Fracture Liaison Services: A Cost-Effective, Multidisciplinary Approach to Secondary Fracture Prevention

Laila S. Tabatabai, MD

HOUSTON Methodist
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Disclosures

Ultragenyx

Radius

Objectives

1. Evaluation for Secondary Causes of Osteoporosis

2. Fracture Liaison Service Models to Fit Your Practice

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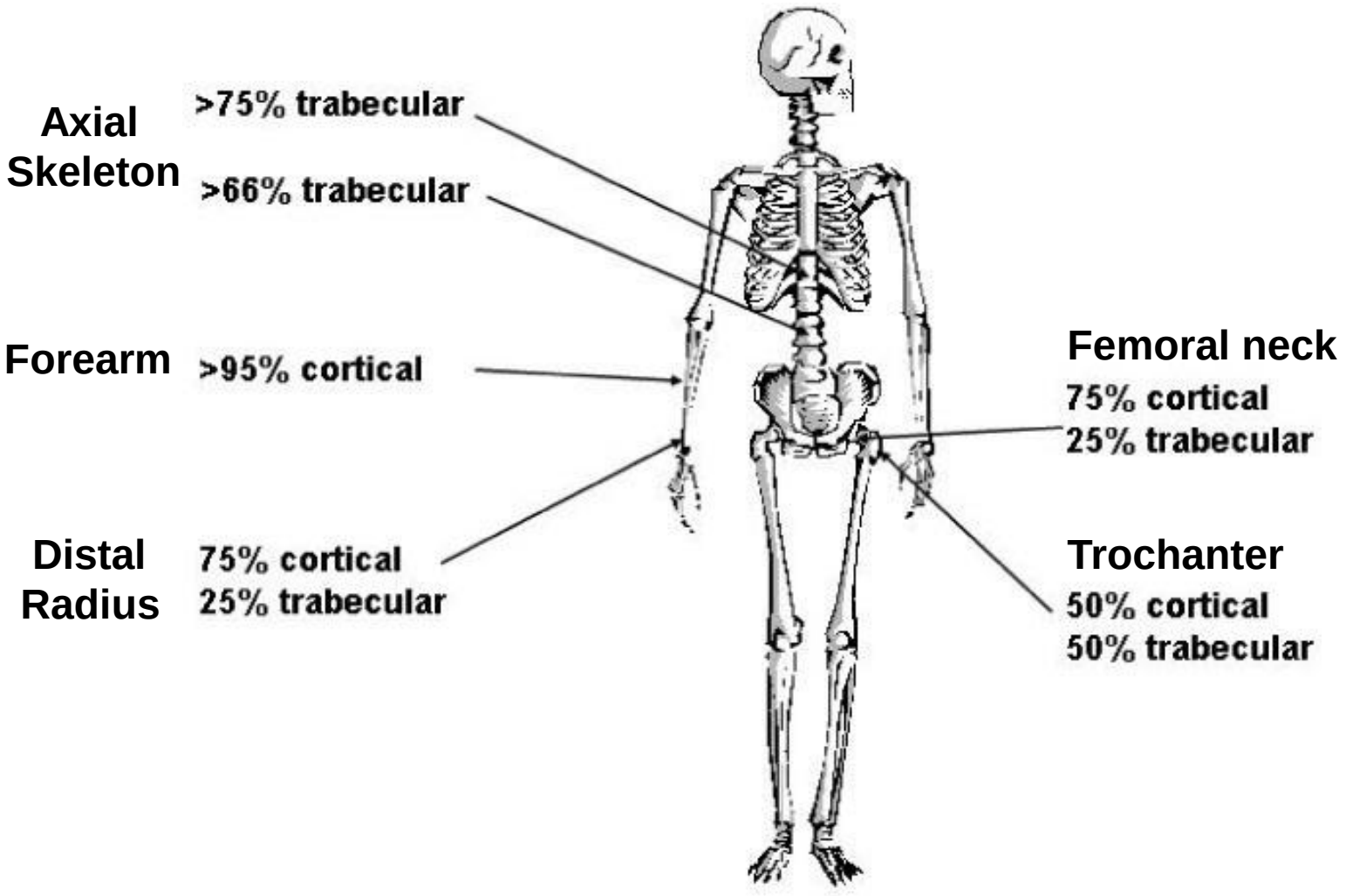
2. Fracture Liaison Service Models to Fit Your Practice

Osteoporosis

- Characterized by **low bone mass** and **microarchitectural deterioration of the bone**[1]
- Can be diagnosed using bone mineral density criteria (**T-score -2.5 or below at the spine, total hip femoral neck or distal radius**)[2]
- Clinical diagnosis made on the basis of **fragility fractures**[3]

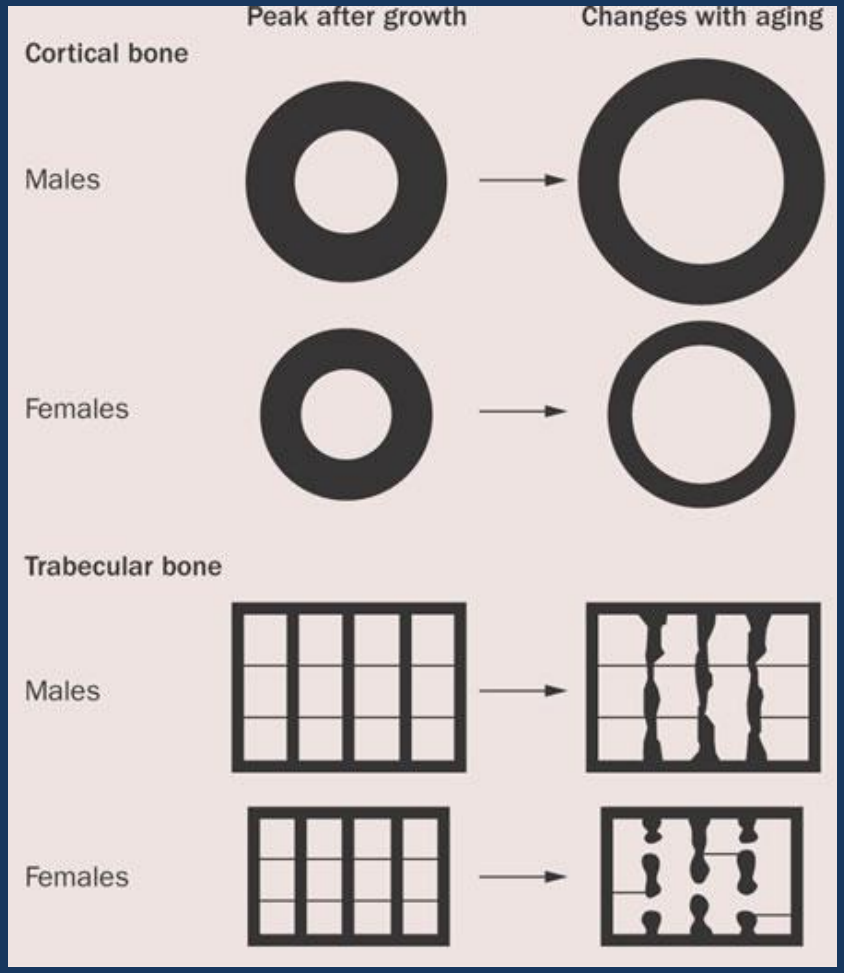
1. NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, Therapy. *JAMA*, 2001.
2. Van den Bergh JP, et al. *Nat Rev Rheumatol*. 2012.
3. Camacho PM, et al. *Endocr Practice*. 2016.


Axial Skeleton
>75% trabecular
>66% trabecular
Forearm
>95% cortical
Distal Radius
75% cortical
25% trabecular
Femoral neck
75% cortical
25% trabecular
Trochanter
50% cortical
50% trabecular

Changes in Bone Structure with Aging

Appendicular Skeleton

Axial Skeleton



Modified with permission from The Endocrine Society © Seeman, E. Sexual dimorphism in skeletal size, density and strength. *J. Clin. Endocrinol. Metab.* **86**, 4576–4584 (2001)

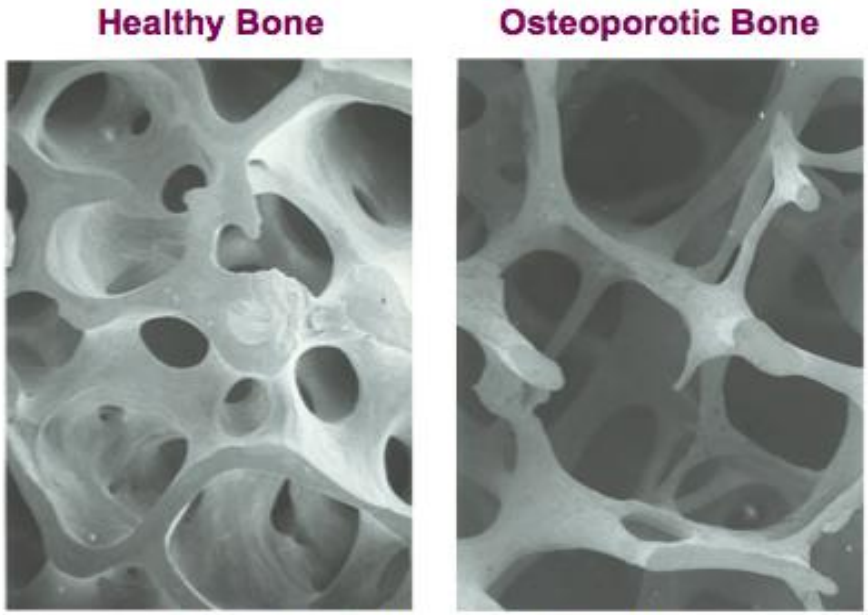
Osteoporosis

- 10 million Americans have osteoporosis
  - 43 million adults have osteopenia (low bone density)
- Expected to increase as the population ages
  - By 2050, nearly 90 million people will be 65 or older
- Fragility fractures
  - > 2 million cases annually in the United States
  - Lifetime incidence of 50% in women and 22% in men

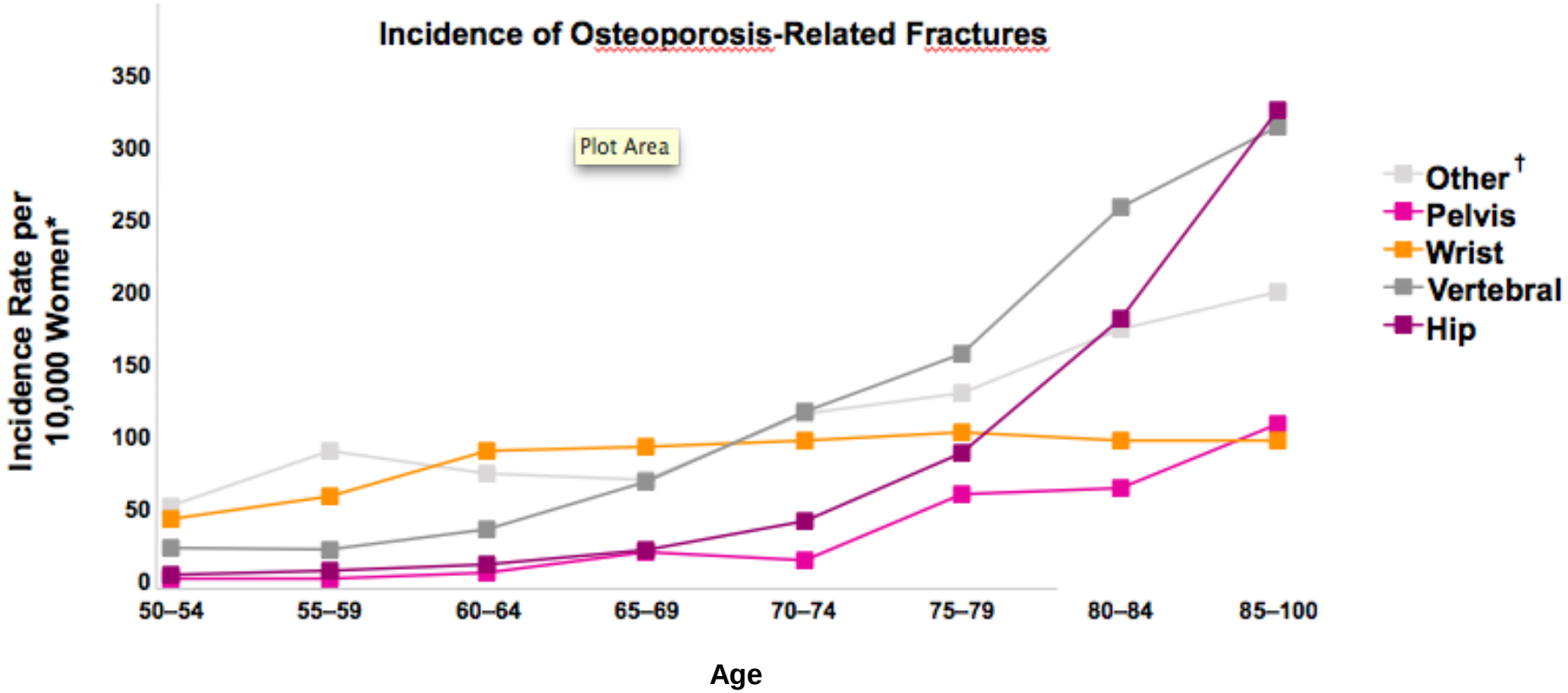
Friedman SM, Mendelson DA. Epidemiology of fragility fractures. *Clin Geriatr Med*. 2014;30(2):175-181.

Fragility Fractures

- Result from a fall from standing height or less
- Minimal trauma
- Would not have occurred in a patient with normal bone
- Exclude fractures of fingers, toes, skull, jaw, clavicles



Fragility Fracture Sites



Health Care Gap in Secondary Fracture Prevention

- American Academy of Orthopedic Surgery (AAOS)
- ASBMR Task Force report on Secondary Fracture Prevention
- National Institute for Health and Clinical Excellence (NICE) Guidelines on Preservation of Bone Mass and Fracture Prevention

→ Osteoporosis Evaluation & Treatment after Fragility Fracture

Meta-analysis: 37 studies on osteoporosis management

- Diagnostic evaluation: <30%
- Treatment initiation: 0.5% - 38%; most studies < 10%

Elliot-Gibson V et al. Practice patterns in the diagnosis and treatment of osteoporosis after a fragility fracture: A systematic review. *Osteoporos Int*. 2004;15(10):767-778.

Secondary Causes of Osteoporosis

What is the single biggest risk factor for osteoporosis in female patients?

Secondary Causes of Osteoporosis

What is the single biggest risk factor for osteoporosis in female patients?

MENOPAUSE

Secondary Causes of Osteoporosis: Hypoestrogenemia

- Amenorrhea

  -female athlete's triad

  1. excessive exercise
  2. restrictive eating/anorexia
  3. amenorrhea

  -Depo provera (depot medroxyprogesterone)

  -hyperprolactinemia

  -premature ovarian failure (surgical, medical – i.e., chemotherapy-induced, spontaneous)

Secondary Causes of Osteoporosis: Nutritional

- Lack of adequate calcium intake
- Vitamin D deficiency
- Protein deficiency (sarcopenia)
- Restrictive eating
  - "gluten-free" without diagnosis of celiac disease
  - vegan, vegetarian
  - dairy-free
  - calorie deficiency

Secondary Causes of Osteoporosis:

- Failure to accrue bone and reach peak bone mass (age 28 – 30)
- "Low bone density for age" → "Osteoporosis"
- Z-scores: young adults, pre-menopausal women, men under age 50
  - compares BMD to average BMD of same age/gender
- T-scores: post-menopausal women, men age 50 and above
  - compares BMD to average BMD of healthy 30-year old

Secondary Causes of Osteoporosis:

- Age
- Race (White, Asian, Hispanic, Black)
- Low BMI (<20)
- Previous fragility fracture
- Parent with a hip fracture (living or deceased)
- Current smoking
- Alcohol: more than 2 units/day
- Steroids: 5 mg of prednisone/day or more for 3+ months

Secondary Causes of Osteoporosis:

- Rheumatoid arthritis (psoriatic)
- Type 1 diabetes
- Osteogenesis imperfecta
- Malabsorption (RYGB, short gut, celiac)
- Chronic liver disease
- Hypogonadism
- Hyperthyroidism (untreated, longstanding)
  - TSH<0.5 uIU/mL

Secondary Causes of Osteoporosis: The Fracture Stories

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- Ask your patient exactly how they fractured
- Disregard emotion, judgment, self-blame
  - "I fell so hard, anyone would have broken a bone."
  - "I fell really hard on the kitchen tile."
  - "I fell with all my weight." Type 1 diabetes
- Fall from standing height or less (curb, 1 step, seated in chair, bike – stationary)
- Exclude fingers, toes, skull, clavicle, sternum
- FRAGILITY FRACTURE = OSTEOPOROSIS

Causes of Secondary Osteoporosis in Adults

Endocrine or metabolic causes	Nutritional/GI conditions	Drugs	Disorders of collagen metabolism	Other
Acromegaly	Alcoholism	Antiepileptic drugs[a]	Ehlers-Danlos syndrome	AIDS/HIV[a]
Diabetes mellitus	Anorexia nervosa	Aromatase inhibitors	Homocystinuria due to cystathionine deficiency	Ankylosing spondylitis
Type 1	Calcium deficiency	Chemotherapy/ immunosuppressants	Marfan syndrome	Chronic obstructive pulmonary disease
Type 2	Chronic liver disease	Depo-Provera	Osteogenesis imperfect	Gaucher disease
Growth hormone deficiency	Malabsorption syndromes/ malnutrition (including celiac disease, cystic fibrosis, Crohn's disease, and gastric resection or bypass)	Glucocorticoids		Hemophilia
Hypercortisolism		Gonadotropin-releasing hormone agents		Hypercalciuria
Hyperparathyroidism		Heparin		Immobilization
Hyperthyroidism		Lithium		Major depression
Hypogonadism		Proton pump inhibitors		Myeloma and some cancers
Hypophosphatasia		Selective serotonin reuptake inhibitors		Organ transplantation
Porphyria		Thiazolidinediones		Renal insufficiency/ failure
Pregnancy	Total parenteral nutrition	Thyroid hormone (in supraphysiologic doses)		Renal tubular acidosis
	Vitamin D deficiency			Rheumatoid arthritis
				Systemic mastocytosis
				Thalassemia

Abbreviations: AIDS = acquired immunodeficiency syndrome; GI = gastrointestinal; HIV = human immunodeficiency virus; GI = gastrointestinal.

Camacho et al. AACE/ACE Clinical Practice Guidelines for the Diagnosis and Treatment of Postmenopausal Osteoporosis, Endocr Pract. 2016; 22(Suppl 4)

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Complete metabolic panel:
  - Calcium, albumin, alkaline phosphatase, AST, ALT
  - Creatinine, BUN, GFR
  - Electrolytes
- Phosphorus
- Total 25-OH-vitamin D (hydroxy-vitamin D)
- Parathyroid hormone (PTH)

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Thyroid stimulating hormone (TSH)
- Serum protein electrophoresis (SPEP) with UPEP, immunofixation, free kappa lambda light chains if indicated
- Celiac testing
- 24-hour urine collection for calcium, creatinine
- Testosterone
- Estradiol
- Iron panel

Secondary Causes of Osteoporosis: Laboratory Evaluation

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In the appropriate patient:

- Hypercortisolism screening
- Mastocytosis evaluation – serum tryptase, urine N-methylhistidine
- Bone turnover markers
- Bone biopsy (CKD/ESRD, “normal” BMD with fragility fracture, etc.)

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Hypercalcemia
  - Evaluate for primary hyperparathyroidism (PTH high or PTH inappropriately normal)
  - If PTH suppressed, consider non-PTH-mediated causes such as malignancy, sarcoid
  - Obtain 24 hour urine calcium and creatinine measurements, calculate Ca/Cr clearance ratio
    - Ca/Cr clearance ratio<0.01 suggests FHH (familial hypocalciuric hypercalcemia)
    - Ca/Cr clearance ratio>0.01 suggests primary hyperparathyroidism

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Parathyroid hormone (PTH)
  - Elevated PTH with high calcium – primary hyperpara
  - Elevated PTH with normal/low calcium – secondary hyperpara (rarely, normocalcemic hyperpara)
    - Consider vitamin D deficiency
    - Consider low calcium intake
    - Consider renal calcium leak

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Renal calcium leak
  - Defect in calcium reabsorption that leads to hypercalciuria
  - Patients have fasting hypercalciuria with secondary hyperparathyroidism, normal calcium levels
  - Obtain 24 hour urine calcium and creatinine measurements

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Hypercalciuria
  - Evaluate for this in patients with hyperparathyroidism (primary or secondary)
  - Young patients with unusually low BMD
  - Kidney stone history
  - 24-hour urine calcium > 250 mg/d is consistent with hypercalciuria
  - (24-hour urine calcium 150 – 250 mg/d is normal)

Secondary Causes of Osteoporosis: Laboratory Evaluation

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- Thyroid stimulating hormone (TSH)
  - suppression to 0.5 or below is linked to bone loss (TSH receptors on bone)
- Serum protein electrophoresis (SPEP)
  - multiple myeloma (osteoporosis/fractures, bone pain, anemia, renal failure, hypercalcemia)
  - M-spike – observation by hematology
- Celiac testing
  - positive serum testing (tissue transglutaminase IgA, IgG; endomysial IgA, deaminated gliadin)
  - EGD with biopsy for confirmation

Objectives

1. Evaluation for Secondary Causes of Osteoporosis

2. Fracture Liaison Service Models to Fit Your Practice

What Fractures Cost...

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MAYO CLINIC

ORIGINAL ARTICLE

Burden of Illness for Osteoporotic Fractures Compared With Other Serious Diseases Among Postmenopausal Women in the United States

Andrea Singer, MD; Alex Exuzides, PhD; Leslie Spangler, PhD; Cynthia O'Malley, PhD; Chris Colby, PhD; Karissa Johnston, PhD; Irene Agodoa, MD; Jessica Baker, BSc; and Risa Kagan, MD

Mayo Clinic Proceedings. January 2015; 90(1):53-62

Hospitalizations by Outcome: 2000 – 2011

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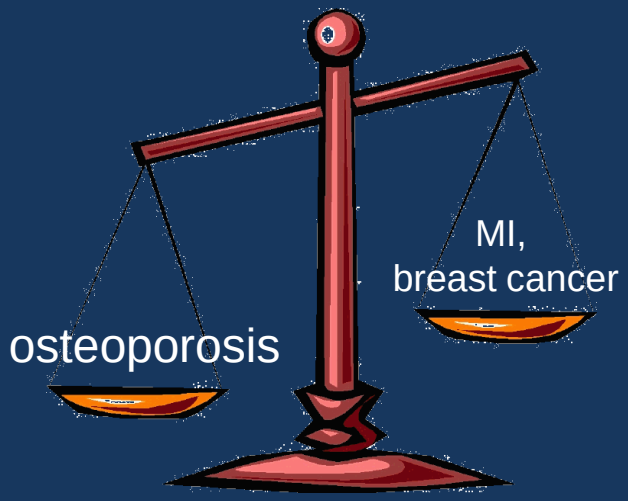
Outcome	Hospitalizations	Age-adjusted admission rate (per 100,000 person-years)	Cost
Myocardial infarction	2.9 million	668	$4.3 billion
Stroke	3.0 million	687	$3.0 billion
Breast cancer	0.7 million	151	$0.5 billion
Osteoporotic fracture	**4.9 million**	**1124**	**$5.1 billion**



Fracture Liaison Services are needed to reduce the burden of osteoporotic fractures

Where and when do fracture liaison services come into play during an admission for osteoporotic fracture?

Myocardial Infarction

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Event: symptoms, EKG changes, troponin elevation

Consultations: Cardiology, Cath Team, CCU Team

Procedural intervention: fibrinolytics, PCI, CABG

Evaluation: TTE, lipid panel, BMI/waist circumference, HbA1c

Medical intervention: aspirin, ACE-I, clopidogrel, beta-blockers, calcium channel blockers, diuretics, smoking cessation

Rehabilitation: cardiac rehab, physical therapy

Follow-up: cardiology, nutrition, diabetes education, endocrinology

Myocardial Infarction

- The interventions and follow-up are geared toward addressing the causes of the myocardial infarction:
  - Obesity
  - Hypertension
  - Hyperlipidemia
  - Diabetes mellitus
  - Tobacco dependence
  - Metabolic syndrome

Obstructive Coronary Atherosclerosis

Osteoporotic Fracture

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Event: fall, hip fracture

↓

Consultations: Orthopedics, Physical Therapy

↓

Procedural intervention: intramedullary nailing, hemiarthroplasty, total hip arthroplasty, nonsurgical management

↓

Evaluation: x-ray

↓

Medical intervention: pain management, Lovenox or SC Heparin

↓

Rehabilitation: long-term care, rehab facility, home

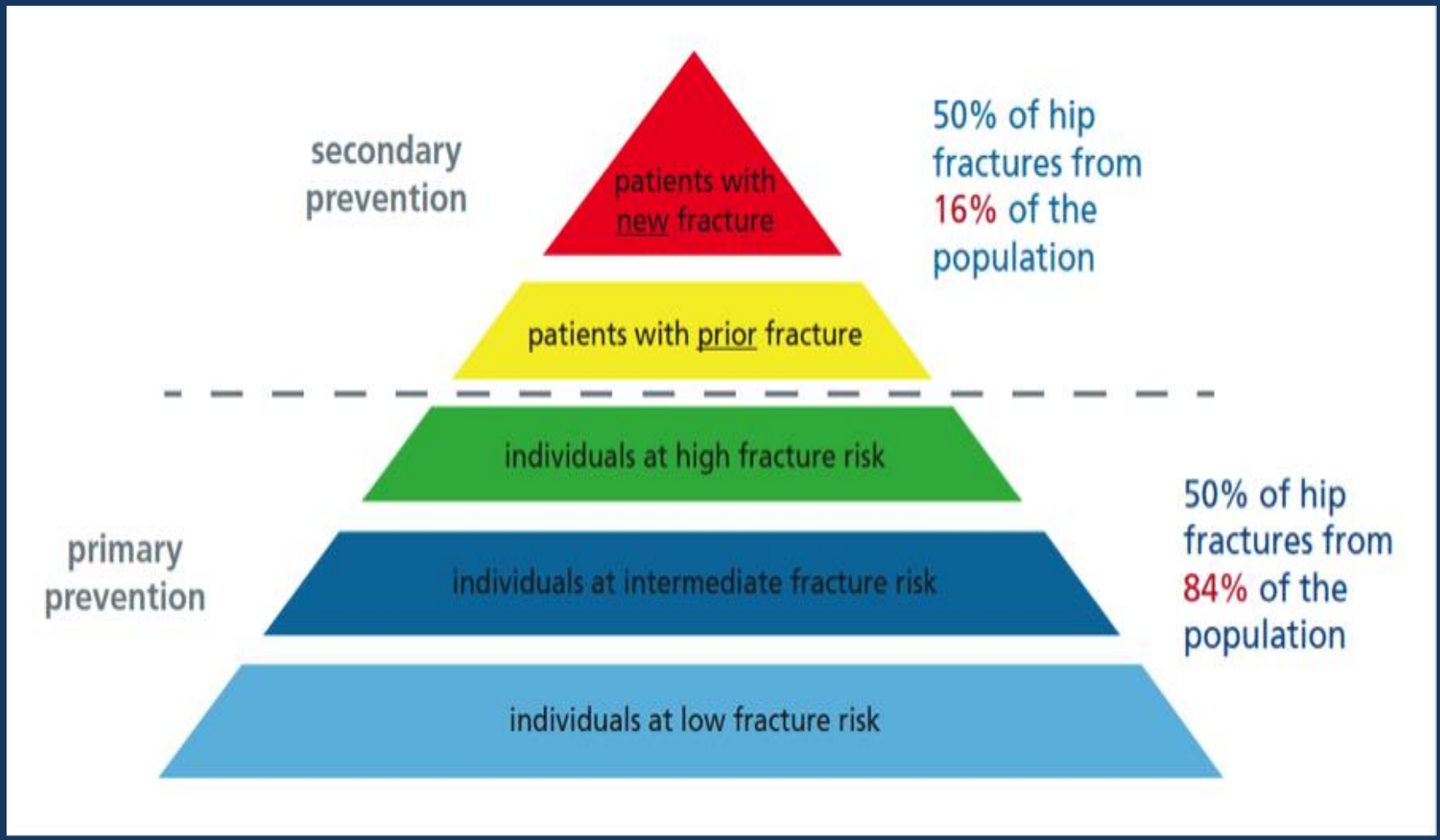
↓

Follow-up: orthopedic surgery, outpatient physical therapy

Osteoporotic Fracture

- The interventions and follow-up are geared toward the fracture, not the root cause(s) or preventable risk factors:

Fracture Liaison Services



IOF (International Osteoporosis Foundation) Capture the Fracture: Identifying Patients https://www.capturethefracture.org/identifying-patients

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Review Article

FRACTURE LIAISON SERVICES: MULTIDISCIPLINARY APPROACHES TO SECONDARY FRACTURE PREVENTION

Patricia Mejia Osuna, MD; Mary D. Ruppe, MD; Laila S. Tabatabai, MD

ENDOCRINE PRACTICE Vol 23 No. 2 February 2017

FLS Structure

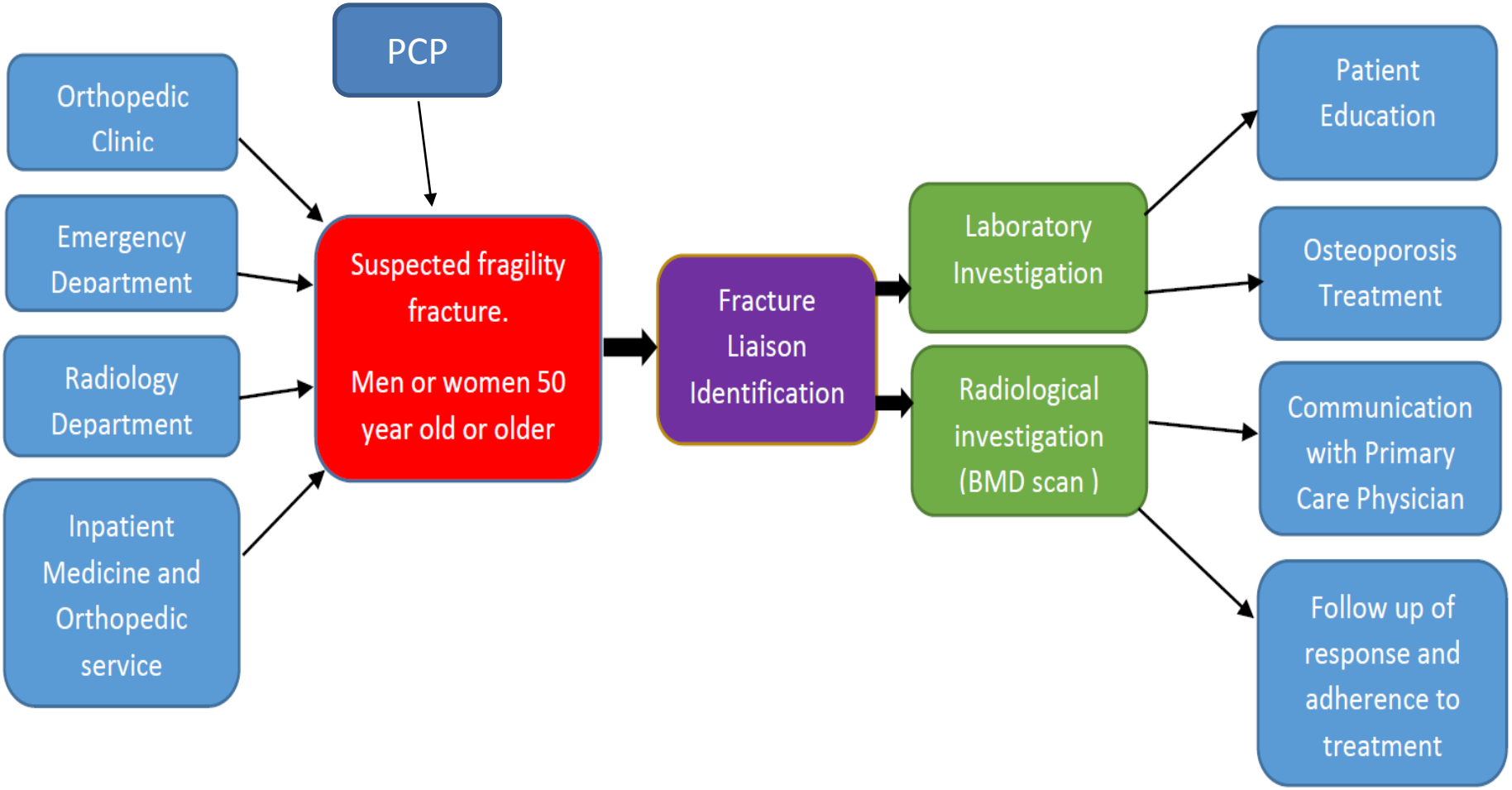

Figure 1: Fracture liaison service structural flow. Osuna PM et al. "Fracture Liaison Services: Multidisciplinary Approaches to Secondary Fracture Prevention."[39]

Classification of FLS Models

Type model	Focus	Identification	Patient education	Investigation	Treatment	Cost	Fracture liaison co-coordinator	% diagnosis	% of treatment
Type A	Comprehensive care	Yes	Yes	Yes	Yes	$$$$	Majority (11 of 13)	79%	46%
Type B	Communication with PCP for recommendations	Yes	Yes	Yes	No	$$$	Majority (12 of 16)	60%	41%
Type C	Awareness of PCP to the event	Yes	Yes	No	No	$$	Sometimes (6 out of 10)	43%	23%
Type D	Patient education	Yes	Yes	No	No	$	Minimal need	N/A	8%

Ganda K, Puech M, Chen JS, et al. Models of care for the secondary prevention of osteoporotic fractures: A systematic review and meta-analysis. *Osteoporos Int*. 2013;24(2):393-406.

Efficacy of FLS Models

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Model	Description	Proportion receiving BMD testing	Proportion receiving osteoporosis treatment
Status Quo	Manitoba statistics for major osteoporotic fractures (2007/2008)	13%	8%
Type D (Zero i model)	Only provides osteoporosis education to the fracture patient. Primary care provider (PCP) is not alerted or educated.	No study on BMD testing	8%
Type C (1 i model)	1. Identification The PCP is alerted that a fracture has occurred and further assessment is needed. Leaves the investigation and initiation of treatment to the PCP.	43%	23%
Type B (2 i model)	1. Identification 2. Investigation Leaves the initiation of treatment for fragility fracture patients to the PCP.	60%	41%
Type A (3 i model)	1. Identification 2. Investigation 3. Initiation of osteoporosis treatment where appropriate.	**79%**	**46%**

FLS in the USA. E. Michael Lewiecki, MD. Presented at ISCD Annual Meeting February 26-28, 2015. New Mexico Clinical Research and osteoporosis Center. University of New Mexico, School of Medicine.

FLS Programs in the U.S.

Program Name and Location	Population and duration	Description	Increase in diagnostic work up	Increase in treatment initiation	Impact on Fractures	Model type	Cost-Savings Potential
Kaiser Permanente's Healthy Bones Program California, US.	More than 625 000 patients for 6 years	All patients 50+ with high risk fracture or fragility fractures	213% woman and 914% in men	145 in women and and 250% in men	40% decline in hip fractures	Type A	If implemented nationally: $5 billion[18]
Geisinger Health System osteoporosis disease management (GHSODMP)	Initial observational study: 15213 over 5 years (1999-2000)	Woman 55+ with fragility fracture	% of DEXA scan increased from 17/1000 to 174/1000	Use of biphosphonates from 0. 7 to 4.9%	40% decline in hip fractures Incidence rate fell from 7.9 to 5.1/1000	Type A	Program: $7.8 million over 5 years
Geisinger, Pennsylvania, US.	HiROC1917 outpatient and 1041 inpatients during 3 years (2007-2011)	All patients above 50 with fragility fracture	92% had DXA scan by 6 months in group followed by HiROC team	87% by HiROC vs 32% by PCP	N/A	Type A and B	N/A

Osuna PM, Ruppe MD, Tabatabai LS.
FRACTURE LIAISON SERVICES: MULTIDISCIPLINARY APPROACHES TO SECON DARYFRACTURE PREVENTION. Endocr Pract. 2017 Feb;23(2):199-206.

Osteoporotic Fracture

With Fracture Liaison Service Involvement

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Event: fall, hip fracture

Consultations: Orthopedics, **Fracture Liaison Service**

Procedural intervention: intramedullary nailing, hemiarthroplasty, total hip arthroplasty, nonsurgical management

Evaluation: x-ray, **DXA (hip, spine, radius bone density)**

lab evaluation - vitamin D measurement and secondary causes of osteoporosis - PTH, serum calcium, phosphorus, SPEP/UPEP, celiac panel, TSH

Osteoporotic Fracture

Medical intervention: pain management, Lovenox or SC Heparin, vitamin D supplementation, adequate calcium intake (1200 mg daily), consideration of abaloparatide or teriparatide (if no contraindications)

Rehabilitation: long-term care, rehab facility, home

Follow-up: orthopedic surgery, outpatient physical therapy, endocrinology/FLS Clinic, home safety evaluation, falls risk assessment

Houston Methodist Hospital (HMH): FLS Cohort

Thank you

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