L'uso dell'intelligenza artificiale

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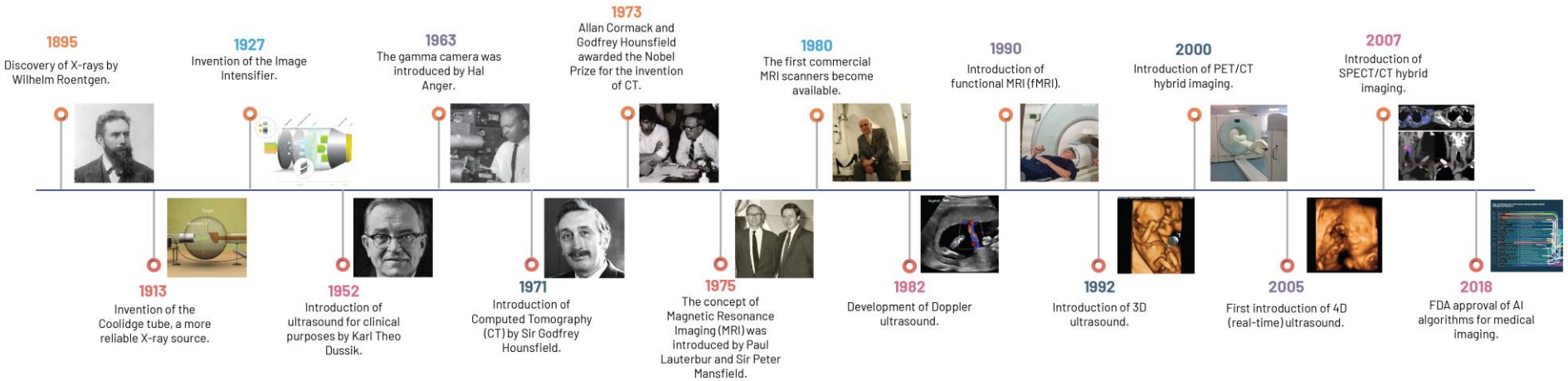
No disclosures related to this presentation.

Trends in Radiology and AI

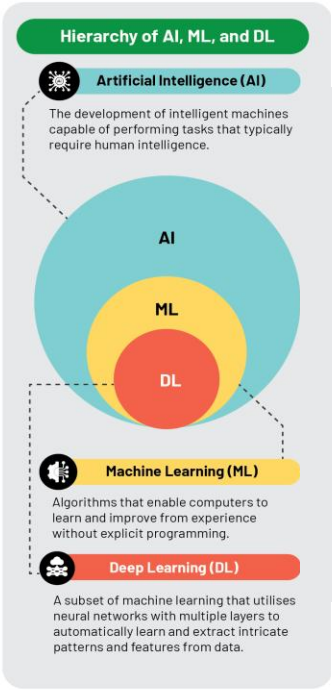


Najjar R. Redefining Radiology: A Review of Artificial Intelligence Integration in Medical Imaging. Diagnostics (Basel). 2023

Trends in Radiology and AI

Decoding the Terminology: AI, ML, and DL

Recognising the nuanced interrelationships between AI, ML, and DL aids in conceptualising each subfield's contribution to AI panorama



Najjar R. Redefining Radiology: A Review of Artificial Intelligence Integration in Medical Imaging. Diagnostics (Basel). 2023

Trends in Radiology and AI

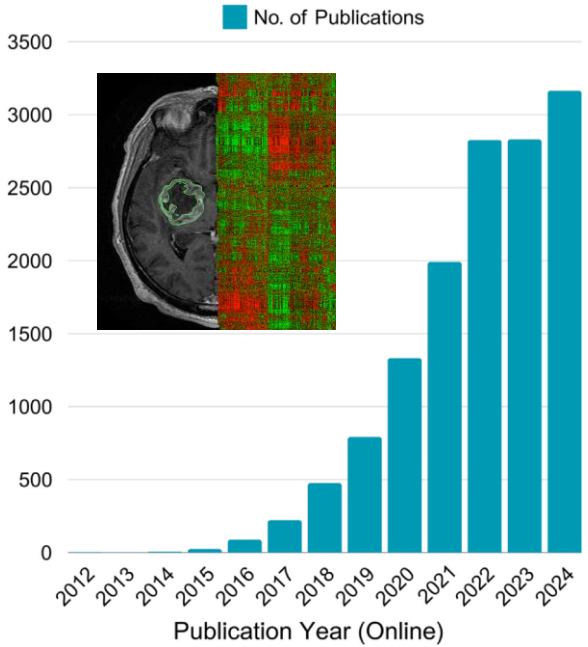
AI studies are gaining popularity, thanks to the **digitalization of medical records** and the increasing **availability of data-reach measurements**, such as CT images and genomics datasets.

Radiology is inherently suited for artificial intelligence, as it relies on **digital images** rich in data—ready to be analyzed, interpreted, and enhanced through AI algorithms.

Images are data.

Trends in Radiology and AI

Radiomics: extracting high-dimensional data from medical images to uncover hidden patterns and support precision medicine — a process that can be enhanced by integrating artificial intelligence techniques.

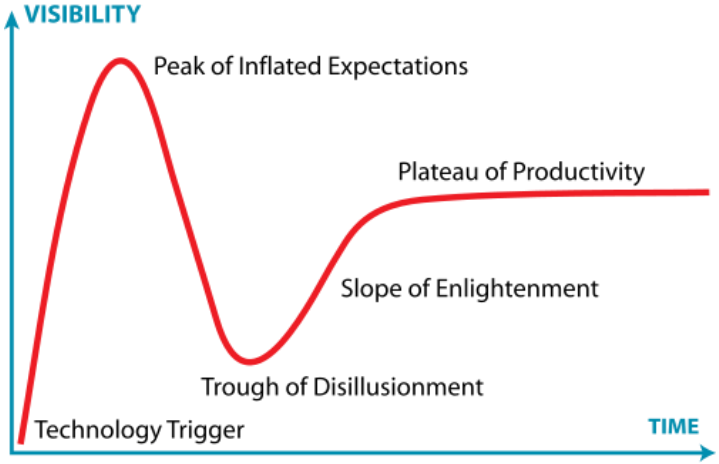


Trends in Radiology and AI

Despite **exponential growth in radiomics literature**, a substantial gap remains between published findings and integration into clinical practice.

Key issues include:

- proliferation of studies prioritizing superficial novelty over foundational understanding
- methodological complexity that often evades rigorous scrutiny during peer review
- significant publication bias
- limited external testing or validation
- insufficient adherence to open science principles



The Hype Cycle *(source: Wikipedia.org)*

Kocak et al. The widening gap between radiomics research and clinical translation: rethinking current practices and shared responsibilities. European Journal of Radiology Artificial Intelligence. 2025

AI in Fragility Fractures & Radiology

Clinical challenges:

I. an acute fracture is missed or detected late;
II. an incidental vertebral fracture is not reported;
III. the fracture is reported, but no osteoporosis assessment or Fracture Liaison Service referral follows.

* In a study of 1,112 abdominal CT, radiologists reported only 30% of vertebral compression fractures. Only 3/30 patients with a reported fracture started osteoporosis treatment within 1 year

An AI alert alone does not close the care gap!

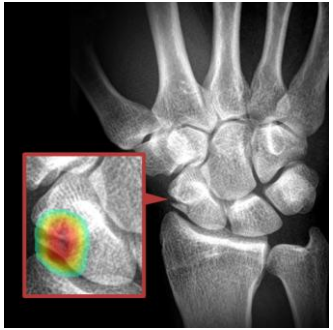
** Wiklund P. Vertebral compression fractures at abdominal CT: underdiagnosis, undertreatment, and evaluation of an AI algorithm. J Bone Miner Res. 2024*

AI for acute fracture detection

This is currently the most **mature application**:

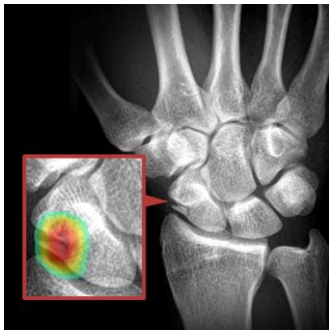
- fracture detection on wrist, hip, pelvis, limb, rib and spine radiographs;
- bounding boxes and heatmaps;
- worklist triage;
- second-reader support for radiologists, radiographers and emergency physicians;
- reduction in false-negative findings and interpretation time.

These systems **detect fractures; they do not determine whether a fracture is a fragility fracture**.



AI for acute fracture detection

A systematic review of commercial products included 17 studies, 38,978 radiographs and 8,150 fractures.
Pooled stand-alone AI sensitivity was 91% and specificity 89%.
Human-plus-AI assessment performed best, whereas rib and spine fractures remained less robust.



Husarek J. Artificial intelligence in commercial fracture detection products: a systematic review and meta-analysis of diagnostic test accuracy. Sci Rep. 2024

AI for acute fracture detection

Different commercial softwares for fracture detection on radiographs:

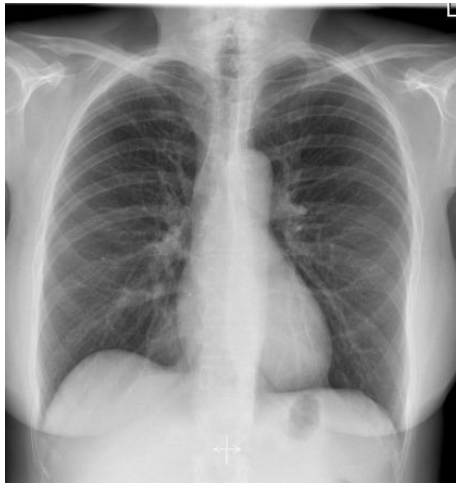
Software	Company	Main application	Clinical status
BoneView	Gleamer	Appendicular, rib and spine fractures	CE and FDA; largest evidence base
Rayvolve	AZmed	Adult and paediatric fractures	CE and FDA
RBfracture	Radiobotics	Fractures and dislocations	CE marked
TechCare Alert	Milvue	Fractures on urgent-care radiographs	NHS use with evidence generation
OsteoDetect	Imagen	Distal radius fractures	FDA; wrist-specific
Annalise Enterprise CXR	Annalise.ai	Traumatic chest radiograph findings, including spinal abnormalities	CE and FDA

*A recent prospective real-world study of BoneView, Rayvolve and RBfracture found that AI mainly reduced reading time and increased diagnostic confidence, without materially improving the accuracy of experienced radiologists: **the practical benefit may therefore be primarily related to workflow**.

** Prucker P. Real-world clinical impact of three commercial AI algorithms on musculoskeletal radiography interpretation: A prospective crossover reader study. Int J Med Inform. 2026*

Opportunistic detection of vertebral fractures

Underdiagnosis of vertebral fractures is a worldwide problem.



Bartalena T. Incidental vertebral compression fractures in imaging studies: Lessons not learned by radiologists. World J Radiol. 2010
Delmas PD Underdiagnosis of vertebral fractures is a worldwide problem: the IMPACT study. J Bone Miner Res. 2005

Opportunistic detection of vertebral fractures

"Radiologists probably underrate the clinical importance of these findings since recognition of vertebral fractures on lateral radiographs or in MDCT sagittal reformatted images is usually not a difficult task."

A higher level of expertise is required in the identification of some conditions: mild grade fractures, differential diagnosis between osteoporotic vertebral fracture and non-osteoporotic deformities, such as Cupid's bow, Scheuermann disease and degenerative wedging.

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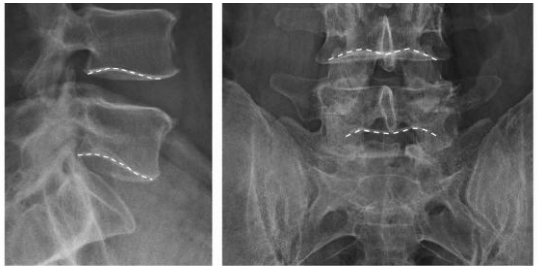

Cupid's bow vertebra

degenerative wedging

Scheuermann disease

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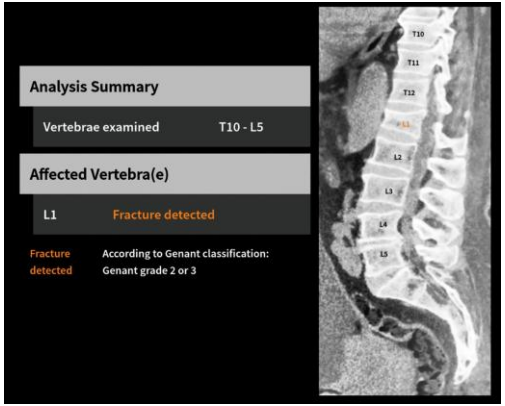
Delmas PD Underdiagnosis of vertebral fractures is a worldwide problem: the IMPACT study. J Bone Miner Res. 2005

Opportunistic detection of vertebral fractures

This is the most directly relevant commercial category.

In October 2025, NICE identified five CT-based technologies that could be used in the NHS while prospective evidence is generated:

Software	Company	Imaging and population	Main function
BriefCase-Triage	Aidoc	Chest/abdominal CT, ≥18 years	Triage of suspected VCF
CINA-VCF Quantix	Avicenna.AI	Chest/abdominal CT, ≥50 years	VCF detection and quantification
HealthVCF	Nanox.AI	Chest/abdomen/pelvis CT, ≥50 years	Detection from T1 to L5
HealthOST	Nanox.AI	Chest/abdomen/pelvis CT, ≥50 years	VCF, vertebral height and low BMD
IB Lab FLAMINGO	ImageBiopsy Lab	Thoracic/lumbar CT, ≥50 years	Vertebral fracture detection and grading



Spångeus A. Breaking the silence: AI's contribution to detecting vertebral fractures in opportunistic CT scans in the elderly-a validation study. Arch Osteoporos. 2025

www.nice.org.uk

Opportunistic detection of vertebral fractures

This is highly relevant to fragility fractures because it identifies previously unknown disease on CT performed for unrelated reasons.

Important **pitfalls** include:

- Schmorl nodes;
- degenerative wedging;
- traumatic deformities;
- malignant pathological fractures;
- borderline grade 1 deformities;
- technical failures caused by incomplete coverage, metal and unusual anatomy.

Opportunistic low-BMD screening

Routine CT is already a bone-density examination—the information is simply not routinely extracted.

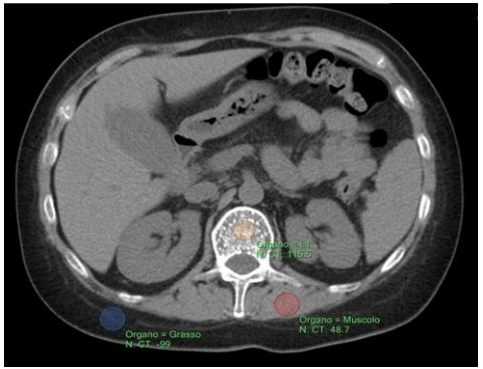
European Journal of Haematology

ORIGINAL ARTICLE | Open Access

The role of opportunistic quantitative computed tomography in the evaluation of bone disease and risk of fracture in thalassemia major

Aldo Carnevale, Fabio Pellegrino, Beatrice Bravi, Maria Rita Gamberini, Irene Gagliardi, Roberto Reverberi, Maria Chiara Zatelli, Melchiore Giganti, Maria Rosaria Ambrosio

First published: 24 August 2022 | https://doi.org/10.1111/ejh.13847 | VIEW METRICS



Carnevale A. The role of opportunistic quantitative computed tomography in the evaluation of bone disease and risk of fracture in thalassemia major. Eur J Haematol. 2022

Opportunistic low-BMD screening

Opportunistic imaging is currently best regarded as a **case-finding or screening tool**, not a universal replacement for DXA: **screening is not diagnosis!**

Some commercial software:

Software	Input	Output	Current maturity
HealthOST	Chest/abdominal CT	Low BMD, VCF and vertebral measurements	FDA 2022; EU MDR CE 2025
Rho	Frontal chest, spine, pelvis, knee or hand/wrist radiographs	Probable low-BMD notification	FDA De Novo 2024; Health Canada
Bunkerhill BMD	Non-contrast abdominal CT	Estimated vertebral BMD and low-BMD flag	FDA 2025; mainly US market
OsteoSight	Standard radiographs	BMD estimation/pre-screening	FDA 2025; limited peer-reviewed evidence

Paderno A. Artificial intelligence-enhanced opportunistic screening of osteoporosis in CT scan: a scoping Review. Osteoporos Int. 2024

Opportunistic low-BMD screening

Technical accuracy is high, but generalisability and clinical utility remain less firmly established.

Reported performance:
BMD prediction accuracy: **86–96%**
AUC for normal versus osteoporotic classification: **0.927–0.984**
Fully automated methods generally performed similarly to hybrid or manually initiated approaches.
Both low-dose chest CT and abdominal CT can be used.
Some models generated DXA-like estimates; others directly classified patients into normal, osteopenic or osteoporotic categories.

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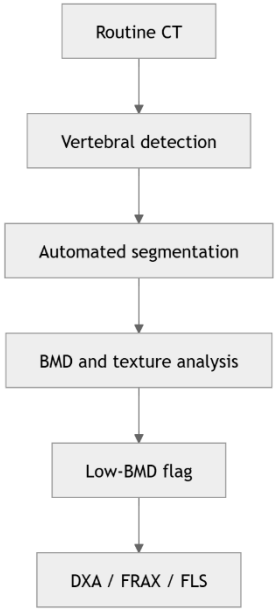
Opportunistic low-BMD screening

The purpose of AI is not to replace DXA, but to identify patients who would otherwise never reach DXA.

The WHO diagnostic framework remains based primarily on central DXA T-scores, while opportunistic CT is best positioned as **case finding and risk stratification**.

Major technical and clinical **confounders**:

- intravenous contrast;
- kVp and tube-current variation;
- reconstruction kernel and iterative reconstruction;
- scanner and vendor differences;
- vertebral haemangiomas or focal lesions;
- fractures and severe degenerative change;
- metal artefacts;
- obesity and incomplete anatomical coverage;
- differences between areal DXA BMD and volumetric CT BMD.



Prediction of future fractures

This is promising but less clinically mature:

- radiomics of trabecular bone;
- deep learning from CT, radiographs or DXA;
- integration of imaging, BMD, age, medications, comorbidities and fracture history;
- prediction of hip and vertebral fractures;
- comparison with FRAX and DXA.

*A 2026 systematic review included 20 radiomics and machine-learning studies; 14 achieved an AUC or $R^2 \geq 0.80$. Nevertheless, most cohorts were retrospective, predominantly female and focused on vertebral bone.

*Jayasuriya AC. Use of artificial intelligence and radiomics for diagnosis and prediction of osteoporotic fractures: a systematic review. Clin Radiol. 2026

The central point: from AI output to clinical outcome

From detection to prevention: what defines success?

AI creates value only when detection leads to appropriate treatment and fracture prevention within a sustainable clinical pathway.

Open questions:

Is the result automatically incorporated into the report?
Is the patient referred for DXA, FRAX assessment or FLS evaluation?
Does the system increase osteoporosis diagnosis and treatment?
Does it eventually reduce subsequent fractures?
How many false-positive referrals can the FLS absorb?

Conclusions

AI can turn routine imaging into an opportunity for earlier osteoporosis detection, without requiring additional examinations or radiation exposure.

Radiographic fracture detection is already clinically available, but it is not synonymous with fragility assessment.

Opportunistic CT analysis for vertebral fractures and low BMD is the most promising osteoporosis-specific AI application.

The value of AI depends on closing the loop from PACS alert to DXA, fracture-risk assessment and clinical referral—not merely on detecting another imaging finding.

Ciao Stefano!

Thank you!

Aldo Carnevale

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