

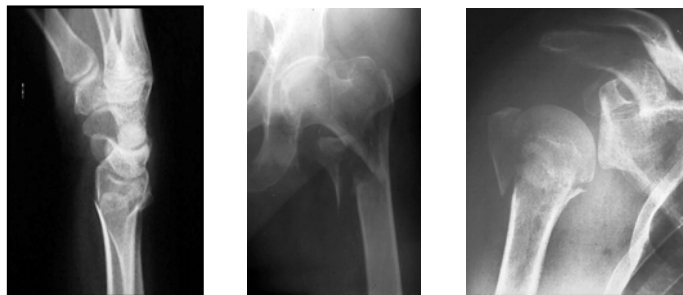
# **Geriatric Fragility Fractures**

**Laura Phieffer, MD**

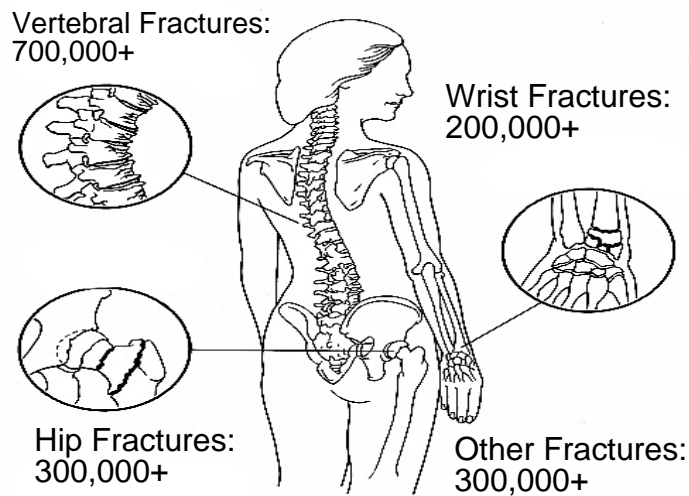
**Director of Orthopaedic Trauma  
Clinical Co-Director of  
The Fragility Fracture Program at  
The Ohio State University Medical Center**

## **Fragility Fracture**

- **Fractures that are a result of minimal trauma (i.e. from a fall from a standing height)**



## 1.5 Million Fragility Fractures Annually



Source: National Osteoporosis Foundation, 2000



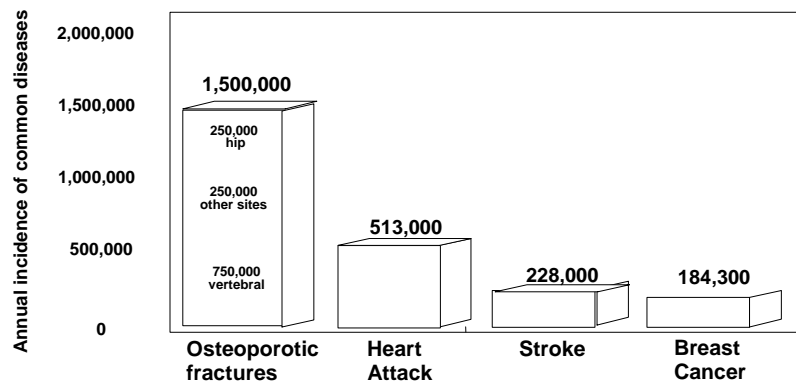
## Fragility Fractures Due to Osteoporosis are Common



- 1 in 2 women and 1 in 5 men over age 50 will suffer a fracture in their remaining life time<sup>1</sup>
- 55% of persons over age 50 are at increased risk of fracture due to low bone mass
- At age 50, a woman's **lifetime risk of fracture exceeds** combined risk of breast, ovarian & uterine cancer
- At age 50, a man's **lifetime risk of fracture exceeds** risk of prostate cancer

1. Johnell et al. Osteoporos Int. 2005; 16: S3-7

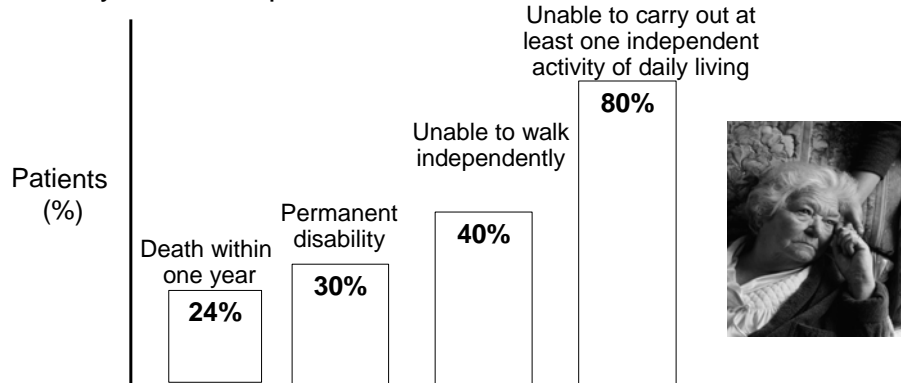
# Osteoporosis-fracture Occurrences vs Other Diseases



Source: National Osteoporosis Foundation

# Consequences of Hip Fracture

One year after hip fracture



Cooper. Am J Med 1997; 103(2A):12s-19s.

## **Morbidity and Mortality of Fractures in Men**

- **Men account for 30% of hip fractures**

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- **Men account for 30% of hip fractures**
- **Annual number of fractures in men should increase as U.S. population ages**
- **Mortality is higher for men following hip and vertebral fractures**

## **Osteoporosis Underdiagnosed**

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- **Fewer than 5% of patients with fractures are referred for evaluation and treatment**
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- **At hospital discharge, 4.5% of men with hip fracture and 27% of women with hip fracture had treatment for osteoporosis**

# Definition of Osteoporosis

A skeletal disorder characterized by...

- **Excessive osteoclast-mediated bone resorption**
- **Compromised bone strength**
- **Increased risk of fracture at all skeletal sites**

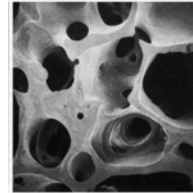
"Osteoporosis is one of the most common and debilitating chronic diseases, and a global healthcare problem."

International Osteoporosis Foundation

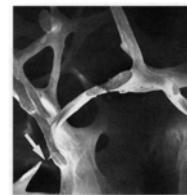
"Osteoporosis has financial, physical, and psychosocial consequences, all of which significantly affect the individual, the family, and the community."

NIH Consensus Statement

Normal



Osteoporosis



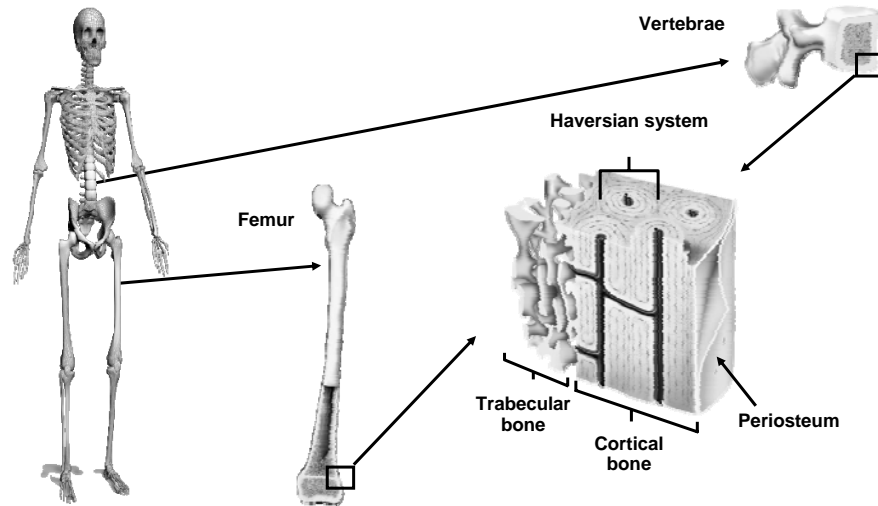
Boyle WJ, et al. *Nature*. 2003;423:337-342.  
NIH Consensus Development Panel. *JAMA*. 2001;285:785-795.  
Images are of a paired iliac crest biopsy and courtesy of Yebin Jiang MD, PhD. Osteoporosis & Arthritis Lab, University of Michigan.

# Skeletal Form and Function

- **The skeleton is a dynamic organ comprised of over 200 discrete bones with mechanical, protective, and metabolic functions**
- **Composed of two types of bone:**
  - Cortical bone: **Outer dense shell**
  - Trabecular bone: **Network of connecting plates inside the cortical shell**
  - **Bone remodeling (formation and resorption "bone turnover") occurs throughout life**

Adapted from: Dempster DW. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*. 6th ed. 2006:7-11

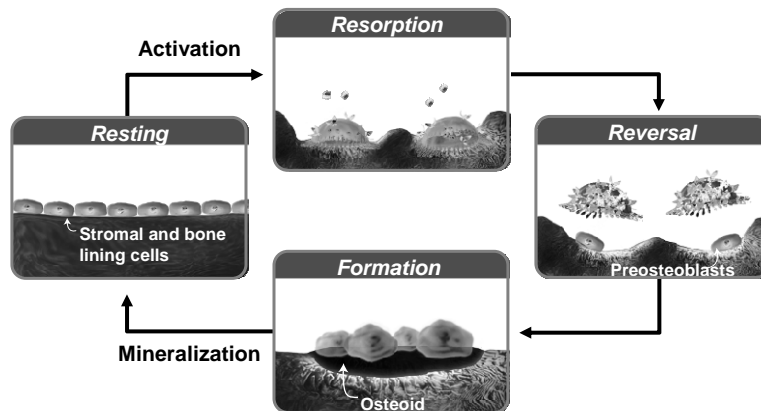
# Skeletal Form and Function



Adapted from: Dempster DW. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*. 6th ed. 2006:7-11.

# The Life Cycle of Bone

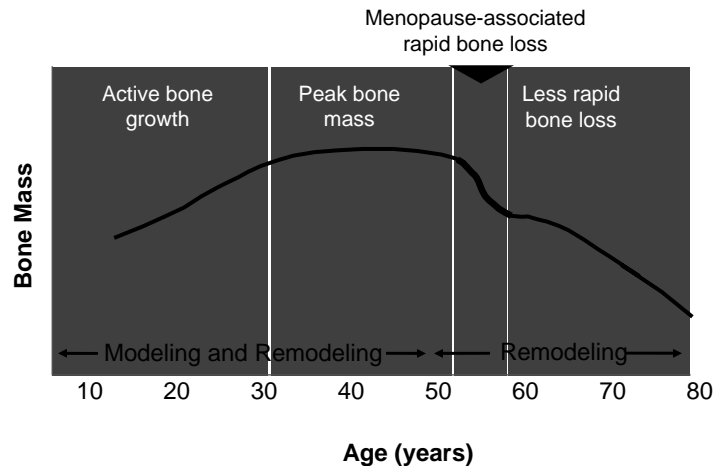
- When bone turnover is increased, bone loss dominates



Adapted from: Baron R. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*. 5th ed. 2003:1-8.  
Raisz LG. *J Clin Invest*. 2005;115:3318-3325.



# Bone Mass Is Lost in Age-Related Remodeling

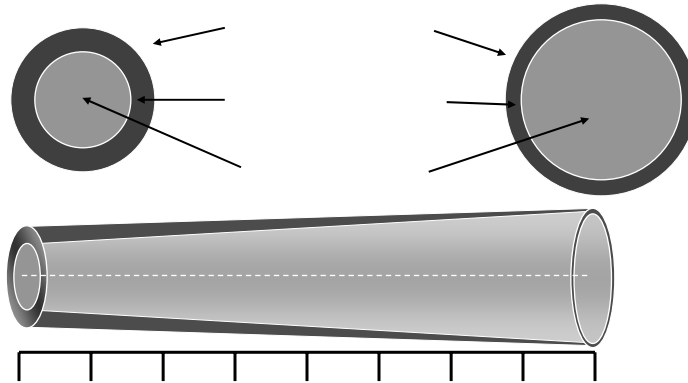


Graph adapted from: Finkelstein JS. *Cecil Textbook of Medicine*. 21st ed. 1999:1366-1373.

## Pathophysiology: Bone Strength

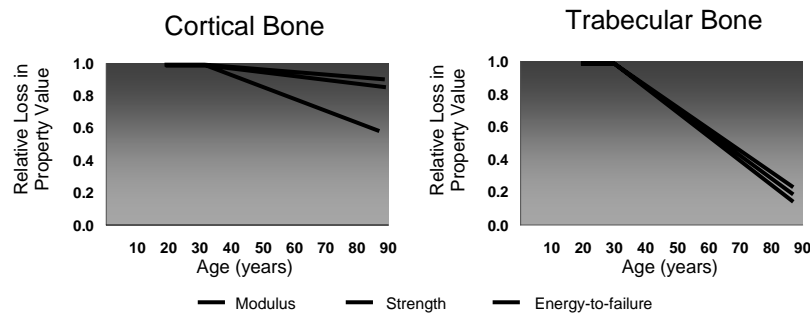
- **Factors that influence bone strength**
  - Bone mass (measured by BMD)
  - Remodeling frequency (bone turnover)
  - Bone size
  - Bone area
  - Microarchitecture
  - Degree of bone mineralization

# Cortical Bone Geometry Changes With Age



Adapted from: Orwoll ES, et al. *Atlas of Osteoporosis*. 2003:167.

# Biomechanical Strength of Bone Decreases With Age



Property	Loss/Decade, %	Loss from 20–80, %
<b>Modulus</b>	–1.5	–7.5
<b>Strength</b>	–2.1	–11.0
<b>Energy-to-failure</b>	–6.8	–34.0

Property	Loss/Decade, %	Loss from 20–80, %
<b>Modulus</b>	–12.8	–64.0
<b>Strength</b>	–13.5	–67.5
<b>Energy-to-failure</b>	–14.0	–70.0

Adapted from: Orwoll ES, et al. *Atlas of Osteoporosis*. 2003:168.

## **Who Has Osteoporosis and Low Bone Mass?**

- **More than 44 million Americans**

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- **More than 44 million Americans**
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  - **\$15 billion for care of fractures**

# Who Has Osteoporosis and Low Bone Mass?

- **More than 44 million Americans**
- **1 in 2 women over 50 years old**
- **1 in 4 men over 50 years old**
- **Associated Costs**
  - **\$15 billion for care of fractures**
- **62 million in U.S. by 2020**

## U.S. Surgeon General 2004



“According to the Surgeon General, an estimated 10 million Americans over the age of 50 have osteoporosis while another 34 million have osteopenia or low-bone mass. This problem affects men and women of all ethnicities. Due to the aging of baby boomers, we will have many more people at risk over the next two decades.

It is vital that Americans know how to prevent and treat bone disease and take action that can lead to better bone health.”

# 2000–2010: National Bone and Joint Decade

- **Goals**

- **Raise awareness of the growing burden of musculoskeletal disorders on society**
- **Empower patients to participate in decisions on their care**
- **Promote cost-effective prevention and treatment**
- **Advance understanding of musculoskeletal disorders through research to improve prevention and treatment**



“The musculoskeletal system gives us support and the power to move. When things go wrong, people are in pain and their lives become limited. The goal of the Bone and Joint Decade...is to keep people moving, to enjoy fuller lives.”

Stuart L. Weinstein, MD; Bone and Joint Decade

Delmas PD, Anderson M. *Osteoporos Int*. 2000;11:95-97.

## The Fragility Fracture Program

- Improve processes and outcomes for older adults undergoing surgery for fragility fractures

*“Multi-disciplinary approach with standardized protocols”*

### Fragility Fracture Program

Hospital  
In-patient

Clinic  
Out-patient

## **Benefits of Inpatient Program**

- **Streamlined admission process**
- **Standardized protocols decrease variability/delays to surgery**
- **Optimal fracture surgery within 24 hours of admission**
- **Daily evaluation to ensure earlier mobility and faster recovery**
- **Co-management with frequent communication to avoid errors and reduce adverse events**

## **Benefits of Inpatient Program**

- **Improved communication with patients, family and entire team**
- **Initiation of research and education**
- **Earlier initiation of rehabilitation and more effective use of discharge planning resources**
- **Screening for osteoporosis and plan management**

## Potential Impact

- **Decreased time to surgical intervention =>**
  - **Decreased patient morbidity<sup>1,2</sup>**
  - **Decreased patient mortality<sup>1,2</sup>**
  - **Shorter length of stay<sup>1,2</sup>**
  - **Increased likelihood to return to pre-injury status**

1 Friedman SM et al. J Am Geriatr Soc 2008

2 Fisher AA J Orthop Trauma 2006

## Potential Impact

- **Cost savings<sup>1</sup>**
  - **Estimate savings of \$3879 /case**
  - **Assuming 350,000 hip fxs per year in the US => 1.36 billion dollars cost savings per year**

1 Friedman SM et al. J Am Geriatr Soc 2008

2 Fisher AA J Orthop Trauma 2006



# Increase awareness and treatment of osteoporosis

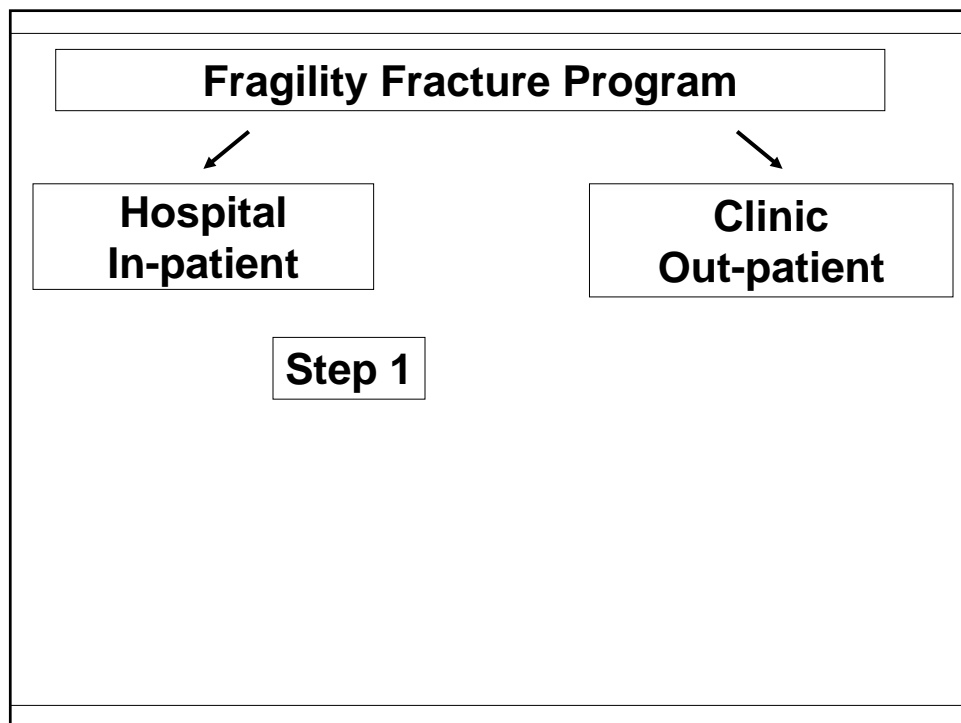
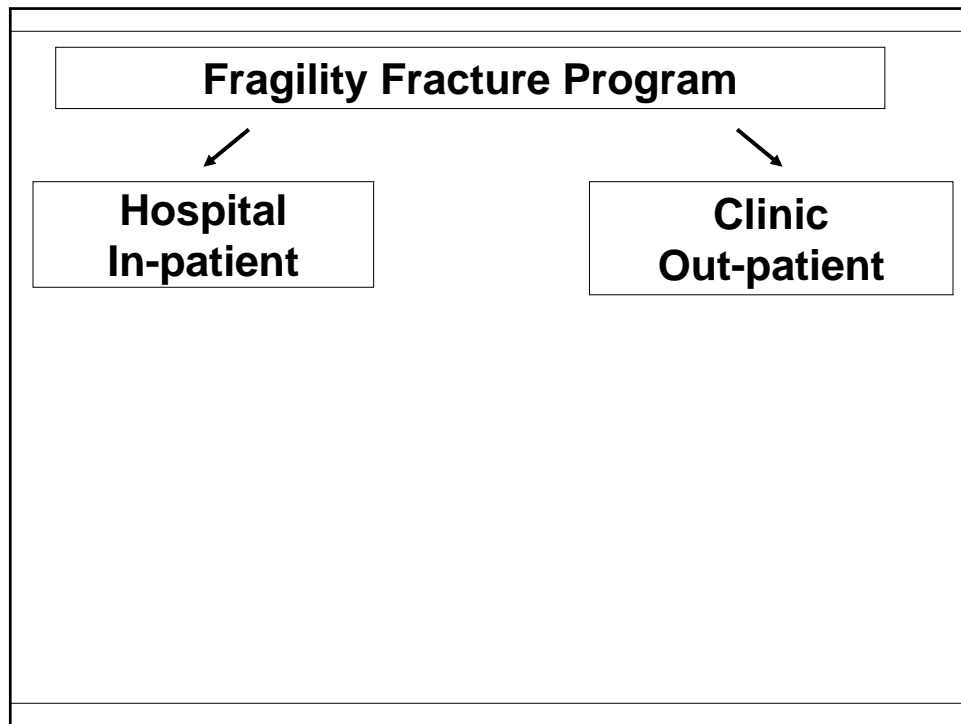
- Fewer than 5% of patients with fractures *receive evaluation and treatment of osteoporosis, the underlying cause of most fragility fractures*<sup>1,2</sup>
- A prior fracture increases the risk of a new fracture 2- to 5-fold
- At hospital discharge, 4.5% of men with hip fracture and 27% of women with hip fracture had treatment for osteoporosis

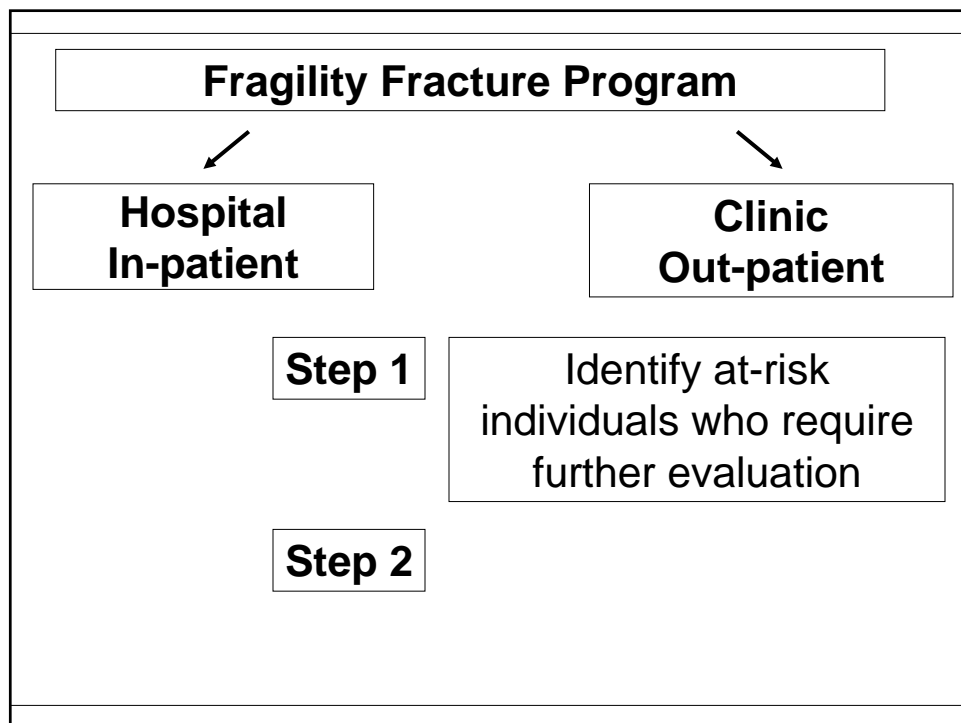
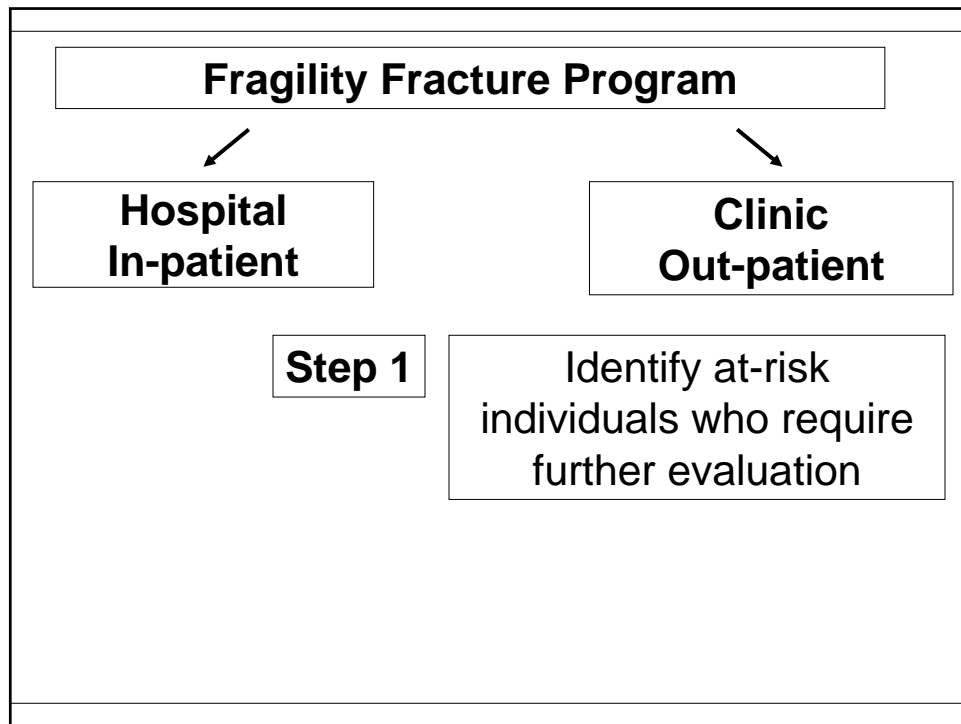
1. Eastell et al. QJM 2001; 94:575-59
2. Bouxsein et al. J Am Acad Ortho Surg. 2004; 12:385-95

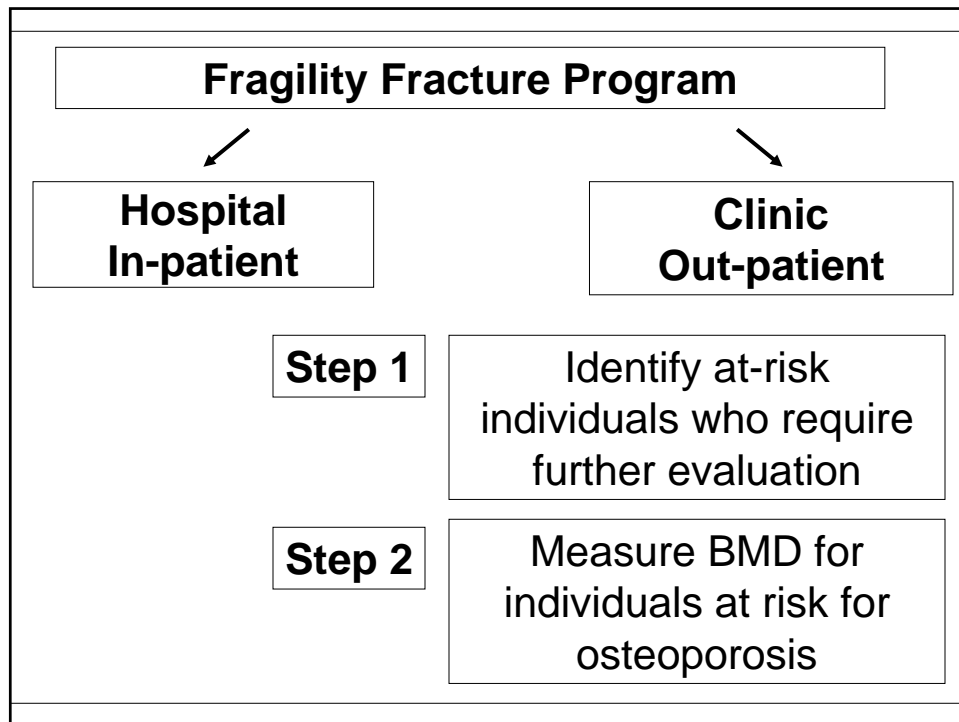
# Increase awareness and treatment of osteoporosis

- Awareness and knowledge about osteoporosis is low among fracture patients
- Our response to a fragility fracture must include a determined attempt to prevent another one
  - Needs a system that achieves this automatically

1. Eastell et al. QJM 2001; 94:575-59
2. Bouxsein et al. J Am Acad Ortho Surg. 2004; 12:385-95







## Risk Factors - Osteoporsis

- Female sex
- Thin or small frame
- Low body weight
- Hispanic or Caucasian race
- Low calcium intake
- Alcoholism (> 2 drinks/day)



## **Risk Factors - Osteoporosis**

- **Sedentary life style**
- **History of smoking**
- **Estrogen deficiency at an early age (< 45 years)**
- **Family history or personal history of fractures or osteoporosis**
- **Use of medications associated with accelerated bone loss (oral corticosteroids > 3 mo)**

## **Osteoporosis in Men**

- **Gradual bone loss begins in men in their 30's**
- **Unlike women, no universal reduction in hormone levels resulting in accelerated bone loss**
- **Men with hypogonadism may experience rapid bone loss**



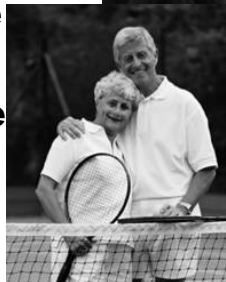
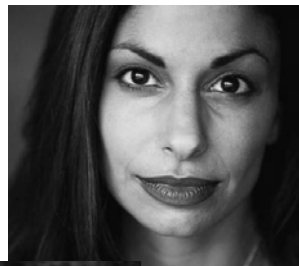
# Ethnicity & Osteoporosis

- Hispanic women at highest risk
- Hispanic women tend to consume less calcium than the RDA
- Caucasian & Asian-American women also high risk



# Ethnicity & Osteoporosis

- The average calcium intake among Asian-American women is about half that of their Caucasian counterparts
- While Asian-American women generally have lower incidence of hip fractures than Caucasian women, the prevalence of vertebral fractures is about equal between the two populations.



# Ethnicity & Osteoporosis



- African-American women generally have higher bone density and are at somewhat lower risk than their Asian-American and Caucasian counterparts, this should not be taken to mean that there is no cause for concern among this population.

# Ethnicity & Osteoporosis



- 10% of African-American women over 50 have Osteoporosis
- 80-95% of all fractures sustained by African-Americans 64+ are osteoporotic
- African-American women more likely to die from hip fractures than White women

## **BMD Screening Recommendations for Postmenopausal Women**

- **National Osteoporosis Foundation<sup>1</sup>**

1. Physician's Guide to Prevention and Treatment of Osteoporosis. 2nd ed. Washington, DC: National Osteoporosis Foundation; 2003.  
2. Screening for osteoporosis in postmenopausal women: recommendations and rationale. *Ann Intern Med.* 2002;137:526-528.

## **BMD Screening Recommendations for Postmenopausal Women**

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  - **Postmenopausal women who present with fractures**

1. Physician's Guide to Prevention and Treatment of Osteoporosis. 2nd ed. Washington, DC: National Osteoporosis Foundation; 2003.

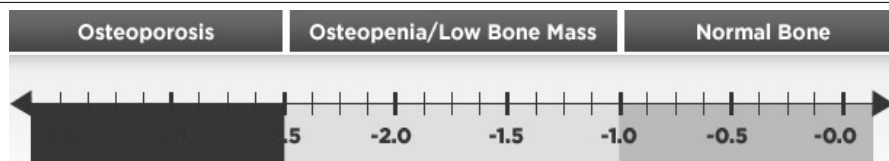
2. Screening for osteoporosis in postmenopausal women: recommendations and rationale. *Ann Intern Med.* 2002;137:526-528.

## Patients Eligible for Medicare Coverage of BMD Testing

- Estrogen-deficient women at clinical risk for osteoporosis
- Individuals with vertebral abnormalities
- Individuals receiving, or planning to receive, long-term glucocorticoid therapy
- Individuals with primary hyperparathyroidism
- Individuals being monitored to assess the response or efficacy of osteoporosis therapy

Medicare and Medicaid Program Instructions. Centers for Medicare & Medicaid Services [Web site].  
<http://www.cms.hhs.gov/manuals>

## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



Normal

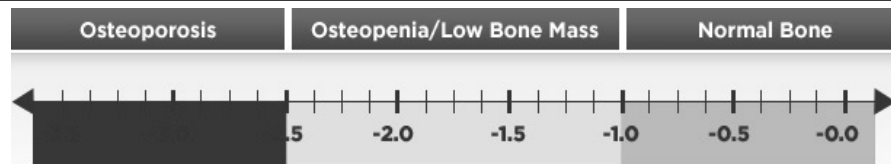
## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



Normal

BMD value within 1 S.D. of young-adult mean  
(T-score at or above -1)

## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



**Normal**

BMD value within 1 S.D. of young-adult mean  
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**Osteopenia**

## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



**Normal**

BMD value within 1 S.D. of young-adult mean  
(T-score at or above -1)

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BMD value between -1 S.D. and -2.5 S.D. below  
young-adult mean (T-score between -1 and -2.5)

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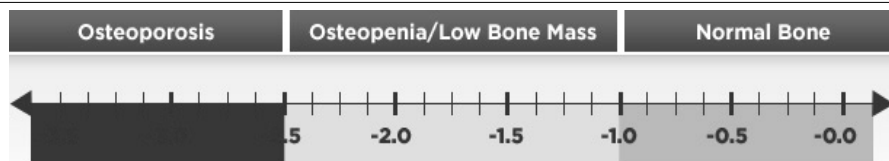
BMD value between -1 S.D. and -2.5 S.D. below  
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**Osteoporosis**

BMD value at least -2.5 S.D. below young  
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**Severe  
Osteoporosis**

## WHO Definition of Low Bone Density and Osteoporosis Based on BMD



**Normal**

BMD value within 1 S.D. of young-adult mean  
(T-score at or above -1)

**Osteopenia**

BMD value between -1 S.D. and -2.5 S.D. below  
young-adult mean (T-score between -1 and -2.5)

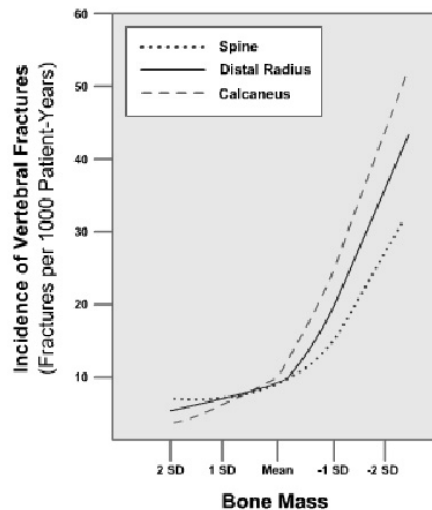
**Osteoporosis**

BMD value at least -2.5 S.D. below young  
adult mean (T-score at or below -2.5)

**Severe  
Osteoporosis**

BMD value at least -2.5 S.D. below young  
adult mean and presence of fracture

# Relationship Between BMD and Fracture Risk



Reproduced with permission from Miller PD, Bonnick SL, Rosen CJ, et al. *Semin Arth Rheum.* 1996;25:361-372.

## Geriatric Fragility Fractures

**Suzanne Stanek, CNP**

Clinical Co-Director of  
The Fragility Fracture Program at  
The Ohio State University Medical Center

# **Fragility Fracture Clinic**

## **Fragility Fracture Program**



**Hospital  
In-patient**



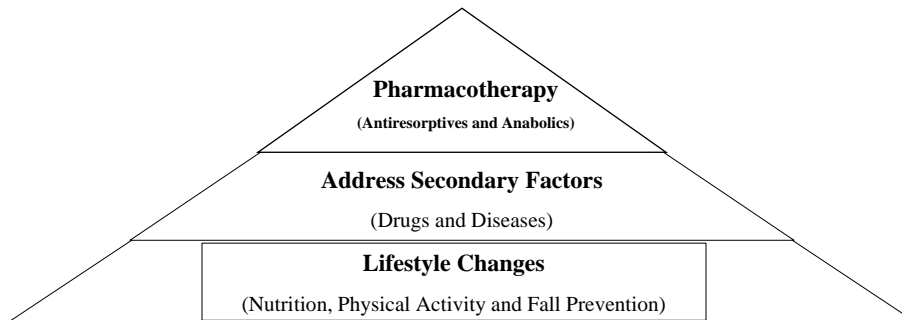
**Clinic  
Out-patient**

## **Fragility Fracture Clinic Objectives**

- **To identify patients at increased risk of fragility fracture**
- **To offer appropriate information to patients regarding osteoporosis management and fall prevention**
- **To provide advice to PCPs on suitable interventions**
- **To provide interventions to reduce risk of fragility fracture**

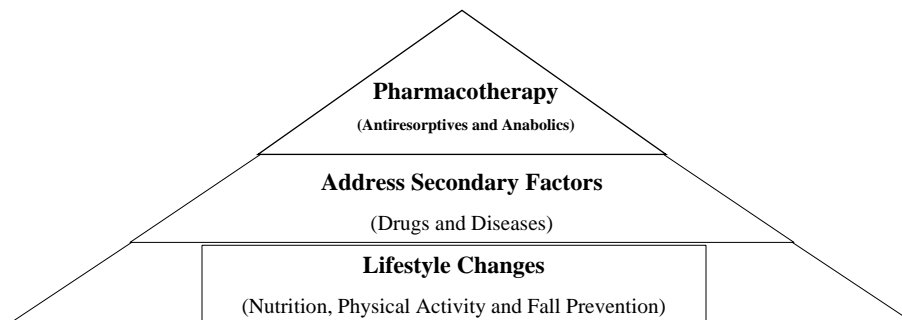


# Prevention & Treatment of Osteoporosis



Bone health and osteoporosis: A report of the Surgeon General. Rockville, MD:  
U.S. Department of Health and Human Services; 2004.

# Secondary Causes of Osteoporosis



Bone health and osteoporosis: A report of the Surgeon General. Rockville, MD:  
U.S. Department of Health and Human Services; 2004.

# Secondary Causes of Osteoporosis

## Genetic Disorders

Cystic fibrosis Ehlers-Danlos Glycogen storage diseases Gaucher's disease Riley-Day syndrome	Hemochromatosis Homocystinuria Hypophosphatasia Idiopathic hypercalciuria	Marfan's syndrome Menke's steely hair syndrome Osteogenesis imperfecta Porphyria
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## Hypogonadal States

Androgen insensitivity Anorexia nervosa Premature ovarian failure	Hyperprolactinemia Panhypopituitarism Athletic amenorrhea	Turner's and Klinefelter's syndrome
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## Endocrine Disorders

Acromegaly Adrenal insufficiency	Cushing's syndrome Diabetes mellitus (Type 1)	Hyperparathyroidism Thyrotoxicosis
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## Gastrointestinal Diseases

Gastrectomy Inflammatory bowel disease	Malabsorption Celiac disease	Primary biliary cirrhosis
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# Additional Secondary Causes

## Hematologic Disorders

Hemophilia Leukemias and lymphomas	Multiple myeloma Sickle cell disease	Systemic mastocytosis Thalassemia
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## Rheumatic and Auto-Immune Diseases

Ankylosing spondylitis	Lupus	Rheumatoid arthritis
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## Miscellaneous

Alcoholism Amyloidosis Chronic metabolic acidosis Congestive heart failure Depression	Emphysema End stage renal disease Epilepsy Gastric restrictive surgeries for obesity Idiopathic scoliosis	Immobilization Multiple sclerosis Muscular dystrophy Post-transplant bone disease Sarcoidosis
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## Medications

Anticoagulants (heparin) Aluminum Anticonvulsants Cytotoxic drugs Glucocorticoids and adrenocorticotropin	Gonadotropin-releasing hormone agonists Immunosuppressants Lithium Methotrexate Progesterone (parenteral, long-acting)	Thyroxine Tamoxifen Total parenteral nutrition
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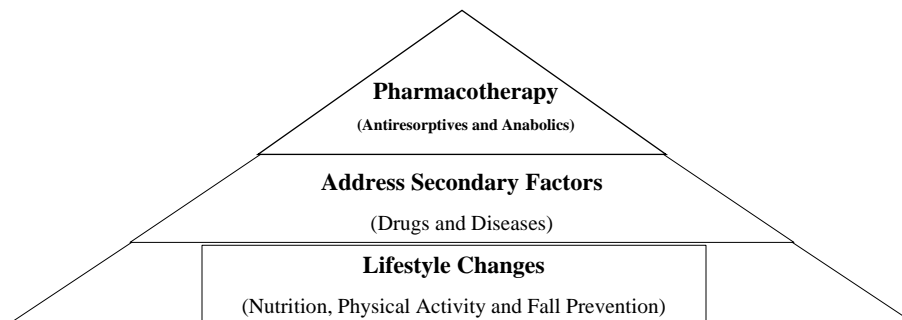
# AACE-Recommended Laboratory Tests

**Complete Blood Count and Sed Rate**

**Serum Chemistry Studies**

<b>Calcium</b>	<b>Creatinine</b>
<b>Phosphorus</b>	<b>25-hydroxyvitamin D</b>
<b>Pre-albumin</b>	<b>Parathyroid hormone (PTH-I)</b>
<b>Alkaline phosphatase</b>	<b>TSH</b>
<b>Liver enzymes</b>	<b>Urinary calcium excretion</b>

## Lifestyle Changes



Bone health and osteoporosis: A report of the Surgeon General. Rockville, MD:  
U.S. Department of Health and Human Services; 2004.

# Modifiable Risk Factors for Osteoporosis

- Inadequate calcium and vitamin D intake
- Physical inactivity
- Excessive alcohol
- Cigarette smoking
- Low body weight (127 lbs)



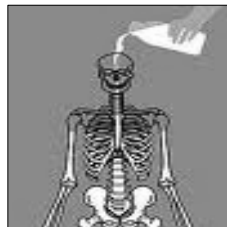
NOF....

## How Much Calcium?

Adult Women and Men 50+ years

1200-1500 mg

*In 2 divided doses*



Maximum 2,000 – 2,500 mg/day

# Calcium: Food Sources

## Dairy products



- Skim milk, 1 glass 300 mg
- Yogurt, 6 oz fruit 200 mg
- Cheese, 1 slice 204 mg
- Cottage cheese, 1 cup 150 mg



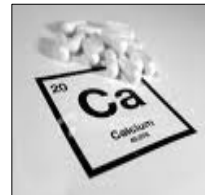
## Fortified foods

- Fortified cereal (Total  $\frac{3}{4}$  c) 1,000mg
- Fortified orange juice, 1 c 300 mg

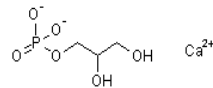
# Calcium Supplements

USP approved

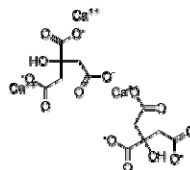
2 Choices



- Calcium carbonate



- Calcium citrate



# Calcium Carbonate



- Requires acid for absorption
  - Take with meals
  - Don't use if taking medication to reduce stomach acid
  - Aging?
- Low cost
- Constipation or upset ?
- Tums, Oscal, Viactive Chews



# Calcium Citrate



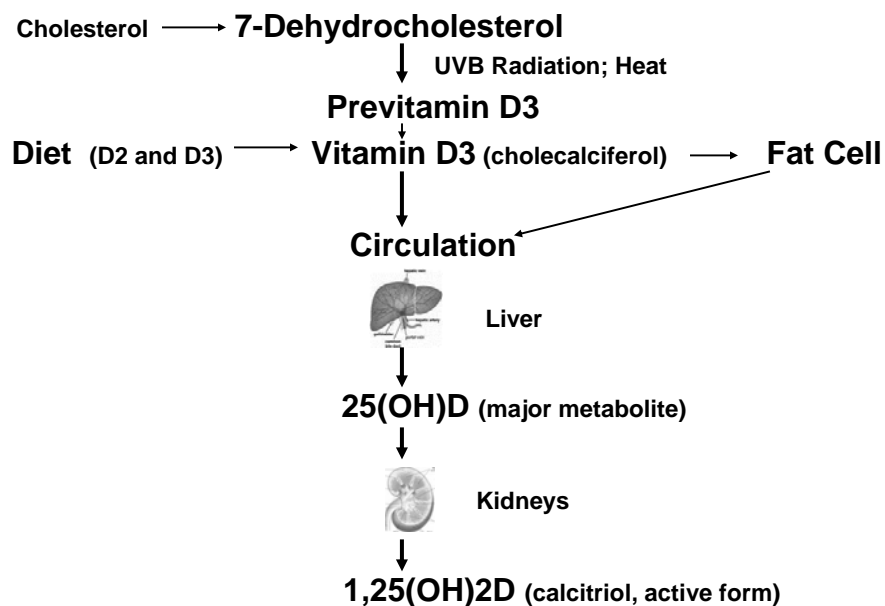
- Acid not required for absorption
  - Can take any time of day
  - Ok with medication to reduce stomach acid
- Costs more
- No constipation or upset
- 2 tablets twice a day

# Risks of Calcium?

- Calcium Stones
  - Evaluate risk
  - Prevention strategies
    - Diet; hydration; thiazides
    - Calcium rich food sources
- Cardiovascular
  - Evaluate risk
  - Prevention strategies
    - Vitamin D supplements
    - Calcium rich food sources



## Synthesis and Metabolism of Vitamin D





## Role of Vitamin D

- **Regulate mineral metabolism**
  - Calcium and phosphorous homeostasis
- **Bone metabolism**
- **Muscle strength; fall reduction**
- **Parathyroid regulation**
- **Inhibit cell proliferation (psoriasis); promote cell differentiation**
- **Insulin secretion**
- **Possible reduction of risk for some chronic diseases**

## Vitamin D Protection

- **Fall reduction**
  - Nursing home residents taking 800 IU vitamin D/day plus calcium had 26% reduction in risk of falls compared with placebo group
- **Anti-fracture efficacy**
  - Women consistent in taking calcium and 700-800 IU D3 had 29% reduction in hip fx (Women's Health Initiative)
- **Optimal protection**
  - only in trials providing 700-800 IU D3 / day or when serum 25(OH)D rose to 40ng/mL

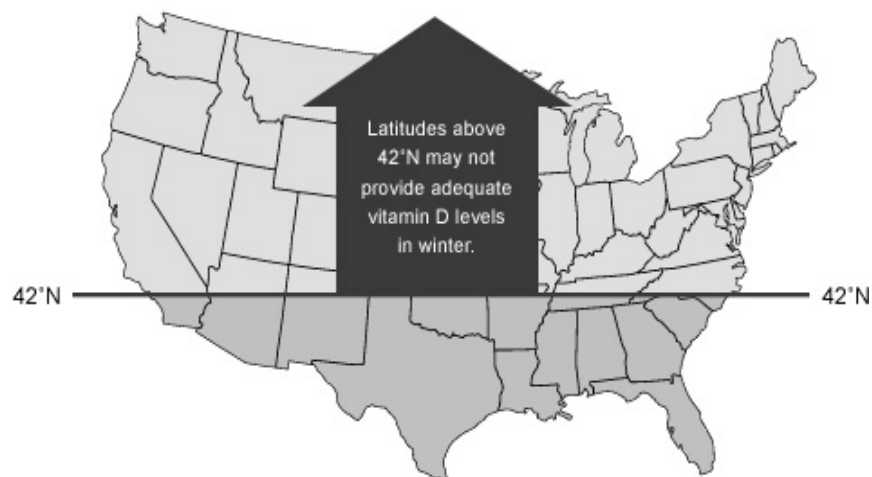


# Dietary Sources of Vitamin D<sup>1</sup>

Food	Amount (IU)
Cod liver oil, 1 Tbsp	1360
Salmon, 3 ½ oz cooked	360
Mackerel, 3 ½ oz cooked	345
Tuna fish, canned in oil, 3 oz	200
Sardines, canned in oil, drained, 1¾ oz	250
Nonfat, reduced fat, and whole milk, vitamin D fortified, 1 cup	98
Margarine, fortified, 1 Tbsp	60
Pudding, prepared from mix and made with vitamin D fortified milk, ½ cup	60
Ready-to-eat cereals fortified with 10% of the DV for vitamin D (servings vary according to the brand)	40
Egg, 1 whole (vitamin D is found in egg yolk)	20
Liver, beef, cooked, 3½ oz	15
Cheese, Swiss, 1 oz	12

NIH Office of Dietary Supplements

## Who May Be D-Deficient?



Source: NHANES III

# Who May Be D-Deficient?

## Screen:

- Adults > 50 years
- Homebound; institutionalized
- Limited sun exposure; sunscreen, protective clothing
- Darkly pigmented skin
- Live north of the Carolinas
- Inadequate intake of vitamin D; malabsorption
- Chronic liver & kidney disease
- Drugs: anticonvulsants, glucocorticoids; antirejection meds

Source: NHANES III

# Reference Range for Serum 25(OH)D

## Hypovitaminosis D

- |                               |             |
|-------------------------------|-------------|
| - Severe deficiency           | < 10 ng/ml  |
| - Mild to moderate deficiency | 10-20 ng/ml |
| - Insufficiency               | 21-29 ng/ml |

<b>Sufficient</b>	<b>30-80 ng/ml</b>
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<b>Possible toxicity</b>	<b>&gt; 80 ng/ml</b>
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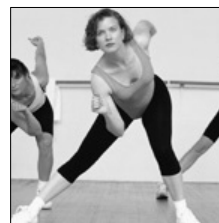
N Engl J Med 357:3, 2007

# Vitamin D Recommendations

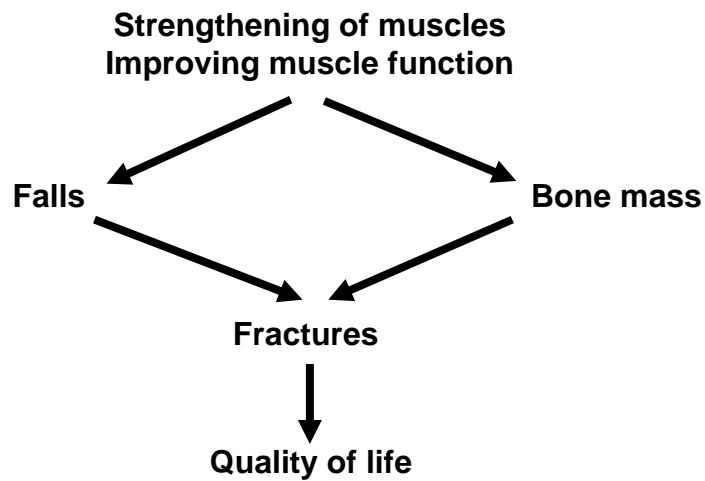
- **Deficiency (<20ng/mL):**
  - Vitamin D2 (ergocalciferol): 50,000 IU once a week for up to 2 - 3 months, or 3x/week for one month. Re-check levels; adjust dose for individual requirements.
- **Maintenance or Insufficiency:**
  - Vitamin D3 (cholecalciferol): 800 – 2,000 IU/day for older adults, or individuals who are chronically ill, housebound, or institutionalized.
- May take any time of the day. May continue smart sun exposure.

National Osteoporosis Foundation

## Exercise



# Exercise: 20 Minutes A Day



## Exercise



**Best to do**  
**Weight-bearing exercises**  
**AND**  
**Strength-training-exercises**  
**AND**  
**Balance-exercises**



# Tai-chi Reduces Fall Risk



Quin et al. Arch Phys Med Rehabil. 2002; 83:1355-9  
Wolff et al. J Am Geriatr Soc. 1996; 44:489-97

## Basic Balance Training

### One foot...5 seconds

Stand facing a counter or table top.

Hold on with both hands, stand on one leg.

Hold for 5 seconds.

Repeat with the other foot.

Repeat sequence holding on with one hand.

Repeat holding on with fingertip.

Repeat sequence without holding on.

Repeat from beginning but close eyes when  
balancing on the one leg.



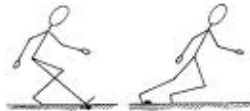
# Fall Prevention

## The “F” Word



\*#\*#\* does happen...

We can prevent most falls!!!



## Risk Factors for Falling:

### Intrinsic Factors

- Frailty and associated deconditioning
- Problems with gait, balance and mobility
- Cognitive impairment or depression
- Poor visual acuity: depth perception & contrast
- Impaired hearing
- Low vitamin D levels
- Previous falls
- “Blackouts”

## Risk Factors for Falling: Extrinsic Factors

### Personal Hazards

- *Use of sedatives; SSRI*
- Inappropriate footwear and clothing
- Not using personal assistive devices

### Hazards outdoors

- Uneven pavement, streets and paths
- Lack of safety equipment

### Hazards indoors

- Snow and icy conditions
- Traffic and public transportation
- Dim lighting
- Steep stairs; lack of handrails
- Slippery floors; loose rugs
- Pets; grandchildren's toys
- Cords for telephone and electrical appliances

## Fall Risk Assessment

- **History of circumstances of the fall**
- **Medical:** drugs; acute or chronic medical problems
- **Cognitive:** mental status
- **Cardiovascular:** heart rate and rhythm; postural hypotension
- **Vision:** depth perception and contrast sensitivity
- **Mobility, gait and balance**
- **Neurological:** leg strength, reflexes, proprioception, foot sensitivity; tests of cortical, cerebellar and extrapyramidal function

# Timed Get Up and Go Test (TUG)

87% sensitive and 87% specific in predicting falls in community dwelling older adults

Performed with patient wearing regular footwear, using usual walking aid if needed, and sitting back in a chair with arm rest.

Observe patient for postural stability, steppage, stride length and sway.

Instruct the patient to:

- Rise from chair
- Stand still momentarily
- Walk short distance (~ 10 feet)
- Turn around
- Walk back to chair
- Sit down



[J of Ger Phys Therapy, 33:4: 2010](#)

## Get Up and Go Test: Interpretation

Low scores correlate with good functional independence; high scores correlate with poor functional independence and higher risk of falls.

Completes task in:

< 10 seconds:	Normal
< 20 seconds:	Adequate for independent transfers and mobility; > 13.5 fall risk
> 20 seconds:	Abnormal
> 30 seconds:	Higher dependence and risk of falls

Posiadio (1991) J Am Geriatr Soc 39:142-8 and Arch Phys Med Rehabil (1986)67: 387 - 38



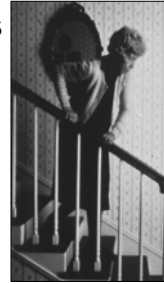
# AACE Recommendations for Fall Prevention

## PCP

- Gait and balance training
- Adjust dosage of drugs with sedative effects

## Home

- Avoid loose rugs
- Remove clutter
- Keep loose wires behind furniture
- Use nonskid mats
- Install handrails in bathrooms, halls, and stairs
- Light hallways, stairs, and entrances
- Wear sturdy, low-heeled shoes



Hodgson SF, Watts NB, Bilezikian JP, et al. Endocr Pract. 2003;9:544-564.

# Treatment Guidelines (NOF)

Postmenopausal women and men  $\geq$  age 50 who present with


- Hip or vertebral fragility fracture
- T-score  $\leq$  -2.5 after exclude secondary causes
- Osteopenia and positive FRAX



- Consultation (general recommendations)
- Basic treatment (calcium + vitamin D)
- Fall evaluation and prevention
- Special pharmacotherapy

Clinician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC: National Osteoporosis Foundation; 2008

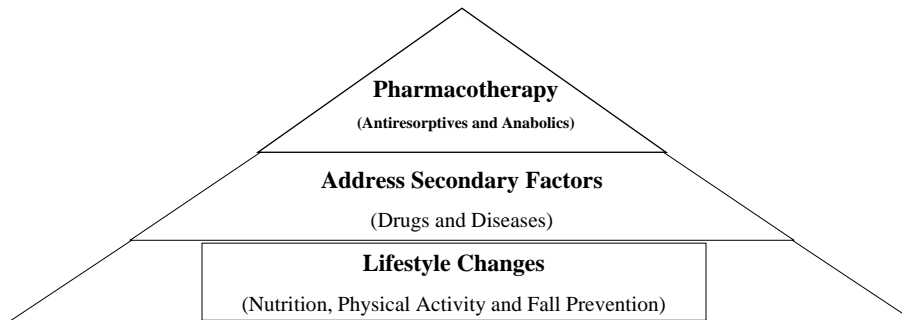
# FRAX Score: Osteopenia

- WHO computer-based algorithm
- Identifies osteopenic patients who may benefit from treatment
- 10 year fracture risk based on specific risk factors and BMD
- Country and race specific 
- Suggest treatment if:
  - 10 yr probability of hip fx  $\geq$  3%
  - 10 yr probability of major osteoporosis-related fx  $\geq$  20%

# Monitoring Therapy Postmenopausal Women

- **Serial BMD**
  - BMD changes slowly
  - Assessment is required every 2 years to measure change
  - Look for maintenance or improvement in BMD
  - Should be performed on the same machine if possible
- **Bone turnover markers**
  - Evolving method of clinical assessment
  - Large changes in biochemical markers associated with fracture reduction

# Pharmacotherapy



Bone health and osteoporosis: A report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services; 2004.

# Pharmacotherapy

## 1. Antiresorptive agents

**Bisphosphonates**

**SERMs** (Selective estrogen receptor modulators)

**Hormones: Estrogen; Androgen**

**Calcitonin**

## 2. Anabolic agents

**r-PTH**

## 3. RANKL inhibitor (new)



# Pharmacotherapy: Bisphosphonates

Bisphosphonate	Labeled Indications	
	Prevention	Treatment
Alendronate	Postmenopausal osteoporosis	Postmenopausal osteoporosis Men with osteoporosis Glucocorticoid-induced osteoporosis
Ibandronate	Postmenopausal osteoporosis	Postmenopausal osteoporosis
Risedronate	Postmenopausal osteoporosis Glucocorticoid-induced osteoporosis	Postmenopausal osteoporosis Glucocorticoid-induced osteoporosis Men with osteoporosis
Zoledronic acid (IV)		Postmenopausal osteoporosis

## Efficacy of Bisphosphonates 30-50% Risk Reduction v.s. Placebo

Bisphosphonate	Risk Reduction	
	Hip	Spine
Alendronate	51-56%	44-48%
Ibandronate	34% (post hoc analysis)	48-49%
Risedronate	30%	41-49%
Zoledronic acid (IV)	41%	46-77%

# Bisphosphonates

- **Contraindicated for poor renal function, hypocalcemia and pregnancy**
- **Caution in patients with abnormalities of the esophagus, reflux or stomach ulcers**
- **Use PPI if taking ASA**
- **Caution for oral surgery & poor dental hygiene**
- **Strict dosing instructions**
- **Consider drug holiday after 5 years therapy**
- **IV Reclast: pretreat with acetomenophen**

Osteoporosis Int (2010) 21: 1793-1802

# Pharmacotherapy: SERMS

Sermes	Labeled Indications	
	Prevention	Treatment
Raloxifene	Postmenopausal osteoporosis  Decrease risk of invasive breast cancer	Postmenopausal osteoporosis

# Pharmacotherapy: HRT Clinical Studies

- **WHI confirmed the effects of hormone therapy on fracture reduction**
  - Hip and vertebral fractures decreased by one-third
  - Total fractures decreased by 24% to 30%
- **WHI found HT provides no cardioprotective benefits and increases breast cancer risk**
- **Other adverse effects (increased risk of stroke, cognitive impairment, deep vein thrombosis)**
- **May be 1<sup>st</sup> line therapy for women < 60 years with menopausal symptoms at low dose; women should discuss benefits and risks with their health care provider (FDA)**

AACE Position Statement on HRT and Cardiovascular risk, 2008

# Pharmacotherapy: Testosterone Clinical Studies

## Testosterone

- Hypogonadism: testosterone replacement increases BMD; fracture prevention is unknown
- BMD did not increase in men with normal pretreatment levels
- May not be appropriate in elderly men, because of potential for undiagnosed prostate cancer

# Pharmacotherapy: Calcitonin

Calcitonin	Labeled Indications	
	Prevention	Treatment
Calcitonin		Postmenopausal osteoporosis of spine  Analgesia for vertebral fractures

# Anabolic Agents Pharmacotherapy: rPTH

rPTH	Labeled Indications	
	Prevention	Treatment
Teraparotide		Postmenopausal osteoporosis Men with osteoporosis Glucocorticoid-induced osteoporosis May increase rate of healing fractures

# Pharmacotherapy: RANKL Inhibitor

RANKL Inhibitor	Labeled Indications	
	Prevention	Treatment
Denosumab		Severe postmenopausal osteoporosis

## Combining Therapies

### Combining Antiresorptive Therapies

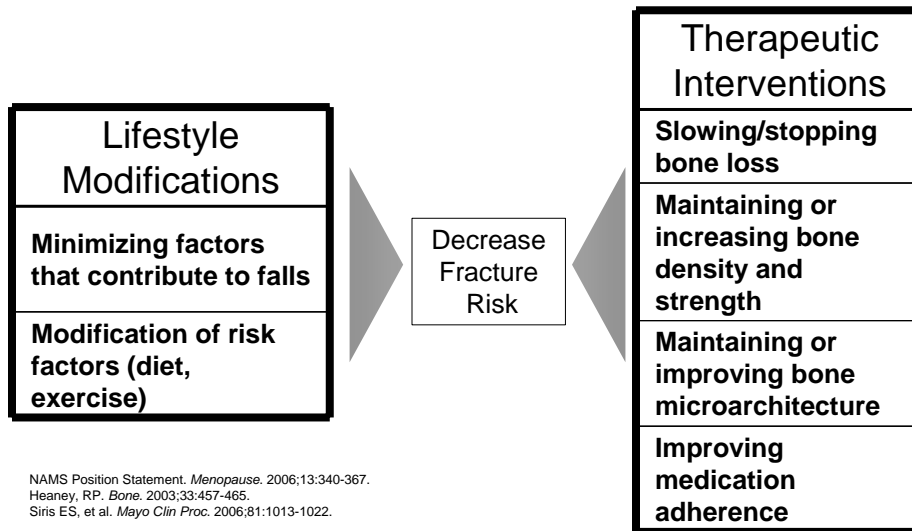
- Clinical studies have not shown combinations of HT or Raloxifene with bisphosphonates to increase BMD or reduce fracture risk more than each agent alone

### Combining Antiresorptive & Anabolic Therapies

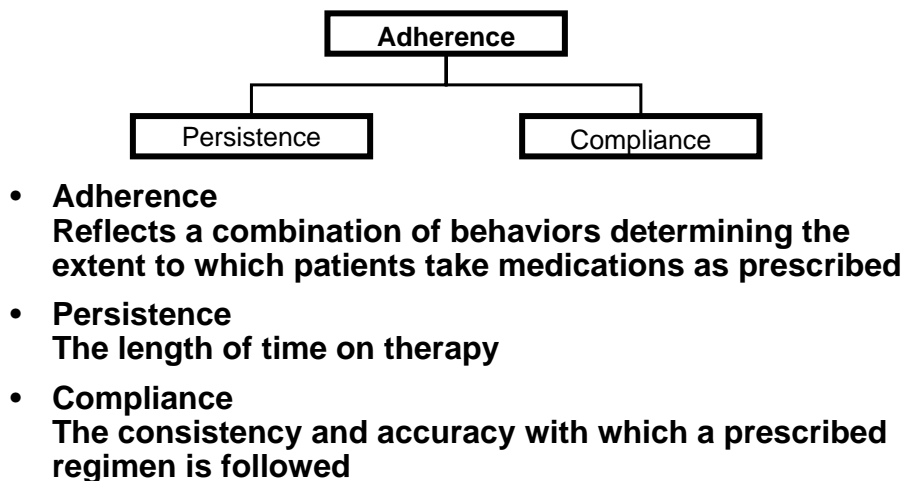
- PTH followed by Alendronate: vertebral BMD increased substantially
- PTH followed by Raloxifene: effective
- Alendronate and PTH used together---less effective
- Alendronate followed by PTH: reduced response
- Raloxifene followed by PTH: complete response to PTH
- Zolendronic acid and PTH: BMD increased



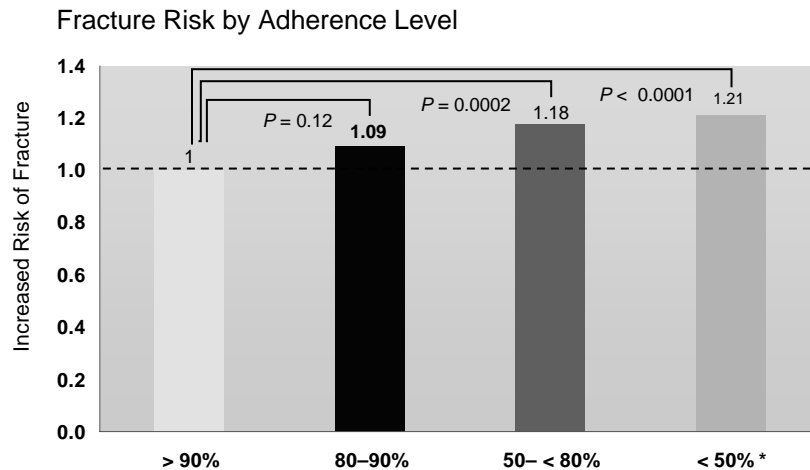
# Multiple Factors May Mitigate Fracture Risk



# Adherence Encompasses Both Persistence and Compliance

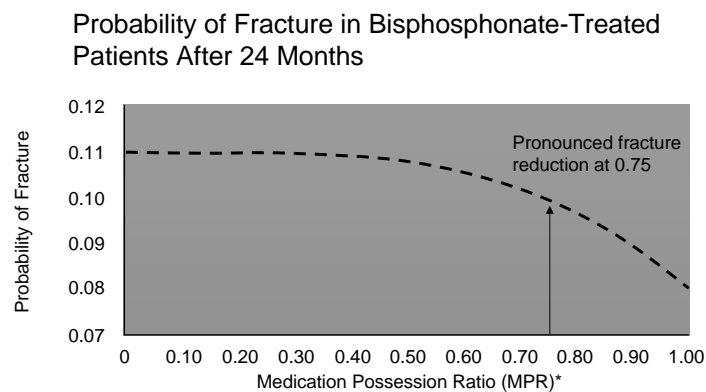


# Poor Adherence Is Associated With Increased Fracture Risk



\*Data on 38,000 women in a managed care database.  
 Huybrechts KF, et al. *Bone*. 2006;38:922-928.

# Improving Adherence Has Been Associated With Decreased Fracture Rates in Postmenopausal Osteoporosis

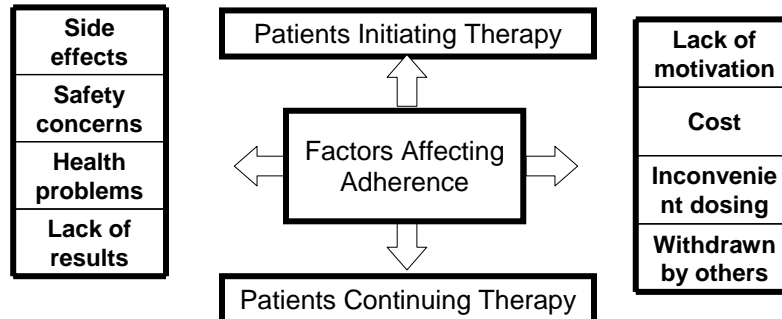


- 100% compliance is associated with a fracture rate of ~ 8%

Data on 35,537 patients from 2 claims databases.  
 \*Medication Possession Ratio (MPR) is a measure of refill compliance using the percentage of time a medication was available to the patient.  
 Siris ES, et al. *Mayo Clin Proc*. 2006;81:1013-1022.

# Osteoporosis Therapy and Patient Adherence

**Less than 25% of patients adhere to their therapy for more than 1 year**

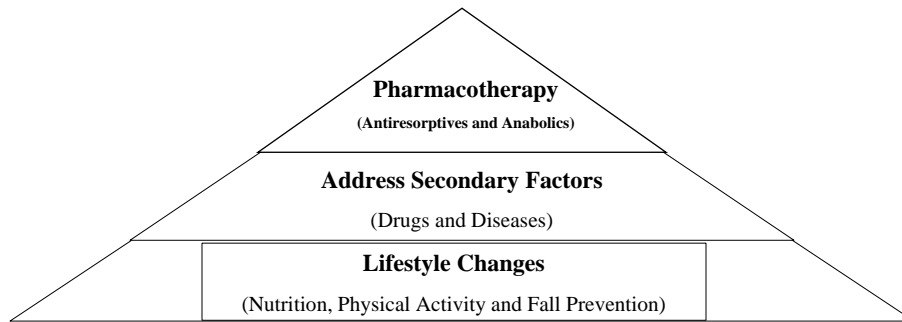


Rossini M, et al. *Osteoporos Int*. 2006;17:914-921.  
 Payer J, et al. *Biomed Pharmacother*. 2007;61:191-193.  
 McCombs JS, et al. *Maturitas*. 2004;48:271-287.

# Fragility Fracture Clinic Prevention and Treatment

- **Assessment**
  - Lab work: calcium, vitamin D, secondary causes
  - Tests: DEXA, FRAX
  - Cognitive & mood assessment
  - Nutritional assessment
  - Risk assessment
  - Medication review
- Fall Prevention
  - Exam: orthostatic hypotension, vision, feet,
  - Gait assessment
  - Balance assessment
  - Home assessment for environmental risks
- Evidence based interventions
- Letter to Primary Care Provider
- Follow-up

# Prevention & Treatment of Osteoporosis



Bone health and osteoporosis: A report of the Surgeon General. Rockville, MD:  
U.S. Department of Health and Human Services; 2004.

# *Thank You!*

