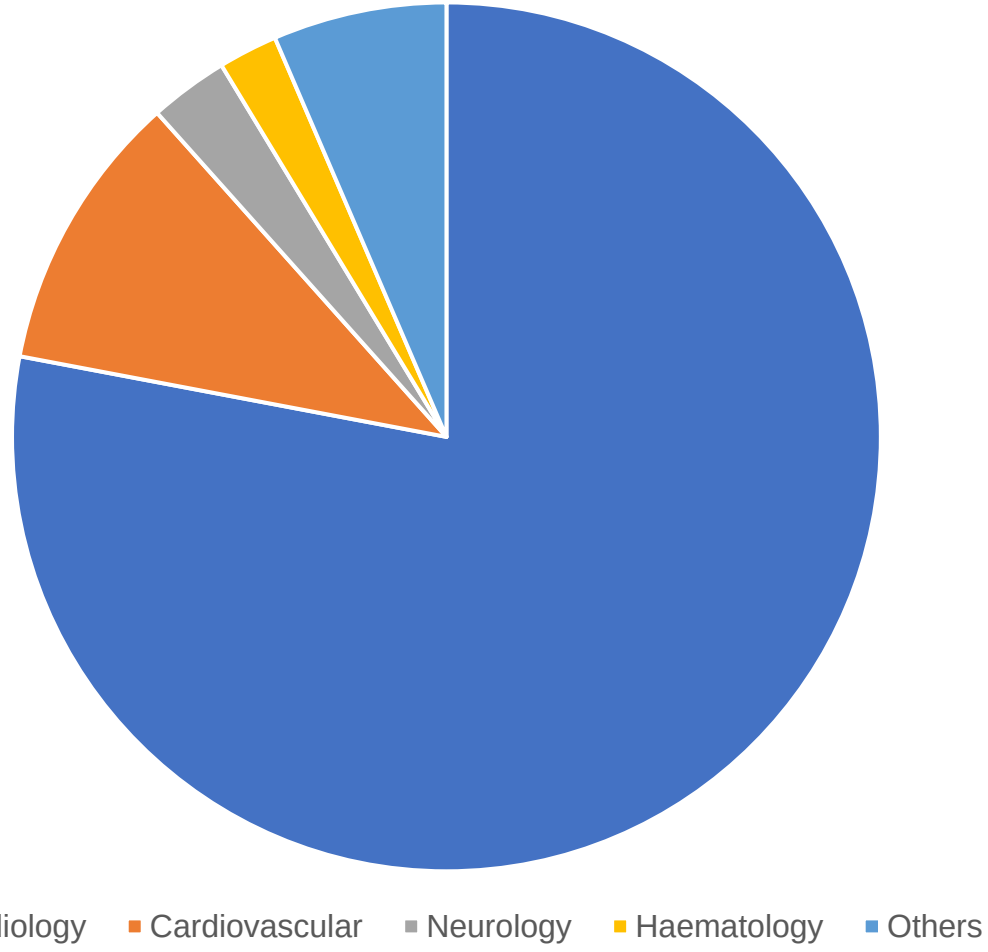
Is Radiology the Gateway to your Enterprise AI Strategy? Key use cases and lessons learnt

Dr. Jamie Chow

Radiologist, Clinical Lead

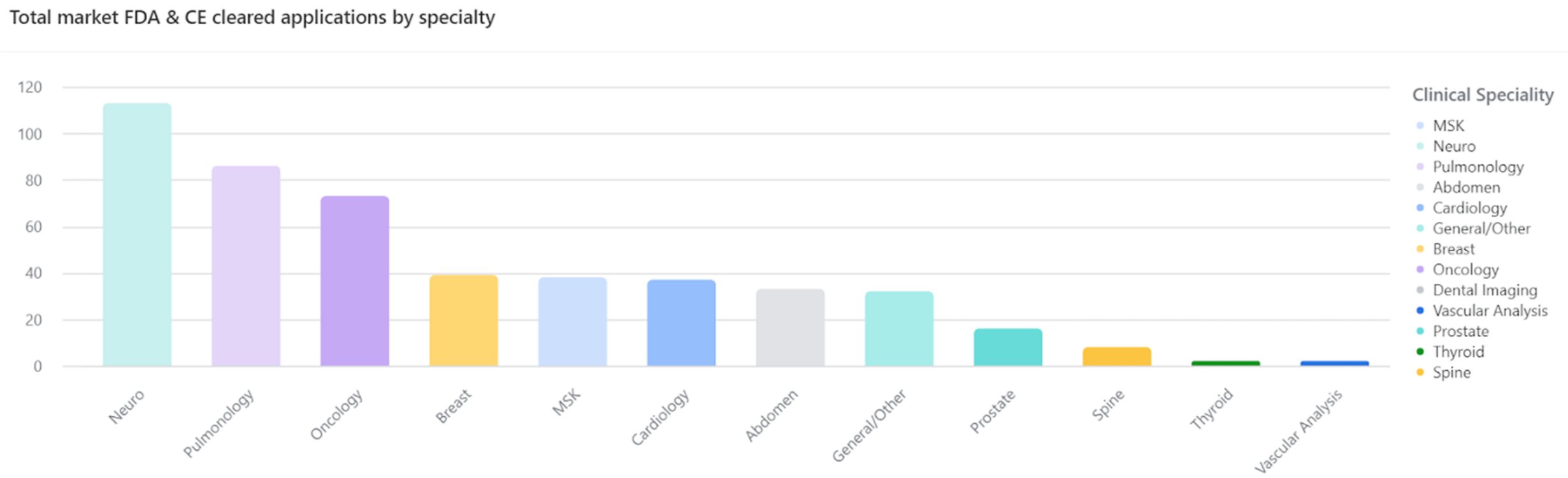
Blackford analysis

FDA AI and ML-enabled medical devices



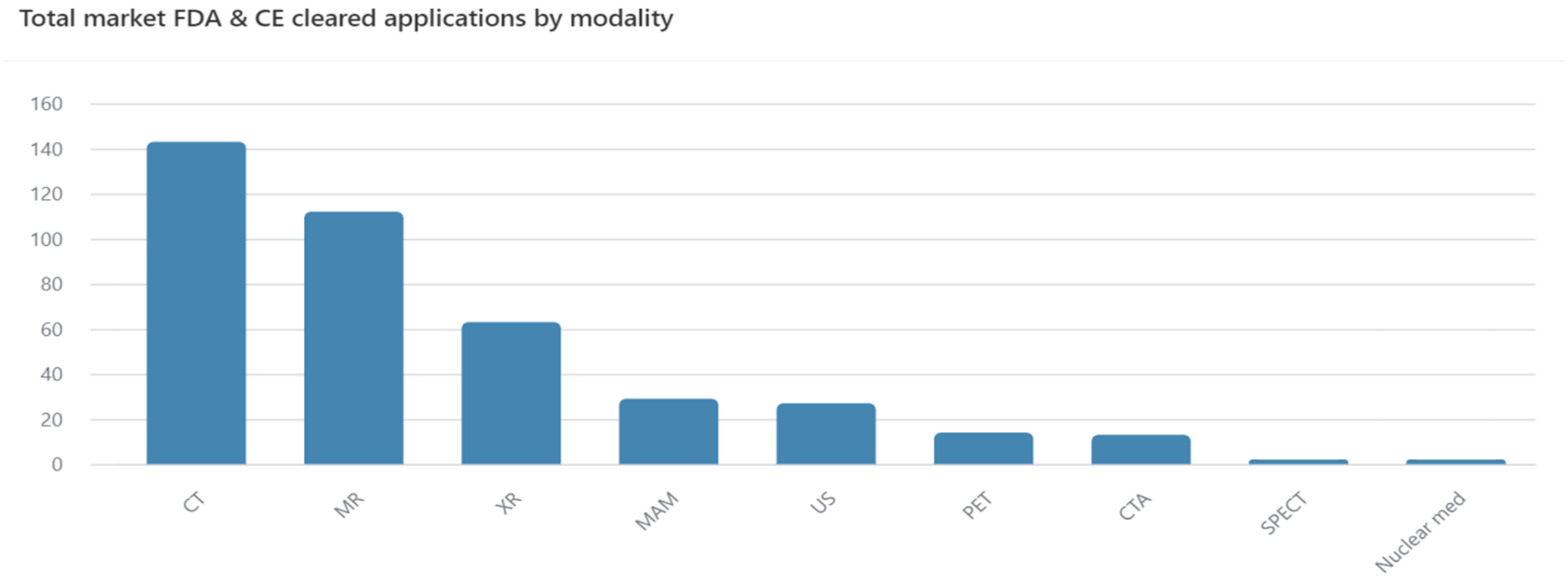
https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices

FDA & CE cleared AI applications by specialty



https://grand-challenge.org/aiforradiology/
https://aicentral.acrdsi.org/
https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices

FDA & CE cleared applications by modality



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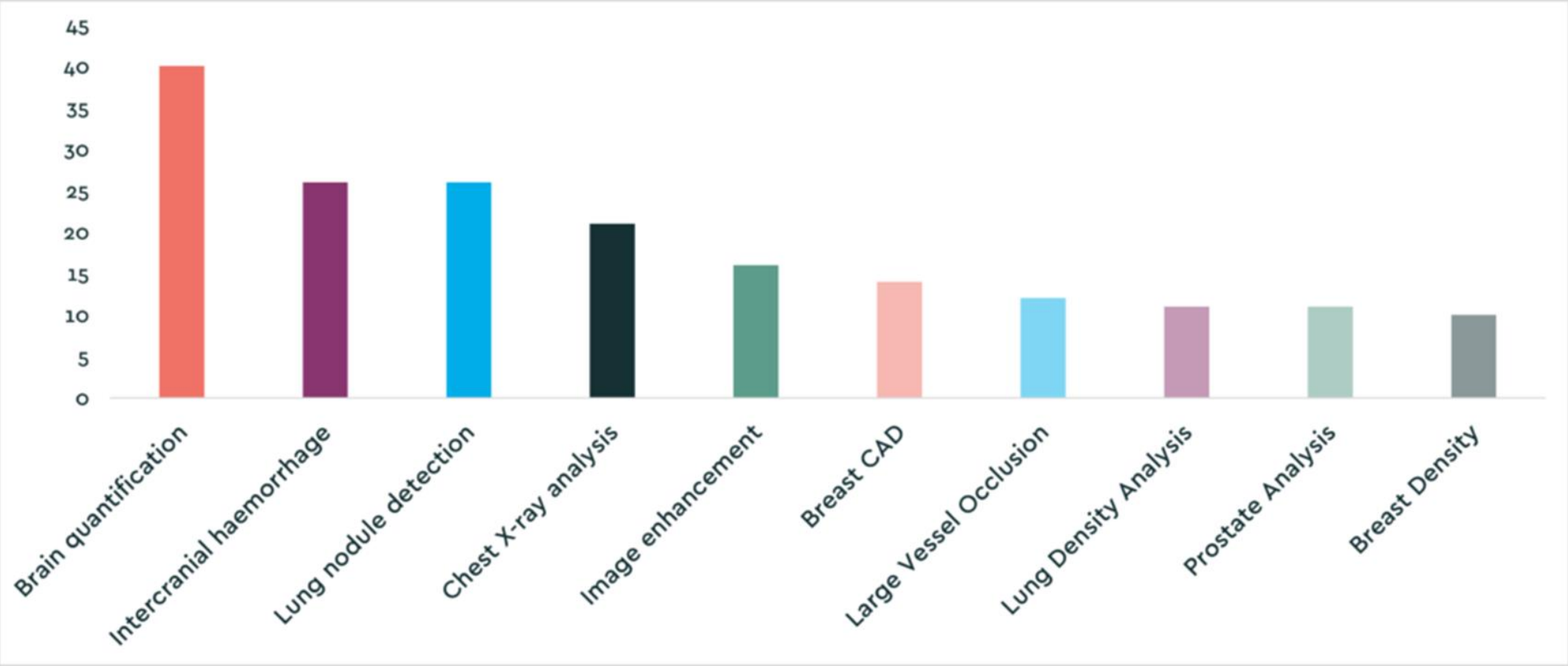
FDA & CE cleared AI applications by use case



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How much of radiology AI is in use today?

2020 ACR Data Science Institute Artificial Intelligence Survey

Bibb Allen MD [a], Sheela Agarwal MD [b], Laura Coombs PhD [c], Christoph Wald MD [d], Keith Dreyer DO, PhD [e]

July 13, 2022 -- VIENNA - Adoption of radiology artificial intelligence (AI) software has increased substantially in the Netherlands over the last few years, and many sites are now utilizing multiple algorithms in clinical practice, according to research presented on July 13 at ECR 2022.

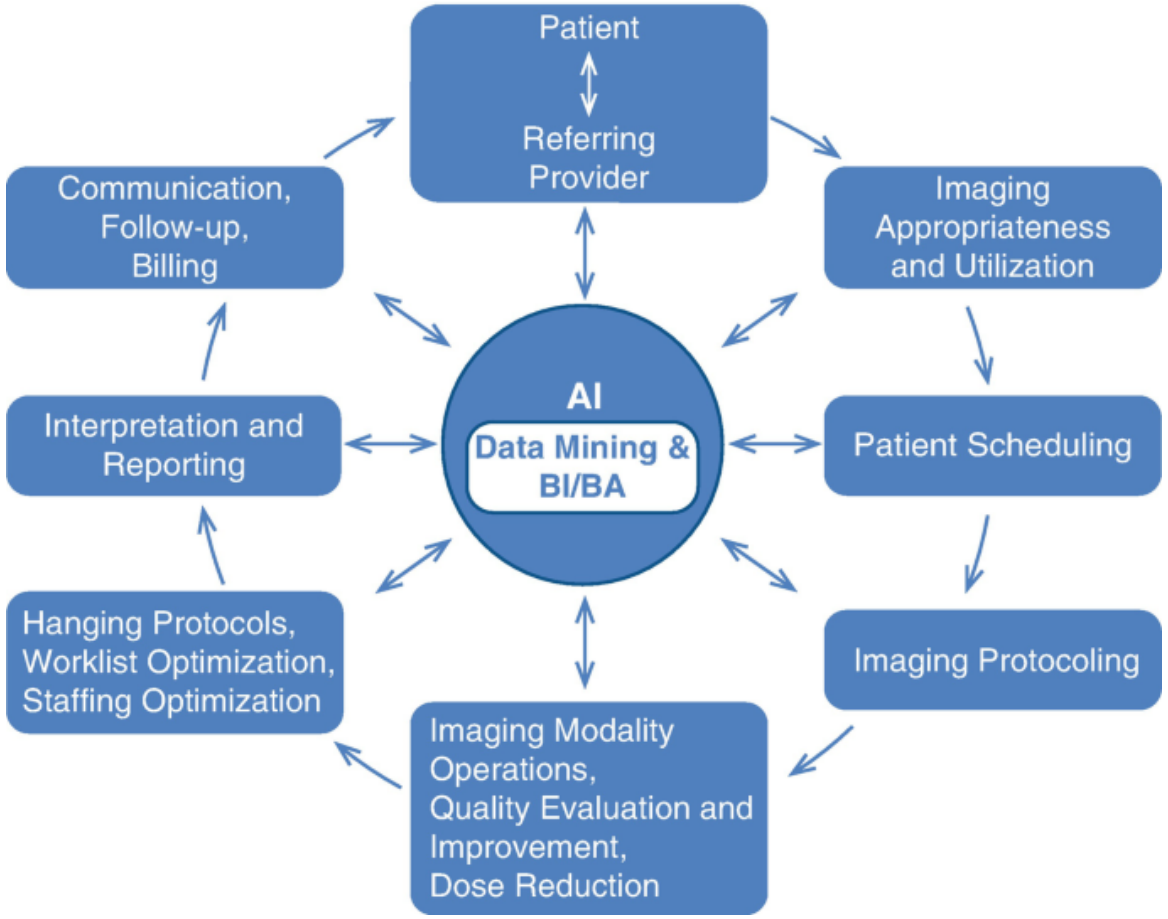
Statement | Open Access | Published: 21 June 2022

Current practical experience with artificial intelligence in clinical radiology: a survey of the European Society of Radiology

European Society of Radiology (ESR)

Democratisation of AI

AI imaging value chain



Morey, J.M., Haney, N.M., Kim, W. (2019). Applications of AI Beyond Image Interpretation. In: Ranschaert, E., Morozov, S., Algra, P. (eds) Artificial Intelligence in Medical Imaging. Springer, Cham. https://doi.org/10.1007/978-3-319-94878-2_11

AI governance

- Robust systems and processes to oversee the safe and effective usage of AI applications along its lifecycle.
- Prioritise AI projects and align with organisational strategy

AI governance

A holistic approach to implementing artificial intelligence in radiology

Bomi Kim[1†], Stephan Romeijn[2*†], Mark van Buchem[2], Mohammad Hosein Rezazade Mehrizi[3] and Willem Grootjans[2]

Addressing the Challenges of Implementing Artificial Intelligence Tools in Clinical Practice: Principles From Experience

Bernardo C. Bizzo MD, PhD [a b c], Giridhar Dasegowda MBBS [b c], Christopher Bridge PhD [b c], Benjamin Miller BS [b c], James M. Hillis MBBS, DPhil [c d], Mannudeep K. Kalra MD [b c e], Kimberly Durniak PhD [a], Markus Stout BS, MBA [b c f], Thomas Schultz BS [b c g], Tarik Alkasab MD, PhD [b c h i], Keith J. Dreyer DO, PhD [b c j k l]

Implementation of Clinical Artificial Intelligence in Radiology: Who Decides and How?

Dania Daye, MD, PhD • Walter F. Wiggins, MD, PhD • Matthew P. Lungren, MD, MPH • Tarik Alkasab, MD, PhD • Nina Kottler, MD, MS • Bibb Allen, MD • Christopher J. Roth, MD • Bernardo C. Bizzo, MD • Kimberly Durniak, PhD • James A. Brink, MD • David B. Larson, MD, MBA • Keith J. Dreyer, DO, PhD • Curtis P. Langlotz, MD, PhD**

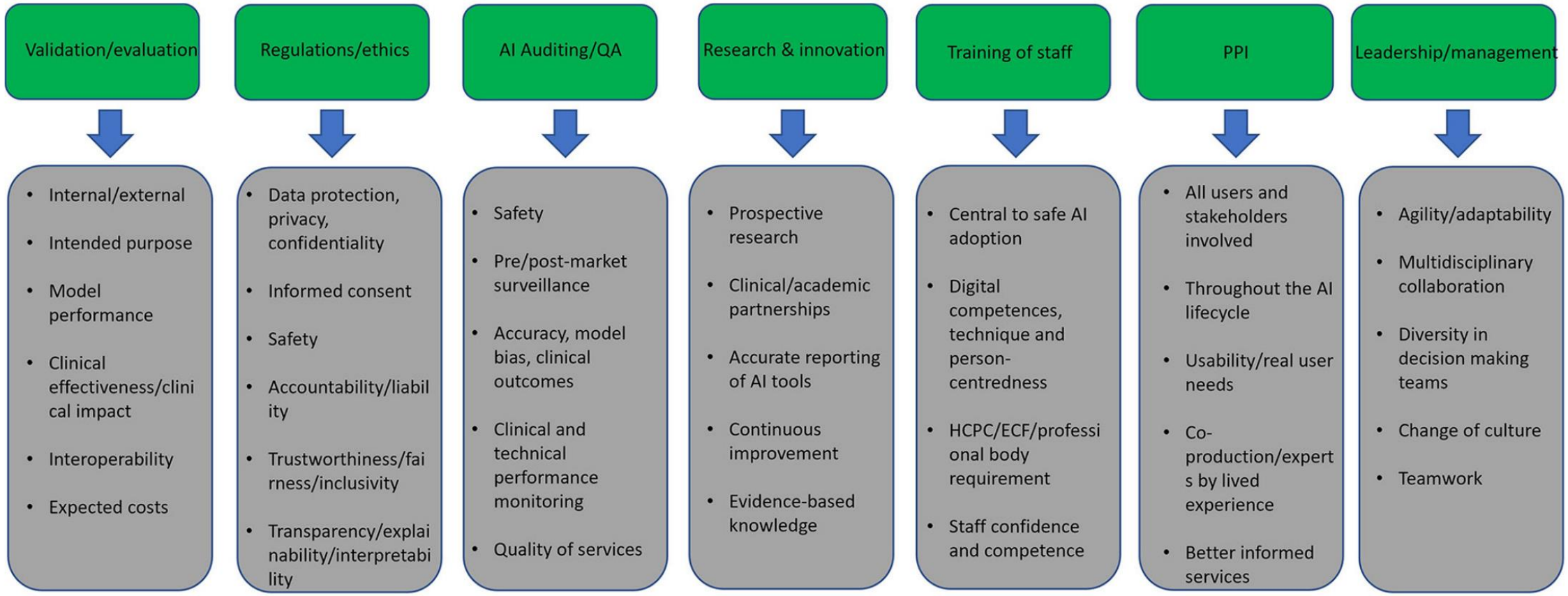
Black box no more: a scoping review of AI governance frameworks to guide procurement and adoption of AI in medical imaging and radiotherapy in the UK

Nikolaos Stogiannos [1 2 3], Rizwan Malik [4], Amrita Kumar [5], Anna Barnes [6], Michael Pogose [7], Hugh Harvey [7], Mark F McEntee [1], Christina Malamateniou [2 8]

Who?

- Executive team
- Clinical leads
- Informatics & IT managers
- Legal & compliance inc. Data governance
- End users
- Researchers/ data scientists
- Ethics representative
- Patient representative/advisory board

Pillars of AI governance



Stogiannos N et al. Black box no more: a scoping review of AI governance frameworks to guide procurement and adoption of AI in medical imaging and radiotherapy in the UK. Br J Radiol. 2023 Dec

Selecting AI applications

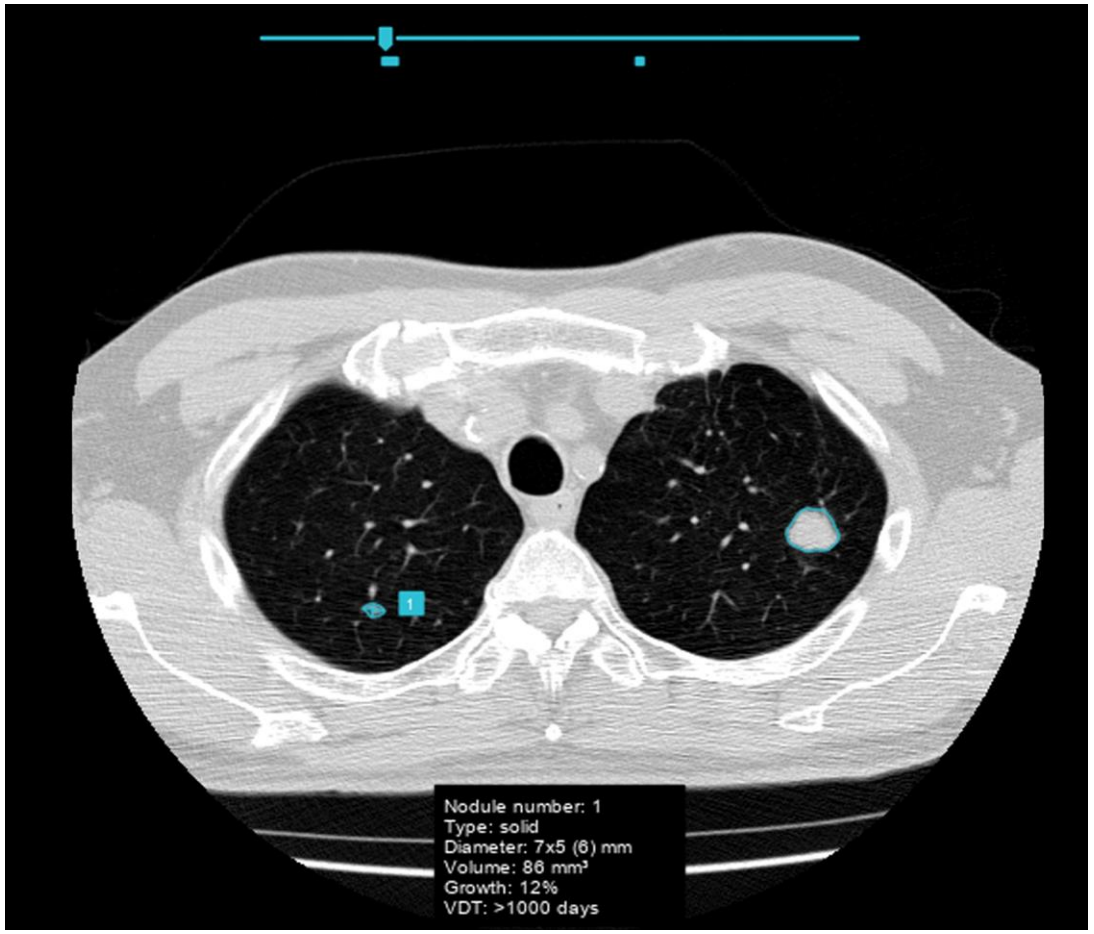
Use cases (Non-exhaustive)

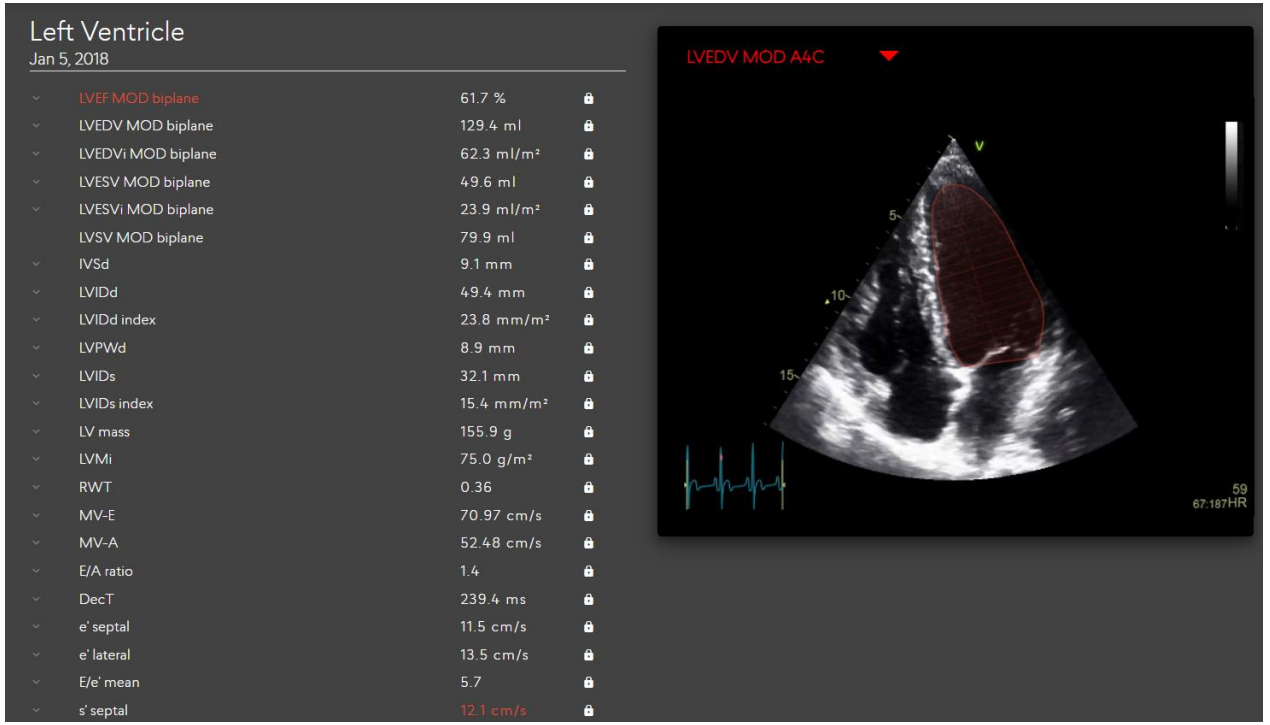
Neuro	Thoracic	Cardiac	MSK	Body	Breast	Operational
• Intracranial hemorrhage detection • Large vessel occlusion detection • ASPECTS scoring • Stroke perfusion • Tumour perfusion • Neuroquantification • Multiple Sclerosis tracking	• CT Lung nodule detection and tracking • PE detection • AD detection • CXR analysis • Triage of pneumothorax • Lung density analysis • RV/LV ratio	• Cardiac MRI segmentation • Cardiac echo analysis • Coronary artery calcification quantification • FFRCT • X-ray CCF assessment • CT Cardiac chamber volume assessment • Coronary inflammation quantification	• Extremity x-ray fracture detection • Cervical spine fracture detection • MRI spine reporting • Bone mineral density quantification • Vertebral compression fracture detection • Bone age • Leg length measurement • Knee osteoarthritis assessment • Scoliosis measurement	• Prostate analysis • Liver iron & fat quantification • Cancer therapy assessment • Abdominal aorta segmentation • US thyroid assessment • Biliary system assessment • Intra-abdominal free air assessment • Renal cyst assessment	• Breast density grading • Breast lesion detection • Mammogram quality assurance • MRI breast analysis • US breast assessment • Patient risk calculation • Breast arterial calcification assessment	• Quality assurance • 3D modelling • Business analytics • AI monitoring • Data standardisation • Hanging protocol optimisation • Follow up management • Patient friendly reports • Improve image quality

Institutional pain points

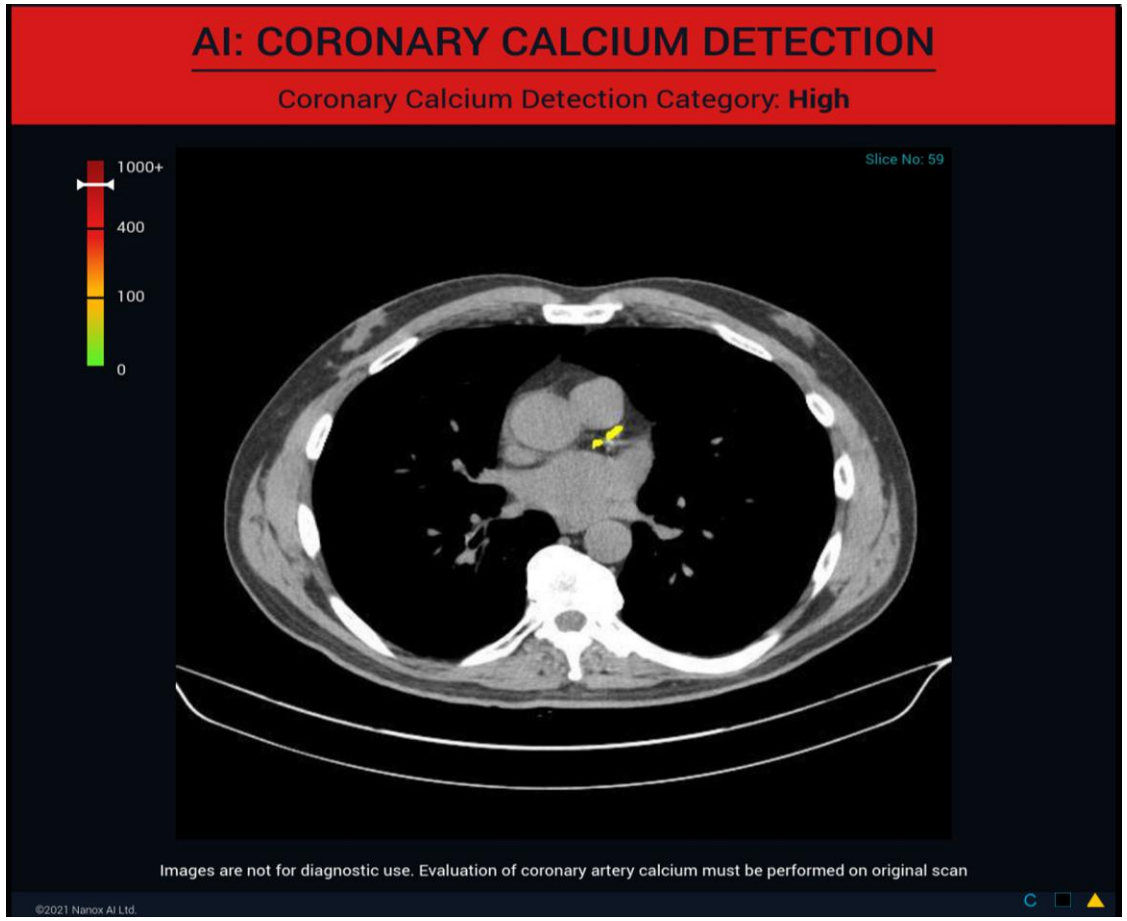
- Improving efficiency (Radiologist throughput and operational efficiency)
- Improving quality across the enterprise
- Improve cost savings or generate revenue
- Staff attraction & retention, reduce burnout
- Referrer attraction / retention
- Attract patients, Patient retention, reduce leakage

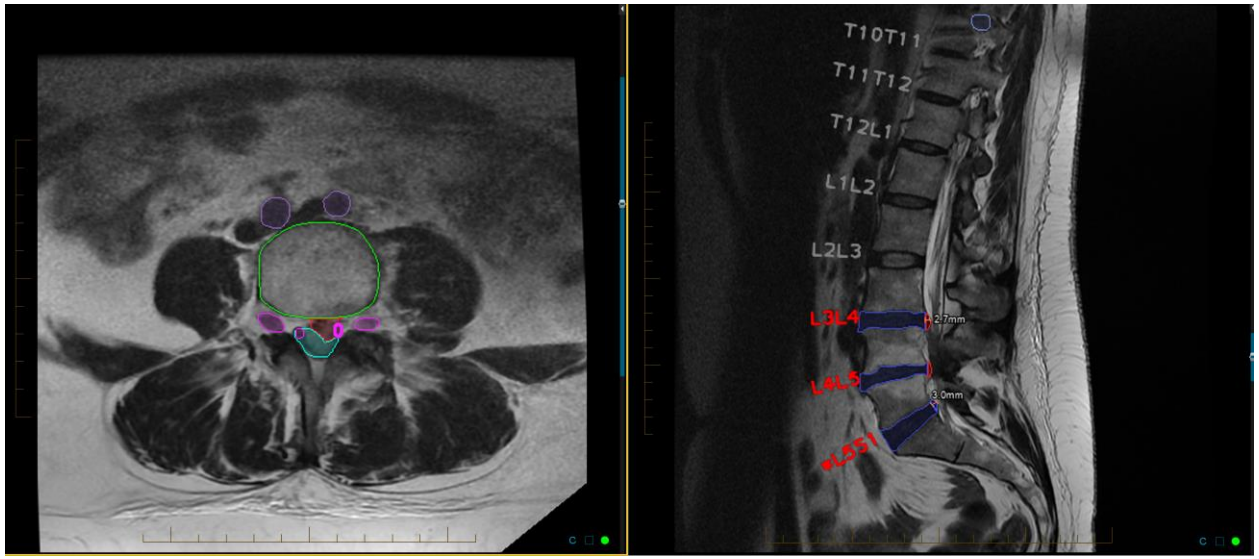
Improving efficiency





Improving quality





Final Report

Findings:
Disclaimer: This is not a final report. It was automatically created by Columbo and intended for radiologist use only.

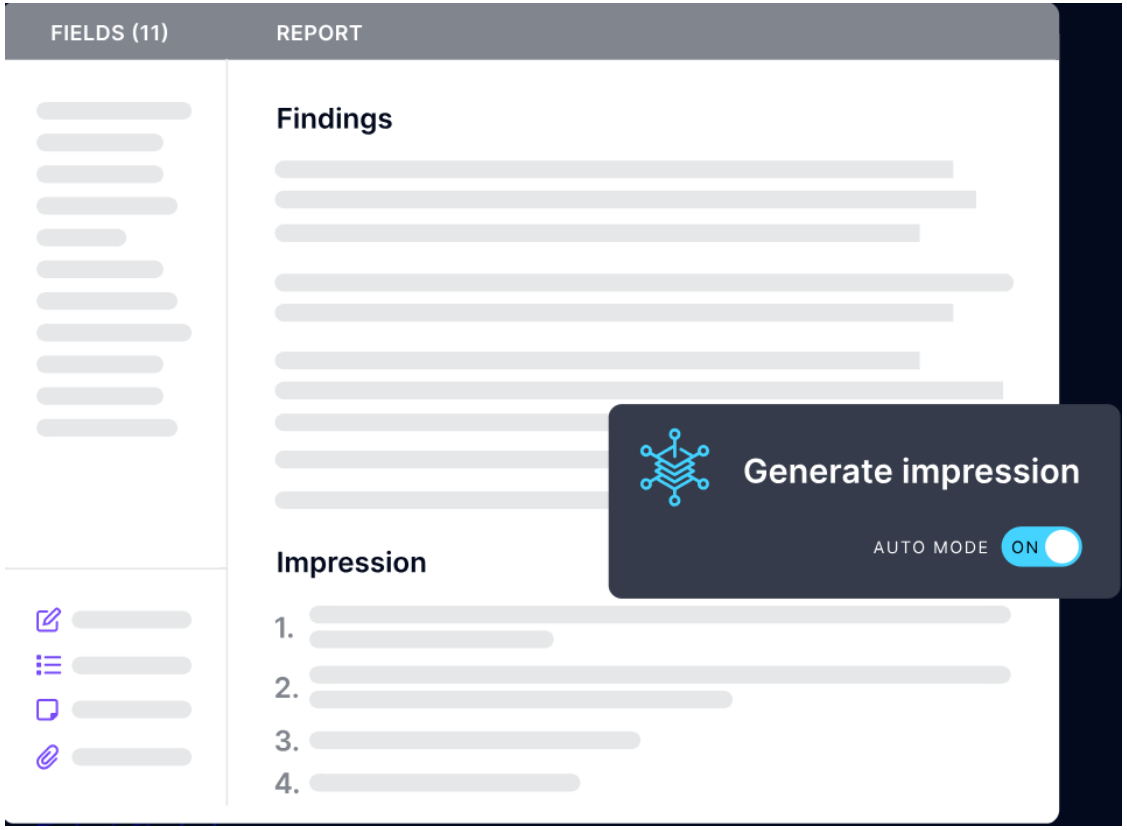
Patient name: ANONYMOUS , Age: 34Y
Exam date:
Exam type: MRI of the Lumbar Spine
Contrast: Without Contrast
MRI pulse sequence: GeneratedAngulatedAxial

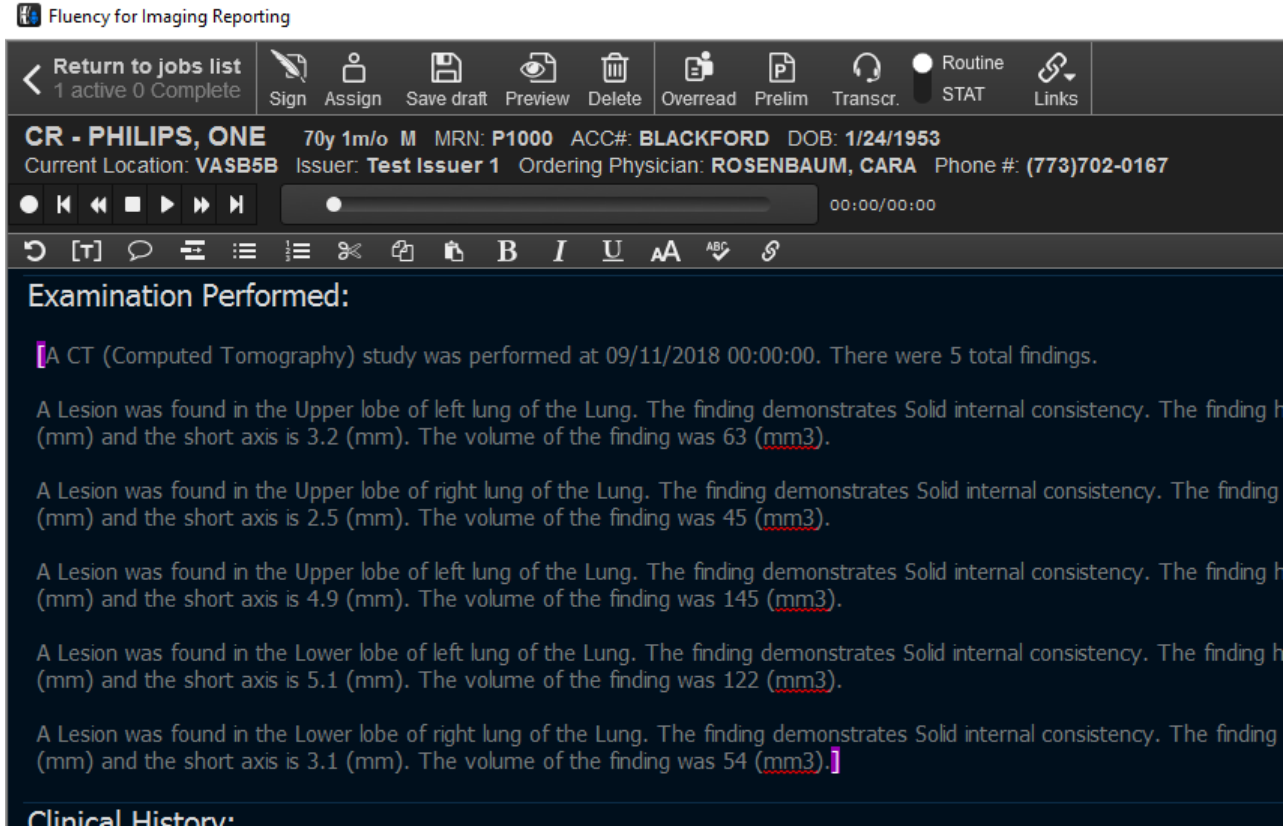
FINDINGS:
General Observations:
Preserved lordosis with L1L4 angle 13.0°.
Preserved intervertebral disc height.
Preserved height of the vertebral bodies.

MRI findings:
Level L1L2 report: No evidence of any disc complications.
Level L2L3 report: No evidence of any disc complications.
Level L3L4 report: There is a right asymmetrical bulging measuring 5.0 mm. There is a mild central disc protrusion with AP size 5.0 mm. 20.0% dural sac compression. There is compression of the left L4 and right L4 nerve roots. Mild central stenosis. Relatively reduced dural sac anterior-posterior diameter with size 11.0 mm.
Level L4L5 report: There is symmetrical bulging measuring 3.0 mm. There is a severe central disc extrusion with AP size 13.0 mm. Caudal migration 8.0 mm. Cranial migration 20.0 mm. 85.0% dural sac compression. There is compression of the left L5 and right L5 nerve roots. Severe central stenosis. Absolutely reduced dural sac anterior-posterior diameter with size 4.0 mm.
Level L5S1 report: There is a right asymmetrical bulging measuring 3.0 mm. There is moderate right foraminal stenosis.

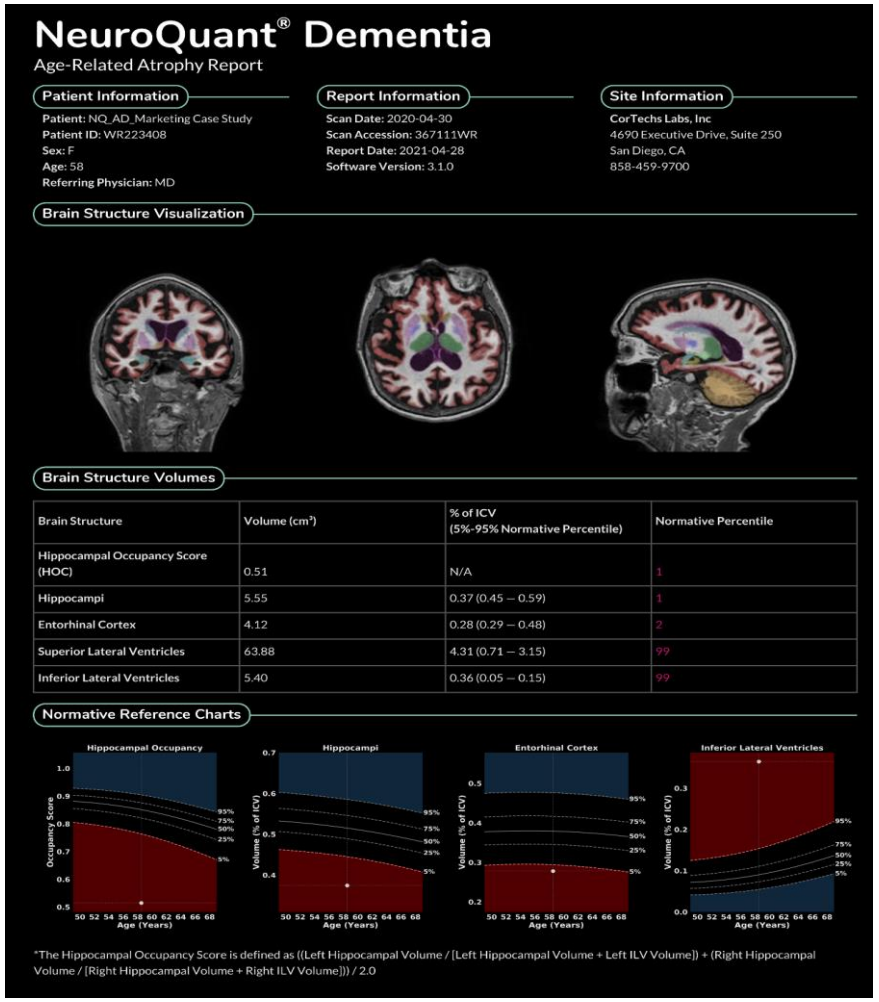
Impression:
L3L4: There is a mild central disc protrusion. There is dural sac compression. There is nerve root compression. Mild central stenosis.
L4L5: There is a severe central disc extrusion. There is caudal migration. There is cranial migration. There is dural sac compression. There is nerve root compression. Severe central stenosis.

Staff attraction/reduce burnout





Referrer attraction



NeuroQuant® Dementia

Age-Related Atrophy Report

Patient Information

Patient: NQ_AD_Marketing Case Study
Patient ID: WR223408
Sex: F
Age: 58
Referring Physician: MD

Report Information

Scan Date: 2020-04-30
Scan Accession: 367111WR
Report Date: 2021-04-28
Software Version: 3.1.0

Site Information

CorTechs Labs, Inc
4690 Executive Drive, Suite 250
San Diego, CA
858-459-9700

Brain Structure Visualization

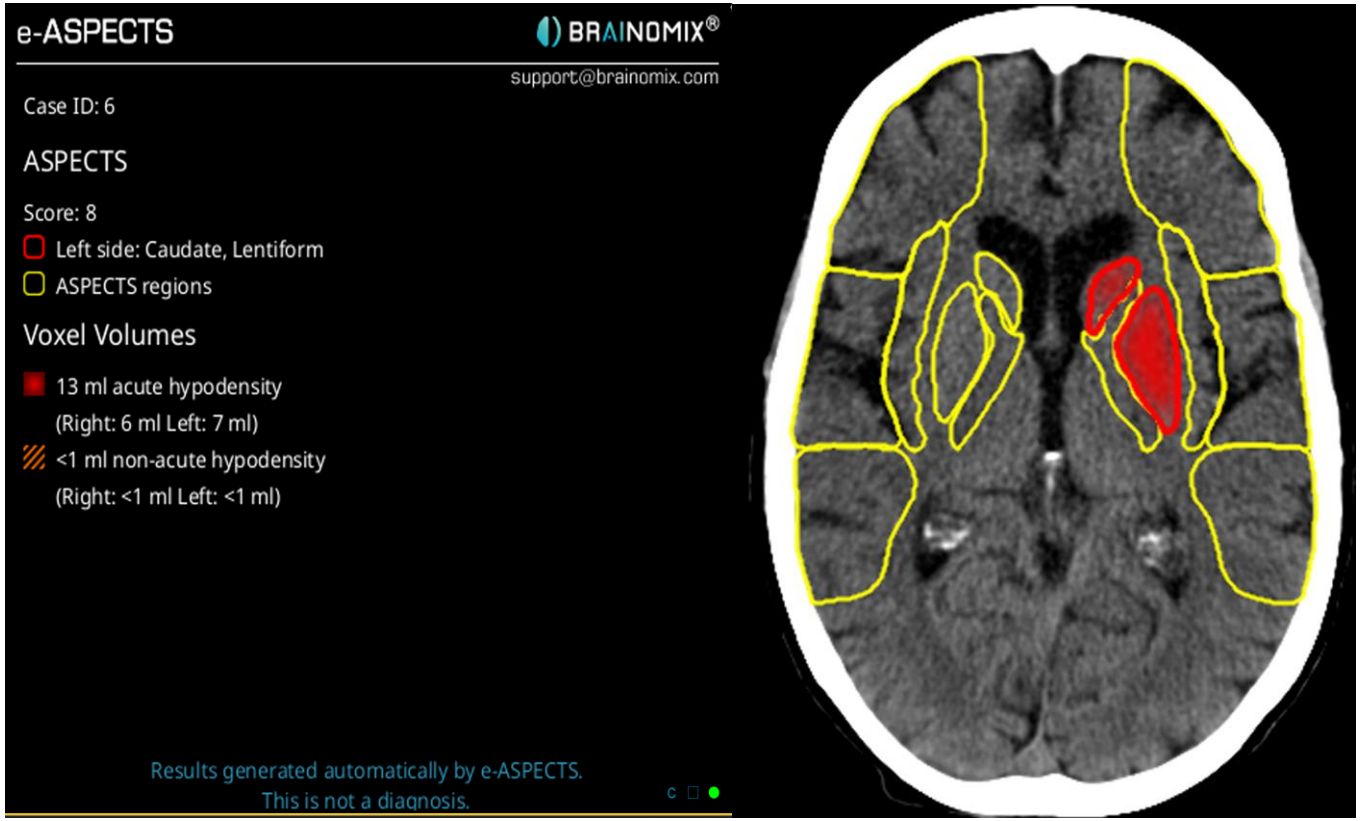
Brain Structure Volumes

Brain Structure	Volume (cm³)	% of ICV (5%-95% Normative Percentile)	Normative Percentile
Hippocampal Occupancy Score (HOC)	0.51	N/A	1
Hippocampi	5.55	0.37 (0.45 – 0.59)	1
Entorhinal Cortex	4.12	0.28 (0.29 – 0.48)	2
Superior Lateral Ventricles	63.88	4.31 (0.71 – 3.15)	99
Inferior Lateral Ventricles	5.40	0.36 (0.05 – 0.15)	99

Normative Reference Charts

Hippocampal Occupancy · Hippocampi · Entorhinal Cortex · Inferior Lateral Ventricles

*The Hippocampal Occupancy Score is defined as ((Left Hippocampal Volume / [Left Hippocampal Volume + Left ILV Volume]) + (Right Hippocampal Volume / [Right Hippocampal Volume + Right ILV Volume])) / 2.0



e-ASPECTS

BRAINOMIX®

support@brainomix.com

Case ID: 6

ASPECTS

Score: 8

Left side: Caudate, Lentiform

ASPECTS regions

Voxel Volumes

13 ml acute hypodensity
(Right: 6 ml Left: 7 ml)

<1 ml non-acute hypodensity
(Right: <1 ml Left: <1 ml)

Results generated automatically by e-ASPECTS.
This is not a diagnosis.

Cost savings or generate revenue

Your Bone Mineral Density (BMD) Report

Patient Name: Doe, John
ID: PseudoID
Date of Exam: 01/15/2024
Date of Birth: 01/14/1968
Gender: Female

AutoBMD™ Powered by HeartLung Technologies
To learn more visit www.heartlung.ai/autobmd

Hounsfield Unit (HU)

A quantitative scale for describing radiodensity.

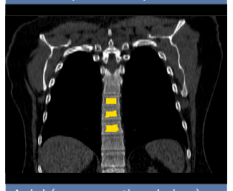
Vertebra 1	176.0
Vertebra 2	188.6
Vertebra 3	197.4
Mean HU	187.3

BMD (mg/cc)

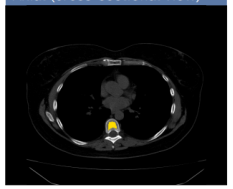
Mean BMD	174.2
Z-Score	0.0
T-Score	-1.3

Sagittal (side view)

Coronal (front view)

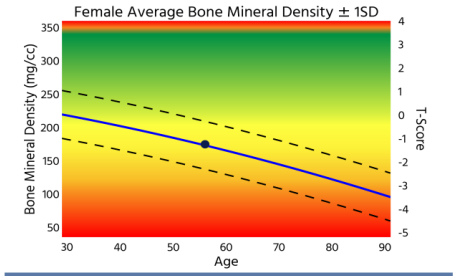


Axial (cross-sectional view)



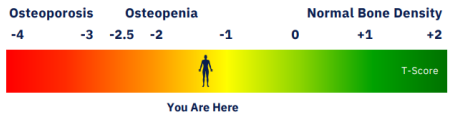
Your Z-Score: 0.0

Z-Score compares your bone mineral density to what is expected for a person of the same age and gender.



Your T-Score: -1.3

T-Score is your bone mineral density (BMD) compared with what is normally expected in a healthy adult of your gender. *Your T-Score of -1.3 indicates that you have low bone density (osteopenia).*

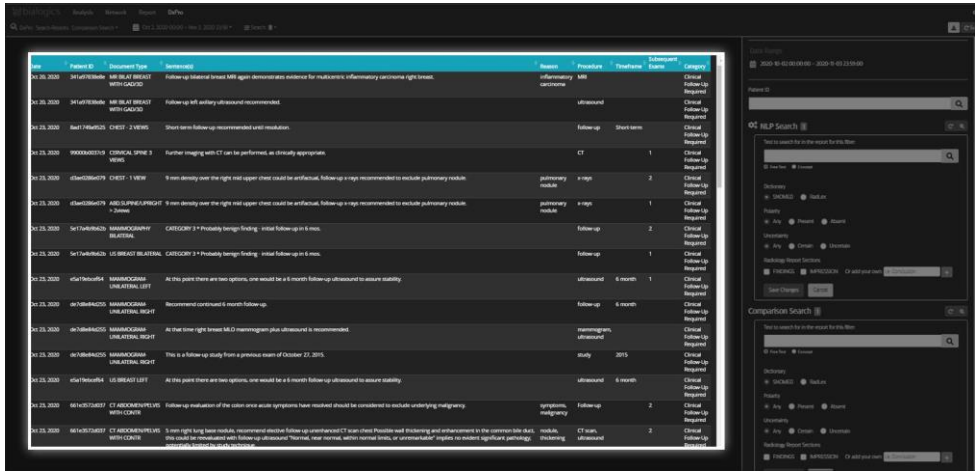


Recommendations

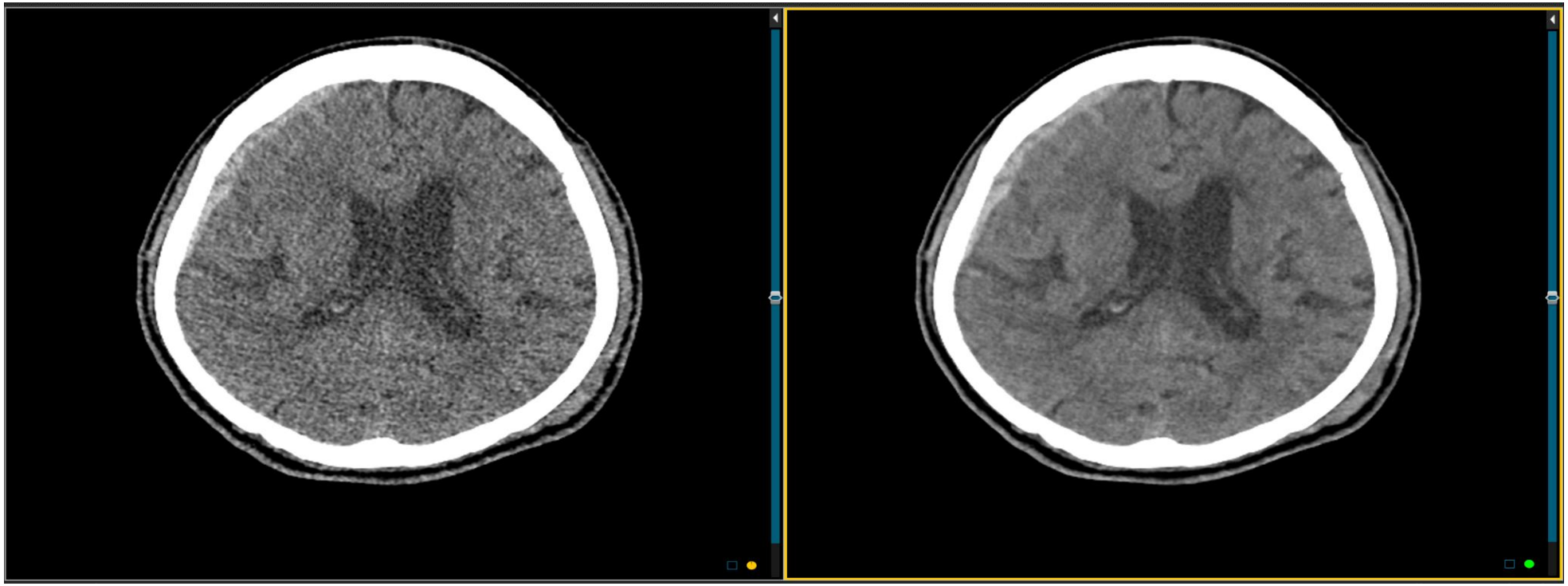
All patients should ensure an adequate intake of dietary calcium and vitamin D. The National Osteoporosis Foundation recommends adults under age 50 need 1,000 mg of calcium and 400-800 IU of vitamin D daily. Adults 50 and over need 1,200 mg of calcium and 800-1,000 IU of vitamin D daily. **Based on your BMD results, you have osteopenia and should seek follow up care with your physicians.**

Follow up

People diagnosed with osteoporosis or at high risk for fracture should have regular BMD tests. For patients eligible for Medicare, routine testing is allowed once every two years. For more information visit www.heartlung.ai/autobmd.



Patient attraction

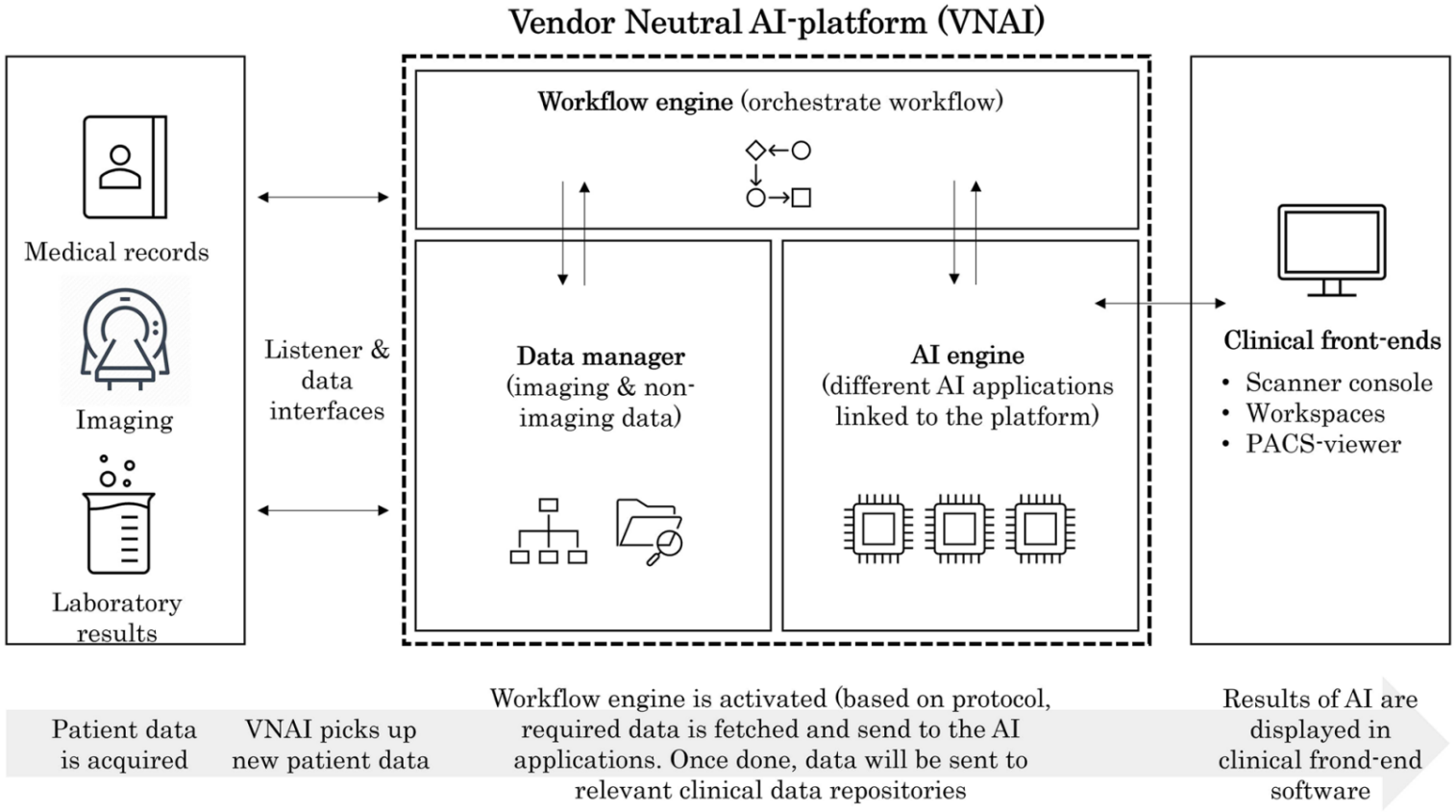


Platforms

Platform benefits

- **Clinical**
  - Collaborative/consultative
  - AI validation & monitoring
- **Technical**
  - Integration layer
  - Study orchestration
  - Workflow enhancements
  - Security checks
  - Single point of contact
- **Contractual**
  - Legal review
  - Procurement & billing

AI platform integration



Kim B, Romeijn S, van Buchem M, Mehrizi MHR, Grootjans W. A holistic approach to implementing artificial intelligence in radiology. Insights Imaging. 2024

Platform

AI Platforms Vendors

Signify RESEARCH

AI ISVs with AI Platforms	Third-Party AI Platform Vendors	Imaging IT/Modality Vendors – Native AI Platforms	Imaging IT/Modality Vendors – Custom Integration	Imaging Informatics Vendors using Third-Party AI Platforms
• Aidoc	• Alma Medical Imaging	• Dicom Systems	• AGFA HealthCare	• Change Healthcare †
• Arterys	• Bayer #	• GE HealthCare	• Canon Medical	• eRAD ‡
• DeepTek *	• Blackford Analysis #	• Laurel Bridge	• Fujifilm Medical	• Infinitt †
• Incepto	• CARPL.ai	• Merative		• Intelerad ‡
• QMENTA	• DeepC (acquired Osimis)	• Sectra		• Mach7 Technologies †
• Quibim *	• Ferrum Health	• Siemens Healthineers		• Philips ‡
• RadLogics *	• Nuance	• Telerad Tech		
• Viz.ai	• TeraRecon			
• Wingspan	• Magentus ^			

Signify Research, AI in Medical Imaging World Market Analysis report

Factors to consider when selecting AI platform

- Use case coverage
- In house developed applications?
- Organisational AI strategy
- Integrations & workflows
- Cloud vs on premise
- AI governance support inc. analytics
- Pricing model
- Customer support & training
- References

Getting started

1. Establish an AI steering committee
2. Identify pain points & priorities
3. Evaluate platform vendors
4. Local validation and integration assessment
5. Deployment & training
6. Continuous evaluation & improvement

Future

- Pathology
- Autonomous AI?
- Multi-modal AI
- Generative AI - LLaVA

Questions?