
4th Annual
National Conference
September 21–23,
2023
RhAPP
RHEUMATOLOGY ADVANCED
PRACTICE PROVIDERS
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PROVIDERS

DEXA Imaging

Michele Volansky, PA-C, MPH
Wendy Simmons, PA-C, DFAAPA

Accreditation Statement

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Accreditation Statement

Michele Volansky, PA-C, MPH:

- Guest Lecturer in Rheumatology: Emory University Medical School, PA Program; Philadelphia College of Osteopathic Medicine, PA program
- Speaker: Astra Zeneca

Wendy Simmons, PA-C, DFAAPA:

- Speaker: AbbVie, Amgen, Boehringer Ingelheim, AstraZeneca, Pfizer, Radius, UCB
- Advisory Board: AbbVie, Amgen, Fresenius Kabi, Lilly, AstraZeneca, UCB
- Consultant: AbbVie, Fresenius Kabi

Objectives

- Define Osteoporosis and understand the pathophysiology.
- Update current epidemiology and prevalence of osteoporosis and fractures.
- Learning DXA “101” following ISCD 2019 Guidelines
- Understand use of DXA and FRAX score in diagnosing and monitoring osteoporosis.
- DXA Interpretations

Overview of Osteoporosis

- **Osteoporosis-** "Bone disease that develops when bone mineral density and bone mass decreases, or when the structure and strength of bone changes. This can lead to a decrease in bone strength that can increase the risk of fractures." (NIH Consensus Development Panel 12/1/2022)

- **Bone Composition** – Bone matrix is 90% collagen (Type I collagen containing crosslinks of N-telopeptides, C-Telopeptides and deoxypyridinolines) and 10% other proteins (osteocalcin, osteonectin and osteopontin. These are basis for one turnover markers.

  - Bone mineral is hydroxyapatite (calcium and phosphorus).

  - Bone cells are osteoclasts, osteoblasts, osteocytes and living cells.

- **Bone Modeling and Remodeling –** Bone growth occurs as result of modeling, renewal of bone substance and alteration in size and shape of bone.

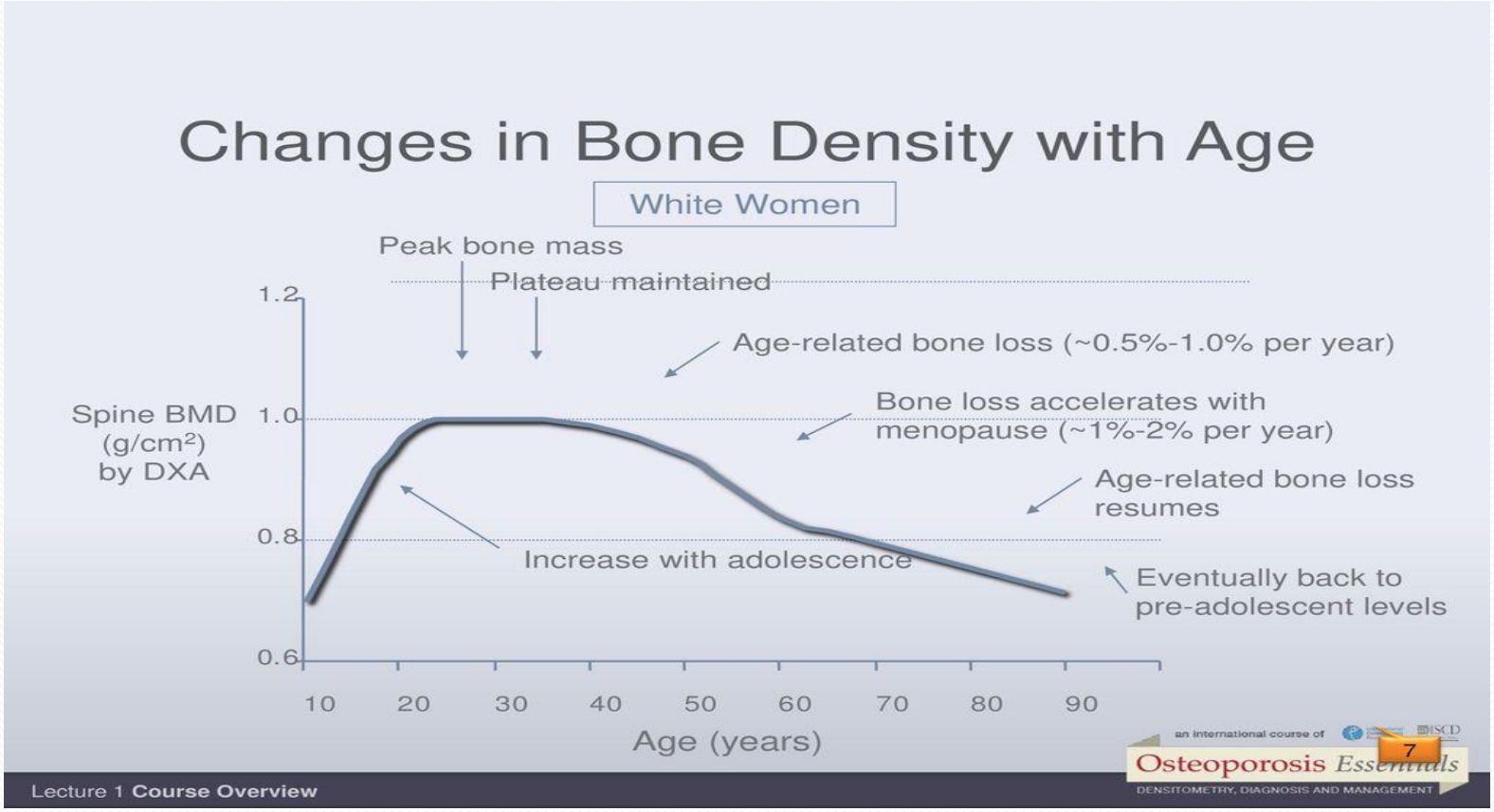
  - Bone health is maintained by remodeling: replacement of old bone with new bone through a remodeling cycle that is a coordinated sequence of activation, resorption and formation.

  -Bone remodeling is done by osteoclasts (cells derived from bone marrow precursors) that remove old bone (resorption) and osteoblasts (cells derived from mesenchymal precursors) that produce new bone matrix, which then becomes mineralized mature bone (formation).

  -Bone loss occurs when resorption exceeds formation.

Overview of Osteoporosis

- Peak Bone Mass – Is the maximum bone mass or density achieved during a lifetime. Occurs when the growth in the size of bones and accumulation of bone mineral has stabilized (consolidation) - Determination of peak bone mass may depend on heredity: sex (higher in men) and race (higher in black population) (70-80%), and lifestyle factors calcium, vitamin D, exercise, tobacco, alcohol (20-30%).



Overview of Osteoporosis

Two Skeletal Regions

- **Central Skelton Region** -spine, hips and shoulders, ribs, pelvis.
- **Peripheral Skeleton Region** - extremities-arms and legs.

Two Types of Bone in Skeletal Regions

- **Peripheral Skeleton – Cortical (Compact Bone)**
  - Makes up the Shafts of long bones, outer envelope of peripheral skeleton
  - Makes up 80% of skeleton, 20% of surface area
  - 3% is renewed each year

Central Skeleton- Cancellous (Trabecular Bone)

- Makes up the inner parts of parts of bones of axial skeleton
- Makes up 20% of skeleton, 80% of surface area
- 25% renewed each year

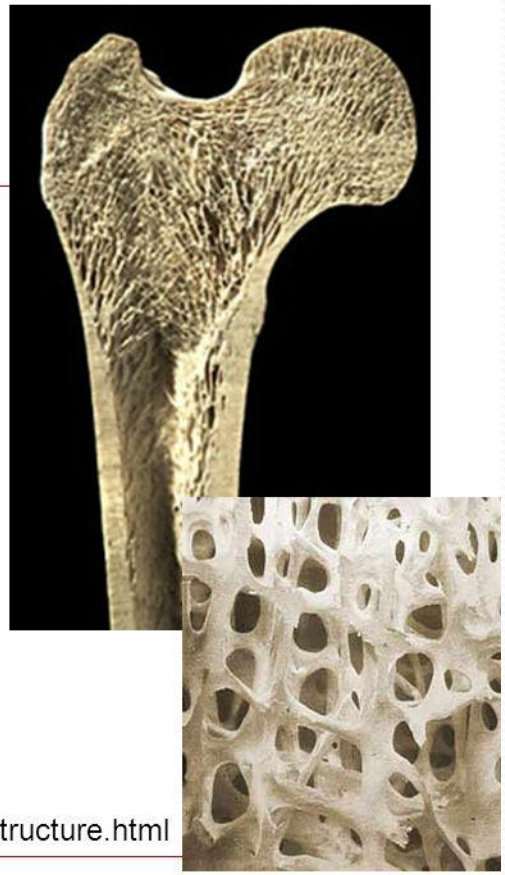
- **10% of skeleton is being remodeled at any one time**

Overview Osteoporosis

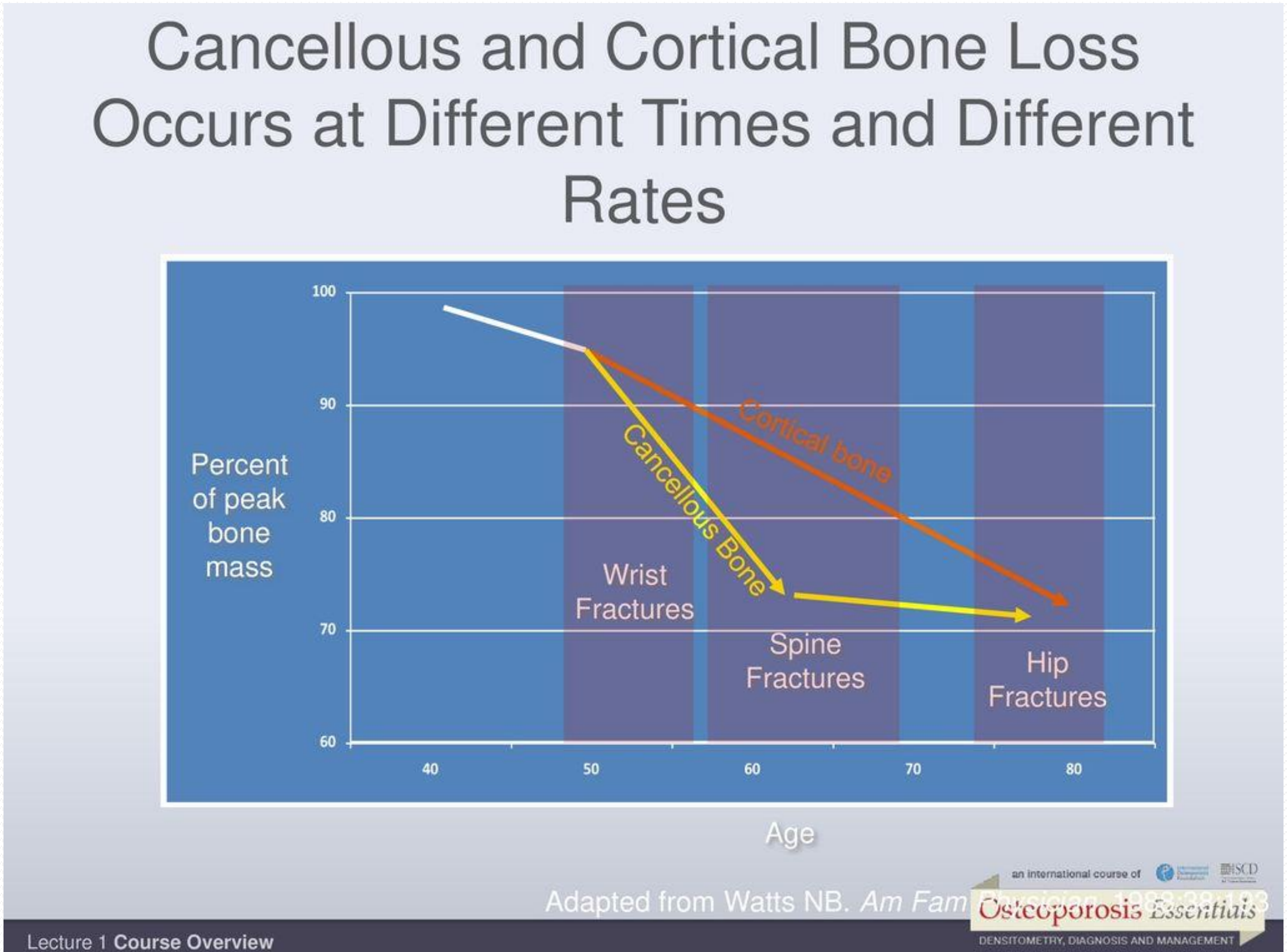
Bone Structure

- Cortical (Compact)
  - Epiphysis (thin shell)
  - Diaphysis (shaft, thicker)
- Cancellous (trabecular, spongy)
  - 20% by mass, 80% by surface
  - 5-70% density of cortical
  - 30-90% porosity
  - Trabeculae
    - Plates and rods (~5 nm X 5 nm X 40 nm)

http://depts.washington.edu/bonebio/ASBMRed/structure.html



Overview Osteoporosis



Overview Osteoporosis

- Osteoporosis diagnosis may be made based on the presence or history of a low trauma or fragility fracture
- Definition of low trauma or fragility fracture:
  - A fracture resulting from the force of a fall from a standing height or less or a bone that breaks under conditions that would not cause a normal bone to break.
- Do NOT let your patient's convince you otherwise !
- Always evaluate the cause of osteoporosis and complete a secondary evaluation.

Overview Osteoporosis

Epidemiology of Osteoporosis and Fractures

- In U.S., estimated 10 million people age 50 years and older.
- 8 million women
- 2 million men
- 43 million (16 million men), low bone mass

- Burden of osteoporosis and fragility fractures is projected to increase at a dramatic rate in next decade.
- Aging population.
- Accelerated by comorbidities and environmental factors.

- http//pubmed.ncbi.nim.nih.gov 2022

DXA “101”

- **ISCD** = The International Society for Clinical Densitometry
- 2019 Adult Official Positions
- Guidelines and Certifications
- www.ISCD.org

DXA "101"

Who deserves a DXA ?

- Women 65 or older
- Men 70 or older
- Postmenopausal women 50-64 and Men 50-69 with risk factors:

FHx osteoporosis/fractures	Chronic Steroids
Frequent falls	Type I DM
Vitamin D deficiency	Thyroid disease
Tobacco use	Heavy alcohol (>3 daily)
Rheumatoid arthritis	Ankylosing Spondylitis
Psoriatic arthritis	Malabsorption (e.g., Celiac)

DXA “101”

- What can we share with our patients?
- DXA (Dual Energy X-ray Absorptiometry)
- Patient concern, very little radiation.
- Measures calcium in bones.
- Estimate risk of fracture.
- Monitor effectiveness of osteoporosis treatments.

Diagnosing Osteoporosis

1. By Bone Mineral Density (BMD)

T- score (If premenopausal women or men < 50 y/o, use Z-score):

- T – score – 1.0 or above is normal BMD
- T –score -1.1 to -2.4 is low bone mass or osteopenia
- T – score -2.5 or below (more negative) is osteoporosis

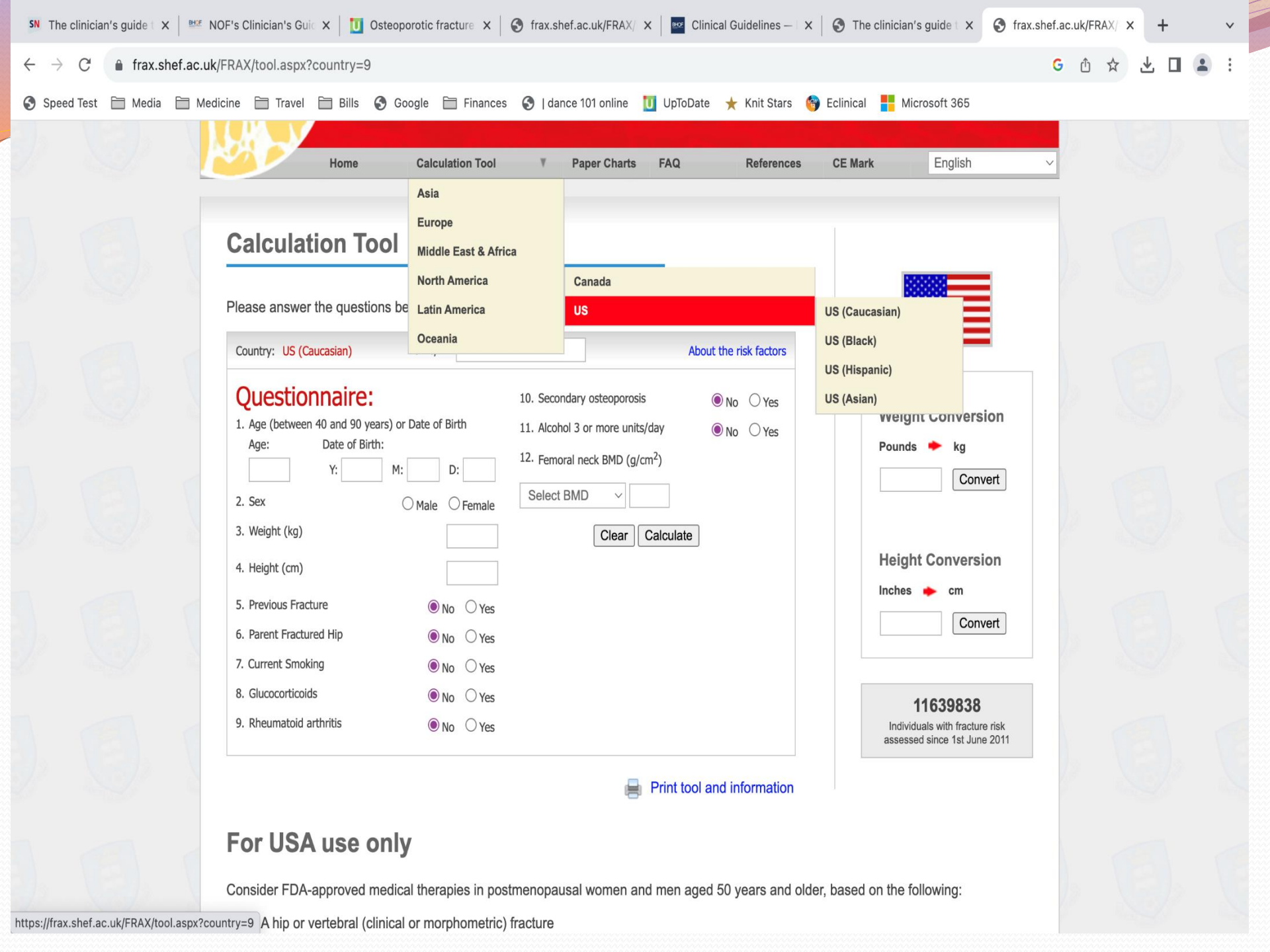
2. By Fracture

Over the **age of 50**, **plus fracture** of the spine, hip, wrists, humerus (shoulder), rib and/or pelvis **= Osteoporosis**, **regardless** of T –score.

3. By FRAX

Fracture risk calculator, usually included in software of DXA, or https://frax.shef.ac.uk/FRAX

- Based on BMD, race, age, sex, weight, height, steroid use, RA, etc…
- Calculates 10 year probability of major osteoporotic fracture (spine, hip, shoulder, forearm) (20%-high) or hip fracture (3% high), then may diagnose osteoporosis.
- Limitations though


The clinician's guide
NOF's Clinician's Gui
Osteoporotic fracture
frax.shef.ac.uk/FRAX/
Clinical Guidelines —
The clinician's guide
frax.shef.ac.uk/FRAX/
frax.shef.ac.uk/FRAX/tool.aspx?country=9
Speed Test
Media
Medicine
Travel
Bills
Google
Finances
| dance 101 online
UpToDate
Knit Stars
Eclinical
Microsoft 365
Home
Calculation Tool
Paper Charts
FAQ
References
CE Mark
English
Asia
Europe
Middle East & Africa
North America
Latin America
Oceania
Canada
US
US (Caucasian)
US (Black)
US (Hispanic)
US (Asian)
Calculation Tool
Please answer the questions be
Country: US (Caucasian)
About the risk factors
Questionnaire:
1. Age (between 40 and 90 years) or Date of Birth
Age:
Date of Birth:
Y:
M:
D:
2. Sex
Male
Female
3. Weight (kg)
4. Height (cm)
5. Previous Fracture
6. Parent Fractured Hip
7. Current Smoking
8. Glucocorticoids
9. Rheumatoid arthritis
10. Secondary osteoporosis
11. Alcohol 3 or more units/day
12. Femoral neck BMD (g/cm2)
Select BMD
No
Yes
Clear
Calculate
Weight Conversion
Pounds
kg
Convert
Height Conversion
Inches
cm
Convert
11639838
Individuals with fracture risk assessed since 1st June 2011
Print tool and information
For USA use only
Consider FDA-approved medical therapies in postmenopausal women and men aged 50 years and older, based on the following:
A hip or vertebral (clinical or morphometric) fracture
https://frax.shef.ac.uk/FRAX/tool.aspx?country=9

Risk factors

For the clinical risk factors a yes or no response is asked for. If the field is left blank, then a "no" response is assumed. See also notes on risk factors.

The risk factors used are the following:

Age	The model accepts ages between 40 and 90 years. If ages below or above are entered, the programme will compute probabilities at 40 and 90 year, respectively.
Sex	Male or female. Enter as appropriate.
Weight	This should be entered in kg.
Height	This should be entered in cm.
Previous fracture	A previous fracture denotes more accurately a previous fracture in adult life occurring spontaneously, or a fracture arising from trauma which, in a healthy individual, would not have resulted in a fracture. Enter yes or no (see also notes on risk factors).
Parent fractured hip	This enquires for a history of hip fracture in the patient's mother or father. Enter yes or no.
Current smoking	Enter yes or no depending on whether the patient currently smokes tobacco (see also notes on risk factors).
Glucocorticoids	Enter yes if the patient is currently exposed to oral glucocorticoids or has been exposed to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids) (see also notes on risk factors).
Rheumatoid arthritis	Enter yes where the patient has a confirmed diagnosis of rheumatoid arthritis. Otherwise enter no (see also notes on risk factors).
Secondary osteoporosis	Enter yes if the patient has a disorder strongly associated with osteoporosis. These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or malabsorption and chronic liver disease
Alcohol 3 or more units/day	Enter yes if the patient takes 3 or more units of alcohol daily. A unit of alcohol varies slightly in different countries from 8-10g of alcohol. This is equivalent to a standard glass of beer (285ml), a single measure of spirits (30ml), a medium-sized glass of wine (120ml), or 1 measure of an aperitif (60ml) (see also notes on risk factors).
Bone mineral density (BMD)	(BMD) Please select the make of DXA scanning equipment used and then enter the actual femoral neck BMD (in g/cm2). Alternatively, enter the T-score based on the NHANES III female reference data. In patients without a BMD test, the field should be left blank (see also notes on risk factors) (provided by Oregon Osteoporosis Center).

Notes on risk factors

Previous fracture

A special situation pertains to a prior history of vertebral fracture. A fracture detected as a radiographic observation alone (a morphometric vertebral fracture) counts as a previous fracture. A prior clinical vertebral fracture or a hip fracture is an especially strong risk factor. The probability of fracture computed may therefore be underestimated. Fracture probability is also underestimated with multiple fractures.

Smoking, alcohol, glucocorticoids

These risk factors appear to have a dose-dependent effect, i.e. the higher the exposure, the greater the risk. This is not taken into account and the computations assume average exposure. Clinical judgment should be used for low or high exposures.

Rheumatoid arthritis (RA)

RA is a risk factor for fracture. However, osteoarthritis is, if anything, protective. For this reason reliance should not be placed on a patient's report of 'arthritis' unless there is clinical or laboratory evidence to support the diagnosis.

Bone mineral density (BMD)

The site and reference technology is DXA at the femoral neck, T-scores are based on the NHANES reference values for women aged 20-29 years. The same absolute values are used in men.

DXA "101"

Interpretation DXA Scan

- Make sure scan is technically valid prior to interpretation.
- Review patient positioning and scan analysis.
- Check DXA printouts, DXA image, DXA graph, numerical results.
- Review for artifacts on DXA – common include degenerative disease, AS fractures, metal.

Reporting DXA Scan

- Include demographics of patient, indications for DXA, manufacturer and model of instrument used, technique, limitations to study, results- including any significant change between current and previous study, diagnosis, FRAX fracture risk.
- Include statement that a medical evaluation for secondary causes of low BMD may be appropriate.
- Suggest timing of next study.

Screener at DXA Facility

HEALTHCARE

Bone Densitometry Patient History

Patient Label

Name:_____ Age:_____

Gender: ❑ Female ❑ Male ❑ Other:_____ ❑ Height:_____ Weight:_____

Have you had recent contrast: ❑ Yes ❑ No

Bone density varies according to a person's age, gender and race. Please choose the one category below that most closely matches your race/ethnicity:

❑ Black/African-American ❑ White/Caucasian ❑ Asian ❑ Hispanic ❑ Native American

Prior bone density study: ❑ Yes ❑ No

Factors that may **INCREASE** your risk of osteoporosis ***(please check all that apply)***:

❑ Post-menopausal woman Age:_____
❑ History of fracture after age 40
❑ Was fracture due to trauma? ❑ Yes ❑ No
❑ Current smoker
❑ Steroid therapy (equivalent to 5 mg prednisone daily for 3 months)
❑ Low testosterone level (men)
❑ Thyroid hormone therapy
❑ Parent hip fracture
❑ Past smoker
❑ Rheumatoid arthritis

❑ Secondary Osteoporosis: Diagnosed by a physician, including:
Type 1 insulin dependent diabetes, osteogenesis imperfecta, untreated long-standing hyperthyroidism (Graves' disease), hypogonadism, menopause less than 45 years, chronic malnutrition (anorexia or bulimia), malabsorption (celiac disease, Crohn's disease, ulcerative colitis), chronic kidney or liver disease, end stage renal disease, multiple myeloma, upper or lower limb paralysis, Muscular Dystrophy, Multiple Sclerosis

❑ Consumption of more than 3 alcoholic drinks per day
❑ Ovaries surgically removed
❑ Hyperparathyroidism

Factors that may **DECREASE** your risk of or treatment of osteoporosis ***(please check all that apply)***:

❑ Hormone replacement therapy (women)
❑ Prescription medication for osteoporosis
❑ Regular exercise
❑ Calcium and/or vitamin D supplements

Medication Name:_____

Duration of Use:_____

Do you have metallic hardware/prostheses, cementing or surgery in your hips or lower back? ❑ Yes ❑ No

REVIEWING THE REPORTS

Bone Density Report

Name:		Sex:	Female	Age:	62
Patient ID:		Ethnicity:	Black	Height:	170.2 cm
Referring Provider:		Date of Birth:		Weight:	88.5 kg

Indication: postmenopausal; screening for osteoporosis; history of glucocorticoids; cancer; asthma or emphysema; hysterectomy; secondary osteoporosis;

Accession number:

Clinical Information Provided by Patient:

Has taken Glucocorticoids	
Has secondary osteoporosis	
Has used the following medications:	
Has the following medical conditions:	Asthma or Emphysema, Cancer, Hysterectomy
Patient maximum height was	67
Menopause Age	25
Onset of menses at age	12
Number of children	2
Missed period for more than 6 months in a row	

Bone Density: Exam date 07/24/2023

Region	BMD (g/cm^2)	T-score	Z-score	Classification
AP Spine(L1-L4)	1.252	0.9	2.7	
Femoral Neck(Left)	0.948	0.0	1.1	
Total Hip(Left)	1.064	0.2	1.1	
Femoral Neck(Right)	0.916	-0.2	0.9	
Total Hip(Right)	1.066	0.2	1.1	
Total Hip Mean	1.065	0.2	1.1	

World Health Organization criteria for BMD impression classify patients as Normal (T-score at or above –1.0), Osteopenia (T-score between –1.0 and –2.5), or Osteoporosis (T-score at or below –2.5).

10-year Fracture Risk:

FRAX not reported because:
All T-scores for Spine Total, Hip Total, Femoral Neck at or above -1.0

Name:
Patient ID: 71
DOB:

Sex: Female
Ethnicity: White
Menopause Age: 53

Height: 57.7 in
Weight: 102.2 lb
Age: 77

Referring Physician:

Rheumatoid Arthritis steroids > 3 mos. in the past

x Right Hip 12/06/2021

Image not for diagnostic use
k = 1.148, d0 = 56.2
102 x 107 NECK: 49 x 15

x Left Hip 12/06/2021

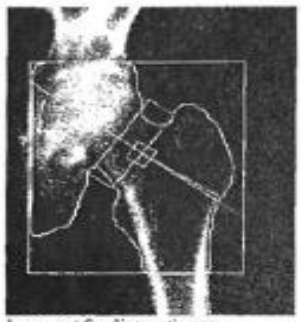
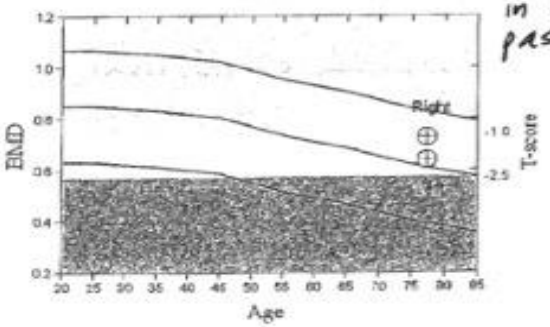


Image not for diagnostic use
k = 1.146, d0 = 52.5
94 x 106 NECK: 46 x 14

Neck



T-score vs. White Female. Source:2012 BMDCS/NHANES White Female. Z-score vs. White Female. Source:2012 BMDCS/NHANES White Female.

(Spine excluded due to scoliosis)

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
Neck					
Left	**4.60**	**2.94**	**0.638**	**-1.9**	**0.3**
Right	5.12	3.71	0.725	-1.1	1.1
Mean	4.86	3.32	0.682	-1.5	0.7
[Diff.]	0.52	0.78	0.087	0.8	0.8
Total					
Left	34.33	25.50	0.743	-1.6	0.3
Right	36.21	31.88	0.880	-0.5	1.4
Mean	35.27	28.69	0.812	-1.1	0.8
[Diff.]	1.89	6.37	0.137	1.1	1.1

Total BMD CV 1.0%
WHO Classification on Bolded Results: Osteopenia

FRAX® WHO Fracture Risk Assessment Tool

10-year Fracture Risk[1]

Major Osteoporotic Fracture ?
Hip Fracture ?
Reported Risk Factors:
US (Caucasian), Neck BMD=0.638, BMI=21.6

[1] FRAX® Version 3.08. Fracture probability calculated for an untreated patient. Fracture probability may be lower if the patient has received treatment.

Comment:
All treatment decisions require clinical judgment and consideration of individual patient factors, including patient preferences, comorbidities, previous drug use and risk factors not captured in the FRAX model (e.g. frailty, falls, vitamin D deficiency, increased bone turnover, interval significant decline in BMD).

ght - Scan Id:A12062109(S/N 3036008M) Analysis:December 06, 2021 11:07 Hip V:13.6.0.7 Operator: SP Comment:
ft - Scan Id:A12062100(S/N 3036008M) Analysis:December 06, 2021 11:08 Hip V:13.6.0.7 Operator: SP Comment:

HOLOGIC®

Diagnosing Osteoporosis

1. By Bone Mineral Density (BMD)

T- score (If premenopausal women or men < 50 y/o, use Z-score):

- T – score – 1.0 or above is normal BMD
- T –score -1.1 to -2.4 is low bone mass or osteopenia
- T – score -2.5 or below (more negative) is osteoporosis

2. By Fracture

Over the **age of 50**, **plus fracture** of the spine, hip, wrists, humerus (shoulder), rib and/or pelvis **= Osteoporosis**, **regardless** of T –score.

3. By FRAX

Fracture risk calculator, usually included in software of DXA, or https://frax.shef.ac.uk/FRAX

- Based on BMD, race, age, sex, weight, height, steroid use, RA, etc…
- Calculates 10 year probability of major osteoporotic fracture (spine, hip, shoulder, forearm) (20%-high) or hip fracture (3% high), then may diagnose osteoporosis.
- Limitations though

Your patient . ompleted a BMD test on 10/17/2022 using the **Lunar Prodigy Advance DXA System** (software version: 13.60) manufactured by **GE Medical Systems LUNAR, System PA+301682.** The following summarizes the results of our evaluation.

PATIENT BIOGRAPHICAL:

83 y/o

Name:
Patient ID:
Gender: Female
Indications: Rheumatoid Arthritis, Advanced Age, History of Fracture (Adult), Caucasian, Early Menopause, Amenorrhea

Birth Date:
Exam Date: 10/17/2022
Fractures: Forearm

Trauma ?
Fragility?

Height: 64.5 in.
Weight: 124.2 lbs.
Treatments: Calcium, Multi-vitamin, Thiazide, Vitamin D

DENSITOMETRY RESULTS:

Site	Region	Measured Date	Measured Age	WHO Classification	Young Adult T-score	BMD	%Change vs. Previous	Significant Change (*)
AP Spine	L3-L4	10/17/2022	83.1	Normal	1.0	1.322 g/cm²	3.7%	-
AP Spine	L3-L4	10/15/2020	81.1	Normal	0.5	1.275 g/cm²	-	-
DualFemur	Neck Left	10/17/2022	83.1	Osteopenia	-1.8	0.786 g/cm²	-1.4%	-
DualFemur	Neck Left	10/15/2020	81.1	Osteopenia	-1.7	0.797 g/cm²	-	-
DualFemur	Neck Right	10/17/2022	83.1	Osteopenia	-1.8	0.794 g/cm²	-0.9%	-
DualFemur	Neck Right	10/15/2020	81.1	Osteopenia	-1.7	0.801 g/cm²	-	-

ASSESSMENT:

The BMD measured at Femur Total Right is 0.767 g/cm² with a T-score of -1.9. This patient is considered osteopenic according to World Health Organization (WHO) criteria. Bone density is between 10 and 25% below young normal. Fracture risk is moderate. Treatment is advised.

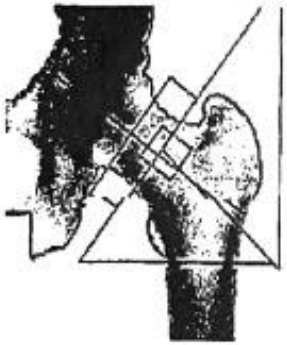
World Health Organization (WHO) criteria for post-menopausal, Caucasian Women:

Normal: T-score at or above -1 SD
Osteopenia: T-score between -1 and -2.5 SD
Osteoporosis: T-score at or below -2.5 SD

RECOMMENDATIONS:

NOF Guidelines recommend treatment for patients with a T-score of -1.5 and below with risk factors or -2.0 and below without risk factors. Effective therapies are available in the form of bisphosphonates (Fosamax and Actonel), and Evista. Hormone therapy may be an option based on review of risks and benefits of treatment. All patients should ensure an adequate intake of d

FRAX* RESULTS: *(version: 3.1)*



10-year Probability of Fracture[1]	
Major Osteoporotic Fracture[2]	Hip Fracture
23.9%	7.5%
Population: USA (Caucasian)	
Risk Factors: Rheumatoid Arthritis, History of Fracture (Adult)	

Based on Femur (Left) Neck BMD

1 -The 10-year probability of fracture may be lower than reported if the patient has received treatment.
2 -Major Osteoporotic Fracture: Clinical Spine, Forearm, Hip or Shoulder

*FRAX is a trademark of the University of Sheffield Medical School's Centre for Metabolic Bone Disease, a World Health Organization (WHO) Collaborating Centre.

ASSESSMENT:

The probability of a major osteoporotic fracture is 23.9% within the next ten years.

The probability of a hip fracture is 7.5% within the next ten years.

RECOMMENDATIONS:

All treatment decisions require clinical judgment and consideration of individual patient factors, including patient preferences, comorbidities, previous drug use, risk factors not captured in the FRAX model (e.g., frailty, falls, vitamin D deficiency, increased bone turnover, interval significant decline in bone density) and possible under- or over-estimation of fracture risk by FRAX.

In addition, the NOF Guide recommends that FDA-approved medical therapies be considered in postmenopausal women and men age >= 50 years with a:

* Hip or vertebral (clinical or morphometric) fracture
* T-score of <=-2.5 at the spine or hip
* Ten-year fracture probability by FRAX of >= 3% for hip fracture or >=20% for major osteoporotic fracture.

FOLLOW-UP:

People with diagnosed cases of osteoporosis or at high risk for fracture should have regular bone mineral density tests. For patients eligible for Medicare, routine testing is allowed once every 2 years. The testing frequency can be increased to one year for patients who have rapidly progressing disease, those who are receiving or discontinuing medical therapy to restore bone mass, or have additional risk factors.

Sincerely,

Breast and Diagnostic Center

Diagnosing Osteoporosis

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Fracture risk calculator, usually included in software of DXA, or https://frax.shef.ac.uk/FRAX

- Based on BMD, race, age, sex, weight, height, steroid use, RA, etc…
- Calculates 10 year probability of major osteoporotic fracture (spine, hip, shoulder, forearm) (20%-high) or hip fracture (3% high), then may diagnose osteoporosis.
- Limitations though

Bone Density Report

Name:		Sex:	Female	Age:	65
Patient ID:		Ethnicity:	Black	Height:	162.0 cm
Referring Provider:		Date of Birth:	05/02/1936	Weight:	66.7 kg

Indication: postmenopausal; screening for osteoporosis; height loss; prior fracture; cancer; asthma or emphysema; hysterectomy; rheumatoid arthritis;

Accession number:

Clinical Information Provided by Patient:

Have had a previous hip or vertebral fracture	
Has had a low trauma fracture	
Has rheumatoid arthritis	
Has used the following medications:	Vitamin D, Tramadol
Has the following medical conditions:	Asthma or Emphysema, Cancer, Hysterectomy, HBP/ COPD
Patient maximum height was	65
Menopause Age	30
No regular weight bearing exercise	
Drinks caffeinated beverages	
Onset of menses at age	12
Number of children	8

Bone Density: Exam date 12/03/2021

Region	BMD (g/cm^2)	T-score	Z-score	Classification
AP Spine(L1-L4)	0.784	-3.3		
Femoral Neck(Left)	0.653	-2.1		
Total Hip(Left)	0.688	-2.2		
Femoral Neck(Right)	0.557	-2.8		
Total Hip(Right)	0.662	-2.4		
Total Hip Mean	0.675	-2.3	0.0	

World Health Organization criteria for BMD interpretation classify patients as Normal (T-score at or above -1.0), Osteopenia (T-score between -1.0 and -2.5), or Osteoporosis (T-score at or below -2.5).

Bone Density Report

Name:		Sex:	Female	Age:	73
Patient ID:		Ethnicity:	White	Height:	165.1 cm
Referring Provider:		Date of Birth:		Weight:	63.5 kg

Indication: postmenopausal; treated - osteoporosis; rheumatoid arthritis;

Accession number:

Clinical Information Provided by Patient:

Has rheumatoid arthritis	
Has used the following medications:	Vitamin D, Calcium, Reclast, 4th infusion 10/2022
Patient maximum height was	66
Menopause Age	45
Onset of menses at age	15
Number of children	2

Bone Density: Exam date 08/28/2023

Region	BMD (g/cm²)	T-score	Z-score	Classification
AP Spine(L1-L4)	0.937	-1.0	1.3	
Femoral Neck(Left)	0.719	-1.2	0.8	
Total Hip(Left)	0.861	-0.7	1.1	
Femoral Neck(Right)	0.680	-1.5	0.5	
Total Hip(Right)	0.884	-0.5	1.2	
Total Hip Mean	0.872	-0.6	1.2	

World Health Organization criteria for BMD impression classify patients as Normal (T-score at or above –1.0), Osteopenia (T-score between –1.0 and –2.5), or Osteoporosis (T-score at or below –2.5).

FRAX® WHO Fracture Risk Assessment Tool

10-year Fracture Risk[1]:

Major Osteoporotic Fracture	14%
Hip Fracture	2.9%

Reported Risk Factors:

FRAX doesn't apply if treated for osteoporosis

Your patient mpleted a BMD test on 02/28/2020 using the **Lunar Prodigy DXA System** (analysis version: 13.60) manufactured by **GE Healthcare**. The following summarizes the results of our evaluation.

PATIENT BIOGRAPHICAL:

Name:					
Patient ID:	(not specified)	**Birth Date:**		**Height:**	72.0 in.
Gender:	Male	**Exam Date:**	02/28/2020	**Weight:**	189.0 lbs.
Indications:		**Fractures:**		**Treatments:**	

ASSESSMENT:

The BMD measured at Femur Neck is 0.780 g/cm² with a T-score of -2.2 is low. Fracture risk is high. A follow up DXA test is recommended in one year to monitor response to therapy.

With a Z-score of -1.5, this patient's BMD is low for someone of this age.

RA

Site	Region	Measured Date	Measured Age	WHO Classification	Young Adult T-score	BMD
Right Femur	Neck	02/28/2020	70.6	N/A	-2.2	0.780 g/cm²
Right Femur	Total	02/28/2020	70.6	N/A	-2.0	0.810 g/cm²
AP Spine					-0.8	1.135

World Health Organization (WHO) criteria for post-menopausal, Caucasian Women:
Normal: T-score at or above -1 SD
Osteopenia: T-score between -1 and -2.5 SD
Osteoporosis: T-score at or below -2.5 SD

L Forearm -0.9

RECOMMENDATIONS:

Mild to aggressive therapies are available in the form of Hormone replacement therapy (HRT), bisphosphonates, Calcitonin, and SERMs. Additionally, all patients should ensure an adequate intake of dietary calcium (1200 mg/d) and vitamin D (400-800 IU daily).

FOLLOW-UP:

follow up scanning may is indicated in 2 years, sooner if on steroids or other circumstances.

Based on these results, a follow-up exam is recommended in February 2022

Sincerely,

DXA on the previous slide shows osteopenia BUT.....
you look at the patient's history:

Left hip wasn't examined in the DXA because he had a left THR BECAUSE of a fragility fracture = OSTEOPOROSIS

REVIEWING THE IMAGES

Name:	Sex: Female	Height: 152.4 cm
Patient ID:	Ethnicity: Black	Weight: 72.1 kg
DOB:	Menopause Age: 39	Age: 76

Referring Physician:

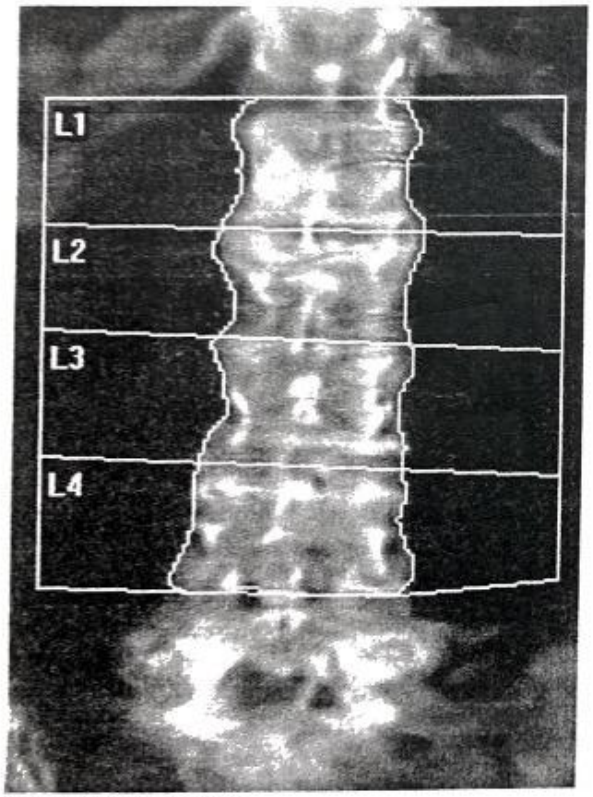


Image not for diagnostic use
k = 1.127, d0 = 47.6
116 x 112

Scan Information:

Scan Date: August 11, 2023 ID:
Scan Type: a Lumbar Spine
Analysis: August 11, 2023 09:36 Version 13.6.1.2:7
Spine
Operator: bj
Model: Horizon W (S/N 305237M)
Comment:

Normal L spine image
(Look at contour of spine here)
NOT color)

DXA Results Summary:

Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T - score	Z - score
L1	12.01	14.53	1.210	1.2	3.6
L2	10.33	12.35	1.196	0.6	3.3
L3	11.85	13.59	1.147	-0.4	2.5
L4	13.75	15.63	1.137	-0.3	2.6
Total	**47.93**	**56.11**	**1.171**	**0.2**	**2.9**

Total BMD CV 1.0%, ACF = 1.028, BCF = 1.010, TH = 7.620
WHO Classification: Normal
Fracture Risk: Not Increased

Name:
Patient ID:
DOB:

Sex: Male
Ethnicity: Black

Height: 166.0 cm
Weight: 68.0 kg
Age: 72

Referring Physician:

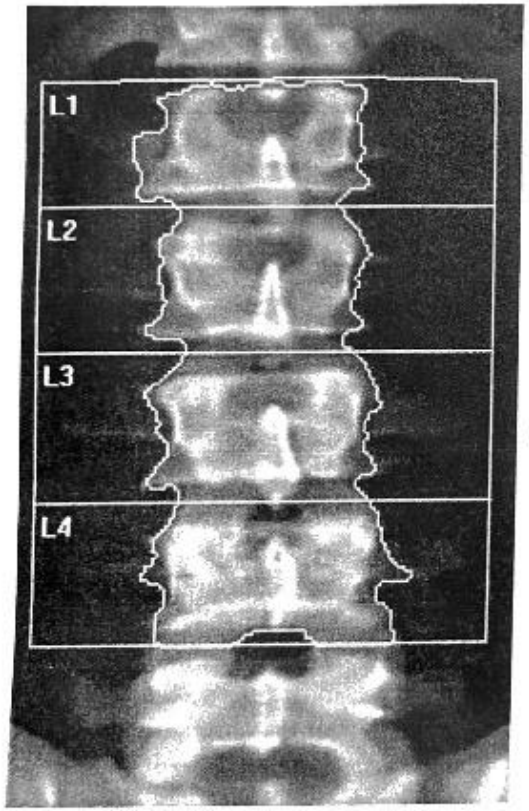


Image not for diagnostic use
k = 1.142, d0 = 43.9
116 x 145

Scan Information:

Scan Date: September 05, 2023 ID:
Scan Type: a Lumbar Spine
Analysis: September 05, 2023 11:49 Version 13.6.1.2:7 Spine
Operator: bj
Model: Horizon W (S/N 305237M)
Comment:

Degenerative changes of spine - BMD exaggerated. (Ignore color)

DXA Results Summary:

Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-score	Z-score
L1	16.92	20.79	1.229	0.5	1.5
L2	18.27	23.39	1.280	0.7	1.8
L3	20.21	28.52	1.411	1.8	2.9
L4	21.09	32.63	1.547	3.1	4.2
Total	**76.49**	**105.33**	**1.377**	**1.6**	**2.7**

Total BMD CV 1.0%, ACF = 1.028, BCF = 1.010, TH = 8.255

WHO Classification: Normal
Fracture Risk: Not Increased

Patient ID:
DOB:

Sex: Female
Ethnicity: Black
Menopause Age: 54

: . cm
Weight: 78.5 kg
Age: 79

Referring Physician:

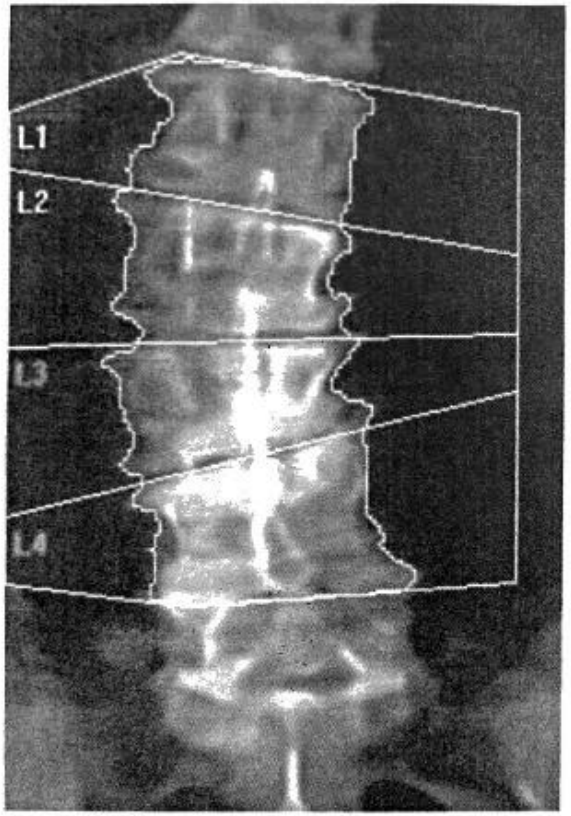


Image not for diagnostic use
k = 1.118, d0 = 45.6
116 x 125

Scan Information:

Scan Date: August 21, 2023 ID: A08212307
Scan Type: a Lumbar Spine
Analysis: August 21, 2023 10:25 Version 13.6.1.2:7
Spine
Operator: bj
Model: Horizon W (S/N 305237M)
Comment:

Spine with significant scoliosis

DXA Results Summary:

Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-score	Z-score
L1	15.06	16.06	1.066	-0.1	2.4
L2	14.95	19.08	1.276	1.3	4.2
Total	**30.02**	**35.14**	**1.171**	**0.9**	**3.6**

Total BMD CV 1.0%, ACF = 1.028, BCF = 1.010, TH = 8.661
WHO Classification: Normal
Fracture Risk: Not Increased

Name:	Sex: Female	Height: 152.4 cm
Patient ID:	Ethnicity: Black	Weight: 72.1 kg
DOB:	Menopause Age: 39	Age: 76

Referring Physician:

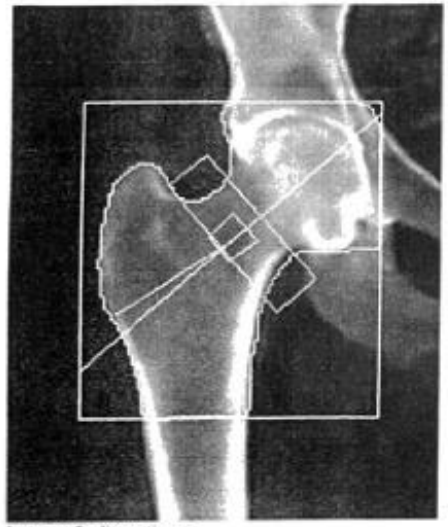


Image not for diagnostic use
k = 1.131, d0 = 51.7
88 x 90
NECK: 49 x 15

Scan Information:

Scan Date: August 11, 2023 ID: A08112305
Scan Type: a Right Hip
Analysis: August 11, 2023 09:40 Version 13.6.1.2:7
Hip
Operator: bj
Model: Horizon W (S/N 305237M)
Comment:

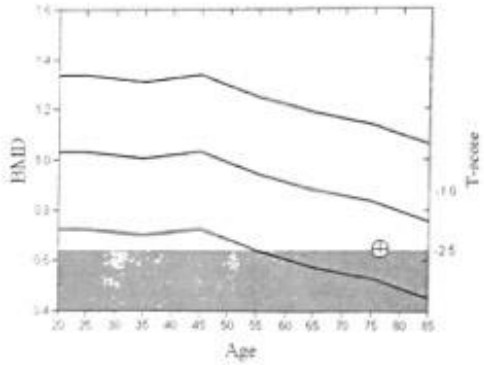
Normal hip image

DXA Results Summary:

Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-score	Z-score
Neck	4.86	3.10	0.638	-2.2	-0.6
Total	**29.57**	**19.13**	**0.647**	**-2.5**	**-1.1**

Total BMD CV 1.0%, ACF = 1.028, BCF = 1.010, TH = 6.593
WHO Classification: Osteoporosis

Total



10-year Fracture Risk

FRAX not reported because:

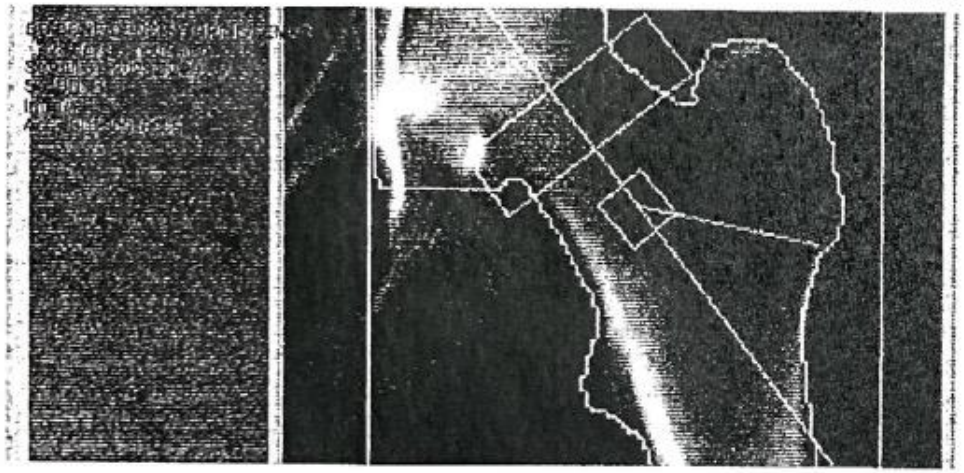
Some T-score for Spine Total or Hip Total or Femoral Neck at or below -2.5
Treated for osteoporosis

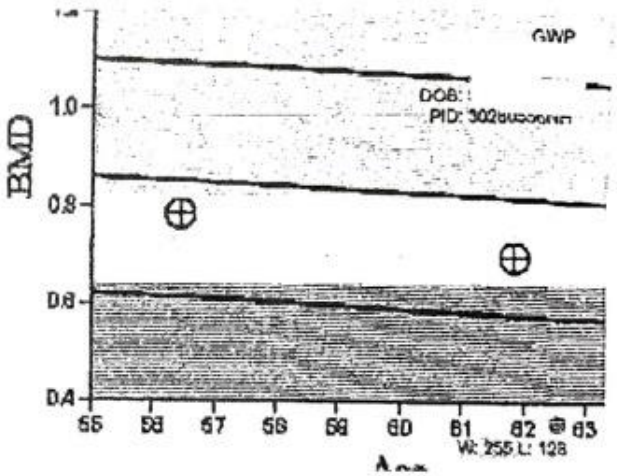
Comment:

.core vs. Black Female. Source: 2012 BMDCS/NHANES Z-score vs. Black male. Source: 2012 BMDCS/NHANES

HOLOGIC

8/28/23, 10:52 AM Enhanced Viewer





Not a great image includes ischium

Bone Density Report

Name:		Sex:	Female	Age:	54
Patient ID:		Ethnicity:	White	Height:	142.2 cm
Referring Provider:		Date of Birth:		Weight:	65.8 kg

Indication: postmenopausal; screening for osteoporosis; history of glucocorticoids; rheumatoid arthritis;

Accession number: BD230017144

Clinical Information Provided by Patient:

Has taken Glucocorticoids	JIA (B|L THR, TKR, elbows)
Has rheumatoid arthritis	
Has used the following medications:	Fosamax (i.e. alendronate), Vitamin D, Calcium
Patient maximum height was	57
Menopause Age	45
Drinks caffeinated beverages	
Onset of menses at age	11
Number of children	0

Bone Density: Exam date 08/04/2023

Region	BMD (g/cm²)	T-score	Z-score	Classification
AP Spine(L3, L4)	0.919	-1.7	-0.6	Osteopenia
Total Forearm(Left)	0.589	0.2	1.1	Normal
1/3 Forearm(Left)	0.564	-2.2	-1.2	Osteopenia
UD Forearm(Left)	0.611	2.9	3.6	Normal

World Health Organization criteria for BMD impression classify patients as Normal (T-score at or above –1.0), Osteopenia (T-score between –1.0 and –2.5), or Osteoporosis (T-score at or below –2.5).

If can't use hips, use 1/3 forearm (not total or UD)

Extended Spine:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Peak Reference	Z-score	Age Matched
L1	12.87	14.87	1.156	1.5	117	2.4	129
L2	10.27	11.64	1.134	1.0	110	2.0	123
L3	13.12	12.62	0.962	-1.1	89	-0.1	99
L4	13.99	12.29	0.879	-1.7	83	-0.6	93

Name: [redacted]
Patient ID: [redacted]
DOB: [redacted]

Sex: Female
Ethnicity: White
Menopause Age: 53

Height: 57.7 in
Weight: 102.2 lb
Age: 77

Referring Physician:

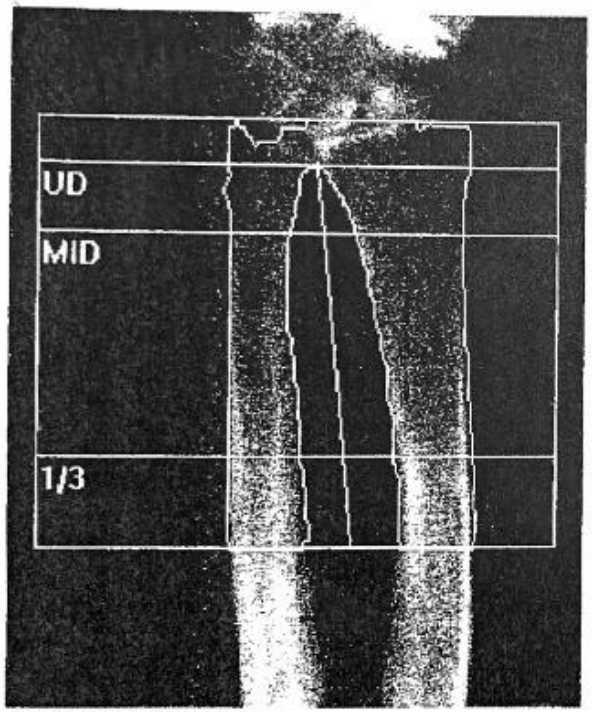


Image not for diagnostic use
k = 1.209, d0 = 72.1
228 x 95, Forearm Length: 25.5 cm

Scan Information:

Scan Date: December 06, 2021 ID: A1206210I
Scan Type: a L.Forearm
Analysis: December 06, 2021 11:07 Version 13.6.0.7:3
Left Forearm
Operator: SP
Model: Horizon A (S/N 303600M)
Comment:

DXA Results Summary:

Radius	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T - score	Z - score
UD	3.76	1.18	0.313	-2.2	-0.2
MID	8.04	3.40	0.423	-3.4	-0.6
1/3	**3.09**	**1.90**	**0.615**	**-1.3**	**1.5**
Total	14.89	6.48	0.435	-2.7	0.0

Total BMD CV 1.0%, ACF = 1.015, BCF = 0.992
WHO Classification: Osteopenia
Fracture Risk: Increased

ADDITIONAL NOTES……

Name:
Birthdate: Sex: F
Med Record:
Account#:
Exam: BC DEXA HIPS PELVIC SPINE

Attending :
Ordering:
AccessionNo:
Date: 5-28-2021

Diagnosis: M81.0 Osteoporosis
M05.79 Rheumatoid arthritis with rheumatoid factor of multiple sites without organ or systems involvement

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Bone Density Report

Name:
Patient ID:
Age: 74
Sex: Female
Ethnicity: Black
Date of Birth:

Indication: postmenopausal; screening for osteoporosis; inflammatory bowel disease; hysterectomy; rheumatoid arthritis;

Referring Provider:

Study: Bone densitometry was performed.

Exam Date: May 28, 2021

Accession number: 7472762

Bone Density:

Region	BMD	T-score	Z-score	Classification
Femoral Neck (Right)	0.635	-2.2	-0.7	
Total Hip (Right)	0.677	-2.3	-1.0	
Total Forearm (Right)	0.443	-2.5	-0.1	Osteoporosis
1/3 Forearm (Right)	0.462	-3.9	-1.4	Osteoporosis
UD Forearm (Right)	0.498	1.0	2.7	

What about spine, left hip?

Bone Density Report

Name:	Sex: Female	Age: 79	
Patient ID:	Ethnicity: Black	Height: 163.0 cm	
Referring Provider:	Date of Birth: 03/03/1944	Weight: 78.5 kg	

Indication: postmenopausal; screening for osteoporosis; asthma or emphysema; hysterectomy; rheumatoid arthritis;

Accession number:

Clinical Information Provided by Patient:

Has rheumatoid arthritis ✓	Plaquenil,
Has used the following medications:	Vitamin D, Calcium
Has the following medical conditions:	Asthma or Emphysema, Hysterectomy
Patient maximum height was	65
Menopause Age	54
No regular weight bearing exercise	
Drinks caffeinated beverages	
Onset of menses at age	12
Number of children	2

Bone Density: Exam date 08/21/2023

Hologic 5/2021

Region	BMD (g/cm²)	T-score	Z-score	Classification	
AP Spine(L1, L2)	1.171	0.9	3.6	Normal	Excluded due to curvature
Femoral Neck(Left)	0.680	-1.9	-0.2	Osteopenia	-1.2
Total Hip(Left)	0.793	-1.5	0.0	Osteopenia	-0.8
Femoral Neck(Right)	0.687	-1.9	-0.1	Osteopenia	-1.4
Total Hip(Right)	0.813	-1.4	0.1	Osteopenia	-1.2
Total Hip Mean	0.803	-1.5	0.1	Osteopenia	

World Health Organization criteria for BMD impression classify patients as Normal (T-score at or above –1.0), Osteopenia (T-score between –1.0 and –2.5), or Osteoporosis (T-score at or below –2.5).

When comparing prior DXA scan of same patient, don't use T-scores, use BMD

DXA BONE DENSITY 1 OR MORE SITES

[redacted]

MRN: Sex Assigned at Birth: Female, (60 yrs), Outpatient
Accession #

Final Result

History: Disorder of bone density, M85.9

LUMBAR SPINE RESULTS:

2019

Region of Interest: AP Spine L1-L4
Bone Mineral Density (g/cm2): 0.838 1.025
T-Score (Standard Deviation Young Adult): -1.9 -1.3
Z-Score (Standard Deviation Age Matched): -0.5
World Health Organization Classification: Osteopenia

PROXIMAL FEMUR RESULTS:

Region of Interest: Left femoral neck
Bone Mineral Density (g/cm2): 0.689 0.806
T-Score (Standard Deviation Young Adult): -1.4 -1.7
Z-Score (Standard Deviation Age Matched): -0.1
World Health Organization Classification: Osteopenia

COMMENTS: The technical quality of the scan is good.

IMPRESSION:
1. Based on World Health Organization classification, the patient's bone mineral density meets criteria for osteopenia.

2. The patient's fracture risk is considered to be increased.

Appointment Info

Exam Date
4/5/2023

[redacted]

Reason for Exam

No reason for exam was entered

Diagnoses

Osteopenia, unspecified location
Estrogen deficiency

Providers

[redacted]

Patient:
MRN #:
ACC #:
Gender: Female

Exam Date: 07/29/2021 12:51 PM
DOB:
Referring Provider:

DEXA BONE DENSITY

PROCEDURE(S): DEXA BONE DENSITY, 7/29/2021 12:14 PM

CLINICAL INDICATION: 75-year-old postmenopausal female for osteoporosis screening.

TECHNIQUE: DEXA imaging was performed utilizing Hologic bone mineral density machine.

COMPARISON: None.

FINDINGS:

LUMBAR SPINE (1-4): Bone mineral density is 1.127 g/cm2. This yields a T score of 0.7. This yields a Z score of 3.2.

LEFT FEMORAL NECK: Bone mineral density is 0.613 g/cm2. This yields a T score of -2.1. This yields a Z score of 0.0.

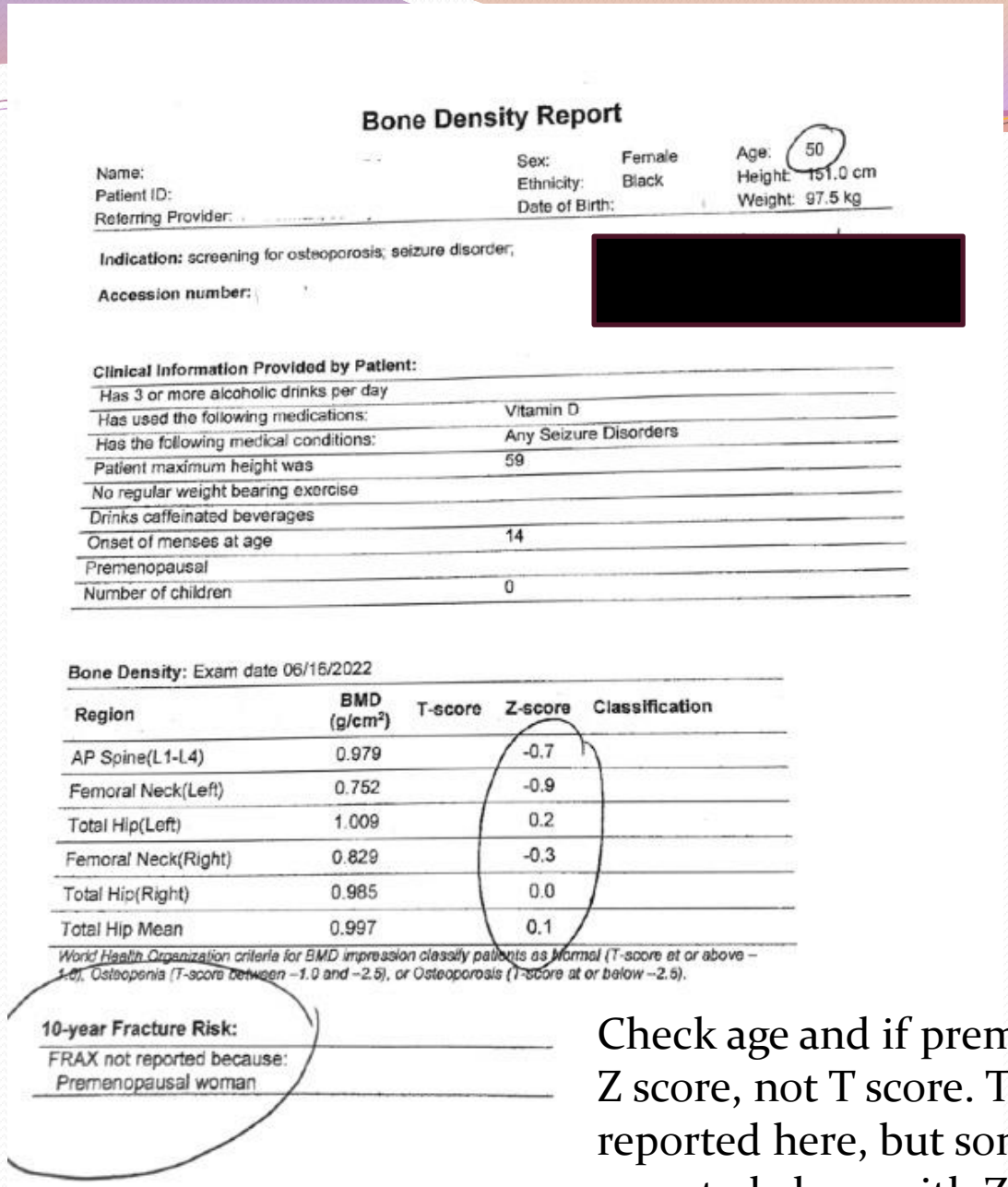
LEFT TOTAL HIP: Bone mineral density is 0.751 g/cm2. This yields a T score of -1.6. This yields a Z score of 0.3.

Rt hip
Not done ??

LEFT FOREARM: Bone mineral density measures 0.655 g/cm2. The T score measures -0.6 with the Z score measuring 2.0.

IMPRESSION:
1. Normal range bone density lumbar spine.
2. Osteopenia range bone density left femoral neck.
3. Osteopenia range bone density left total hip.
4. Normal range bone density left forearm.
5. Recommend follow-up DEXA scan in one to 2 years following caldum

Fri Jul 30, 2021 9:04 AM



Bone Density Report

Name:
Patient ID:
Referring Provider:

Sex: Female
Ethnicity: Black
Date of Birth:

Age: 50
Height: 151.0 cm
Weight: 97.5 kg

Indication: screening for osteoporosis; seizure disorder;

Accession number:

[redacted]

Clinical Information Provided by Patient:

Has 3 or more alcoholic drinks per day	
Has used the following medications:	Vitamin D
Has the following medical conditions:	Any Seizure Disorders
Patient maximum height was	59
No regular weight bearing exercise	
Drinks caffeinated beverages	
Onset of menses at age	14
Premenopausal	
Number of children	0

Bone Density: Exam date 06/16/2022

Region	BMD (g/cm^2)	T-score	Z-score	Classification
AP Spine(L1-L4)	0.979		-0.7	
Femoral Neck(Left)	0.752		-0.9	
Total Hip(Left)	1.009		0.2	
Femoral Neck(Right)	0.829		-0.3	
Total Hip(Right)	0.985		0.0	
Total Hip Mean	0.997		0.1	

World Health Organization criteria for BMD impression classify patients as Normal (T-score at or above –1.0), Osteopenia (T-score between –1.0 and –2.5), or Osteoporosis (T-score at or below –2.5).

10-year Fracture Risk:

FRAX not reported because:
Premenopausal woman

Page 1 of 3

Check age and if premenopausal, use Z score, not T score. T scores aren't reported here, but sometimes are reported along with Z scores

Birthdate: 1943 **Sex:** F **Ordering:**
Med Record: **AccessionNo:**
Account#:

World Health Organization criteria for BMD impression
classify patients as:
Normal (T-score at or above -1.0),
Osteopenia (T-score between -1.0 and -2.5), or
Osteoporosis (T-score at or below -2.5).

10-year Fracture Risk(1):

Major Osteoporotic Fracture	19%
Hip Fracture	4.1%

Reported Risk Factors:
US (Caucasian), Neck BMD=0.671, BMI=26.9, previous fracture
(1) FRAX(R) Version 3.08. Fracture probability calculated for an untreated patient. Fracture probability may be lower if the patient has received treatment.

Previous Exams:

Region	Exam Date	Age	BMD g/cm2	T-score vs Baseline	BMD Change vs Baseline	BMD Change vs Previous
AP Spine (L1-L4)						
	08/13/2021	77	0.839	-1.9	-6.7%#	5.7%#
	10/19/2007	63	0.794	-2.3	-11.8%*	-11.8%*
	06/21/2004	60	0.900	-1.3		
Total Hip(Left)						
	08/13/2021	77	0.863	-0.6	-7.0%#	-4.8%#
	10/19/2007	63	0.906	-0.3	-2.3%	-2.3%
	06/21/2004	60	0.928	-0.1		
Total Hip(Right)						
	08/13/2021	77	0.899	-0.4	N/A	-4.5%#
	10/19/2007	63	0.941	0.0	N/A	N/A
	06/21/2004	60	0.000	0.0	N/A	N/A

Nice yearly comparison

*Denotes significance at 95% confidence level, LSC for AP Spine

PEARLS

- Always look at the images
- -1.0 T-score is a normal bone density
- Use Z scores if premenopausal women or men < 50 y/o
- Always calculate FRAX with osteopenia on DXA
- Beware of false elevations of BMD and T-scores, especially at lumbar spine
- Fragility Fracture = Osteoporosis no matter what the DXA scan says
- When comparing the same patient's prior DXA, compare BMD, not T scores, BUT treatment will be based on T scores

References

- ISCD-International Society of Clinical Densitometry
- IOF-International Osteoporosis Foundation
- https://deptswashington.edu/bonebio/ASMBRed/structure.html
- https://www.ncbi.nim.nih.gov AM Abdelmohsen 2017
- http://pubmed.ncbi.nim.gov 2022
- www.ISCD.org 2019 Guidelines
- Personal clinical DXA's, FRAX and patient cases
- www.bonehealthandosteoporosis.org
- www.uptodate.com/contents/overview-of-dual-energy-x-ray-absorptiometry

- wendywsimmons@aol.com
- mvolansky@comcast.net