MRS BAD BONES: Service Evaluation of Osteoporosis Secondary Prevention in Hip Fragility Fractures during COVID-19 Pandemic

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MRS BAD BONES: Service Evaluation of Osteoporosis Secondary Prevention in Hip Fragility Fractures during COVID-19 Pandemic

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Abstract

Background: Management of osteoporosis is an important consideration for neck of femur fracture patients due to the morbidity and mortality it poses. Orthogeriatric teams input is invaluable in coordinating secondary fragility fracture prevention. The COVID-19 pandemic resulted in the rapid restructuring of healthcare teams and led to the redeployment of the orthogeriatricians.

Objective: This study explored the impact COVID-19 had on secondary prevention of neck of femur fragility fractures, and potential interventions to improve assessment and management.

Methods: A retrospective audit in neck of femur fracture patients pre- and post- UK lockdown in response to the COVID-19 pandemic. A re-audit was conducted following the implementation of our new mnemonic ‘MRS BAD BONES’:

Medication Review
Rheumatology / Renal Advice
Smoking Cessation

Blood tests
Alcohol limits
DEXA scan

Bone-sparing medications
Orthogeriatric review
Nutrition
Exercise
Supplements

Results: Data for 50 patients was available in each phase. The orthogeriatric team reviewed 88% of patients pre-lockdown falling to 0% due to redeployment, before recovering to 38% in the post-intervention period. Lockdown brought a significant drop in prescription of vitamin D/calcium supplements from 81.6% to 58.0% (P=0.0156); of bone-sparing medications from 60.7% to 18.2% (P=0.0037), and DEXA scan requests from 40.1% to 3.6% (p=0.0027). Following the implementation of our mnemonic, there was a significant increase in prescription of vitamin D/calcium supplements to 85.7% (P=0.0034), bone-sparing medications to 72.4% (P=0.0002) and DEXA scan requests to 60% (P<0.0001).

Conclusions: COVID-19 had a major impact on the secondary prevention of fragility fractures in this population. The ‘MRS BAD BONES’ mnemonic significantly improved the management and could be used in a wider setting.

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ABSTRACT

Background

Management of osteoporosis is an important consideration for neck of femur fracture patients due to the morbidity and mortality it poses. Orthogeriatric teams input is invaluable in coordinating secondary fragility fracture prevention. The COVID-19 pandemic resulted in the rapid restructuring of healthcare teams and led to the redeployment of the orthogeriatricians.

Objective

The study aimed to determine the impact coronavirus disease 2019 (COVID-19) had on secondary prevention of fragility fractures in neck of femur fracture patients, and to optimise management in this population.

Methods

A retrospective audit in neck of femur fracture patients pre- and post- UK lockdown in response to the COVID-19 pandemic. A re-audit was conducted following the development of our new mnemonic, which addressed key factors in assessment and management of osteoporosis:

Medication Review
Rheumatology / Renal Advice
Smoking Cessation

Blood tests
Alcohol limits
DEXA scan

Bone-sparing medications
Orthogeriatric review
Nutrition
Exercise
Supplements

Fisher's exact test was used for comparison analyses between each phase.

Results

Data for 50 patients was available in each phase. The orthogeriatric team reviewed 88% of patients pre-lockdown falling to 0% due to redeployment, before recovering to 38% in the post-intervention period. Lockdown brought a significant drop in prescription of vitamin D/calcium supplements from 81.6% to 58.0% (P=0.016); of bone-sparing medications from 60.7% to 18.2% (P=0.004), and DEXA scan requests from 40.1% to 3.6% (p=0.003). Following the implementation of our mnemonic, there was a significant increase in prescription of vitamin D/calcium supplements to 85.7% (P=0.003), bone-sparing medications to 72.4% (P=0.0002) and DEXA scan requests to 60% (P<0.0001).

Conclusion

The redeployment of the orthogeriatric team, due to the COVID-19 pandemic, impacted on secondary prevention of fragility fractures in this population. The 'MRS BAD BONES' mnemonic significantly improved the management and could be used in a wider setting.

KEYWORDS: osteoporosis; fragility fracture; guidelines; acronym; COVID-19

INTRODUCTION

Osteoporosis, characterised by the progressive degradation of the microarchitecture of bone tissue and resultant loss in bone density, is a leading cause of femoral neck fractures in the elderly [1]. In the United Kingdom (UK), there are approximately 536,000 new fragility fractures each year, of which 79,000 are neck of femur fractures [2]. This is a significant cause of increased morbidity and mortality amongst the elderly, with an average cost of treatment to the National Health Service (NHS) estimated at £12,000 per patient [3-4]. Furthermore, patients who suffer an osteoporotic fracture are at a greater risk of sustaining a second osteoporotic fracture [3].

The management of neck of femur fractures has evolved over time. Best practice tariffs have been established to optimise the care of these patients, which should include post-operative rehabilitation and assessment for secondary fracture risk under the guidance of geriatrician-directed multidisciplinary teams [5]. Orthogeriatric-co-management has significantly reduced 30-day mortality in hip fracture patients from 13.4% to 10.3% [6], with positive influence on functional outcomes and future fracture risk [7]. The National Institute for Health and Care Excellence (NICE) guidelines specifically support the management of bone health during admission for neck of femur fractures and recommend initiating bisphosphonate therapy (or an alternative) in addition to calcium and vitamin D supplementation to all patients with fragility fractures [8].

This year has brought an unprecedented challenge to healthcare services worldwide, with the declaration of the global pandemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on March 11, 2020 [9]. The pandemic resulted in the rapid restructuring of healthcare teams to respond to the large influx of medically unwell patients across hospital sites. Within our Trauma and Orthopaedic (T&O) department, this resulted in the redeployment of the orthogeriatric team, who had previously been responsible for

coordinating management of secondary prevention of fragility fractures in the neck of femur fracture population.

This project was part of a quality improvement initiative. The aim of this study was to determine the impact coronavirus disease 2019 (COVID-19) had on secondary prevention of fragility fractures in neck of femur fracture patients, and to optimise management in this population.

METHODS

All requirements to carry out the study were sent to the research and development (R&D) department to assess risks to patient identification. R&D approved the study (identification number: 698), and confirmed that as the project was a local audit without use of patient identifiable information, there was no need for further ethical approval. This study was based on neck of femur fracture patients admitted to the major trauma centre, University Hospital Coventry and Warwickshire (UHCW) between February 2020 and June 2020. Patients were recruited consecutively by admission dates, and the same inclusion and exclusion criteria were applied. The inclusion criteria involved all low energy neck of femur fracture patients aged 60 or over on admission. The exclusion criteria involved patients with peri-prosthetic fractures, patients who were managed non-operatively, patients who were taking bone-sparing treatment pre-admission, patients who it was documented as inappropriate to commence bone-sparing treatment due to a palliative approach, and patients who died whilst in-hospital.

Data was collected in 2 phases of 50 consecutively admitted patients; the first phase recruited patients admitted immediately prior to the national UK lockdown on March 23,

2020 to determine the department's baseline compliance. The second phase refers to those admitted immediately after the lockdown.

All patients were assessed as to whether secondary prevention of fragility fractures had been carried out upon discharge as described by UHCW trust guidelines. Figure 1 describes the local guidelines used for managing vitamin D and calcium deficiency in illustrative form. This involved measuring serum vitamin D, PTH, adjusted calcium and estimated glomerular filtration rate (eGFR) then prescribing appropriate supplements [10]. The percentage of patients who had these parameters measured was recorded. Figure 2 demonstrates the osteoporosis treatment local guidelines in the neck of femur fracture population. Women less than 75 years old and all men met the criteria for dual energy x-ray absorptiometry (DEXA). The DEXA scan service continued as normal during the lockdown period. Women aged 75 or older met the criteria for bone-sparing medications (BSM), taking into consideration gastrointestinal side effects and renal function.

Available case notes, primarily orthogeriatric review, drug charts, discharge summaries, DEXA scan request forms and laboratory results were reviewed, with local laboratory parameters used. The lowest measurable value in our laboratory for vitamin D serum levels is <10nmol/L so for the purposes of analysis, this was substituted for a value of 10nmol/L. eGFR was calculated using the Modification of Diet in Renal Disease (MDRD) equation (ml/min/1.73m^2). Adjusted calcium in mg/dL was calculated using [0.8 x (normal albumin - patient's albumin)] + serum calcium level. A normal albumin level was defaulted to 40g/L.

For these first 2 phases, data was collected retrospectively using information available from electronic patient records. Consequently, we were only able to assess orthogeriatric reviews, blood test results, DEXA scan requests, bone-sparing medications and supplements prescribed.

The results of the review were presented at the monthly Trauma and Orthopaedic quality improvement projects (QIP) meeting. A new mnemonic, ‘MRS BAD BONES’, was developed as a tool to improve junior doctor, advanced nurse practitioner (ANP) and medical student awareness of secondary fragility fracture prevention. The mnemonic represents the following:

Medication Review
Rheumatology / Renal Advice
Smoking Cessation

Blood tests: calcium, eGFR, PTH and vitamin D
Alcohol limits
DEXA scan

Bone-sparing medications: Bisphosphonates
Orthogeriatric review
Nutrition
Exercise
Supplements: calcium and vitamin D

A third and final phase of data was then collected prospectively following the dissemination of the acronym at the QIP meeting. Due to the limitations of data available from phase 1 and 2, we decided to only measure the same 5 parameters in phase 3, despite there being 11 in the mnemonic. All data was analysed using IBM SPSS statistics v24.0. The mean was used for averages. Fisher’s exact test was used when comparing groups of categorical data to provide exact *P* values. *P* values lower than *0.05* were considered statistically significant, with further sub-stratification to * <0.05, ** <0.01, *** <0.001 and **** <0.0001.

RESULTS

Baseline Characteristics

Data for 50 consecutive neck of femur fracture patients was collected during the periods pre-UK lockdown, post-UK lockdown and post-intervention of our mnemonic ‘MRS BAD BONES’. During data collection, a number of patients were excluded from analysis: 8 patients with peri-prosthetic fractures, 8 patients who were managed non-operatively, 12 patients who were taking bone-sparing treatment pre-admission, 9 patients who it was documented as inappropriate to commence bone-sparing treatment due to a palliative approach, and 14 patients who died whilst in-hospital. The demographics of the patients can be seen in table 1. The percentage of patients who were reviewed by the orthogeriatric team pre-lockdown was 88% but this fell to 0% following the lockdown, due to redeployment in response to COVID-19 pressures. During the post-intervention period, this recovered to 38% as the orthogeriatric team returned to the T&O wards with the easing of local COVID-19 pressures.

	Pre-lockdown	Post-lockdown	Post-intervention
Number (N)	50	50	50
Age	83.8	82.4	82.7
Female:Male	33 : 17	27 : 23	36 : 14
Orthogeriatric Review	88%	0%	38%

Table 1. The demographics of the neck of femur fracture patients whose data was analysed for this study. The mean ages, the female:male ratio, and the percentage of patients who received an orthogeriatric review are shown.

The percentage of patients who had blood tests performed as per the local guidelines, which includes estimated glomerular filtration rate (eGFR), adjusted calcium (aCa) and vitamin D (vit D) was high (96-100%), with no significant difference between all 3 phases (P=0.777); (Table 2). However, only 5 PTH blood tests were performed, all in the pre-lockdown period, with an average of 7.0 (4.3-10.8). This represents just 10% of the pre-lockdown population sample, just over 3% of the total sample population but also a significant fall into the post-lockdown and intervention phases (P<0.0001).

Blood Test	Pre-lockdown %	Post-lockdown %	Post-intervention %
Vit D	98	100	96
aCa	100	98	96
PTH	10	0	0
eGFR	100	100	100

Table 2. The percentage of patients receiving blood tests advised by the guidelines during each phase, which includes eGFR, adjusted calcium, parathyroid hormone and vitamin D.

Average vitamin D, adjusted calcium and eGFR serum levels for the cohorts can be seen in the table 3. They show deficiency in serum vitamin D but normal adjusted calcium levels and eGFR, when adjusted for age, sex and ethnicity.

Blood Test	Pre-lockdown	Post-lockdown	Post-intervention
Vit D (nmol/L)	46 (12-113)	37.8 (10-90)	49.1 (10-116)
aCa (mg/dL)	2.30 (2.06-2.65)	2.28 (2.05-2.54)	2.29 (2.06-2.78)
eGFR (ml/min/ 1.73m^2)	80 (18-179)	86 (12-183)	83 (8-156)

Table 3. Average vitamin D, adjusted calcium and eGFR serum levels represented as mean and range.

Secondary Prevention of Fragility Fractures

The purpose of this audit was to assess whether the correct bone health management had been initiated following the UK-wide COVID-19 lockdown. This was broken down into the steps advised by the local guidelines, with the following treatments: vitamin D/ calcium supplementation, bone-sparing medications and DEXA scanning. We also noted a subgroup of patients who met the criteria for a DEXA scan, but did not have a DEXA requested, and instead were commenced onto bone-sparing treatment. The percentages and fractions of patients who received the correct osteoporosis management is displayed in table 4 and figure 3.

Osteoporosis Management	Pre-lockdown %	Post-lockdown %	Post-intervention%
Vit D/Ca supplements	81.6 (40/49)	58.0 (29/50)	85.7 (42/49)
Bone-sparing medication	60.7 (17/28)	18.2 (4/22)	72.4 (21/29)
DEXA scan	40.1 (9/22)	3.6 (1/28)	60.0 (12/21)
No DEXA scan but bone-sparing medication	69.2 (9/13)	7.4 (2/27)	88.9 (8/9)

Table 4. The percentage and fraction of patients who received the correct osteoporosis management during the three phases. The patients who met the criteria for a DEXA scan but were commenced onto bone-sparing medications instead is also represented.

Vitamin D/ calcium prescription

The number of patients receiving the correct vitamin D/ calcium treatment following the lockdown was significantly reduced (*P=0.016*) with a drop from 81.6% to 58%. Following the implementation of the 'MRS BAD BONES' mnemonic it was found that prescriptions increased to 85.7% (*P=0.003*) and this was significant when compared to the post-lockdown data (see figure 3). However, there was no significant difference between the post-intervention and pre-lockdown findings (P=0.692).

Bone-sparing medication prescription

As seen in figure 4, following the UK lockdown, just 18.2% of patients, compared to 60.7% of patients pre-lockdown, were prescribed bone-sparing medication. This represents a significant drop (*P=0.004*). However, following the implementation of the 'MRS BAD BONES' mnemonic, prescription of these medications significantly increased to 72.4% compared to post-lockdown (*P=0.0002*).

DEXA scan requests

There was a significant drop in DEXA scan requests from 40.1% to 3.6% of the eligible patients (*P=0.003*) in the post-lockdown period despite a normal service. In the post-intervention phase, this number increased to 60% and was of significance (*P<0.0001*) compared to the post-lockdown data, as represented in figure 5. Whilst the percentage of patients with DEXA scans requested increased from 40.1% in the pre-lockdown period, to 60% in the post-intervention period, this was not statistically significant (*P=0.366*). There were a number of patients who were eligible for a DEXA scan as per the guidelines but did not have one requested. Alternatively, they were commenced onto bone-sparing medication. As seen in table 3 and figure 6, pre-lockdown, 69.2% of this subgroup had bone-sparing medication prescribed. Following the lockdown, this dropped to 7.4%, which

was a significant drop (*P=0.0001*). Post-intervention this significantly increased to 88.9% (*P<0.0001*) when compared to the post-lockdown figures.

DISCUSSION

A significant percentage of the neck of femur fracture patients who attended UHCW did not receive the correct secondary fragility fracture prevention treatment following the UK lockdown due to the COVID-19 pandemic. Other than PTH, blood testing was performed as per guidelines during the three phases but post-lockdown, these serum results were not actioned appropriately. The redeployment of the orthogeriatric team, who primarily action these results, was the biggest factor leading to this. Clinical management of patients with fragility fractures is often suboptimal even under normal circumstances; a prior study on secondary prevention of fragility fractures showed that despite steps being taken to better the awareness amongst junior doctors and nurse practitioners, improvements were still below target [11].

The direct implications on these patients not receiving adequate bone protection are unclear, and follow up of this cohort may be useful for outcome studies. However, the literature suggests a 10-13% overall risk of sustaining a secondary contralateral neck of femur fracture, which leads to a one-year mortality of 31.6% compared to 27.3% for the index fracture. Furthermore, a risk of 28.6% is seen for any other osteoporosis-related fracture. It is clear this injury causes a significant morbidity and mortality amongst the elderly, and financial burden to the NHS [12-13].

The blood tests revealed deficiency in serum vitamin D, which is to be anticipated in this population[9], but normal adjusted calcium levels and eGFR. No PTH measurements were performed post-lockdown, with very few prior; no particular reason for this was identified.

Parathyroid pathologies are relatively common endocrine disorders, particularly in elderly women [14]. PTH is vital for the maintenance of calcium homeostasis through its catabolic and anabolic actions that regulate bone remodelling. Hypoparathyroidism can lead to osteoporosis. PTH replacement therapy has been shown to remedy this abnormality [15]. Equally, patients suffering with primary hyperparathyroidism, particularly the normocalcemic variant, have more skeletal complications than is classically seen in hypercalcaemic primary hyperparathyroidism. One study found osteoporosis in 57% of a population with normocalcemic primary hyperparathyroidism [16]. Hence, measuring serum PTH, as per the local guidelines, is important in this cohort, and needs to be improved.

NICE recommendations to consider DEXA scanning and treatment of target groups to prevent fragility fractures are based on vast evidence that they reduce the risk of hip fracture and are cost effective when compared to untreated osteoporosis [17-18]. In younger patients, bone mineral density assessment is needed to confirm the diagnosis of osteoporosis as often high energy trauma is required to fracture the proximal femur. However, appropriate treatment can be commenced in elderly patients with a fragility fracture without the requirement for a DEXA scan [19]. Hence, it is good clinical practice to address this whilst the patient is still in hospital.

Strengths

This study highlighted the positive impact on patient care that can be achieved by service changes implemented at a junior level. Following the dissemination of our findings, and implementation of the mnemonic, ‘MRS BAD BONES’, there was a significant improvement in the management of bone health compared to the post-lockdown period, and was comparable to the pre-lockdown data. Mnemonics are used in various sectors for teaching purposes. Though used in a hospital setting here, this acronym has the potential to be used

in a wider setting, including primary care and medical education. Studies have demonstrated the role of mnemonic strategies in reshaping brain networks and improving memory performance [20]. Finally, though utilised during the COVID-19 pandemic, the use of this mnemonic has the potential to have an ongoing positive impact in the post-COVID-19 era.

Limitations

Not all parameters included in the mnemonic ‘MRS BAD BONES’ were assessed in this study due to restricted access in requesting archived written documents during the pandemic. Consequently, data was primarily collected using information available from electronic patient records. Those parameters not assessed include: medication review, rheumatology / renal advice, smoking cessation, alcohol limits, nutrition and exercise. The authors opted to use ‘MRS BAD BONES’ despite this limitation because of the importance of each parameter as well as being a memorable acronym that provides a holistic approach to managing fragility fractures as endorsed by NICE. Drugs, particularly glucocorticoids, can induce osteoporosis and so a medication review is an important assessment.
Rheumatology or renal advice can be sought in complex cases where specialist treatment input is required, particularly in patients with severe renal impairment or intolerance of first line bisphosphonates. Lifestyle changes including smoking cessation, drinking alcohol within recommended limits, optimising nutrition and regular exercise can all improve bone health and reduce risk of fragility fractures [17]. Further research may provide insight into whether these factors were significantly effected by the use of the mnemonic. Furthermore, the return of the orthogeriatric team to the orthopaedic unit will have contributed to improvements. Due to the unpredictability of the pandemic, their arrival was an unforeseen factor during the intervention phase. However, 62% of the patients in the post-intervention phase did not receive an orthogeriatric review because they were discharged prior to their

return. Hence, a large proportion of these patients had optimised management prior to the gradual return of services. Another limitation is that the guidelines state male, and female patients less than 75 years old should have a DEXA scan. Our results showed a significant proportion of patients eligible for DEXA scanning were instead commenced onto bone-sparing medications. The local guidelines do not take into consideration the experience and clinical judgement made by the orthogeriatric team who on occasions will commence male, and female patients less than 75 years old deemed high risk for osteoporosis onto bone-sparing medications without the need for bone density assessment. An update on the local guidelines to reflect this should be considered when next reviewed. A final limitation of this study is that 50 consecutive neck of femur fracture patients were collected in the three phases over a five month period. This may be considered a small population over a short duration. A longer period of analysis including recruitment of non-hip fragility fracture patients may be useful to further evaluate the findings. Additionally, dissemination of this mnemonic in other orthopaedic units might be useful to further validate our results.

CONCLUSION

Management of bone health is an important consideration for neck of femur fracture patients due to the morbidity and mortality osteoporosis poses, and the significant financial burden fragility injuries cause the NHS. Orthogeriatric team input is invaluable in coordinating secondary prevention of fragility fractures. However, with the uncertainty of future SARS-CoV-2 outbreaks, subsequent orthogeriatrician redeployment may be required. Despite this, ensuring fragility fracture management is not forgotten is vital. Here we present the use of a mnemonic, ‘MRS BAD BONES’, aimed at junior doctors, ANPs and medical students, which could be used to improve awareness of major areas of assessment

and management of secondary prevention of fragility fractures and maintain optimal quality of care.

Acknowledgment: I thank all the staff in the Trauma and Orthopaedic department, University Hospital Coventry and Warwickshire for their tireless work throughout the COVID-19 pandemic.

Conflicts of Interest: none declared

ABBREVIATIONS

UK: United Kingdom

NHS: National Health Service

NICE: National Institute for Health and Care Excellence

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

COVID-19: coronavirus disease 2019

UHCW: University Hospital of Coventry and Warwickshire

DEXA: dual energy x-ray absorptiometry

BSM: bone-sparing medications

T&O: trauma and orthopaedics

eGFR: estimated glomerular filtration rate

MDRD: modification of diet in renal disease

ANP: advanced nurse practitioner

aCa: adjusted calcium

PTH: parathyroid hormone

Vit D: vitamin D

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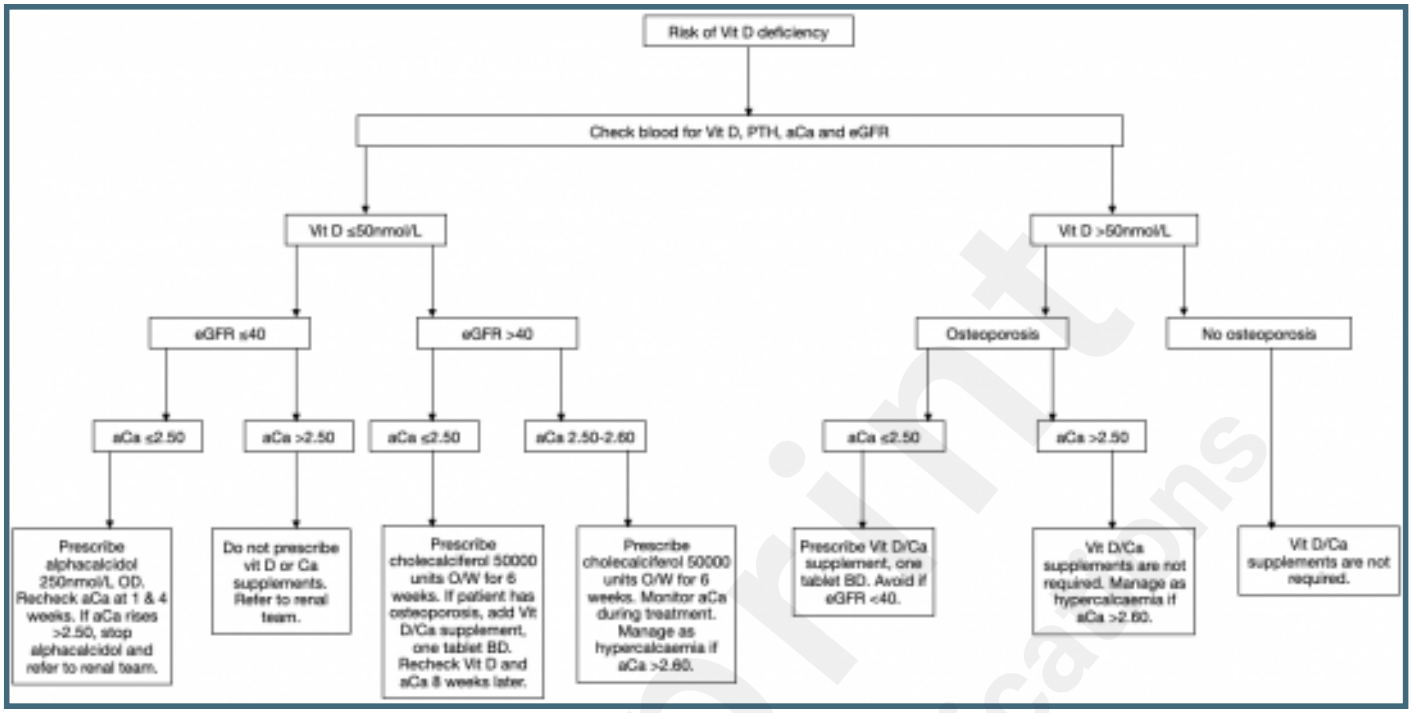
Supplementary Files

Figures

Assessment and management of the neck of femur fracture patients at risk of vitamin D deficiency, as described by UHCW guidelines. Key: aCa = adjusted calcium, Ca = calcium, eGFR = estimated glomerular filtration rate, PTH = parathyroid hormone, vit D = vitamin D.



Osteoporosis assessment and treatment for the neck of femur fracture population as per UHCW guidelines. Key: eGFR = estimated glomerular filtration rate, DEXA = dual energy x-ray absorptiometry, GI = gastrointestinal.