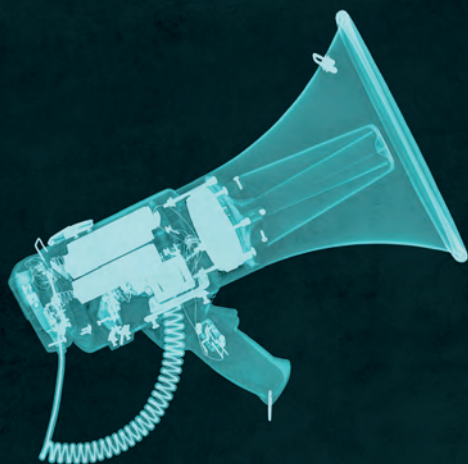
is a STEM ambassador, talking to children and teenagers in schools about her work as a physicist. "There is this silly idea that physicists need to look a certain way because of the media," she says. "But this is medical physics, not theoretical physics, and we need to be able to speak to patients and other healthcare professionals."

Maryam sees redressing the disparity as a "wonderful opportunity to design for difference, rather than averaging it out". She adds: "Radiotherapy can lead the way, not just by aiming precisely, but by learning to see and think differently!"

What's clear is that despite the persistence of knowledge and treatment gaps that must be closed to ensure health equality for women and people of colour, momentum is building. "The fact we are having this conversation now is brilliant," says Virginia. "A lot of work has been done but there is a long way to go." ●

STEPS TO REDRESS DISPARITIES

- **Code First Girls | Empowering Women in Tech through Education** aims to reduce the gender gap in tech by providing free courses and employment opportunities. b.link/ist9sehq
- **EORTC** now increasingly requires sex-disaggregated outcome analysis in oncology trials. b.link/qn2nys6b
- **ESMO** has embedded sex and gender into its systemic oncology guidelines. b.link/jzaljizl
- The **ESTRO/EORTC E²-RADIatE** initiative is building a real-world radiotherapy data platform with a wealth of outcome and dosimetry data. b.link/t319r40q
- The **NIH's Sex as a Biological Variable (SABV)** policy has mandated sex-aware research in all funded studies, since 2016. b.link/mhja19wl
- **Physiological Measurement**, co-published by IOP Publishing and IPeM, now requires sex and gender reporting in all manuscript submissions. b.link/76yg65bu
- Sweden's **Janusmed Sex and Gender database**, documents sex-based differences in drug response. b.link/stax7v7v
- The **STEM Ambassadors Programme** recruits volunteers to bring real-life examples of STEM careers into schools, colleges and universities across the UK. b.link/w5rg0srw
- The **WISE (Women into Science and Engineering) Awards** celebrate people and organisations working hard to make STEM a more equitable industry for women. b.link/so7vr5bf
- The **UK Biobank** and other population-scale genomic resources contains hormone-informed, sex-aware data relevant to radiogenomic modelling. b.link/ckbi3pg6
- The **White House's 2024 Executive Order** on women's health, catalysed investment into new research infrastructure. b.link/dpbafe7a
- The **World Economic Forum and McKinsey Health Institute** are tracking progress of closing the women's health gap using a Women's Health Impact Tracking platform b.link/347se56t





Staff profile: Dr Nina Lauvitel

I'm the Policy and Professional Manager at IPEM. I support the development and dissemination of policy that advances IPEM's charitable objective. This includes management of our workforce intelligence surveying programme, support to professional policy campaigns and oversight of the production of resources.



Tell us about what led you to IPEM?

Shortly before joining IPEM, I completed a PhD in speech and language therapy. I did work with lots of different clinical populations, but my main area of focus was gender-affirming voice and communication therapy. My doctoral thesis explored how a range of factors – both voice-related and non-voice-related – contribute to vocal satisfaction in trans women. Although I no longer work in academia, I'm proud of the results of my work. I have published three journal articles, and I am continuing to work on papers

for publication outside of my IPEM work.

Which elements of your job do you like the most?

I have really enjoyed learning about the scientific and professional landscape of medical physics and clinical engineering. I've also enjoyed applying my knowledge of social science research methodologies to writing reports that have impact.

What are the biggest challenges you see for your role?

My role has a very wide remit, so

maintaining oversight over everything can be challenging. It's very important to keep IPEM's over-arching goals in mind. We want to foster strong networks within our community, support professional development and champion the importance of our profession within the wider healthcare system and to policymakers.

Why should people join IPEM?

It's a really great way to be a part of a vibrant and engaged professional community, and to make your voice heard on the issues that matter most to your profession. You'll also benefit from the professional status and development opportunities offered to you by IPEM membership.

Are there any IPEM member benefits you would like to highlight?

As an IPEM member, you'll have an opportunity to make your voice heard and speak to the issues that matter most to your profession. You'll be well positioned to support our advocacy work and contribute to meaningful change.

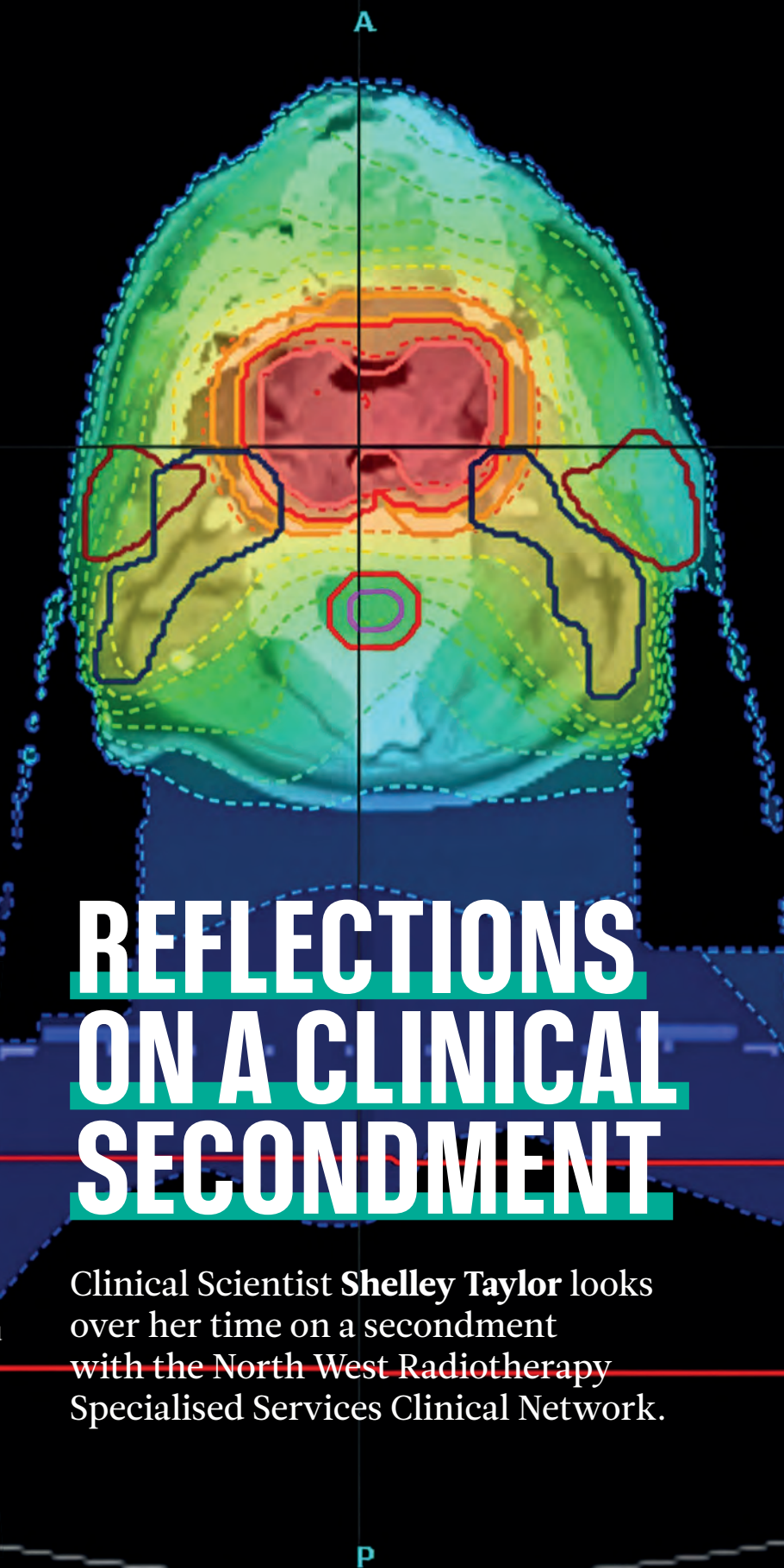
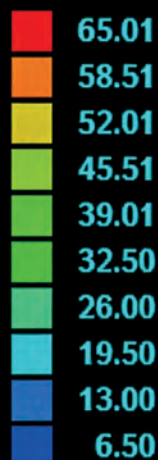
What does IPEM do to advocate for the profession?

We engage and build relationships with key decision makers who are in a position to bring about change, such as the NHS and government across the devolved nations and other professional bodies. Our workforce data is well-respected by those we engage with and is regularly used in conversations about supporting the workforce.

What do you do in your free time?

In my free time, I love creative writing – I am working on writing a novel of my own, which I'm really passionate about. I also enjoy Dungeons and Dragons and other tabletop roleplaying games, which I've been playing regularly with the same group of friends since university. I've also recently been taught how to crochet by a work colleague. A handful of us like to get together and work on crochet projects during our lunch breaks sometimes. ●

Dose: Gy



Since June 2024 I have been on secondment as a Quality Improvement Practitioner with the North West Radiotherapy Specialised Services Clinical Network (SSCN), formerly Operational Delivery Network. When the opportunity arose to take on a secondment with the North West SSCN, I knew it was something I didn't want to miss out on. At that point I had been working as a registered Clinical Scientist for almost five years and felt ready to take on a new challenge. Working with the network has given me the opportunity to work on projects with teams of people that I wouldn't have had the chance to in my normal job.

There are 11 radiotherapy networks across the country, each working to deliver the Radiotherapy Service Specification set out by NHS England Specialised Commissioning. This specification outlines the standards and expectations for high-quality, equitable and efficient radiotherapy services across the country.

The North West SSCN, managed by Danny Hutton, is the largest radiotherapy network in England. The network comprises three main centres and five satellite centres and serves a population of 7.2 million, delivering over 200,000 fractions to 20,000 patients annually. Since March 2023, the North West SSCN

REFLECTIONS ON A CLINICAL SECONDMENT

Clinical Scientist **Shelley Taylor** looks over her time on a secondment with the North West Radiotherapy Specialised Services Clinical Network.

-15.00 min
W/L: 400/40

has offered a clinical secondment to staff within the network, working 0.6WTE for the network for a year. The secondment provides an opportunity to gain experience in a network, working on projects outside of the typical clinical role, while improving links between the centres in the network.

The first secondment was carried out by Lee Whiteside, a Research Radiographer at The Christie NHS FT. For his secondment, Lee developed a network-wide clinical trials dashboard, which contains information about all clinical trials available to patients across the network, and which centre each trial is open at. This gives clinicians a central location where they can identify appropriate clinical trials for their patients. Lee stayed on with the network at 0.2WTE for a second year to develop a patient-facing dashboard, to give patients the opportunity to learn about clinical trials themselves, if they would like to.

The secondment for 2025–26 focusses on adaptive radiotherapy and the radiotherapy dataset (RTDS). A literature review on adaptive radiotherapy will be performed, followed by a Delphi study, with an aim to reach a professional consensus in the North West over which patients benefit from which types of adaptive radiotherapy and for what proportion of patients is adaptation appropriate. The RTDS component of the secondment seeks to understand issues surrounding the quality of RTDS data and identify areas of improvement across the network. This is part of a wider piece of work being carried out by the network to be more data-informed across its workstreams. This role is being carried out by Danielle Cartwright, a Clinical Scientist from Clatterbridge Cancer Centre.

I have worked three days a week with the network from June 2024 to June 2025 and I am continuing to work one day a week until March 2026, with the rest of my time based at the Rosemere Cancer Centre at Lancashire Teaching Hospitals NHS FT as a Radiotherapy Physicist. My work with the network has focussed on advancing the use of ProKnow and AI autocontouring across the network.

AI autocontouring

AI autocontouring is a hot topic at the moment. The software uses artificial intelligence to automatically contour relevant anatomy – predominantly organs at risk (OARs) – in preparation for computerised treatment planning. Without the technology, clinicians and treatment planning staff contour these regions manually, a time-consuming process that must be done for every patient. In an already pressurised NHS, autocontouring software has the potential to relieve some of this burden, leaving staff to check the contours produced automatically, rather than producing them from scratch. The King's Technology

Evaluation Centre (KiTEC) has recently carried out a study to demonstrate the benefits of the technology on radiotherapy treatment planning workflows. However, the centralised government funding announced in 2024, which paid for autocontouring software and licence fees, has been rescinded by the current government, leaving radiotherapy centres to find the funding themselves from already stretched reserves.

I carried out a review into the status of autocontouring implementation across the network, finding that all centres have embedded the technology into their treatment planning workflows. Additionally, all centres are collaborating with vendors to help with development of their models. From this review it became clear that the removal of the technology would have a significant impact on the planning of patient treatments.

ProKnow

The majority of my work has centred around ProKnow, a cloud-based repository for radiotherapy treatment plans which enables comparison of plans both locally and nationally. The article “Cloud-Based Cancer Treatment Comparison” by John Byrne in the Spring 2025 issue of *Scope*, covers the function and capabilities of ProKnow in detail. The functionality of ProKnow relies on plans being uploaded to the software, so part of my role has been to encourage and support the centres in the network to make ProKnow “business as usual”. I have been a point of contact for all centres in the North West for any ProKnow queries and have been able to deliver training, support and advice. Over the course of the 12 months I have been in this role, the number of plans from the North West in ProKnow have increased by over 6000.

I regularly attend ProKnow meetings with members of the profession across England, which has enabled me to have an input into the development and future direction of ProKnow. One such meeting is the audit group meeting, which provides oversight on the national audits which are currently in progress. These audits aim to compare the radiotherapy plans for patients across the country, highlighting any similarities and variation in these plans nationally,

**IN AN ALREADY PRESSURISED
NHS, AUTOCONTOURING
SOFTWARE HAS THE POTENTIAL
TO RELIEVE SOME OF THIS BURDEN**

giving centres the opportunity to see where their treatment plans sit in the national picture and enabling improvements to be made. Without ProKnow this information would have been nigh on impossible to obtain. Audits currently in progress are: breast, lower gastrointestinal, head and neck, prostate and lung, with more audits to commence in the coming months.

Another national meeting I have had the opportunity to attend during my secondment is the ProKnow Technical Oversight Group meeting. This group proposes projects to be carried out and coordinates task and finish groups to complete the projects. One such project that I am very keen to be involved in is to carry out work to incorporate patient outcome data into ProKnow. The ability to directly correlate patient outcomes with dose distribution data will enable us to develop our treatment planning techniques to produce the best possible treatments for our patients.

Outside of routine ProKnow work, I have collaborated with teams across sectors (healthcare and academia) on a project on ProKnow with the BARD (breast cancer after radiotherapy dataset) team. The aim of this project was to determine whether ProKnow could be used to simplify the process to identify appropriate patients for inclusion in BARD, with promising results to be communicated imminently.

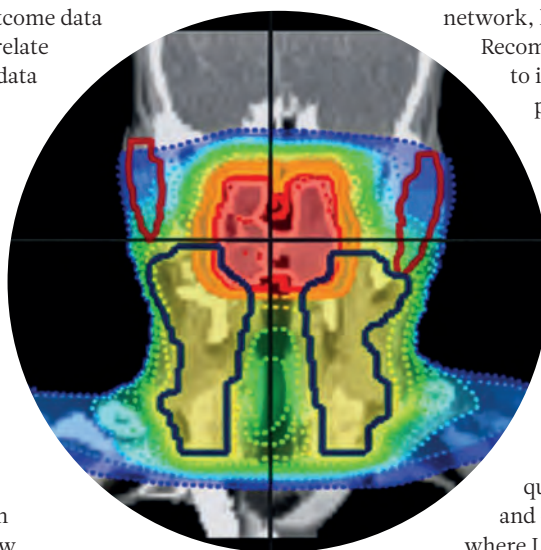
In March 2025, I led on the organisation of The North West Conference on ProKnow and AI Autocontouring in Radiotherapy. The event provided a forum for colleagues across the North West to showcase the excellent work being done in the region – promoting innovation and best practices in the field and supporting education and professional development within radiotherapy. We also welcomed a range of invited speakers from across the country and finished the day with a panel discussion on the Future of ProKnow, AI autocontouring and AI in radiotherapy with a panel of experts.

Following the conference, we are in the early stages of organising a webinar on the clinical uses of ProKnow to take place in the autumn, to raise awareness of

the capabilities of ProKnow with clinical colleagues who may not have experience with the system.

Other network project involvement

I have also been able to get involved with other projects within the network. I am involved in the production of a publication on the levels of job satisfaction and burnout in members of the radiotherapy workforce in the North West. It is really important to determine the current state of the workforce, both in terms of staffing levels and satisfaction, as this will provide evidence to drive positive change. I have also carried out an audit into peer-review practice across the network, looking at compliance with the RCR Recommendations, and I've had the opportunity to input into processes surrounding the production of network clinical protocols.



Summing up

My secondment has enabled me to work with colleagues in radiotherapy and the wider field of medical physics, and clinical colleagues outside my own department, in both the NHS and industry. The year has been a significant change from my normal job as a Clinical Scientist in radiotherapy, where my responsibilities include: machine quality assurance, treatment planning and checking, carrying the “physics phone”

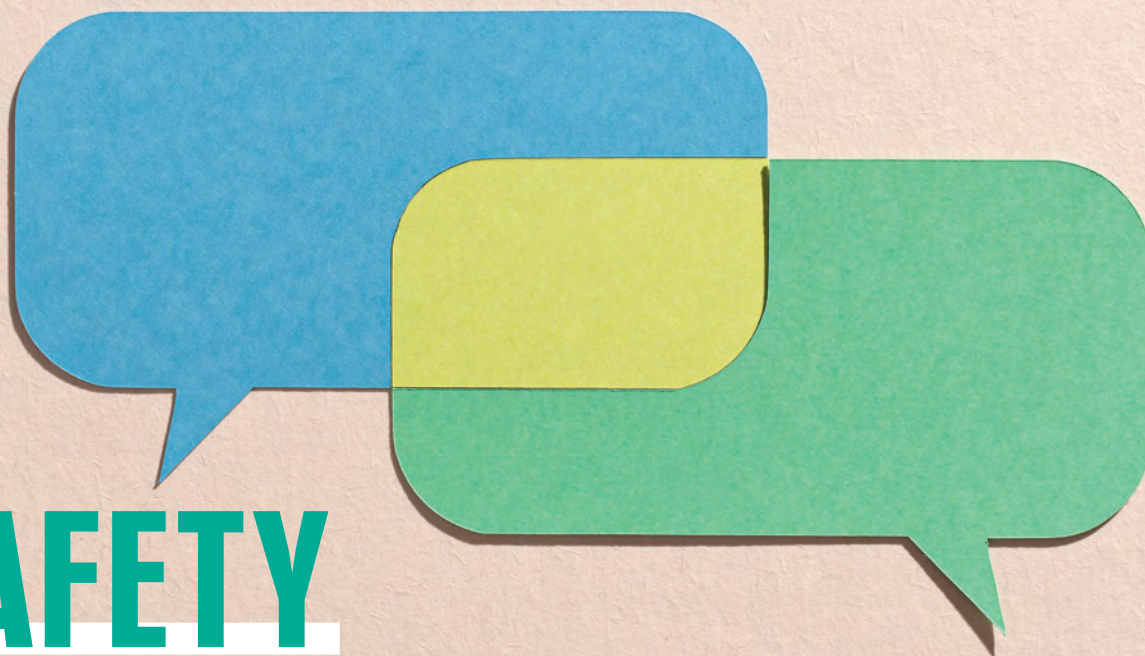
where I am on call when issues arise in the department, reviewing incidents as a member of the multi-disciplinary Incident Review Group, training junior members of staff in departmental practice; and development work including: new QA procedures, commissioning of treatment planning systems and development of new planning class solutions.

I have really enjoyed the variety of work I have been involved in this year, contributing to work that is beyond the scope of my clinical role, and the exposure to the world of radiotherapy that is often behind the scenes of the day-to-day work we do. I hope to continue my involvement in national work, as I believe we should support each other in the work we do, since we are ultimately all working to the same purpose: to provide the best treatments for our patients.

The range of work completed by myself and Lee and the opportunities received during the secondments show how valuable such secondments can be, both for the personal development of secondees and for the contributions made to the work of the network.

One final note: if anyone has the chance to take up a similar position, I would highly recommend that you take the opportunity – you won't regret it. ◉

**WE ARE ULTIMATELY ALL
WORKING TO PROVIDE THE BEST
TREATMENTS FOR OUR PATIENTS**



SAFETY MANAGEMENT

An overarching overview

Quality Superintendent **Isabel Ho** discusses safety management concepts and theories, interspersed with reflective learning for readers.

Effective safety management is paramount in healthcare, particularly in high-risk environments such as radiotherapy. Learning from established safety management system (SMS) models, widely proven in high-risk industries, such as aviation, nuclear and transport, offers invaluable interdisciplinary insights. The recently published *Advancing Safer Radiotherapy* (ASR) guidance introduced the model of SMSs and recommended SMSs building on the established strong foundation of quality management systems (QMSs) adopted in radiotherapy for several

decades. However, an effective SMS requires a deep understanding and intentional application of key fundamental concepts beyond mere technical implementation. Advancing safety practice encourages a psychologically safe workplace culture that encourages open reporting, system thinking and learning from both successes and unintended events. Several critical elements must be carefully considered to support effective learning and build a strong foundation of understanding performance variation.

Power of neutral language

Language is foundational to enabling a true culture shift in safety. ASR has

replaced “radiotherapy error” with “radiotherapy event”. This adoption of neutral, non-threatening language is crucial; it encourages open reporting by removing negative connotations, fostering an environment where staff feel safe to report unintended events without fear of blame. This shift of language is well-established in aviation and is increasingly being adopted across healthcare, notably championed by the Patient Safety Incident Response Framework (PSIRF).

While traditional “error” investigations in radiotherapy often focus on learning from failures, learning from what goes well isn’t common practice. Methodologies such as root cause analysis, while widely adopted for decades, have been challenged by safety experts worldwide. Similarly, shifting from “near miss” to “good catch” celebrates successful safety interventions and invites positive dialogue, appreciating the adaptive role of our human operators in maintaining safety within complex adaptive systems.

// UNINTENDED EVENTS TYPICALLY RESULT FROM MULTIPLE CONTRIBUTORY FACTORS, NOT INDIVIDUAL FAILINGS

Self reflection: *How would you feel emotionally if involved in an “error” versus an “event”? Or a “near miss” versus a “good catch”?*

Complexity and performance variability

Radiotherapy teams operate within complex adaptive systems, moving beyond the era of purely mechanical fixes, maintenance and traditional equipment quality assurance programmes. While quality management systems have evolved, the focus has extended far beyond radiation equipment to encompass wider team functions and clinical and wider quality governance processes. In this complex environment, performance variability is the norm, not an anomaly.

The nature of a complex system is inherently “un-easy” due to its unpredictability, non-linearity, emergence, adaptability, self-organisation and interdependence. A reductionist approach of breaking unintended events into smaller simpler components is no longer sufficient. Advancing practice requires a

deep appreciation of patterns across systems where certain combinations of factors produce specific outcomes; acknowledge unintended events typically result from multiple contributory factors not root causes or individual failings, as commonly perceived.

Self reflection: *Training records are often updated late, with competency confirmations mostly verbal. How does this undermine system credibility, culture and governance?*

System thinking in radiotherapy

A systems-based approach is commonly used in engineering and is starting to gain more ground in healthcare. It is essential for understanding the interdependent and interconnected nature of work in a complex adaptive system (CAP), such as radiotherapy. Systems thinking focuses on how different components interact and influence each other. For example, the System Engineering Initiative for Patient Safety (SEIPS) model examines how people, tools and technologies, tasks, environments and organisations interconnect.

This approach serves as a tool to bring together multiple perspectives across different levels of the system and to consider how work-as-done is actually delivered. Contributory factors, such as workload, resource constraints and competing demands, shape people’s decisions and actions in the moment. From this perspective, human error is not viewed as individual failure, but as a “symptom” of system design weaknesses.

Understanding the interactions between system components helps explain why decisions made sense at the time and how processes can be designed or “engineered” and optimised with diverse input from all interested parties involved. There are many models offer different safety perspectives and support system thinking in practice that are worth exploring for those interested in deepening their understanding.

We must learn from work-as-done, not just work-as-imagined, if we are to better “engineer” safety management systems. While work-as-imagined reflects policies and procedures, work-as-done captures the adaptations and trade-offs people make to keep systems running. Bridging the gap between these two requires not only technical and system knowledge, but also curiosity and appreciation of different perspectives, human factors awareness, design thinking and meaningful dialogue across different levels.



Self reflection: Think about a recent incident investigation you've been involved in or observed. How might the language used, the questions asked and the conclusions drawn have been different if a systems-based approach had been applied, compare with the traditional root cause analysis? What does this reveal about your own underlying assumptions around error, accountability, and blame? How might these insights improve future learning response?

Measurement beyond performance data

The role of quality governance is to monitor how well a service is run and how it holds itself to account. This is fundamentally different from management's role in operational and project delivery. This inherent tension requires careful balance, ensuring an equitable view of operational performance, quality and financial responsibilities.

Good governance relies on well-led organisations with clear structures, effective processes, strong leadership, defined accountability and, crucially, robust data and intelligence capabilities.

To effectively monitor service delivery, organisations must go beyond traditional output metrics, such as the number of patients treated or the number of radiotherapy events reported. Instead, they must ask deeper questions: How

well was the treatment delivered? To what extent did a healthy culture exist among team members?

Traditional bar and pie charts are insufficient for providing meaningful insight. Scientific quality improvement (QI) methodologies such as statistical process control (SPC) and Pareto analysis offer more advanced tools to support adoption of advanced practice. These methods help uncover hidden process variation, reveal underlying patterns that are not obvious and extract actionable intelligence from routine data.

Although radiotherapy departments collect and analyse RTE taxonomy data, the full potential for learning can only be realised through the application of appropriate analytical tools at the local level with clearly defined process. By triangulating multiple data sources, we can ask better questions and begin to move beyond traditional performance metrics to enable quality assurance that leverages the interconnection between reliable performance, safety and quality.

Self reflection: What conclusions might you draw when reviewing the same dataset using a bar chart, run chart, red-amber-green (RAG) rating, and an SPC approach? Is safety a key performance indicator, or is it a subjective experience—a feeling shared by individuals and teams? While quantitative data may offer an overview, direct observation reveals the reality of work-as-done, in contrast to “paper safety” or work-as-imagined. This is an intentional effort to become consciously aware of the drift in safety perception within our working environment. When asked about safety in your workplace, do you refer to reported incident data before answering, or do you instinctively rely on your lived experience?

Learning from everyday work

Radiotherapy has a long history of adopting quality management approaches, yet we are not immune to “paper safety” where emphasis is often placed primarily on written procedures and the very goal of quality management system, continual improvement, has taken a backseat.

While documentation is important, advancing practice requires a more balanced approach between work-as-imagined and work-as-done.

Real-world adaptations, sometimes referred to as “trade-offs”, are essential to the functioning of a complex adaptive system. Bridging the gap requires multidisciplinary and interdisciplinary knowledge, an understanding of human factors and ergonomics, and a willingness to challenge the status quo. Such difficult yet meaningful dialogue often leads to deeper learning and greater influence than traditional classroom or online training sessions.

Self reflection: Think of a recent moment when you learned something valuable during an informal conversation in a corridor or over a coffee break. What made that experience engaging or impactful, and how did it compare to learning in a more formal setting, such as department incident meeting or team huddle? Consider which format felt more meaningful or effective for ongoing learning and what learning experience more engaging and reflective.

The journey forward

To make meaningful progress in safety practice, we need to open up broader, more inclusive conversations across our community. While traditional subject-matter expertise remains important, no one has all the answers, especially when we work within the limits of our own disciplines and resources.

Moving forward doesn't always mean doing more; sometimes it's about thinking differently, for example, making better use of existing QMS and gradually developing a broader SMS framework, we can better support learning and encourage the sharing of essential, safety critical information timely. Small steps, such as self-reflection exercises, help create a foundation of quality – ensuring safe, effective and positive experiences through personalised care. ●

Isabel Ho is Quality Superintendent of Radiation Oncology Services at HCA Healthcare.

Clinical Academic Sonographer **Dr Jacqueline Matthew** outlines vital work to bring better tools, evidence and equity to pregnancy ultrasound.

For most people, pregnancy ultrasound is a routine part of care – one that brings reassurance and important information at critical points in pregnancy. But for clinicians, researchers and parents alike, the reality behind the scan can be more complex.

Over 20 years working as a radiographer and sonographer in the NHS, I've seen how life-changing good imaging can be.

But I've also seen where the system struggles: long scan times, variability in results, limited specialist input in day-to-day practice and, importantly, technology accessibility and use that hasn't kept pace with what modern pregnancy care demands.

It was this frustration, and a growing interest in how advanced imaging, such as fetal MRI, could support diagnostic challenges, that pulled me toward research. Today, I work as a clinical academic in the Department of Early Life Imaging at King's College London, where I've combine frontline clinical experience with translational research. I'm also co-founder and Chief Medical Officer of Fraiya, a King's Health Partners spinout company building AI tools for pregnancy ultrasound.

Why this work matters

Pregnant women have historically been left out of clinical research, often because of complex ethical and regulatory concerns. But that exclusion has consequences. It means gaps in evidence. It means assumptions built on data that doesn't reflect real-world pregnancy populations. And it means missed opportunities to improve outcomes in maternity care.

We founded Fraiya to address a simple but urgent problem: too many pregnancy anomalies are not identified early, too many sonographers are working under intense pressure and too many parents receive uncertain or delayed answers. Fraiya's core product, FraiyaScan, is a CE-marked, AI-assisted tool that supports sonographers during the mid-pregnancy anomaly scan. It helps capture and organise the right images in real time, checks whether standard planes have been acquired, and enables consistent, accurate measurements to be taken across the

Profile (1.00)



REIMAGINING PREGNANCY ULTRASOUND

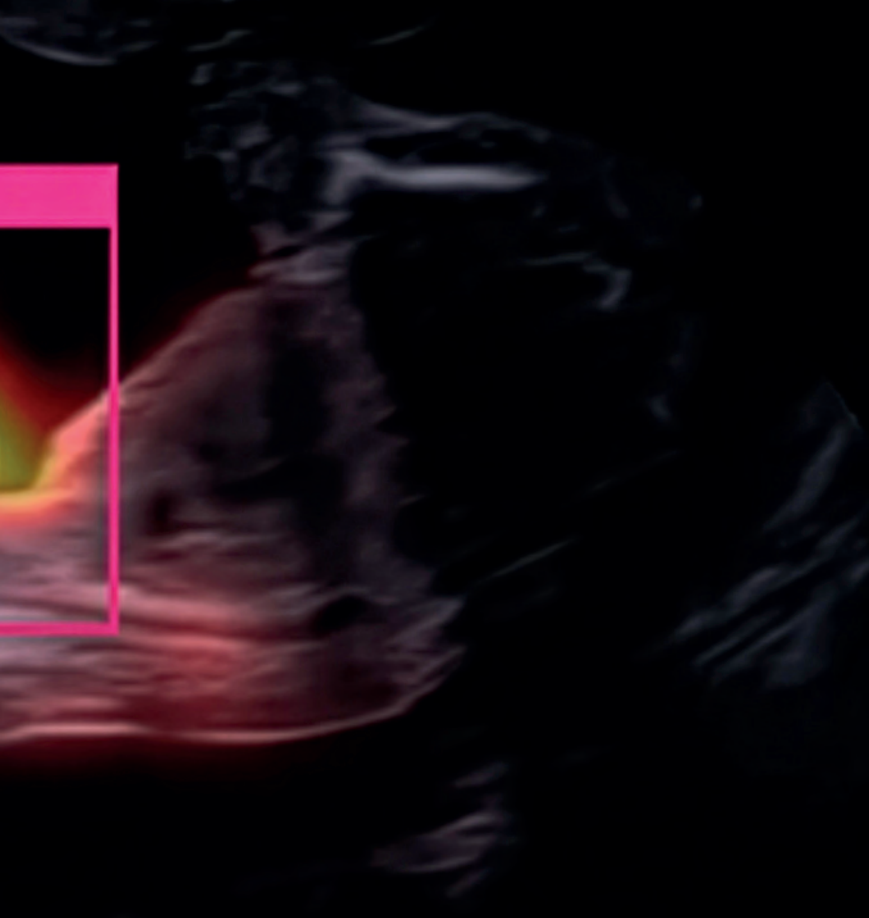
AI and equity- focused research

whole exam – not just from one selected image.

It's not about replacing sonographers. It's about giving them tools that help make their job easier, faster and more reliable, whilst reducing inherent variability and improving equity in care.

A trial with women at the centre

This year, our group was successfully awarded a £1.7m NIHR invention for innovation product development award, for a two-year health economic evaluation



and technology assessment study across four NHS trusts. The trial, led by myself and Professor Reza Razavi, who is an internationally renowned academic and paediatric cardiologist, will involve more than 9500 participants and compare traditional ultrasound workflows to those supported by FraiyaScan and a remote expert review system. The aim? To evaluate whether AI can reduce scan times, improve detection rates and standardise care delivery.

What sets this trial apart isn't just its scale, but its focus, as there are surprisingly few prospective studies of AI tools in real-world use. We built the trial with people at the centre, including sonographers, radiologists, midwives, obstetricians, fetal medicine specialists, engineers, clinical academics and women with lived experience. We didn't just ask what data we needed to collect, we asked what mattered to the people being scanned, the people doing the scans and those making decisions from the results. We're capturing not just technical performance, but usability, workflow impact and acceptability. For example, how does it feel to have AI support during a scan? Does it affect how clinicians explain findings? What do parents value most? These questions are essential to designing safer, more inclusive technology.

Equity in pregnancy research

My experience working with research studies in our specific clinical academic setting – one of the UK's most diverse urban populations – revealed something troubling. Healthy control participants in pregnancy imaging studies often didn't reflect the communities

we served, while high-risk clinical groups were more diverse. This disparity raised important questions: Were our recruitment methods equitable? What messages were we sending? What barriers were present?

With funding support from the College of Radiographers and Industrial Partners grant, I launched a project to explore health equity in pregnancy research participation. The team worked with parents, community organisations and healthcare professionals to understand what motivates or discourages research involvement. We also looked at how participation could be more inclusive, from how studies are explained to how appointments are structured and, importantly, what the research priorities were for all stakeholders.

The insights were clear: participation is about trust, relevance and respect. People want to contribute but it needs to feel worthwhile, accessible and aligned with their values. That ethos is now embedded in how we run Fraiya. From product development to trial design, we involve those who'll use or be affected by the technology. Because innovation that ignores lived experience rarely delivers meaningful change.

Leading from lived experience

As someone who has personally navigated gaps in pregnancy care, I carry multiple perspectives into the work I am involved with. That's one of the strengths of clinical academic pathways, they allow people like me, who've spent years on the frontline, to help shape the next generation of tools and evidence.

I also believe we need to do more to support women in medical physics, engineering, and imaging sciences, especially those working at the boundaries and overlapping spaces of clinical care, research, and commercial innovation. Representation matters not only in leadership but in design decisions, trial protocols, and business models. We need technologies built by people who understand the systems they're working in as well as the people they're building for.

Final thoughts

Pregnancy ultrasound is more than just a scan. It's a conversation, a checkpoint and often a turning point in someone's life. That's why it deserves better tools, better evidence and better equity. Much of my work has been built on trust, often in the face of competing priorities. I believe that by working together across disciplines and by centring people in the design of meaningful solutions, we can help make pregnancy care safer, faster and more equitable for everyone. ●

Dr Jacqueline Matthew is a clinical academic sonographer in fetal imaging and co-founder and Chief Medical Officer of Fraiya.

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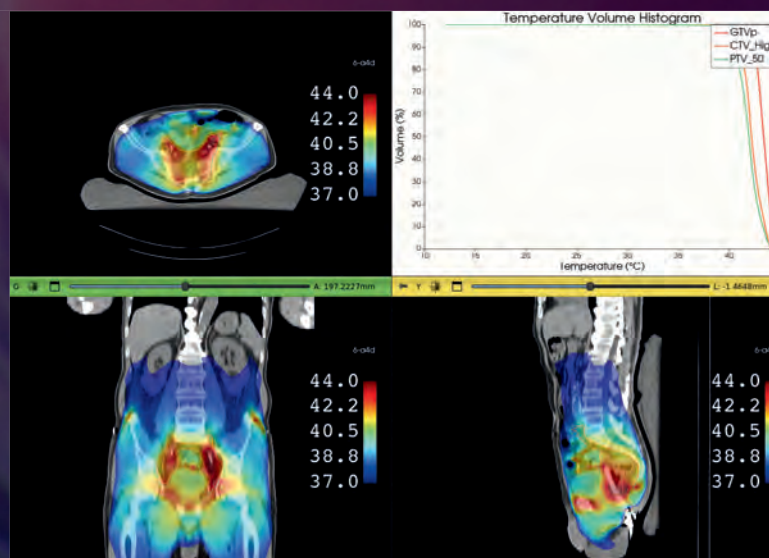


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[1] Datta NR et al. Local hyperthermia combined with radiotherapy and/or chemotherapy: recent advances and promises for the future. Cancer Treat Rev. 2015 Nov, PMID: 26051911.



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AI IN BREAST SCREENING

Hopes, fears and the human touch

A new study published in *BMJ Public Health* explores how women eligible for the NHS Breast Screening Programme perceive the integration of artificial intelligence into mammogram reading.

As the NHS grapples with radiologist shortages and mounting screening backlogs, artificial intelligence (AI) offers a promising tool to enhance diagnostic efficiency. But is the public ready for it?

Behavioural scientists led by Dr Lauren Gatting at King's College London Technology Evaluation Centre (KiTEC), conducted 12 focus groups involving 64 women aged 45–70 from diverse backgrounds across England. Their goal: to understand the acceptability of AI in breast cancer screening through in-depth qualitative analysis.

The findings reveal a complex blend of optimism, caution, and resistance. Four key themes emerged: fear of diagnostic errors, concerns over the pace of technological change, insistence on human involvement, and a demand for rigorous testing and phased implementation.

Participants welcomed the idea of AI augmenting human performance – especially if it meant fewer missed cancers. But they worried about the fallibility of algorithms and were deeply uneasy about AI replacing human expertise. False negatives loomed large in their minds, while awareness of overdiagnosis and false positives was notably low.

For many, AI conjured images of futuristic robots and disembodied machines, intensifying concerns about losing control over personal healthcare. Some feared AI would be deployed without consent or adequate communication. “It’s coming whether we like it or not,” said one participant.

Data privacy and ownership emerged as additional flashpoints. Women questioned who would control their medical data, how it would be used, and whether private companies might profit unfairly. The NHS’ reputation for being stretched financially added another layer of distrust, as many worried that cost-cutting might drive AI adoption.

Crucially, human readers were seen not just as diagnosticians but as sources of empathy and reassurance. Many insisted that AI should assist, not replace, clinicians. “You have to have human beings to give the overall decision,” one woman insisted.

Participants called for AI tools to be subjected to extensive trials before being rolled out, emphasising the need for clear evidence on accuracy, safety and effectiveness. A step-by-step implementation—paired with ongoing human oversight—was considered essential for gaining public trust.

The research underscores the importance of involving patients in decisions about medical technology and crafting communication that acknowledges both their hopes and concerns. Without such engagement, researchers warn, AI integration risks alienating the very people it aims to help.

The study contributes to a growing body of work urging caution, transparency and inclusivity as AI reshapes healthcare. Its insights will be critical for NHS policymakers, developers and healthcare professionals as they navigate the delicate task of aligning cutting-edge innovation with patient-centred care. ●

IMAGE: ISTOCK

The first patient with breast cancer has recently been scanned in a new, exciting study conducted at Guy's and St Thomas' Hospital and King's College London, which is investigating the possibility of monitoring treatment response of patients with bone metastases at the early stages of treatment. Led by Research Fellow in Osteoporosis Dr Amelia Moore and Chair in Molecular Imaging Professor Gary Cook, the project explores a promising avenue in personalised medicine and improving women's health.

Dr Moore says: "There are approximately 57,000 women affected by breast cancer in the UK each year, and one of their greatest fears is that the cancer will spread to their bones, referred to as bone

Clinical Scientist **Georgios Krokos** outlines a new study that it is hoped will improve scans to determine how well treatment is working for women with breast cancer.

BONE METASTASES SCANS

Improving outcomes for breast cancer



Right. Frontal X-ray of the left hip of a 40-year-old female patient with primary breast cancer, showing secondary bone cancer.



metastases. This is because more than 70% of the 10000 patients dying each year in the UK of breast cancer have bone metastases. Bone is the most common site for breast cancer to spread, and once bone metastases develop, they can cause significant morbidity including pain, fractures at the sites of cancer, spinal cord compression and increased calcium levels (hypercalcemia). Furthermore, bone metastasis can make the bones fragile and likely to break, particularly in the ribs, spine, pelvis and long bones of the limbs, which can dramatically affect mobility, independence and quality of life.”

Improve scans

The aim of the study is to determine whether we can improve scans of breast cancer that has spread to the bones to more accurately determine how well treatment is working.

$\alpha\text{v}\beta 3$ integrin is a protein expressed by osteoclast cells, which are involved in the development and progression of bone metastases in breast cancer. [$^{99\text{m}}\text{Tc}$]-maraciclalide is a radioactive tracer that targets the $\alpha\text{v}\beta 3$ integrin, allowing us to visually determine osteoclast activity in the metastatic bone lesion using single photon emission computed tomography (SPECT).

The team has previously shown that [$^{99\text{m}}\text{Tc}$]-maraciclalide can be used to highlight bone metastases in men with prostate cancer and the aim of the current study is to determine whether this same tracer and scan can be used to detect bone metastases in women with breast cancer and predict treatment response.

A novel aspect of the study is the utilisation of both SPECT and positron emission tomography (PET) imaging. Dr Moore says: “One of the study objectives is to compare the $\alpha\text{v}\beta 3$ integrin changes measured from the [$^{99\text{m}}\text{Tc}$]-maraciclalide SPECT performed at the Nuclear Medicine Department at Guy’s Hospital with standard imaging using the F-18 fluorodeoxyglucose (FDG) PET/CT scan performed at the PET Centre at St Thomas’ Hospital. The two different imaging modalities complement each other because the changes observed with the [$^{99\text{m}}\text{Tc}$]-maraciclalide SPECT scan is related to osteoclast activity, whereas the

[^{18}F]FDG PET/CT scan is used to visualise areas of high glucose metabolism and is related to changes in tumour activity. An exciting area for future collaboration between the two imaging teams would be in investigating regional changes in bone formation using the tracer [^{18}F] sodium fluoride and the new total-body PET/CT scanner and measuring changes in bone resorption using the [$^{99\text{m}}\text{Tc}$]-maraciclalide SPECT scan. The potential to measure both bone formation and resorption would be an important contribution to improving diagnosis and management of both metabolic diseases, such as osteoporosis, and metastatic bone disease.”

Bone health

Bone health is a growing area of concern, particularly in postmenopausal women with breast cancer. Dr Moore says: “Osteoporosis is a metabolic bone disease characterised by weakened bone strength and is a significant concern for women with breast cancer because some of the treatments, particularly hormone therapy and some chemotherapy drugs, can accelerate bone loss and increase the risk of fractures. Oestrogen plays a key role in maintaining bone health because it keeps the osteoclast cells, which are responsible for bone resorption, in check. Bone resorption and bone formation are an important part of the bone remodelling cycle, which is essential for maintaining bone strength and integrity. However, some breast cancer treatments lower oestrogen levels, either by blocking oestrogen’s effects (e.g. aromatase inhibitors) or by reducing oestrogen production (e.g. through surgery or medications such as gonadotropin-releasing hormone [GnRH] agonists). Low oestrogen levels are a major risk

factor for osteoporosis, because increased bone resorption can start earlier than it naturally would through the menopause.”

Despite the high prevalence of bone metastasis in patients with breast cancer, treatment response is still a challenge with no recognised method currently available which highlights the importance of this study.

“Although some imaging methods exist for assessing treatment response in bone metastases, (e.g. X-rays, bone scan, CT scan and magnetic resonance imaging (MRI), it is recognised that these are relatively insensitive and it may be several months before a response or lack of response can be measured, such that skeletal metastases are often regarded as being non-measurable disease,” says Dr Moore. “The delay in being able to accurately assess bone metastases means that many patients will experience side effects from treatment they are not benefiting from.”

Personalised therapy

Dr Moore says when recruitment was initiated for the study earlier this year, there was a lot of enthusiasm, but there were some issues to address. “All participants have been very receptive to hearing about the study. However, there are several challenges that we have experienced regarding recruitment including competitive recruitment with other studies that might also benefit participants. We also need to perform the first [$^{99\text{m}}\text{Tc}$]-maraciclalide SPECT scan before the patient switches to a new endocrine treatment, and sometimes the patient must start a new treatment before we can perform the scan. Good communication with the breast cancer research team where the patients are seen in clinic and the imaging teams is key to the success of the study”

This research aims to bring us closer to personalised therapy by identifying whether a treatment is successfully controlling bone metastases at an early stage – an important milestone in improving the lives and health outcomes of women with breast cancer. ●

Dr Georgios Krokos is a Clinical Scientist – PET Medical Physicist, working at the PET Centre at Guy’s and St Thomas’ Hospital

ARE YOU SITTING COMFORTABLY?

Investigating upright radiotherapy of the breast



Design evolution of Simon Ingram's upright arm supports for radiotherapy of the breast

Dr Tracy Underwood, Head of Translational Research at Leo Cancer Care Ltd and a UKRI Future Leaders Fellow, discusses research that could overturn an established assumption.

At Leo Cancer Care, we're reassessing a long-held belief in radiotherapy – that most patients must be treated lying down. As a med-tech start-up, we are developing upright radiotherapy systems that rotate the patient instead of the treatment beam. This approach can reduce

the size and cost of treatment facilities, particularly for proton and ion therapy, where rotating gantries are large, expensive, and technically complex.

Marie, named in recognition of Marie Skłodowska-Curie's legacy, combines an upright rotating patient positioning system, developed at our UK site, with an upright computed tomography (CT) scanner designed by our Wisconsin team. Marie recently gained FDA approval and will initially be used alongside proton beamlines from other manufacturers at clinics in the US. It is designed to be compatible with multiple beam modalities, including protons, carbon ions and photons.

How do patients respond?

For upright radiotherapy to become routine, it must be grounded in robust clinical evidence, inclusive and human-centred design and cross-sector research. With grant support from UKRI, we've established a UK research network that includes University College London, UCLH, the University of Nottingham, Sheffield Hallam University and Loughborough University. Together, we are addressing key research questions including: How do patients respond to upright positioning? Might this posture improve treatment experience or outcomes? What are the implications for stability, comfort and setup reproducibility? How do anatomical shifts affect dose delivery, target coverage and exposure to organs at risk?

When IPEM President Dr Anna Barnes invited me to

contribute to this special issue celebrating women in medical physics, I was pleased to join the celebration and to reflect on the many exceptional women I have the privilege of working with across industry, academia and clinical radiotherapy. One of our current research priorities is assessing the feasibility of upright breast radiotherapy. Much of the scientific work in this area is being led by women: researchers, clinicians and engineers collaborating across disciplines and international boundaries. To date, more than 75 women have also volunteered to participate in our studies, generously contributing their time and perspectives to help us explore the clinical implications of upright positioning in breast radiotherapy. It is both humbling and inspiring to work with these participants – many of whom have lived experience of cancer and radiotherapy – all motivated by a shared desire to inform care decisions for future patients.



Gordon Sands, Elizabeth Chabner, Jemma Nunn and Tracy Underwood

Patient perspectives and arm positioning

One of our key collaborators in this area is Professor Heidi Probst, an academic therapeutic radiographer at Sheffield Hallam University and Honorary Fellow of IPEM. Prof Probst has spent her career championing the patient voice in radiotherapy. Her previous projects include “Respire”, a patient-facing deep inspiration breath hold (DIBH) learning resource, and the development of the “Support 4 All” bra, designed for use during treatment to improve comfort and breast positioning.

In partnership with Prof Probst's team, we ran a series of patient engagement workshops across the UK using a portable version of our upright positioning system. Working alongside Sarah “Smizz” Smith, a therapeutic radiographer and live-drawing artist, the workshops first explored the most challenging elements of conventional supine breast radiotherapy from a patient perspective. They then considered how upright positioning might improve the experience. Common themes included an increased sense of agency, reduced physical vulnerability and the opportunity to have more natural social interactions and eye contact with radiographers during set-up.

A persistent challenge in upright breast radiotherapy is how to position the arms to allow clear beam access while maintaining patient comfort. For many patients, especially those recovering from surgery or chemotherapy, raising their arms into a conventional radiotherapy treatment position can be extremely uncomfortable, or even impossible. To address



A patient perspectives workshop on breast radiotherapy, led by Heidi Probst and Janet Ulman.

this, we worked closely with physiotherapists to develop devices to support an arms-up upright posture that is as neutral and pain-free as possible. In the past, radiotherapy immobilisation designs have often failed to reflect the diverse needs and comfort of patients. To improve this, we embarked on a collaborative design effort, led by our Senior R&D engineer Simon Ingram together with human-centred designer Dr Ross Tierney, Professor Mike Fray from Loughborough University's design school, physiotherapists, radiographers and charities including Macmillan Cancer Support and HER Breast Friends. After many iterations, we now have prototypes that, based on patient and clinician feedback, appear to be both clinically viable and comfortable for a wide range of women.

International research collaborations

Our research is enriched by collaborations across Europe and the US. In France, Sophie Boisbouvier, a research radiographer at Centre Léon Bérard, led the first two research studies using the Leo upright positioning system. Alongside her PhD research, Sophie is a passionate advocate for building research pathways for therapeutic radiographers in France – her leadership is having real international impact.

From across the Atlantic, we've collaborated with Dr Elizabeth Chabner, a radiation oncologist and founder of Chabner XRT, a product line of post-surgical and radiotherapy-specific bras currently in use across the globe. Her clinical insights and deep commitment to patient care have shaped our research into upright breast radiotherapy.

Most recently, we carried out a healthy volunteer study in Woking with Dr Chabner. This study was led by Dr Gordon Sands with key contributions from Jemma Nunn (both at Leo Cancer Care) with recruitment support from local Women's Institutes, and Research Ethics Committee support from University College

London. A total of 21 women took part, allowing us to collect 3D surface scan data to assess the impact of the Chabner XRT bra on external anatomy, beam access across different arm positions and setup reproducibility in both upright and supine postures. Early findings are promising: analysis of the external body contours suggests that upright photon-based breast treatments are feasible in terms of beam clearance.

We also believe that the Chabner XRT, Support 4 All, or similar bras will play a valuable role in upright treatment. In an upright posture, breast tissue tends to fall medially under gravity, which can deepen the inframammary fold. A well-designed bra can reduce/eliminate this fold and potentially improve dosimetry by decreasing field size and lung dose. Patient feedback also tends to be very positive, many women report that wearing a bra during treatment would enhance their sense of modesty, dignity, and psychological comfort.

Understanding internal anatomy

How posture affects internal anatomy, particularly the relationship between the heart and the breast, is another critical line of investigation. Prof Penny Gowland and her magnetic resonance imaging (MRI) physics team at the University of Nottingham are world leaders in the field. Surprisingly little is known with regards to how anatomy and physiology change between supine and upright postures, as upright MR and CT scanners are not yet widely available. There is evidence from CT-based studies that on average lung volumes are greater for upright body positions. Working with Prof Gowland's group, we're using one of the UK's few upright MRI scanners – adapted by Dr Olivier Mougin to have the necessary capabilities – to study how the positions of the heart, lungs and breast tissue shift between supine and upright postures. Together with Dr Rashed Sobhan from Prof Gowland's team, we've now scanned around 30 healthy women. We will now work with teams at UCL and UCLH (led by A/Prof Jamie McClelland, Derek D'Souza and Prof Catharine Clark) to analyse how these body changes might influence radiotherapy treatment planning. The dataset from Nottingham will feed into future dosimetry studies, helping clinicians predict heart and lung doses in upright breast treatments, whether using photons or protons.

Conclusion

Our work is driven by a diverse, collaborative network of researchers. While this issue rightly celebrates women in medical physics, we're grateful to everyone we work with across disciplines, sectors, and genders. Continued research is vital to understand how upright radiotherapy could be applied across a broader range of cancer sites and anatomies. We welcome collaboration with partners interested in exploring these questions further. ●

Trainee Clinical Scientist **Saoirse Conroy** outlines a project to create a baby phantom and a national diagnostic reference level for full-body neonatal X-rays.

Every time an X-ray is taken, a trade-off is made between diagnostic benefit and radiation risk. For adults, this balance is fairly straightforward. But for babies the stakes are higher. Their tiny, rapidly developing bodies are far more vulnerable to the stochastic effects of radiation. And yet, these are the very patients who might undergo over 30 X-rays in one go as part of a skeletal survey.

When a child attends the hospital with suspicious injuries they can be referred for an X-ray skeletal survey following guidance from the Royal College of Radiologists (RCR). They recommend a systematic, full-body set of X-rays, with up to 34 views of the patient's whole body during the

IMAGE: ISTOCK

3D PRINTED BABIES AND X-RAY BEAMS

How phantoms could make scans safer for infants



3D-printed phantom of the front of a baby's skull

initial scan, and a further 11 or so views during a follow-up scan 14 days later.

While the guidance from the RCR is thorough on what images to take, it doesn't provide any advice on how much dose the patient is expected to receive. That means no standard for exposure settings, no benchmark dose levels and no guarantee that imaging across hospitals is consistent.

That's where my MSc project came in. I set out to create a national diagnostic reference level (NDRL) for these full-body X-rays, collecting real-world data from over 1700 paediatric patients across all 12 regions of the UK. But that wasn't all. I also wanted to go beyond the spreadsheets and physically test how dose could be optimised – without exposing a single baby to more radiation

Enter the phantom

To improve the protocol at a local level, I needed a way to test changes to scanning protocols – without exposing any real babies to extra radiation. The answer? Phantom models.

In medical imaging, phantoms are artificial stand-ins for human bodies, built to mimic the way tissue and bone respond to X-rays. But ready-

made paediatric phantoms are expensive and very much out of a masters project budget. So instead of buying one, I decided to build my own.

Using anonymised neonatal X-rays as blueprints, I set out to create three anatomical phantoms: a skull, a spine and a knee. The process was part engineering, part art.

It started with pixel data from real patient images, which were exported and turned into 3D coordinates. The trick was figuring out how each pixel's brightness could be translated into height for 3D printing. To do this, I ran test prints – little blocks of polylactic acid (PLA), the chosen printing material – at different heights and compared how they showed up under X-ray. This helped calibrate the conversion between image

greyscale and physical dimensions.

Once that relationship was cracked, each X-ray image was transformed into a 3D-printable file. But there was a problem: high-resolution X-ray images when directly converted created files the size of a coffee table. So, a bit of clever averaging was introduced to reduce the resolution just enough to stay printable without losing too much detail.

The result? Phantoms that could mimic real patients under the scanner, that in person looked more like plastic stalagmites.

PLA is a cheap, readily available 3D printing material. It has a mass attenuation curve that is very similar to that of human soft tissue, making it an ideal material to represent soft tissue in an X-ray phantom. "But soft tissue isn't like bone", I hear you cry. Worry not, as I will let you in on a little secret... Infant bone is not like

bone either. Infant bone resembles cartilage much more than it does hard calcified adult bone; it has far more elasticity than adult bone and requires far lower exposure settings to be visible on a standard X-ray than

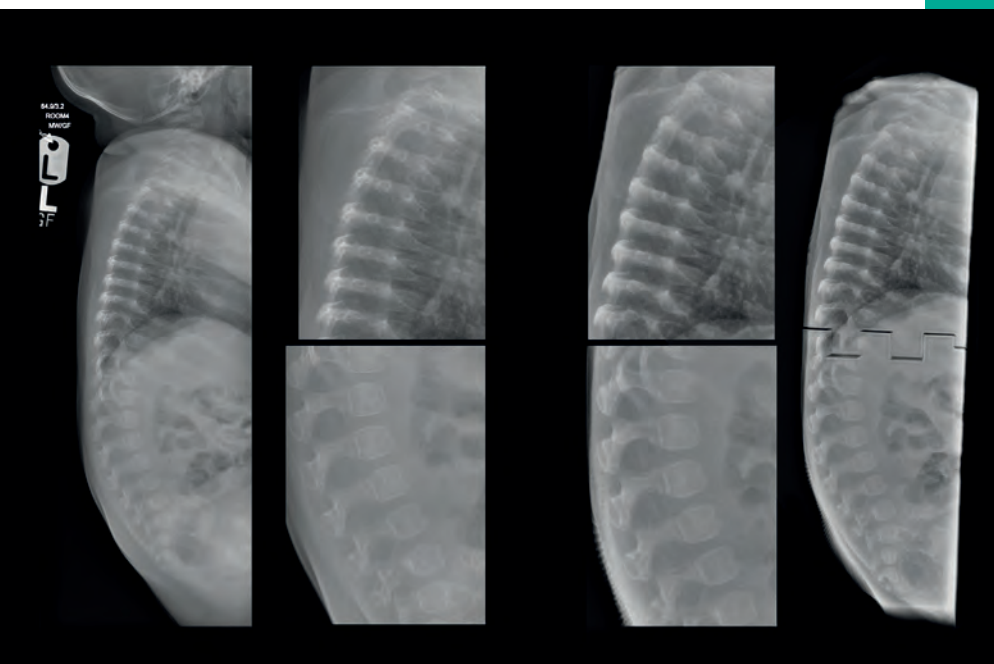
adult bone. Because of this, PLA could be used to also mimic infant bone with just a few cm of extra printing height.

Putting the phantoms to the test

Once the phantoms were printed, I ran them through the same X-ray protocols used on real infants. But I didn't stop there – I also tried out various alternative scanning settings. Could reducing the radiation dose still produce images good enough for diagnosis?

Two paediatric radiologists reviewed the phantom scans blind. And the results were surprising: for the skull and spine, they found virtually no meaningful difference in image quality across the range of settings, despite quite stark differences

IT'S A POWERFUL REMINDER THAT INNOVATION DOESN'T HAVE TO BE FLASHY – IT JUST HAS TO WORK



Left. Comparison between the patient's spine (left) and the phantom (right).
Below. 3D-printed phantoms of a baby's spine

in the measured dose area product (DAP). The machine's post-processing software had such a strong influence on contrast and clarity that small tweaks to exposure settings barely made a dent. The DAP readings for the patients original scan settings were close to the median of all the settings tested, so we decided to keep these settings the same going forward.

There was one exception. The knee phantom – scanned using a lower milliamperes-seconds (mAs) setting – produced what one radiologist called a “crisper” image. It also had a lower

DAP reading than the patients original setting. As a result, we decided to adjust the local knee protocol, lowering the radiation exposure without compromising image quality. Mission accomplished: practical dose optimisation, with no babies harmed in the making.

Bigger implications

These humble phantoms aren't just about tweaking one X-ray room's imaging settings. Their impact stretches far wider.

Firstly, the same models could be used repeatedly to compare different scanners, settings, or imaging techniques. They're reusable, modifiable and cheap to replicate. Secondly, they open the door for hospitals without access to commercial phantoms to conduct their own local dose optimisation work. Thirdly, they set a precedent: you don't need a massive budget to make imaging safer. You just need a printer, a plan and a bit of creativity.

But no research project is complete without its hiccups – and this one had plenty. What sounded like a simple case of “just print a 3D baby part” quickly turned into a series of unexpected challenges.

The first hurdle? G-code errors. When rotating the digital phantom models slightly, strange holes appeared in the first 12 layers of the print – leading to weak, unstable bases. It took a few frustrating sessions before I realised: just zero the rotation. Problem solved.

Next, print temperatures caused all sorts of chaos. Prints cooled too quickly, causing layers to peel away. Adhesion

to the print bed failed completely at one point, lifting the entire print off the plate and almost destroying the printer nozzle. I had to re-tune the nozzle and bed temperatures and keep the printer chamber warm and enclosed during prints. Lesson learned: environmental control matters.

Another hidden gremlin – the filament itself. It became tangled and coiled, because swapping filament mid-print is a fiddly nightmare. My attempt to untangle the reel manually led to a full-on filament spaghetti monster. It took hours to wind it back without snapping the thread.

Even when everything seemed to work, I ran into warping. The two parts of the spine phantom didn't align because one warped slightly from the cooling fan, meaning I had to shave and reshape it by hand to get a usable result.

But despite the bumps in the road, the final phantoms worked. They scanned, produced images, and let us test real-world protocol changes in a way that was safe, cheap and surprisingly effective.

Tiny bones, big impact

What started as a data-driven effort to create a national benchmark for paediatric X-ray exposure evolved into something much more tangible: printed bones, real test scans and practical changes to how infants are imaged at my local hospital.

This project proved that meaningful improvements to patient safety don't always require million-pound budgets or commercial tech. Sometimes, they just need a curious mind, a few reels of PLA, and a lot of persistence. In a healthcare system often stretched thin, low-cost solutions like these phantoms offer a powerful reminder: innovation doesn't have to be flashy – it just has to work. And when it comes to protecting the most vulnerable patients in the NHS, that matters more than anything. ●

Saoirse Conroy is a Trainee Clinical Scientist in Medical Physics, studying at King's College London and training at St George's Hospital and Royal Marsden. If you would like to know more about the project, email saoirse.conroy@nhs.net



We look back over the career of the former Head of Medical Physics and Bioengineering at University Hospital Southampton and IPEM Past President.

IN MEMORY OF DR PETER C JACKSON



Peter Jackson, an esteemed medical physicist and former President of the Institute of Physics and Engineering in Medicine (IPEM), passed away peacefully earlier this year. He was 75.

Peter's career in medical physics spanned over four decades, characterised by leadership, innovation and a lifelong commitment to service – both in the NHS and within the wider scientific community. After earning his BSc in Physics from the University of Bath in 1972, Peter began his professional journey at Bristol General Hospital. His early years in the field were marked by rapid progression, culminating in the award of a PhD in 1982. He went on to author the widely used reference book *Radionuclide Imaging in Medicine – Theory and Practice*, published in 1986.

Over the years, Peter's work took him across the globe, including visits to Sri Lanka, Oman, Japan and North America, where he contributed to the training and

development of fellow physicists and supported international collaborations in medical imaging and MRI technology. His dedication to advancing clinical science was reflected not only in his own research but also in his efforts to mentor others and share knowledge through both formal and informal avenues.

In 1994, Peter was appointed Head of Medical Physics and Bioengineering at Southampton General Hospital, a role he held until his retirement in 2008. During his tenure, he demonstrated a rare ability to balance scientific rigour with compassionate leadership, consistently placing patient care and staff development at the heart of his work. As President of IPEM, he played an influential role in shaping the profession, representing the Institute nationally and internationally with humility and distinction.

After his retirement from the NHS, Peter continued to contribute through consultancy work and maintained a strong connection to the field he loved. His service was not confined to professional

boundaries – he was deeply involved in his local church communities, serving as a church steward, youth leader, Gift Aid Secretary and later as a trustee and school governor. His strong Christian faith was central to his life and inspired his commitment to serving others.

Those who knew Peter remember not only his intellect and professionalism, but also his warmth, humility and joy. With a broad smile and an infectious laugh, he lit up every room he entered. He was a devoted husband, father and grandfather and gave his family the same dedication and support he gave his profession. Peter gave generously of his time and energy.

He lived his life with quiet purpose, guided by faith and an unflinching desire to help others – a legacy that lives on through his family, his colleagues and the many professionals he mentored throughout his career.

Peter is survived by his wife, three children and four grandchildren. He will be remembered with deep affection and enduring respect by all who knew him. ◉

Radiotherapy Physicist **Polly Darby** reports back on the European Society for Radiotherapy and Oncology Congress 2025.

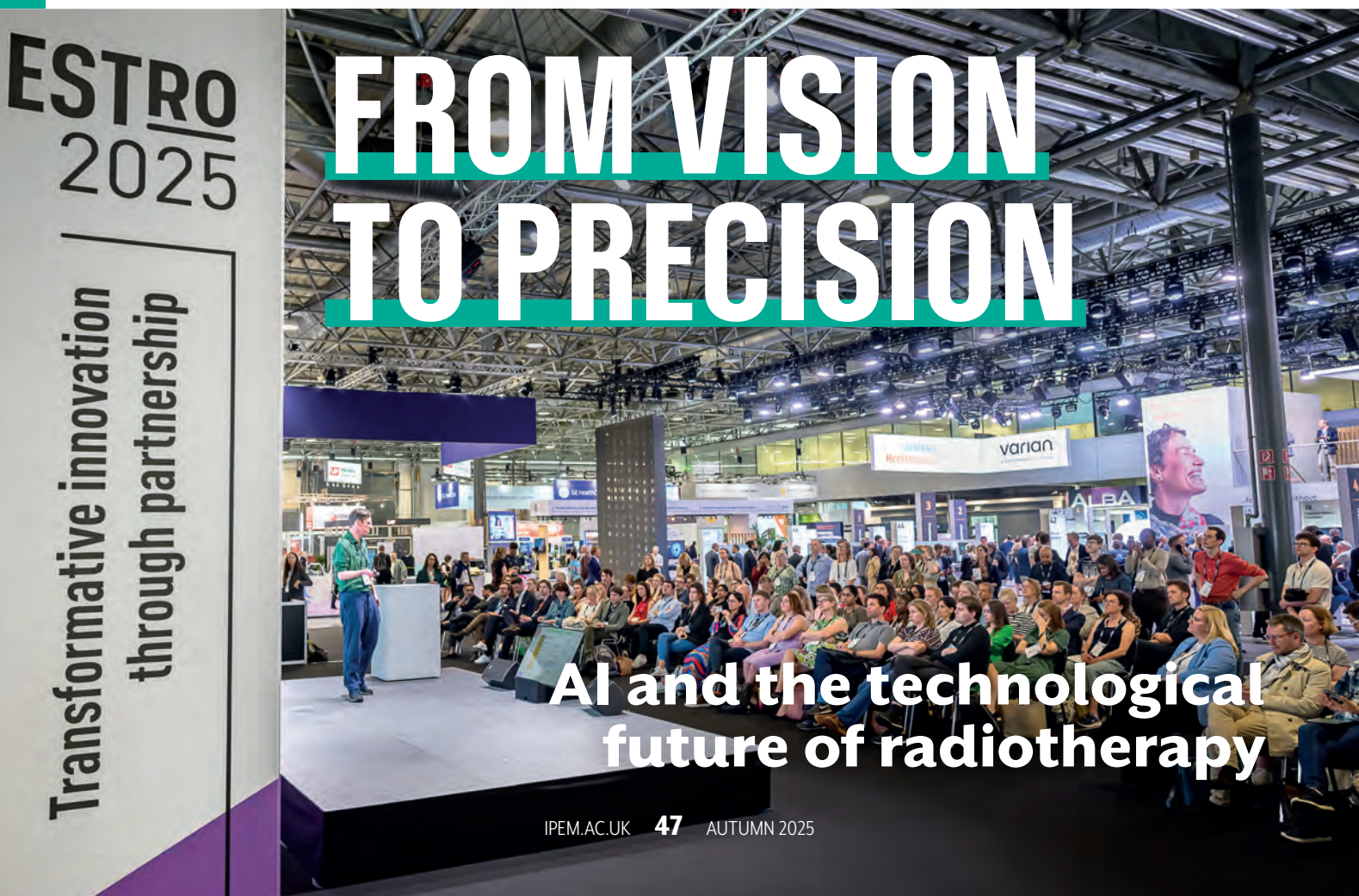
Sitting in front of the main stage on the final day of the European Society for Radiotherapy and Oncology (ESTRO) Congress 2025, I feel a mix of cautious optimism and genuine excitement. The congress theme, “transformative innovation through partnership”, could not be more fitting. Over the past few days, I have witnessed an exciting blend of new technology, clinical insights and cross-disciplinary collaboration, all contributing to a compelling vision for the future of radiation oncology. The transformation of radiotherapy over the

IMAGES: © ESTRO / MARKO KOVIC

past three decades is well recognised, evolving from 2D to 3D conformal radiotherapy and then to intensity-modulated and image-guided therapies. What is now emerging is even more profound: a paradigm defined not just by spatial accuracy but by intelligent precision. At the core of this shift are artificial intelligence (AI), automation and a network of partnerships that are reimagining how we deliver, plan and even conceptualise cancer treatment.

The AI-driven radiotherapy pathway

The integration of AI into the radiotherapy workflow is now a reality, shaping clinical practices. AI is being implemented in several key areas: contouring and segmentation, treatment planning and optimisation, image guidance and adaptation and outcome prediction and decision support. Historically, each of these stages required significant time and expert input. Now, deep-learning models are accelerating tasks such as organ-at-risk (OAR) delineation, enabling clinicians to focus on complex, value-driven decisions. Automation platforms powered by AI can generate clinically acceptable contours in



minutes, thereby reducing interobserver variability and allowing for more detailed peer review.

Yet perhaps more exciting is the potential of AI to adapt treatment in real time. AI-supported adaptive radiotherapy (ART) workflows are emerging, enabling efficient daily replanning of treatments based on anatomical changes, offering unprecedented levels of personalisation.

From dose escalation to dose avoidance

The technological evolution in radiotherapy has traditionally focused on dose escalation – delivering higher radiation doses to tumours while keeping exposure to surrounding tissues within tolerable limits. Although this approach has led to improved local control of cancer, it has also revealed an ongoing issue – many patients still experience significant acute and late toxicity.

At ESTRO 2025, it is becoming increasingly clear that the next phase must equally prioritise dose avoidance. This focus is especially important as patients are living longer, making survivorship a significant aspect of care. Administering even a single unnecessary gray (Gy) to an organ at risk is a potential cause of lifelong morbidity. AI and automation can contribute meaningfully by optimising beam angles and fluence to minimise low-dose exposure, predicting toxicity through radiomics and the utilisation of big data and guiding strategies for reducing treatment margins with real-time imaging and motion tracking.

Redefining margins with imaging and intelligence

If incidental dose is the problem, treatment margins are part of the solution. The clinical target volume to planning target volume margin serves as a buffer, compensating for uncertainties in patient setup, motion and anatomical change. But margins come at a cost: more irradiated normal tissue.

Emerging technologies showcased at ESTRO allow for precise imaging at the moment of treatment. When combined with AI-based image analysis and motion modelling, these advancements enable the possibility of individualised treatment margins. This means that we may be able to reduce margins without compromising safety, which could significantly improve the therapeutic ratio.

Imaging dose: the hidden burden

As imaging becomes more central to radiotherapy, another concern surfaces – imaging dose. Cone-



A selection of photographs from ESTRO 2025, which took place in Vienna, Austria on 2–6 May.



beam computed tomographs (CTs) and kV-kV pairs contribute cumulative doses, particularly concerning in paediatric or reirradiation cases.

Some vendors are now exploring AI-enhanced image reconstruction, which enables lower imaging doses without compromising image quality. AI can denoise and enhance images taken at a fraction of the standard dose, maintaining visibility of soft tissue contrast for guidance or adaptation. The drive toward “intelligent imaging” – characterised by high-quality, low-dose and context-aware imaging – is one of the most promising trends for reducing cumulative exposure.

SBRT and reirradiation

Another strong theme across this year’s congress is the growing application of stereotactic ablative body radiotherapy (SABR) and reirradiation. Both techniques





require extreme precision and high planning complexity. AI has several promising roles in these areas, particularly in the design of treatment plans using knowledge-based planning and in the deformation of previous dose distributions onto new anatomy.

In the context of reirradiation, AI-enabled cumulative dose summation from previous and current scans is empowering clinicians to assess treatment feasibility with greater confidence. For SABR, intelligent planning systems are capable of generating multiple treatment plan variants that are optimised for robustness, conformity, or delivery speed. This flexibility enables clinicians to select the best approach tailored to each patient's unique situation and preferences.

Partnership: the engine of transformation

The central theme of this year's ESTRO congress, "transformative innovation through partnership", highlights an important truth in radiotherapy – innovation thrives when practice meets possibility. This collaboration is most evident in the partnerships formed among the NHS, academic institutions and industry. These collaborations are not merely coincidental, they are essential structural components that drive progress.

NHS: the clinical foundation. The NHS offers a real-world environment where technologies must prove their value, not just theoretically, but in terms of patient outcomes, safety and workflow efficiency. NHS centres function as both incubators and testing grounds, ensuring that tools developed through research or industry are genuinely effective in a high-volume clinical setting.

Academia: the engine of research. Academic institutions have taken the lead in algorithm development, modelling and early validation. Through clinical trials, open datasets and multicentre studies, academia builds the scientific legitimacy behind AI. Furthermore, academia plays a key role in training the future workforce – from physicists who understand AI algorithms to radiation oncologists who can interpret AI-informed risk models.

Collaborative academic networks, such as those established through the National Institute for Health and Care Research, Cancer Research UK and Horizon Europe projects, have the potential to enable pan-European studies on adaptive therapy and AI-driven prediction tools, setting new standards for clinical evidence.

Industry: The bridge to scale Industry partners, particularly those providing treatment planning systems, imaging platforms and linear accelerators, play a vital role in scaling innovations. They possess

the engineering expertise necessary to turn prototypes into market-ready products, seamlessly integrating them into existing workflows and providing the support needed for widespread implementation.

Forward-thinking companies are not just vendors, they are co-developers, working side by side with NHS clinicians and academic researchers to build tools that meet real-world needs. The most successful technologies today are those shaped not in isolation, but in multi-stakeholder development cycles that include clinical feedback, regulatory oversight and patient involvement.

Challenges ahead

Despite the potential benefits, adopting AI in radiotherapy isn't without its challenges. The key issues include:

- **Data bias:** Many AI tools are trained on homogeneous datasets. It's crucial to expand these datasets to include diverse populations.
 - **Transparency:** Black-box models raise concerns about understanding and trust. Users need to comprehend how these tools function to feel confident using them.
 - **Regulation:** Establishing clear standards and validation frameworks is essential to ensure clinical safety and facilitate adoption.
 - **Access:** We must ensure that advanced AI tools do not exacerbate global health disparities.
- The discussions at ESTRO highlight a growing awareness of these challenges and a commitment to responsible innovation.

Conclusion: towards intelligent precision

The atmosphere at ESTRO 2025 is vibrant, driven not by hype but by a shared commitment to reshaping radiotherapy through intelligent technology. AI is not meant to replace clinicians, physicists, or radiographers; rather, it enhances their expertise, allowing them to focus on complex decision-making and patient-centred care.

The most important lesson for this year's congress may well be that technology alone is not transformative – partnership is key. Only through deep collaboration between the NHS, academia, and industry can we turn innovation into real impact and vision into precision.

This is not just the age of precision radiotherapy. It is the dawn of intelligent, collaborative radiotherapy – and it is being built, one partnership at a time. ●

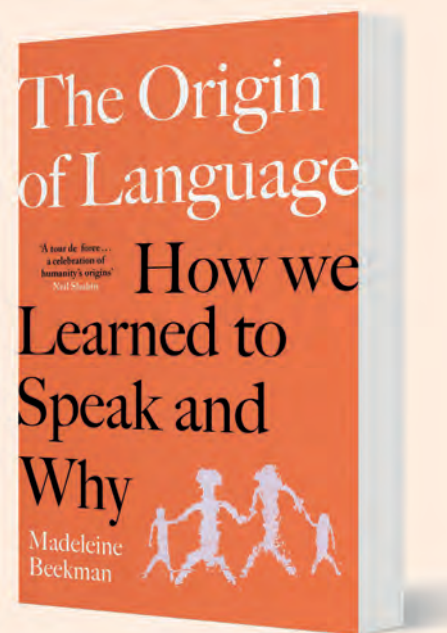
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BOOK PITCH

The Origin of Language: How We Learned to Speak and Why



Professor Madeleine Beekman outlines the ideas behind and the content within her new book.



Most of us take our ability to speak for granted. But if you think about it, language is far from intuitive. For starters, we are the only species to have the ability to convey abstract concepts like infinity, justice or equality, via a series of superbly controlled burst of air. How and why did evolution craft such bizarre capability? *The Origin of Language* explores humans' evolutionary journey, uncovering a series of mishaps that, combined, made us speak. Because what is stunning about our decent from other apes over the last 6 million years or so is that it boils down to just six or seven key moments. For me, losing a chromosome, neoteny (the slowing down of development as embryo), chromosome inversion, gene repair, gene duplication, and the decent of the larynx collectively sum up how we got from chimpanzees to chatty apes.

Language first became a possibility when our brains grew large enough and our voices versatile enough for us to assign complex meanings to complex sounds. The versatility required to mould the sounds of human speech was an indirect side-effect of the skull change necessitated by our brain change. So, you could say that big brains themselves were the childcare solution our species sorely needed. But our big

brains were also the cause of the problem.

Our babies are born earlier because their heads are too large – and our birth canals are too small – for them to be born any later. But why did our brains get so big? And why did our hips get so narrow?

The pelvis problem was a side-effect of our walking upright. As our ancestors became better at walking on two legs, the pelvis adapted to improve our balance and allow for more secure attachment of the thigh muscles that now carried our weight. Those changes inadvertently pinched and narrowed the birth canal. Which was tolerable, until we let our heads get too big.

The brain problem originated with a torn chromosome inverting to create a “gene nursery”. Then a long-broken gene in the nursery got repaired and started copying itself. Once active, those copies served to slow down the process whereby glial cells

in the brain differentiate into neurons.

Bigger brains mean earlier births. Earlier births require more support. Language is how we ask for help and coordinate it. But developing a proto-language calls for more cognitive resources – bigger brains. With our ability to voice the needs of mother and child, we could accommodate more offspring with each generation. Which only exacerbated the demands of childcare but also safeguarded the survival of our species.

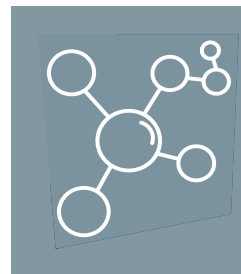
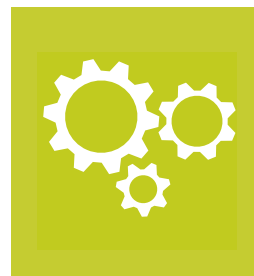
The tangible end product is a recursive language with unrivalled expressive power. A means of mind-melding that would eventually enable modern science and technology – taking us as high as the moon and as low as nuclear war. ●

MPCE RESEARCH RELATED TO LANGUAGE AND SPEECH

- Implementation of Air Recon DL on clinical real-time protocols for imaging speech (abstract for a session Delivered at IPPEM event “Everything MRI All At Once”): b.link/ynfum9d5
- A streaming brain-to-voice neuroprosthesis to restore naturalistic communication: b.link/9h37xkmc
- Weill Cornell Medicine's Bridge2AI initiative, in which an artificial intelligence platform uses voice to diagnose disease: b.link/c0pw8c00

Madeleine Beekman is Professor Emeritus at the University of Sydney

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