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Reducing Diagnostic Error in Radiology: The Role of Artificial Intelligence

Dr Peter MacMahon

Consultant Radiologist, Mater Misericordiae University Hospital, Dublin,
Clinical Professor, School of Medicine,
University College Dublin

#SCALearning25

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Understanding and Improving Diagnosis in Healthcare

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Reducing Diagnostic Error in Radiology:
The Role of AI

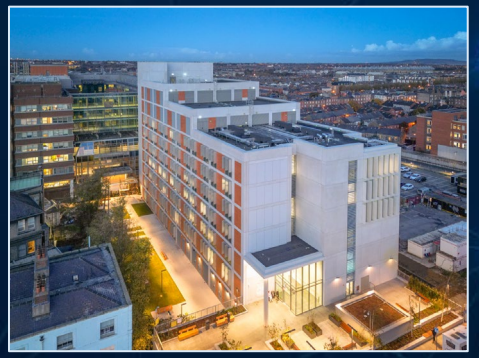
Prof Peter MacMahon

Consultant Radiologist, Mater Hospital

No declarations

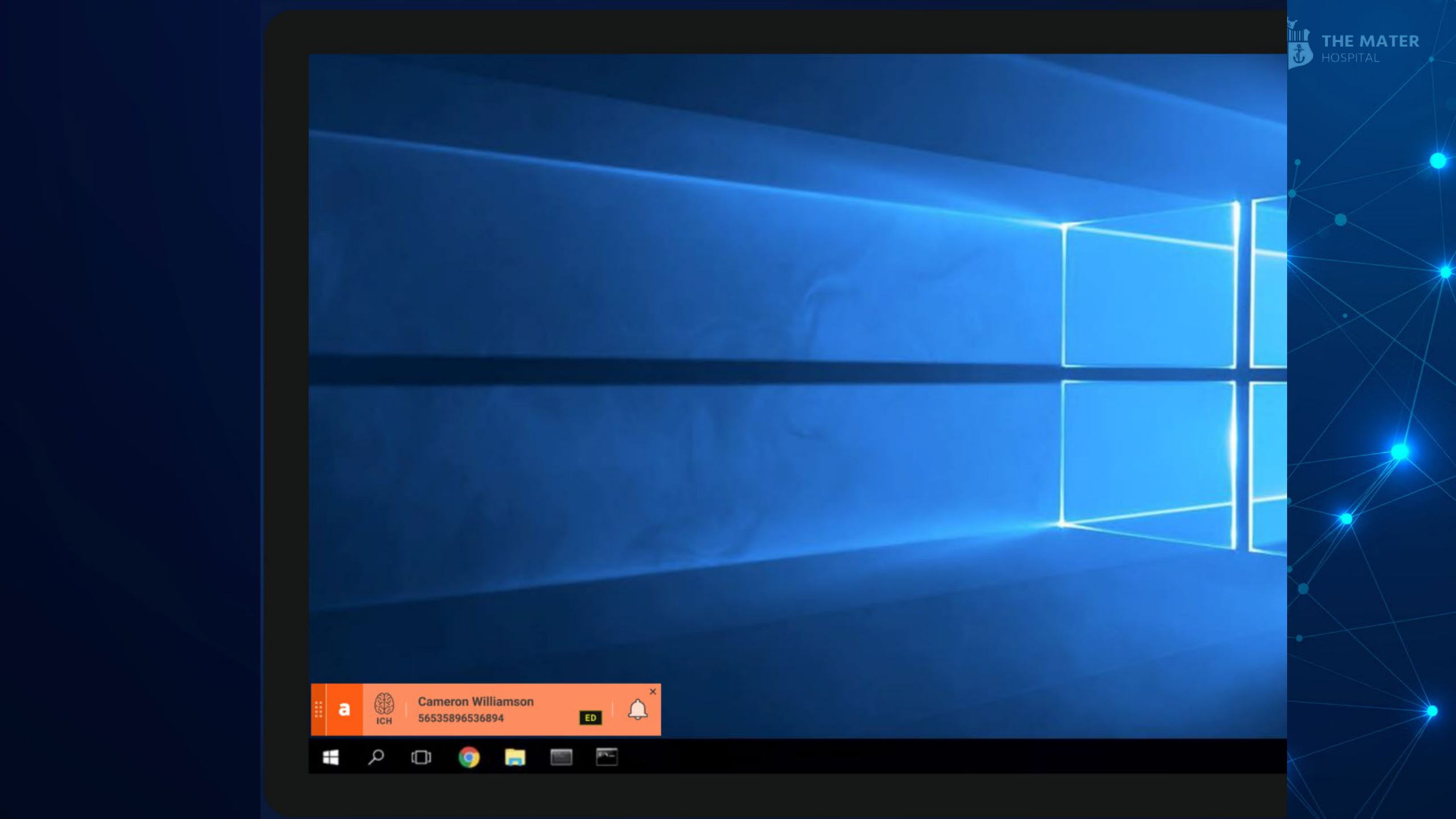
- No financial disclosures

Location: Mater Hospital. **Time**: 2am



- You are a trainee radiologist in your second year
- You have been working since 8am, the previous day
- You have analysed 25 emergency patient scans since 5pm
- Each scan is 500-1000 images

- Another patient scan arrives for reporting…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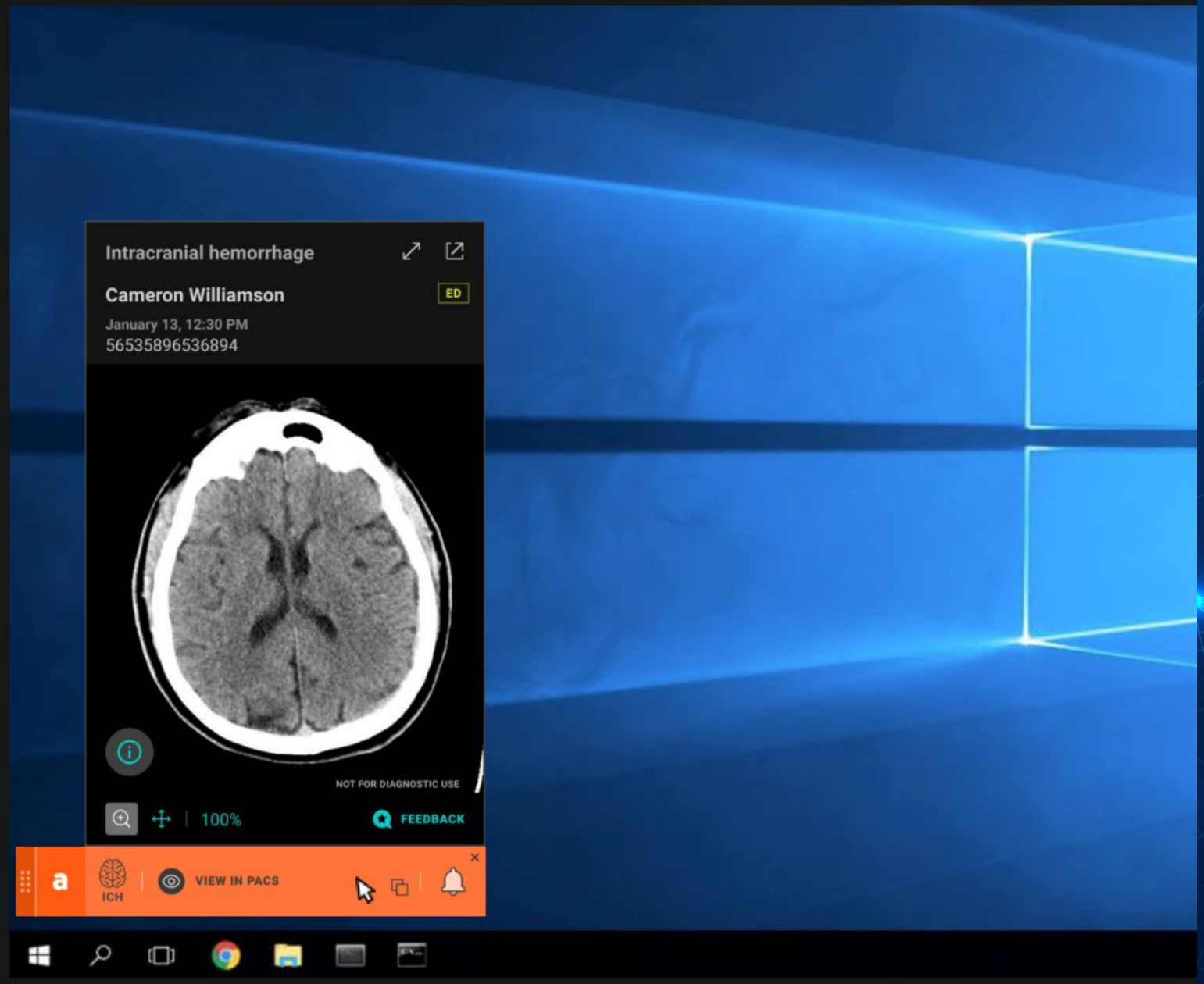
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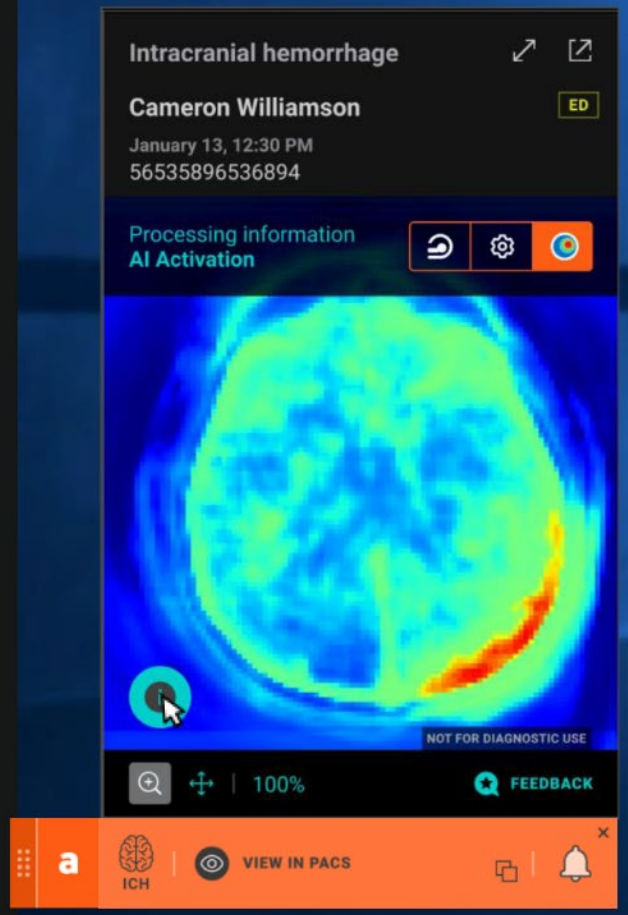
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AI in Radiology:

- AI is being used routinely, clinically, reliably, effectively, and today
- AI tools in radiology are currently deployed for specific clinical tasks, rather than acting as a universal solution

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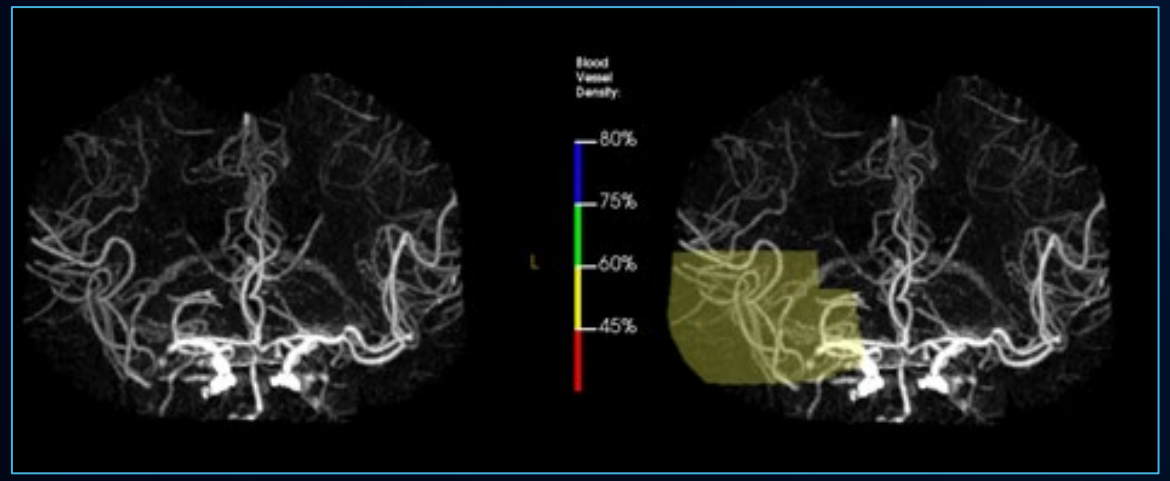
Stroke: Identifying vessel occlusions



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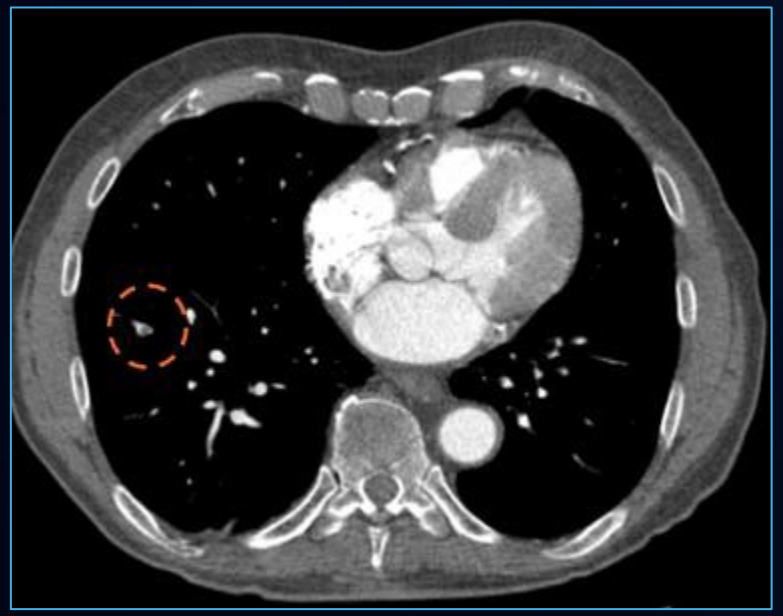
Chest



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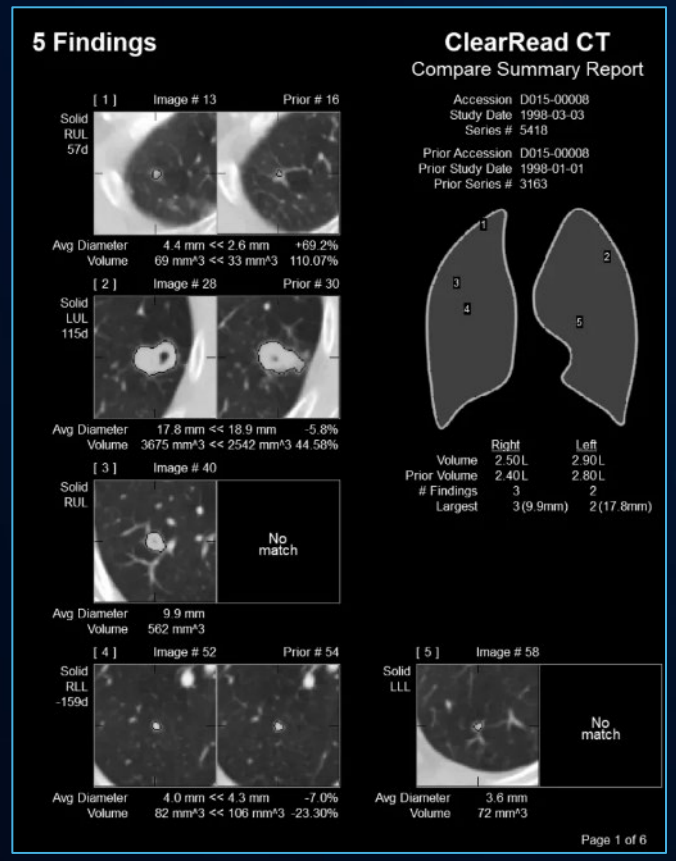

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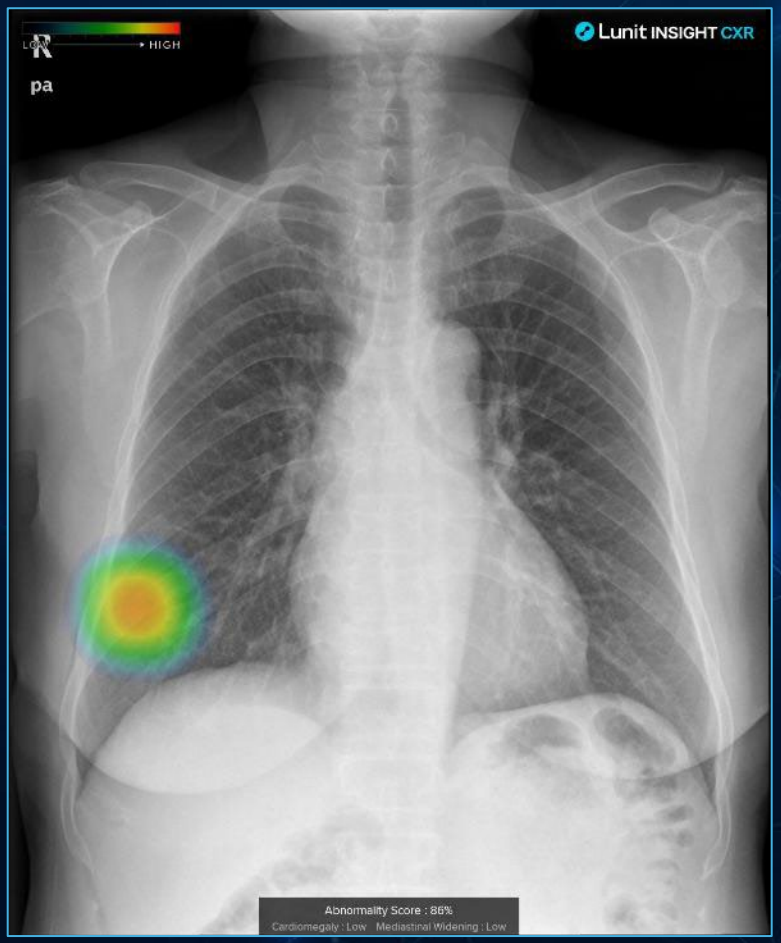

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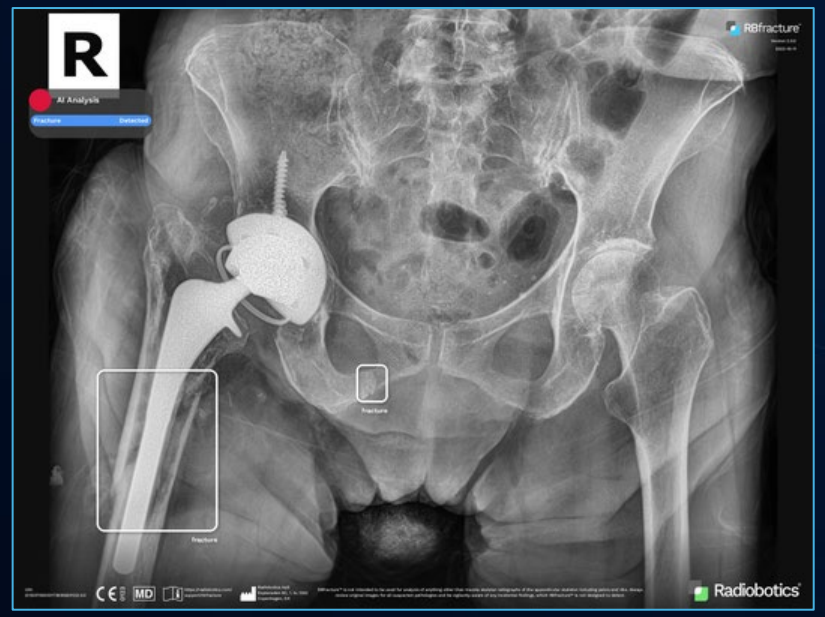
Bone Xray Analysis

Gleamer



Radiobotics

Gleamer

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Where diagnostic error arises in Radiology:

1) Seeing (perceptual)

- Subtle findings are easy to miss (tiny bleeds, hairline fractures)
- Fatigue, time pressure, interruptions, poor image quality / motion

2) Interpreting (reasoning)

- Anchoring on the first impression
- Availability bias (recent case colours judgment)
- Limited clinical context or misleading history

3) System & workflow (process faults)

- Delays (worklist order, backlog)
- Incomplete priors or outside imaging
- IT friction: multiple systems, alert overload

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How AI helps reduce these errors:

1) Seeing (perceptual)

- Second-reader highlights: flags subtle bleeds/fractures; heatmaps = “look here”.
- Smart triage: suspected critical scans jump the queue.
- Quality checks: detects motion/artefact; prompts a quick re-scan.

2) Interpreting (reasoning)

- Objective measurements: volumes, diameters, change-from-prior → less subjectivity.
- Consistency rules: cross-checks findings vs priors and clinical data.
- Decision support: suggests differentials; warns about common traps (e.g., anchoring).

3) System & workflow (process)

- Auto-prioritise & route: right study to right reader, fast.
- Closed-loop alerts: critical results notified and escalated if not acknowledged.
- Priors & outside imaging: auto-fetch/compare to prevent misses and delays.

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RCTs

THE LANCET
Digital Health

Articles

Screening performance and characteristics of breast cancer detected in the Mammography Screening with Artificial Intelligence trial (MASAI): a randomised, controlled, parallel-group, non-inferiority, single-blinded, screening accuracy study

Veronica Hernström, Viktoria Josefsson, Hanna Sartor, David Schmidt, Anna-Maria Larsson, Solveig Hofvind, Ingvar Andersson, Aldana Rosso, Oskar Hagberg, Kristina Lång

Summary

Background Emerging evidence suggests that artificial intelligence (AI) can increase cancer detection in mammography screening while reducing screen-reading workload, but further understanding of the clinical impact is needed.

Lancet Digit Health 2025
Published Online
February 3, 2025

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Mammography Screening RCT

- The largest medical A.I. randomized controlled trial yet performed, enrolling >105,000 women undergoing mammography screening

- The use of AI led to **29% higher detection of cancer**, no increase of false positives, and reduced workload compared with radiologists without AI

AI in Radiology: Current Applications

- AI is designed to augment, not replace, the radiologist's expertise

Tangible Benefits: Our Experience

- At the Mater, we have deployed AI tools for:

  Stroke:

  1. Automatic stroke volume assessment
  2. CTA analysis for Large Vessel Occlusion (LVO)
  3. Automated analysis of perfusion brain CT

  4. Non-contrast head CT for intracranial haemorrhage

  5. CT Cervical Spine (C-spine) for fracture detection

  6. CT Pulmonary Angiogram (CTPA) for Pulmonary Embolism (PE)

  7. CTs for incidental PE detection

  8. Plain radiographs for fracture detection in multiple body areas (e.g. wrist, ankle, elbow) including effusions, lesions and dislocations

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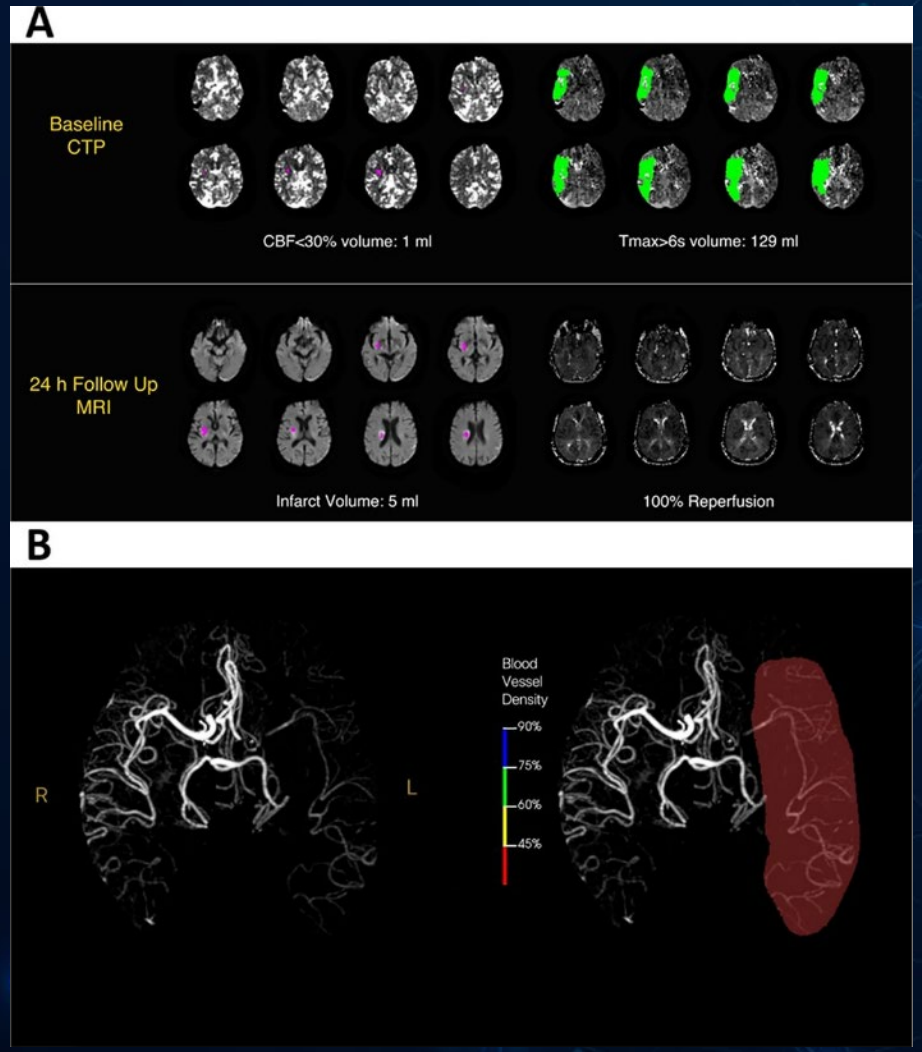
RAPID AI @ the Mater

RAPIDAI®

- Deployed in the Mater 2015
- Mater first in Ireland, first in British Isles, and one of the first in Europe
- Now the most commonly used stroke AI software world-wide



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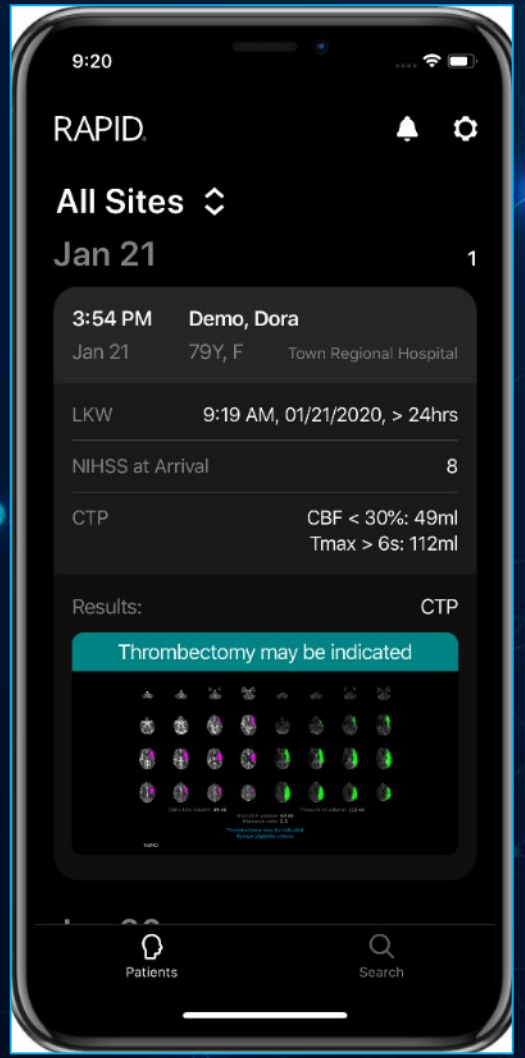
RAPID AI @ the Mater

RAPIDAI

- Estimates ASPECTS in stroke
- Assesses for haemorrhage
- Assesses for large vessel occlusions
- Analyses perfusion imaging



AI @ the Mater

- We have been exposed to the concept of automated analysis of medical imaging relatively early (2015)

- Quickly understood the tool made mistakes and that it was our job to understand the limitations and be ready to over-rule

- Fundamentally, it relatively reliably provides clinically important information that justifies any limitations
  - *It does not need to be perfect to be useful*

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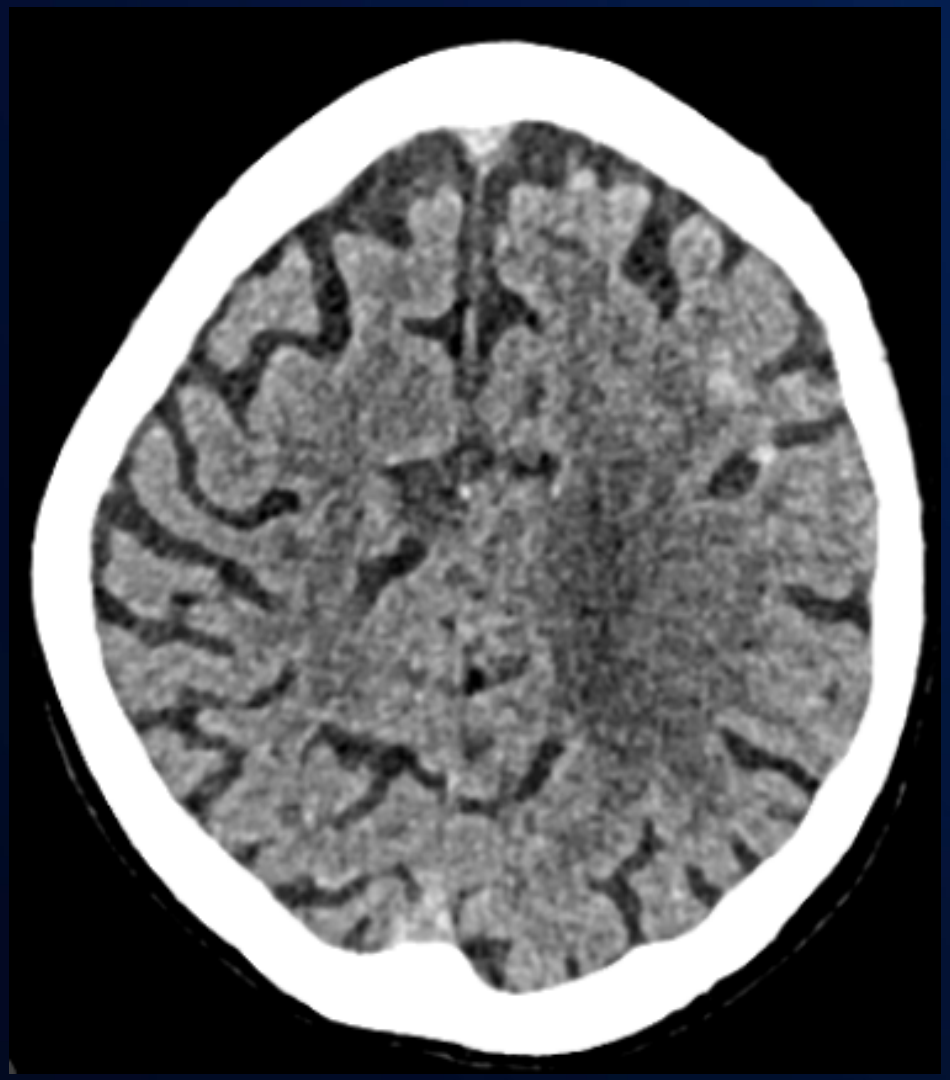
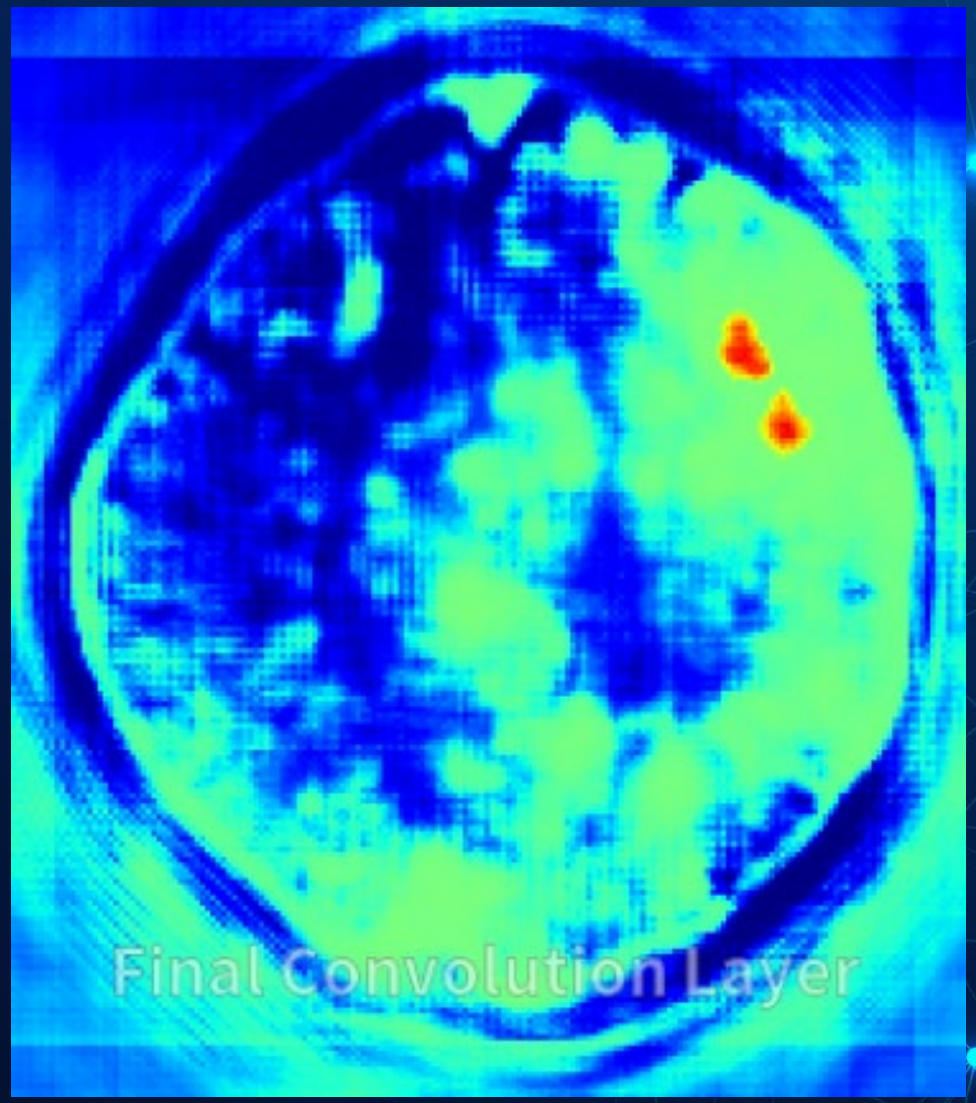
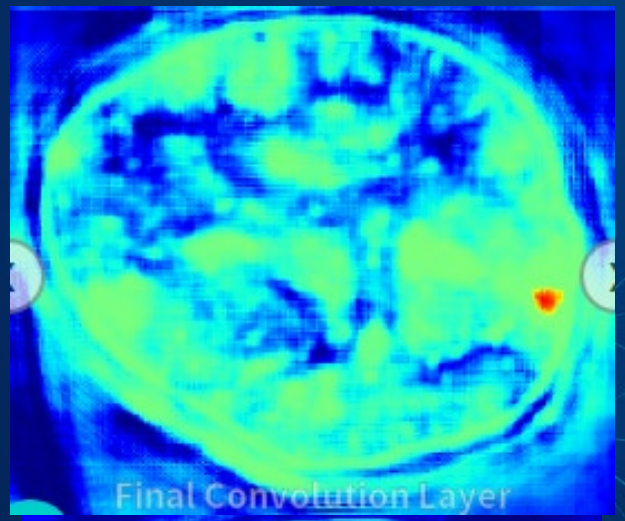
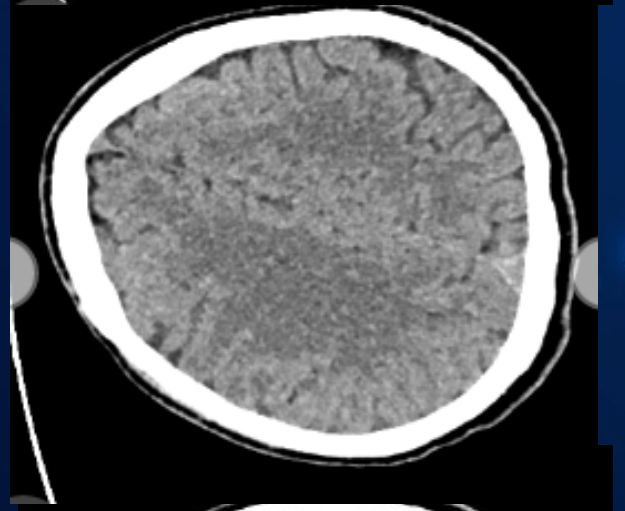
True positive:

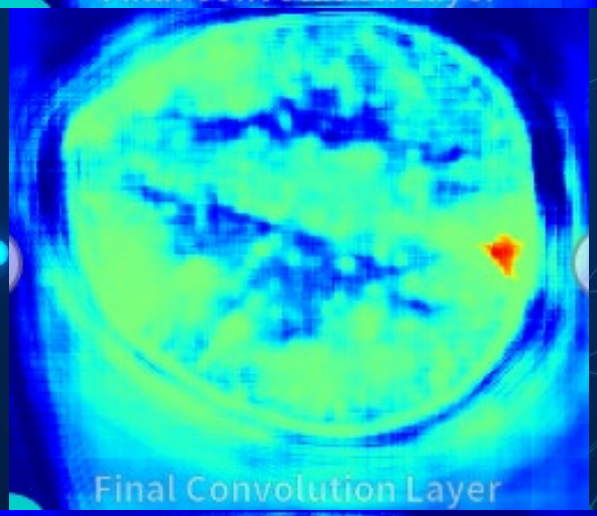


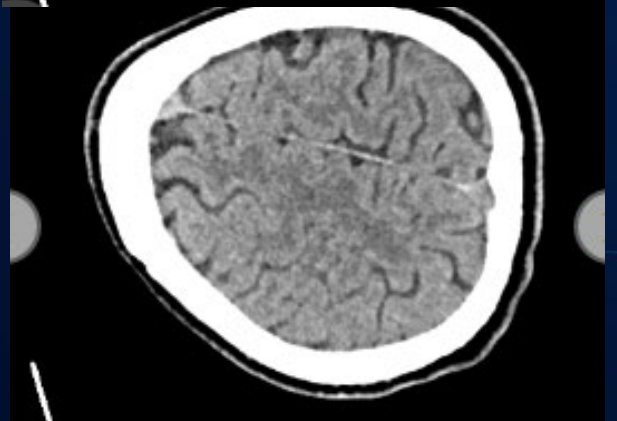


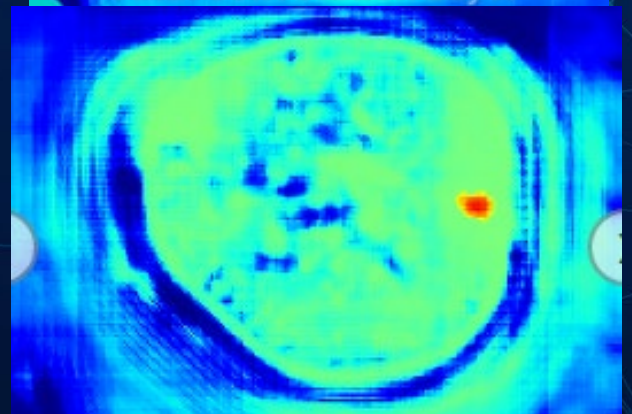
False Positive











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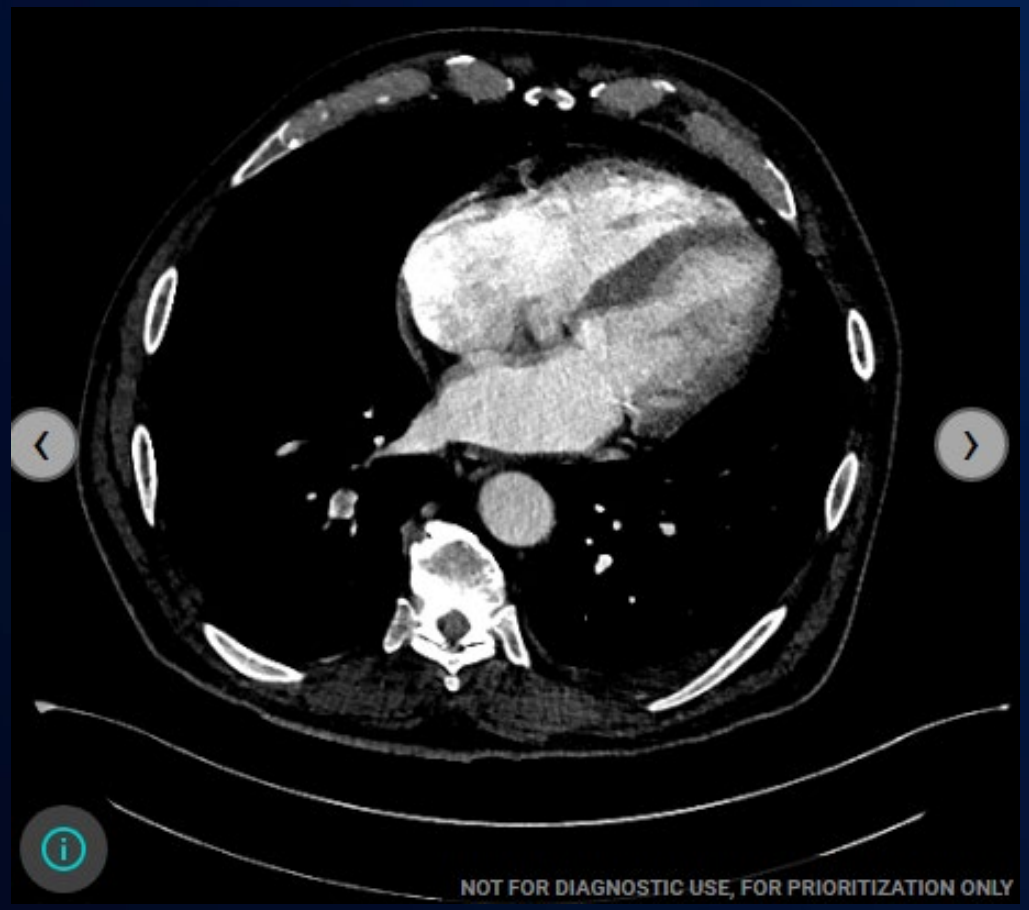

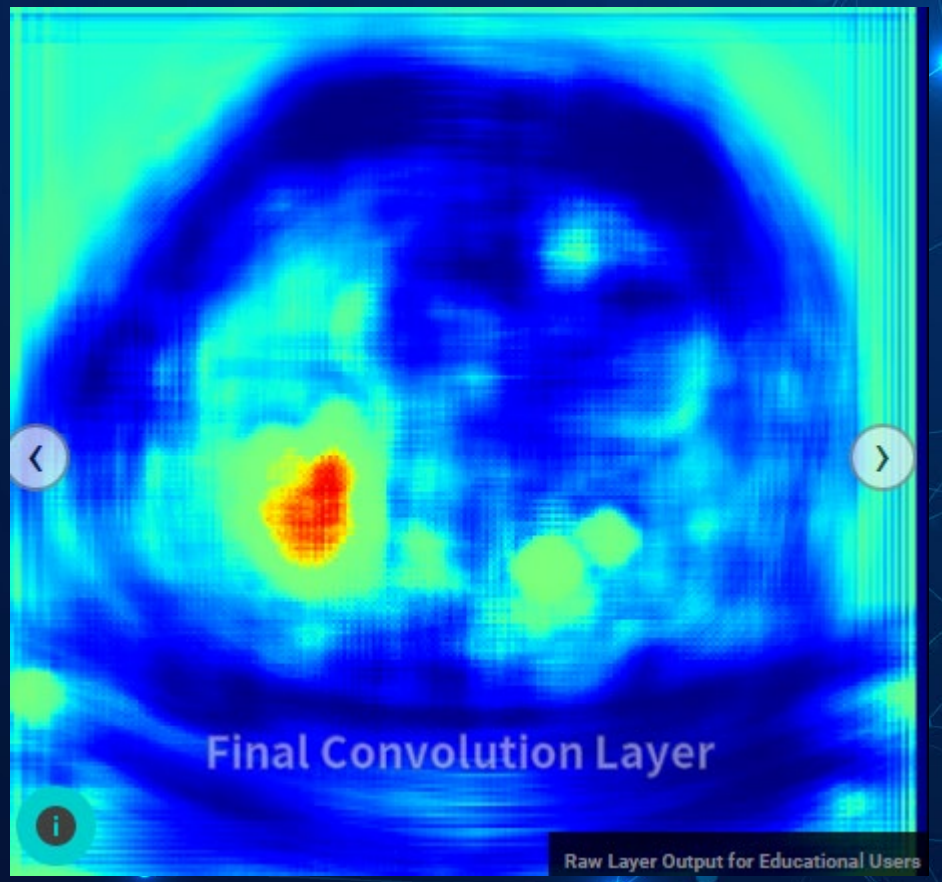

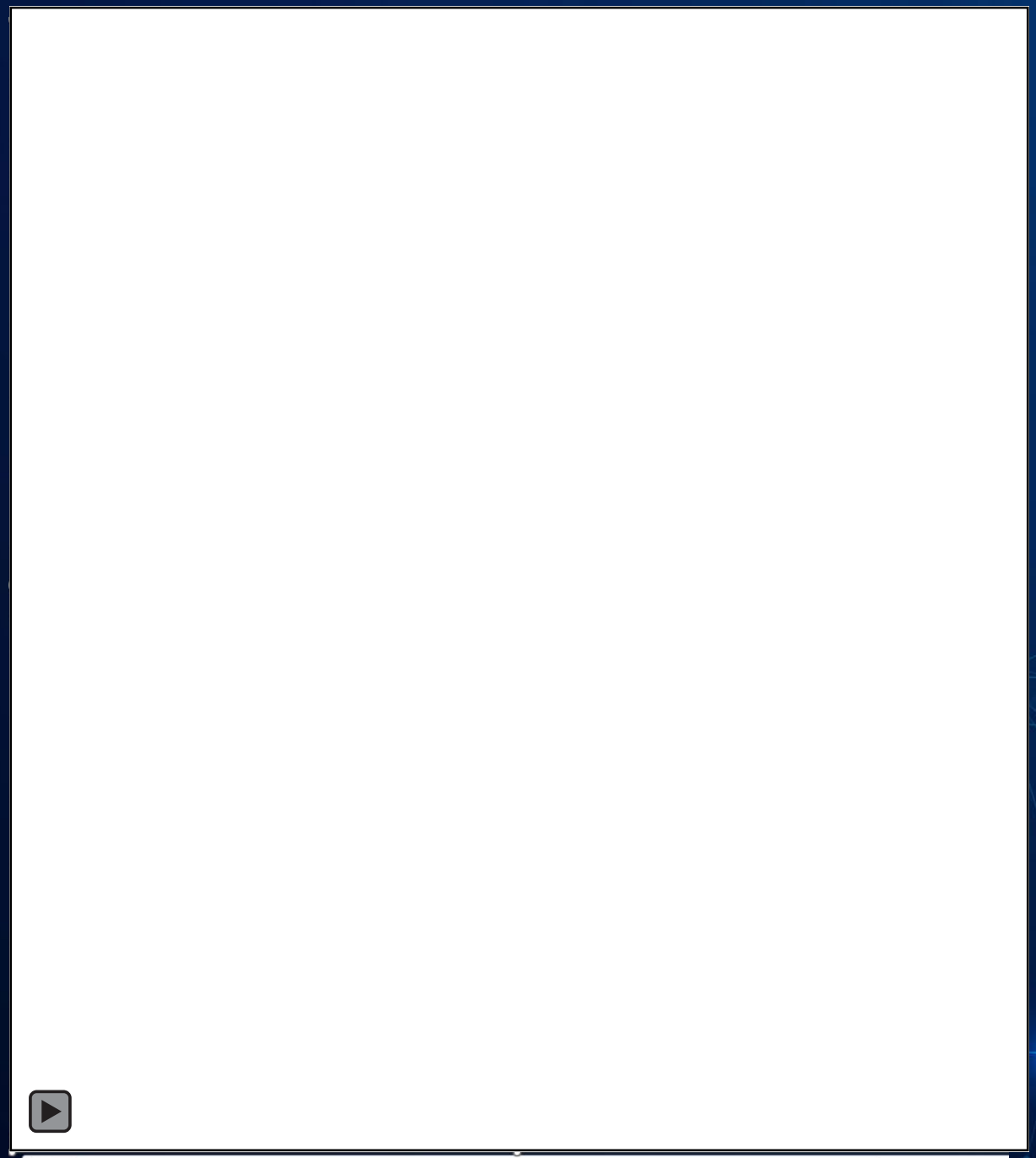
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Shaping the future of AI in healthcare: Learning from practice

NHS and RCR Global AI Conference 2025

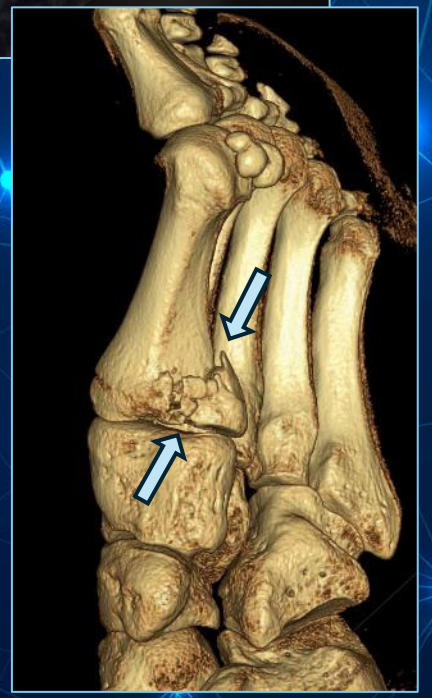
3-4 February 2025, QEII Centre, London and Online

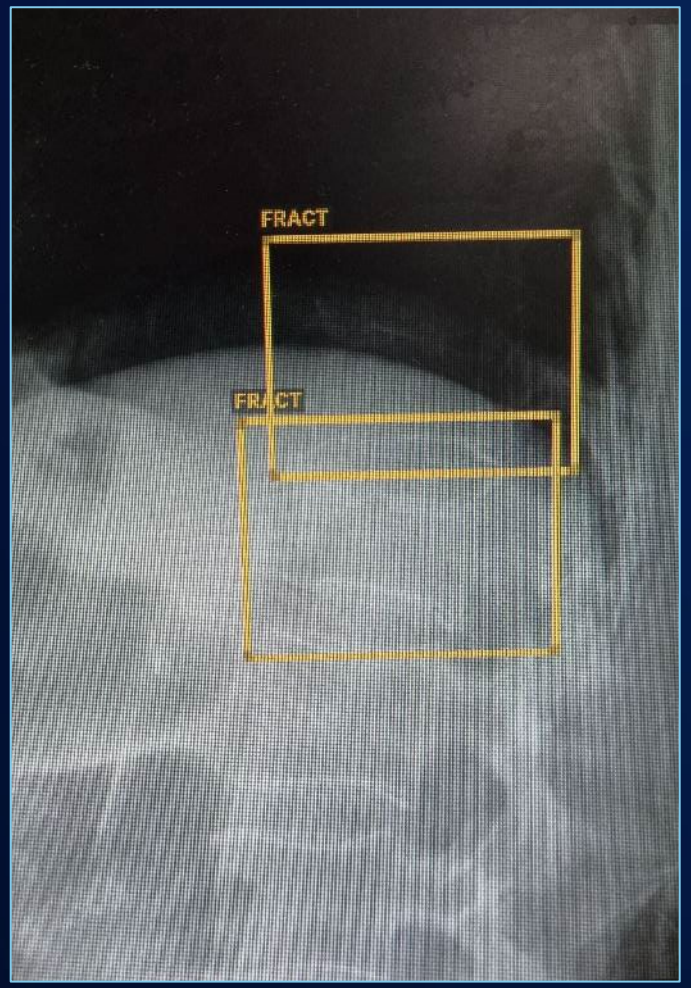
AI systems double detection rates for symptomless blood clots in lungs

The introduction of an Artificial Intelligence-enhanced scanning system at a hospital in Dublin in early 2023 led to a marked increase in the detection of pulmonary embolisms – blood clots in the lungs that can be fatal if untreated.

The finding, by researchers at Mater Misericordiae University Hospital
presented at the NHS and Royal College of Radiologists' Global AI Con
that detection rates of symptomless, 'incidental' embolisms in patient
chest CT scans doubled after AI was introduced.


FRACT





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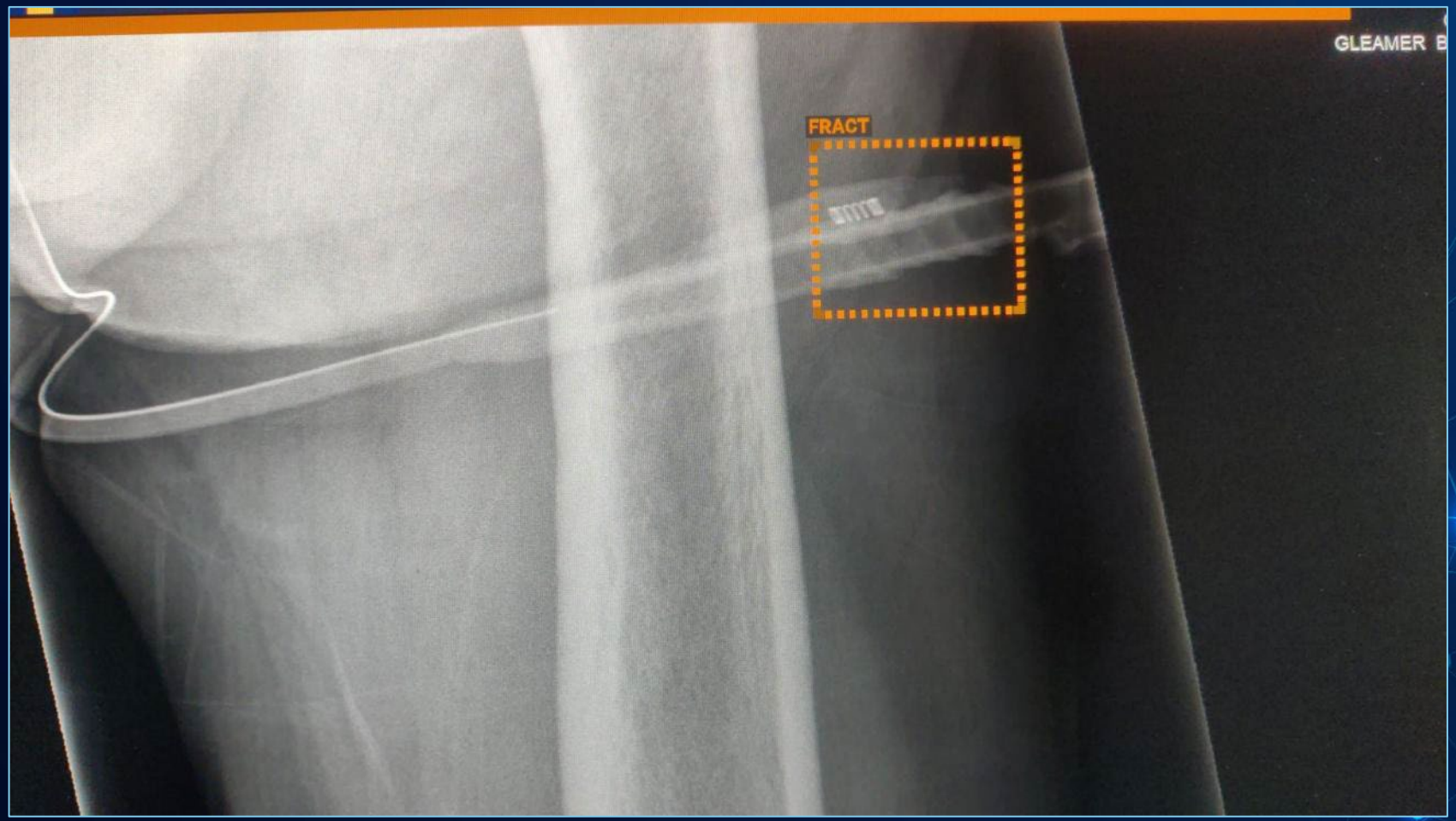
AI-Enhanced Fracture Detection in the **Mater ED**

Results:

- Pelvic/hip **fracture detection increased** from 12.7% in 2023 to 19.2% in 2024 (p=0.02)
- Spinal fractures **increased** from 14.7% to 21.3% (p=0.03)

AI diagnostic performance:

- Spine radiographs: Sensitivity 90%, Specificity 93%, PPV 79%, NPV 97%
- Pelvis/hip radiographs: Sensitivity 85%, Specificity 92%, PPV 71%, NPV 96%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Cauda Equina Syndrome

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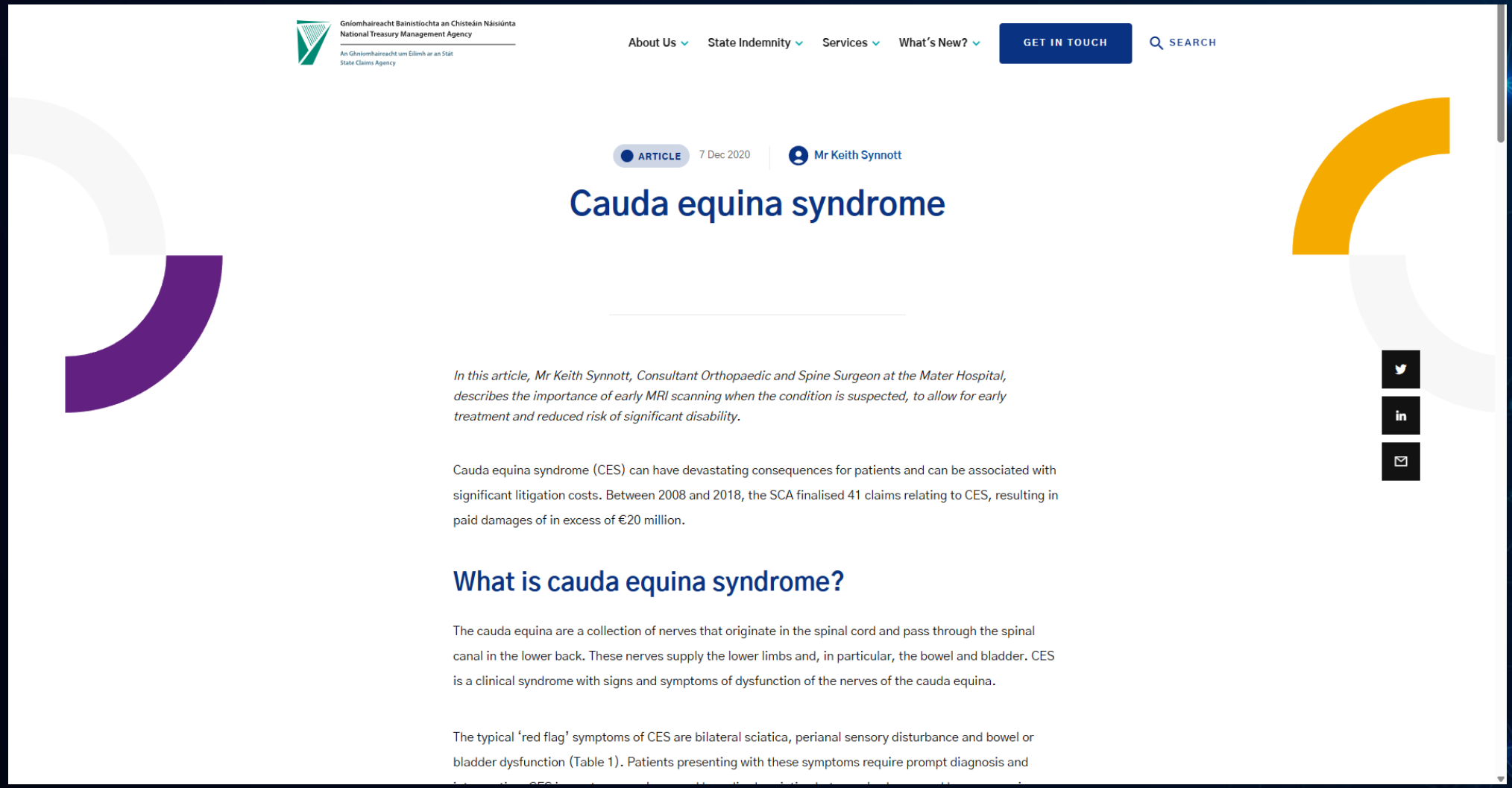
Cauda Equina Syndrome



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ARTICLE 7 Dec 2020 Mr Keith Synnott

Cauda equina syndrome

In this article, Mr Keith Synnott, Consultant Orthopaedic and Spine Surgeon at the Mater Hospital, describes the importance of early MRI scanning when the condition is suspected, to allow for early treatment and reduced risk of significant disability.

Cauda equina syndrome (CES) can have devastating consequences for patients and can be associated with significant litigation costs. Between 2008 and 2018, the SCA finalised 41 claims relating to CES, resulting in paid damages of in excess of €20 million.

What is cauda equina syndrome?

The cauda equina are a collection of nerves that originate in the spinal cord and pass through the spinal canal in the lower back. These nerves supply the lower limbs and, in particular, the bowel and bladder. CES is a clinical syndrome with signs and symptoms of dysfunction of the nerves of the cauda equina.

The typical 'red flag' symptoms of CES are bilateral sciatica, perianal sensory disturbance and bowel or bladder dysfunction (Table 1). Patients presenting with these symptoms require prompt diagnosis and

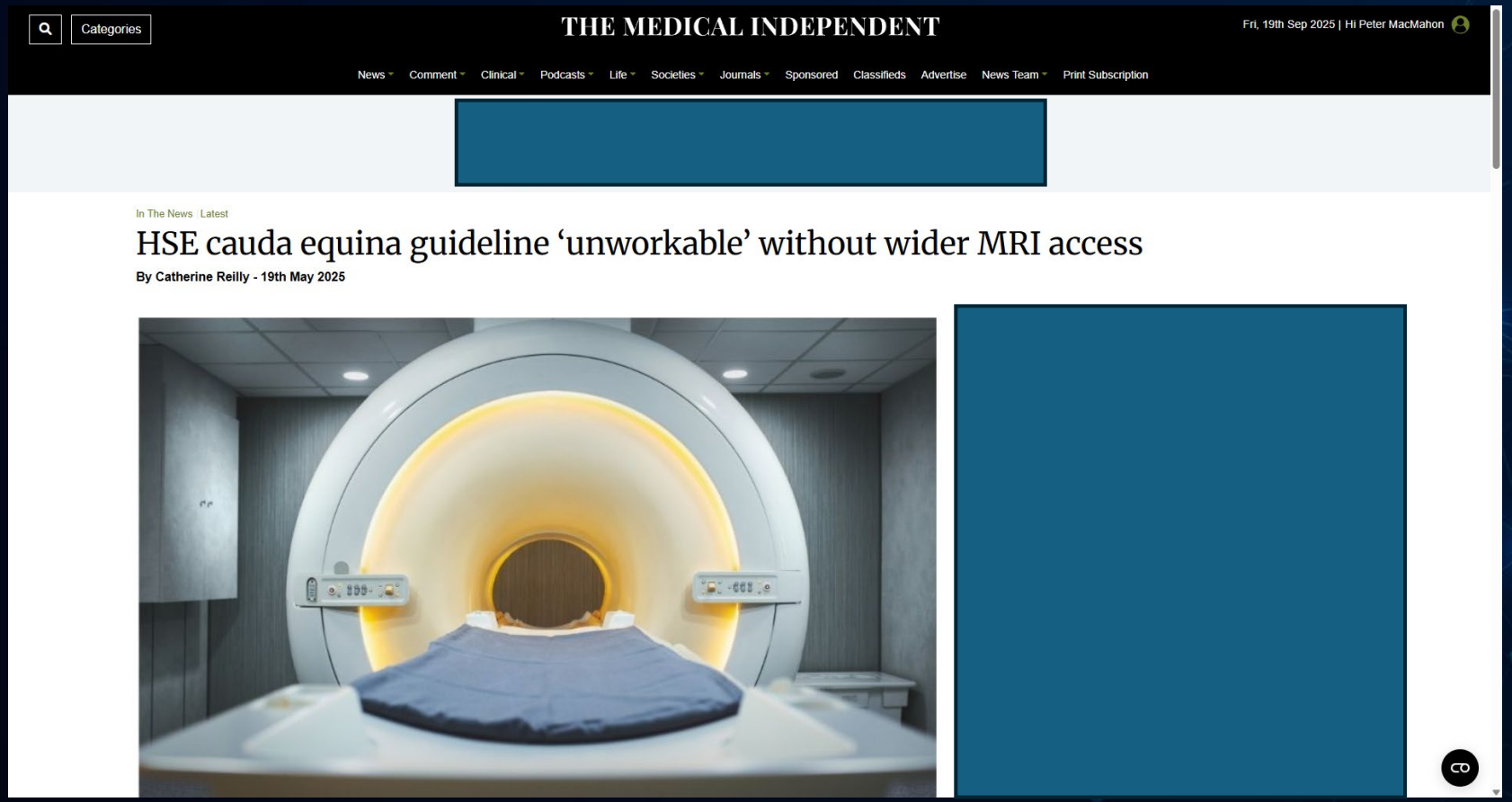
Cauda Equina Syndrome

sufficient to reach a diagnosis.[2] On occasions where an MRI is contraindicated, diagnosis may be made with computed tomography (CT) scanning with, or without, myelography.

> Where there is any clinical suspicion of CES an urgent MRI scan should be performed.
>
> **Mr Keith Synnott**
> Consultant Orthopaedic and Spine Surgeon at the Mater Hospital

There is evidence that clinical evaluation alone is neither sensitive nor specific enough to make or out rule a diagnosis of CES.[3,4] Presentations with just back pain may be associated with bowel or bladder issues. Where there is any clinical suspicion of CES an urgent MRI scan should be performed. The sole reliance on clinical judgment, even that of a senior consultant, is not recommended. Cases of CES can present to any GP or ED nationally but treatment is provided in a limited number of centres, necessitating transfer and

Cauda Equina Syndrome



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CT Spine

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SuperCT Spine

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Challenges and Limitations: A Reality Check

- Integration Complexity
- Validation
- Cost and Procurement
- Ethical and legal concerns

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Ethical and Legal Concerns

- Do patients need explicit consent for the use of AI?
- Will there be an over-reliance on AI?
- Who is legally responsible?

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Is the least risky path the best?

- Testing everyone for everything will mean we will miss nothing
- However, we cannot afford that, and it is not the right thing to do
- The problem is AI may always pick the least risky path
- In diagnostic testing: Being sensible and prudent is imperative, accepting that we cannot be perfect

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Will **AI** be Transformative in Diagnosis?

- Yes, but likely slower than everyone thinks
  - AI will reshape care, but only if we chip away at the hard, boring bits first
  - Clinicians remain the fail-safe for years to come

- Radiology with AI can be safer, faster but still needs to be human

Thank you

Peter J. MacMahon

Emergency and Musculoskeletal Radiologist, UCD Clinical Professor

Mater Misericordiae University Hospital, Dublin, Ireland