Clinical Question 1

- **What parameters indicate a diagnosis of osteoporosis?**

- **How does this differ from assessment of fracture risk?**

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Learning Objectives

Upon completion of this module, participants will be better able to:
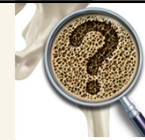
Perform risk assessments and screening for all patients at high risk for fracture

Explain the factors that determine osteoporotic fracture risk
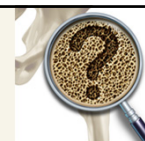
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Clinical Question 1

🔍 **What parameters indicate a diagnosis of osteoporosis?**

🔍 **How does this differ from assessment of fracture risk?**

Clinical osteoporosis can be diagnosed by a fragility fracture, in particular a spine fracture or a hip fracture. In addition, a bone mineral density T score at spine, total hip, femoral neck, or one third radius of -2.5 or less would be a densitometric definition of osteoporosis. Other single fragility fractures might be incorporated into the FRAX algorithm for evaluation of future fracture risk. Frequent fragility fractures may also qualify a patient for a diagnosis of osteoporosis.

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Checklist for Fracture and OP Risk Factors

HISTORY	PHYSICAL EXAM	IMAGING / LABS	FALLS RISK
Age >65 yrs	Kyphosis?	Bone mineral density	Has the patient experienced frequent falls (i.e. fallen ≥2 times in the past year)?
History of fragility fracture	Loss of height (2 cm or 3/4") as measured by HCP	Osteopenia noted on routine X ray	Unsteady walk and poor balance?
Parental history of hip fracture	Rib to Pelvis < 2 finger breadths	Standard lab test for osteoporosis assessment	Is assistance needed to get up from a chair?
Systemic glucocorticoid use [cumulative exposure >5 g] (≥3 months)	Occiput to wall > 3 finger breadths	**Labs:**	Assistive device needed (cane, walker, wheelchair)?
Comorbidity (e.g. rheumatoid arthritis, celiac disease, COPD, chronic liver disease)		• Calcium, corrected for albumin	Can the patient complete a "Get-up and Go Test"?
Medications that may cause OP		• Thyroid stimulating hormone (TSH)	
Smoke or excess alcohol		• Complete blood count	
Menopausal status		• Serum protein electrophoresis for patients with vertebral fractures	
Fall Risk		• Creatinine o 25-hydroxy vitamin D (25-OH-D)*	
		• Alkaline phosphatase	

DEFINITION OF A FRAGILITY FRACTURE:[*] A fracture that occurs *spontaneously* or following a *minor trauma* such as:
- Fall from a standing height (i.e. on the ice)
- Fall from a sitting position
- Fall from a supine position (bed or reclining deck chair < 1 metre high)
- Fall after having missed 1 to 3 steps in a staircase
- After a movement outside of the typical plane of motion or coughing

[*]Fragility fracture includes all bones, except skull and face, patella, hands and feet, cervical spine.
Osteoporosis Canada 2016. Checklist for Risk of Broken Bones and Osteoporosis. Accessed July 8th 2016. http://www.osteoporosis.ca/osteoporosis-and-you/diagnosis/risk-factors/.
Bessette L et al. Contemp Clin Trials. 2008;29:194-210.   Brown JP, et al. J Bone Miner Res. 2007;23(Suppl 1):M350.

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Women >50 and Osteoporosis[1]
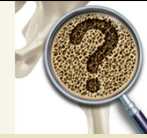
- **1** in **3** women will suffer from an osteoporotic fracture during their lifetime[1]

- Over **80%** of all fractures in Canada after age 50 are osteoporotic[1]

- Osteoporotic fracture incidence in women over 50 years of age[1]
  - → **22%** of women over 50 experience a wrist fracture
  - → **27%** experience a vertebral fracture
  - → **15%** experience a hip fracture
  - → **7%** experience a pelvic fracture
  - → **29%** experience other fractures including clavicle, humerus, femur, tibia/fibula, and hands/fingers

Almost 50% of fractures occur at the spine or hip and are associated with significant morbidity and mortality.[2-6]

1. Burge R, et al. *J Bone Miner Res*. 2007;22:465-475; 2. Watts NB, et al. *Endocr Pract*. 2010;16:1-37. 3. Hajcsar EE, et al. *CMAJ*. 2000;163:819-822.;
4. Cooper C. *Am J Med*. 1997:103:12S-19S; 5. Jean et al. *JBMR*. 2013; 28:360-71. 6. Papaioannou A, et al. *CMAJ*. 2010;182:1864-1873.

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Fragility Fracture Increases Risk of Hip Fracture
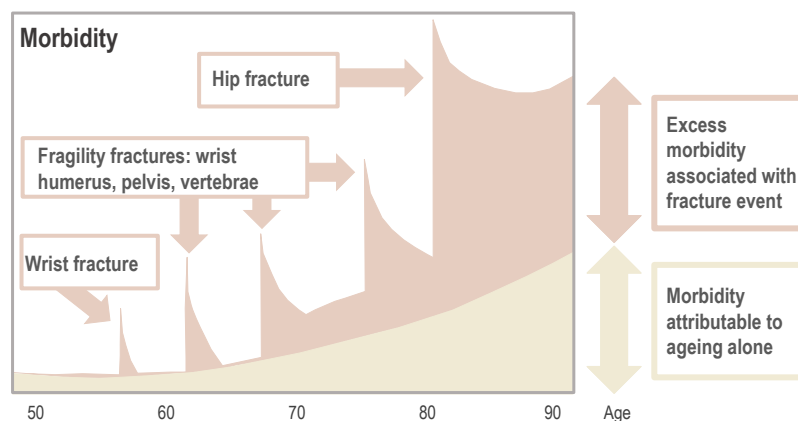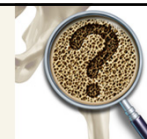
Adapted from Kanis JA, & Johnell O. *J Endocrinol Invest* 1999;22(8):583-8.

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Risk Of Sustaining A Second Hip Fracture is High During First 12 Months Following First Hip Fracture

Incident hip fractures in residents of Funen County, Denmark, from 1994 through 2004

Period estimates of incidence of second hip fracture for men (square) and women (circle) by time from first fracture. Values are poisson regression-based estimates and 95% CI of rate per 1000 person years (py).
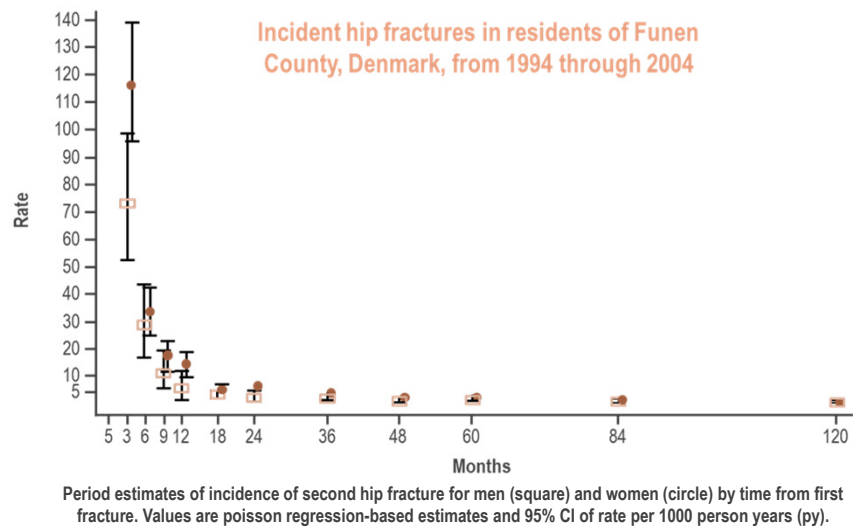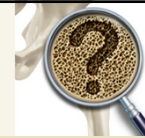
Nymark T, et al. *Osteoporos Int.* 2006;17:1353-1357.

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In Patients at Imminent Risk, Absolute Cumulative Fracture Risk Remains Elevated Over Time
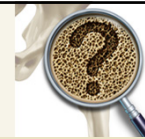
Cumulative Risk of Subsequent Fracture

Increasing absolute cumulative risk

Imminent risk

30.9%

17.9%

9.8%
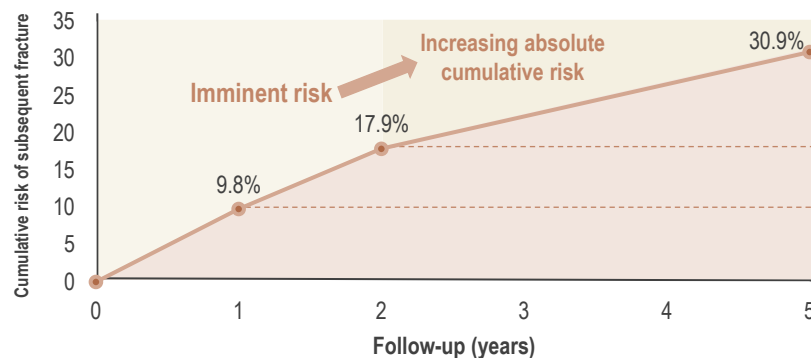
Analysis of a large Medicare sample of women ≥ 65 years old with an incident clinical fracture.
Balasubramanian A, et al. Presented at: ASBMR annual meeting; October 16-18, 2016; Atlanta, GA.

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BMD Alone is Not an Indicator of Fracture Risk
BMD vs. Osteoporotic Fracture Rates/Number

Legend:
- BMD Distribution
- Fracture Rate
- Number of Fractures

Y-axis (left): Fracture Rate Per 1000 Person-Years
Y-axis (right): Number of Fractures
X-axis: BMD T-scores (>1.0, 1.0 to 0.5, 0.5 to 0.0, 0.0 to -0.5, -0.5 to -1.0, -1.0 to -1.5, -1.5 to -2.0, -2.0 to -2.5, -2.5 to -3.0, -3.0 to -3.5, < -3.5)

Adapted from Siris ES, et al. (2001) *JAMA* 286, 2815-22.

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Several Factors Contribute to Long-Term Fracture Risk

Risk Factors for Future Fracture:
- **Prior fracture**[1-5]
  - Recent fracture
  - Any history of fracture
- **Age**[5]
- **Low BMD**[5]
  - Female sex
  - Asian or white ethnicity
  - Family history of hip fracture or osteoporosis
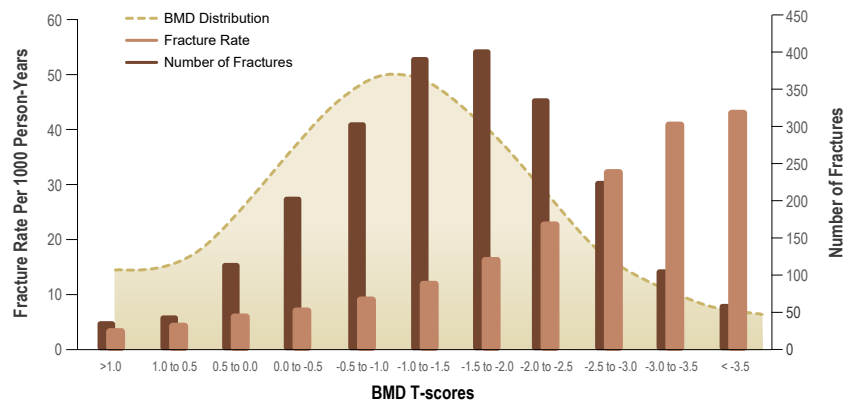 - Small frame
  - Certain comorbid conditions (e.g., RA, COPD, Parkinson's)
- Other genetic / nonmodifiable risk factors[5,6]
- Other potentially modifiable risk factors[5]
  - Low BMI
  - Calcium/vitamin D deficiency
  - Estrogen deficiency
  - Inadequate physical activity
  - Excessive alcohol intake
  - Tobacco smoking
  - Frequent falling and other fall-related risk factors
  - Use of certain medications (e.g., glucocorticoids)

BMD = bone mineral density; BMI = body mass index; COPD = chronic obstructive pulmonary disease; RA = rheumatoid arthritis
1. Kanis JA, et al. *Bone*. 2004;35:375-382. 2. Kanis JA, et al. *Lancet*. 2002;359:1929-1936. 3. Black DM, et al. *J Bone Miner Res*. 1999;14:821-828. 4. Eisman JA, et al. *J Bone Miner Res*. 2012;27:2039-2046.
5. Cosman F, et al. *Osteoporos Int*. 2014;25:2359-2381. 6. US Department of Health and Human Services. Bone health and osteoporosis: a report of the surgeon general. 2004. Rockville, MD.

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Additional Factors for Fracture Risk

- Age, Sex
- Fragility Fracture after age 40
- Fall History ≥2 Times in past year
- Medications
- Comorbidities
- Alcohol Intake ≥3 drinks per day
- Caffeine Intake
- Nutrition (balanced diet with adequate Ca2+ and vit D)
- Physical Activity or Inactivity
- Hormonal Status
- Ethnicity: Caucasian, Asian and Hispanics have a higher fracture risk

Cauley JA. Clin Orthop Relat Res. 2011;469(7):1891–1899.

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Relationship between BMD and Fracture Risk is Strongly Dependent on Clinical Risk Factors

CLINICAL RISK FACTORS

BMD
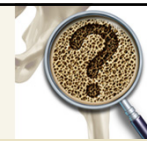
Fracture Risk

Bates DW, et al. JAMA 2002;288(15):1836-1900; Geusens P, et al. (2011). Medscape. Accessed June 30, 2016 at www.medscape.org/viewarticle/747951_2.

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Long-Term Fracture Risk Can Be Quantified Using FRAX® or Other Risk-Assessment Tools
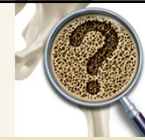
- FRAX® provides a conservative estimate of 10-year fracture risk but does not necessarily identify patients with shorter-term risk who require urgent intervention (pharmacological) to prevent subsequent fractures[1-3]

Input[1]

Age

Gender

BMD

Fracture History

Other Characteristics
- Smoking
- Alcohol use
- Rheumatoid arthritis
- Glucocorticoids use
- Etc

Calculator[1]

FRAX® Fracture Risk Assessment Tool

Home   Calculation Tool   ▼   Paper Charts   FAQ

Country: US (Caucasian)   Name/ID: About the risk factors

Questionnaire:
1. Age (between 40 and 90 years) or Date of Birth   10. Secondary osteoporosis   ● No ○ Yes
   Age: Date of Birth: 11. Alcohol 3 or more units/day ● No ○ Yes
        Y: M: D: 12. Femoral neck BMD (g/cm²)
2. Sex   ○ Male ○ Female   Select BMD ▼
3. Weight (kg)   Clear   Calculate
4. Height (cm)
5. Previous Fracture   ● No ○ Yes
6. Parent Fractured Hip   ● No ○ Yes
7. Current Smoking   ● No ○ Yes
8. Glucocorticoids   ● No ○ Yes
9. Rheumatoid arthritis   ● No ○ Yes

Output[1]

10-year Risk of Fracture

Hip Fracture   Major Osteoporotic Fracture

If level of risk ≥ 3%   If level of risk ≥ 20%

Intervention

FRAX® is a registered trademark of Professor J.A. Kanis. University of Sheffield.
BMD = bone mineral density; FRAX = fracture risk assessment tool.
1. FRAX. https://www.shef.ac.uk/FRAX/. Accessed March 15, 2018. 2. Kanis JA, et al. *Osteoporos Int*. 2011;22:2395-2411. 3. Silverman SL, et al. *Curr Osteoporos Rep*. 2010;8:192-197

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