Comparison of radiology augmented vs asynchronous implementation of AI enabled Vertebral Fracture reporting

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Purpose or Learning Objective:

Osteoporotic vertebral fractures (VFs) are among the most common fragility fractures and are associated with increased morbidity, mortality, and future fracture risk. Despite their clinical significance, vertebral fractures frequently remain under-recognised on routine CT imaging performed for non-musculoskeletal indications. This represents a missed opportunity for early diagnosis of osteoporosis and timely referral to Fracture Liaison Services (FLS), which have been shown to reduce subsequent fracture risk. Artificial intelligence (AI) tools capable of opportunistic detection of vertebral fractures on CT imaging offer a potential solution to this gap. However, the optimal clinical workflow for integrating AI outputs into radiology reporting and downstream care pathways remains uncertain.

The purpose of this study was to compare the performance of two AI-enabled pathways for identifying and acting on vertebral fractures: (1) synchronous AI-augmented general radiology reporting, in which AI findings are presented to the reporting radiologist at the time of routine CT interpretation, and (2) asynchronous dedicated musculoskeletal (MSK) expert review of CT scans flagged by AI. The primary objective was to assess whether synchronous AI prompting is sufficient to ensure consistent reporting and referral, or whether an asynchronous expert review pathway provides superior capture of clinically relevant vertebral fractures.

This study is part of the ADOPT trial - **A**I-enabled **D**etection of **O**steo**P**orosis for **T**reatment.

The aims for the overarching project were as follows:

To increase commissioning and adoption of ***AI-enabled vertebral fracture pathways*** by:

1. Generating a **robust, multi-site, clinical evidence** base for AI-VF detection within a real-world clinical pathway
2. Generating an **independent health economic impact assessment** for *AI-enabled VF pathways*, **based on 'hard' clinical endpoints**
3. Optimising the technology and **real-world workflow** to promote successful long-term utilisation, across both radiological and clinical teams with a patient centric approach

Methods or Background:

This retrospective service evaluation was conducted using the Nanox-AI HealthVCF solution, an AI algorithm designed to identify moderate and severe vertebral fractures on CT imaging. All CT scans acquired between December 2023 and November 2024 that included the thoracic and/or lumbar spine were eligible for inclusion, regardless of the original clinical indication. The AI system automatically re-analysed these scans and flagged studies with suspected moderate or severe vertebral fractures.

In the synchronous pathway, AI-flagged CT images were annotated and presented directly to the reporting radiologist within the routine reporting workflow. Radiologists were expected to review the AI findings, confirm or refute the presence of vertebral fractures, and, where appropriate, include the diagnosis in the report and refer the patient to the Fracture Liaison Service.

In parallel, all AI-flagged CT scans were automatically exported to a separate server for asynchronous review by a consultant musculoskeletal (MSK) radiologist. This MSK radiologist independently assessed each flagged scan, confirmed the presence or absence of vertebral fractures, and served as the reference standard for the purposes of pathway comparison.

Outcomes assessed included the proportion of AI-flagged scans confirmed as vertebral fractures by the MSK radiologist, the proportion of confirmed fractures that were reported and referred via the synchronous pathway, and the rate of missed reporting stratified by reporting radiologist subspecialty and employment status (e.g. trainees, substantive consultants, outsourced or locum radiologists). Fisher's exact test was used to compare categorical outcomes between groups, with statistical significance set at $p < 0.05$.

Results or Findings:

During the 12-month study period, a total of 10,679 CT scans were analysed by the AI system. Of these, 1,311 scans (12.3%) were flagged by the AI as potentially containing moderate or severe vertebral fractures. Asynchronous review by the MSK radiologist confirmed vertebral fractures in 946 of the flagged scans, corresponding to a positive predictive value of 72.2% for the AI system.

Despite AI-informed prompting within the synchronous reporting workflow, 20.9% of AI-flagged scans with at least one MSK-confirmed vertebral fracture were not confirmed by the reporting radiology and so not referred to the Fracture Liaison Service. This represents a substantial proportion of missed opportunities for secondary fracture prevention, even in the presence of AI assistance.

Analysis by reporter group demonstrated trainees had the lowest 'missing' rate (5.8%), with the highest missing rate being for outsourced (45.6%) and locums radiologists (48.4%) compared with 10.2% for other MSK radiologists ($p<0.001$). When stratified by subspecialty, the highest non-MSK missed reporting rates were seen in Chest/Nuclear Medicine (29.6%), Head and Neck (26.7%), and Breast radiology (26.3%). These findings suggest that both subspecialty focus and familiarity with longitudinal patient management pathways may influence engagement with opportunistic fracture detection.

Conclusion:

Our findings demonstrate that, while AI-based opportunistic detection of vertebral fractures is effective in identifying a large number of previously unrecognised fractures, the method of integrating AI outputs into clinical workflows critically influences downstream outcomes. Synchronous AI augmentation of general radiology reporting improved visibility of vertebral fractures but was insufficient to ensure consistent reporting and referral to FLS, with approximately one in five confirmed fractures still being missed.

Several factors may contribute to this observation. General radiologists reporting CT scans for non-MSK indications may prioritise the primary clinical question and may be less inclined to act on secondary findings, even when highlighted by AI. Time pressures, cognitive load, and uncertainty regarding responsibility for referral may further reduce follow-through. In contrast, asynchronous review by a dedicated MSK radiologist provides focused expertise, consistency, and a clear mandate to identify and act upon vertebral fractures, independent of the original imaging indication.

The lower missed rate observed among trainees is noteworthy and may reflect closer adherence to AI prompts, greater engagement with feedback, or more recent training emphasising osteoporosis and secondary prevention. Conversely, higher missed rates among outsourced and locum radiologists may relate to reduced integration within local care pathways, limited access to referral mechanisms, or lower perceived ownership of downstream patient management.

These findings have direct relevance for Fracture Liaison Service (FLS) workflow design. Even with AI-informed prompting embedded within routine radiology reporting, a significant proportion of CT scans with MSK-confirmed vertebral fractures were not reported or referred, resulting in missed opportunities for secondary fracture prevention.

The results demonstrate that reliance on synchronous, generalist radiology reporting—despite AI augmentation—does not effectively translate AI detection into FLS-triggering clinical action. In contrast, an asynchronous workflow in which AI-flagged scans are systematically reviewed by a dedicated MSK radiologist provides a more robust and consistent decision-making framework for FLS referral. This model aligns closely with FLS principles, which depend on reliable case identification, standardised decision thresholds, and clear accountability for referral.

By decoupling vertebral fracture detection from the competing priorities of primary diagnostic reporting, asynchronous MSK review enables AI outputs to function as a population-level triage tool that feeds directly into FLS pathways. Such a workflow supports equitable fracture identification across subspecialties, mitigates variability related to reporter experience or employment status, and strengthens the integration of opportunistic imaging findings into osteoporosis care.

Implementation of AI-based opportunistic detection of vertebral fractures requires consideration of method of clinical confirmation if it is to improve patient outcomes. These findings support the adoption of AI-enabled, asynchronous expert review as a preferred implementation strategy for vertebral fracture detection within FLS-based decision making. Embedding this approach into routine practice may enhance the clinical impact of AI, ensure consistent referral to fracture prevention services, and ultimately improve patient outcomes through earlier and more reliable secondary fracture prevention.

Personal Information:

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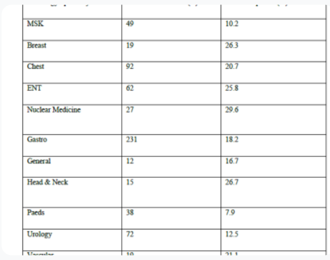

MSK	49	10.2
Breast	19	26.3
Chest	92	20.7
ENT	62	25.8
Nuclear Medicine	27	29.6
Gastro	231	18.2
General	12	16.7
Head & Neck	15	26.7
Paeds	38	7.9
Urology	72	12.5

Fig 1: Fig 1: Rate of reporting based on Radiology consultant sub specialty

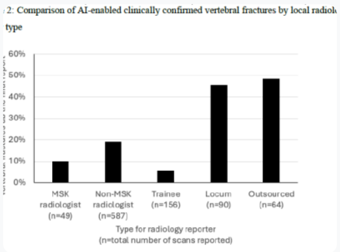

Fig 2: Fig 2: rate of missed vertebral fractures based on radiologist experience and location

Fig 3: Asynchronous workflow user interface for FLS based AI-VF