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Vertebral fragility fractures (VFFs) are the most common type of osteoporotic fracture with an incidence of 12% in women aged 50–79 years, increasing to 20% in women over 80 years of age 1,2. The presence of a VFF is a strong predictor of subsequent osteoporotic fractures, in particular a threefold increased risk of hip fractures in patients with a previous VFF 3. Hip fractures are associated with an eightfold increased risk in age-adjusted mortality and patients' functional quality of life is significantly reduced, with less than 50% of patients returning to their pre-injury functional baseline 4. Whilst the morbidity and mortality impact of VFFs are well-documented, the economic burden is also highly significant. In 2019, there were approximately 527,000 fragility fractures in the UK with an estimated direct cost of over £5 billion and a predicted increase in the number of fractures of 26% by 2034 5. Early diagnosis of VFFs, whether clinically or radiologically, enables healthcare providers to initiate treatment, and potentially reduce the risk of further fractures and associated health and economic burden.

Whilst patients with symptomatic VFFs are diagnosed clinically and commenced on a treatment pathway, patients with clinically occult VFFs may not be identified due to a number of factors, one of which is underreporting of VFFs by radiologists and reporting radiographers on imaging studies 6. The reasons for radiological underdiagnosis are multifactorial - including a failure to routinely review the spinal components of imaging; ambiguous reporting terminology; uncertainties around vertebral fracture assessment systems; and a lack of awareness of the clinical significance of VFFs 7.

In 2019, the Royal College of Radiologists (RCR), in collaboration with the Royal College of Physicians (RCP) and the Royal Osteoporosis Society (ROS), undertook a national audit across all four home nations of the UK to evaluate radiological reporting of VFFs in patients aged 70 years over. The audit retrospectively assessed reporting of incidental spinal VFFs present on computed tomography (CT) studies that included the spine but where the spine was not the area of clinical interest. Patients with a history of trauma or malignancy were excluded 8. Additionally, the audit reviewed pertinent aspects in the diagnostic and treatment pathway, including report communication/information mechanisms (the use of alerts) and access to a

patients per department 8. The Genant semi- quantitative tool was utilised as the standard method for the audit for reviewing the vertebrae as this method of visual inspection is easy to implement and standardise, suited for the working practices of non-musculoskeletal radiologists, and is referred to in the ROS guidance 3,9.

In the 2019 audit cycle, 63% of eligible departments supplied audit data (127/202 departments) in 6,357 patients. The patient reporting section showed a generalised lack of compliance with the four main audit standards:

- report/comment on spine/bone,
- fracture severity assessment,
- use of recommended reporting terminology (i.e. fracture),
- appropriate recommendations for further management)

This highlighted key organisational issues restricting effective communication of the report findings or onward referrals 8,10.

Following publication and dissemination of the audit findings, a range of interventions were initiated by the RCR, working with the RCP and ROS, to promote radiological awareness and reporting of VFFs and to improve communication and onward further management of these fractures 11. Interventions included:

- publication of a national RCR guidance document on VFF reporting;
- publication of an editorial in Clinical Radiology;dissemination of the audit publication and national guidance links to RCR audit leads across the UK with a recommendation to discuss the documents and recommendations in departmental REALM (radiology events and learning meetings);
- a webinar on the topic hosted by the RCR in late 2022 10,11.
- A national re-audit was scheduled for 2022 to allow any changes in practice after the initial audit and interventions to start to take effect.

The overall audit participation rate in the 2022 re-audit cycle was 67% (4% increase1) of eligible departments supplying audit data (129/194 departments) in 7,316 patients 12. The re-audit results showed improvements within a relatively short post-intervention period across all the audit parameters. In particular, there was a 6% increase in reporting of moderate/severe VFFs. There was improved compliance with the four main audit standards (comment on spine/bone 14% increase, fracture severity assessment 8.5% increase, use of recommended reporting terminology 7.5% increase, and appropriate recommendations for further management 9.1% increase) 12. Selected additional organisational improvements are included, as follows: -

- Departmental policy for alerting significant, unsuspected or urgent findings to include VFFs - 20%
- Agreed onward referral pathway for patients identified with VFFs - 31%
- Onward referral pathway also includes teleradiology studies - 13%
- Radiology department has access to a FLS - 7%

Subsequent work was conducted to quantify the possible economic benefits of the 6% increase in VFF diagnostic yield that was observed between the two audits. The Vertebral Fracture Identification Toolkit, developed by the ROS, has a Benefits Calculator that estimates potential osteoporotic fracture reductions and related cost savings based on different models of inputted data 13,14. An estimate of non- trauma CT studies that included the thoracolumbar spine for patients over 70 years of age was obtained after direct communication with NHS England. This figure was then extrapolated to represent a UK- wide figure (using the relative numbers of NHS Trusts or equivalent in the four countries in the UK). An estimate of 1.8 million CT scans performed in 2022 was obtained. Using the incidence figure of 21.7% obtained in the 2022 audit, out of 1.8 million CT studies, an estimated 390,000 patients will have a VFF. A 6% rise in the 390,000 diagnostic yield could potentially result in the diagnosis of 23,400 more patients 13. In the UK, the approximate total cost of a hip fracture in the first year is currently £23,500. In a cohort of 23,420 patients receiving no treatment, 890 hip fractures can be anticipated in the first year using the ROS Benefits Calculator. This number drops to 328 patients once treatment is started, i.e. 562 fractures are potentially avoided with significant associated cost savings of £13,207,000 secondary to increased radiological diagnosis 13,14. This only works if report transfer mechanisms are effective and established and if onward referral is in place.

An onward referral mechanism to a secondary fracture prevention service (e.g. FLS or osteoporosis assessment clinic equivalent) is the final component of the VFF pathway from diagnosis to treatment. FLS availability in the UK is currently around 51% and will require adequate resources and staff to accommodate the expected increase in referrals due to changes in radiological reporting practice 5. It is evident that artificial intelligence (AI) will play a more significant role in the years to come and a number of AI systems currently under

FLS network. This, in turn, would realise the long term financial, morbidity and mortality savings of a functioning VFF pathway.

The potential substantial improvements in patient health and wellbeing and the associated cost savings that have been identified are secondary to a cooperative, multi-professional national audit and re-audit following targeted interventions. It will be necessary to make significant, ongoing investments in personnel and equipment as well as repeated audit cycles at the clinical and radiology departmental levels for the maximum benefits to be realised and maintained.

1 All increases are represented as percentage point changes.

Conflict of interest:

The authors have no conflicts of interest to declare

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