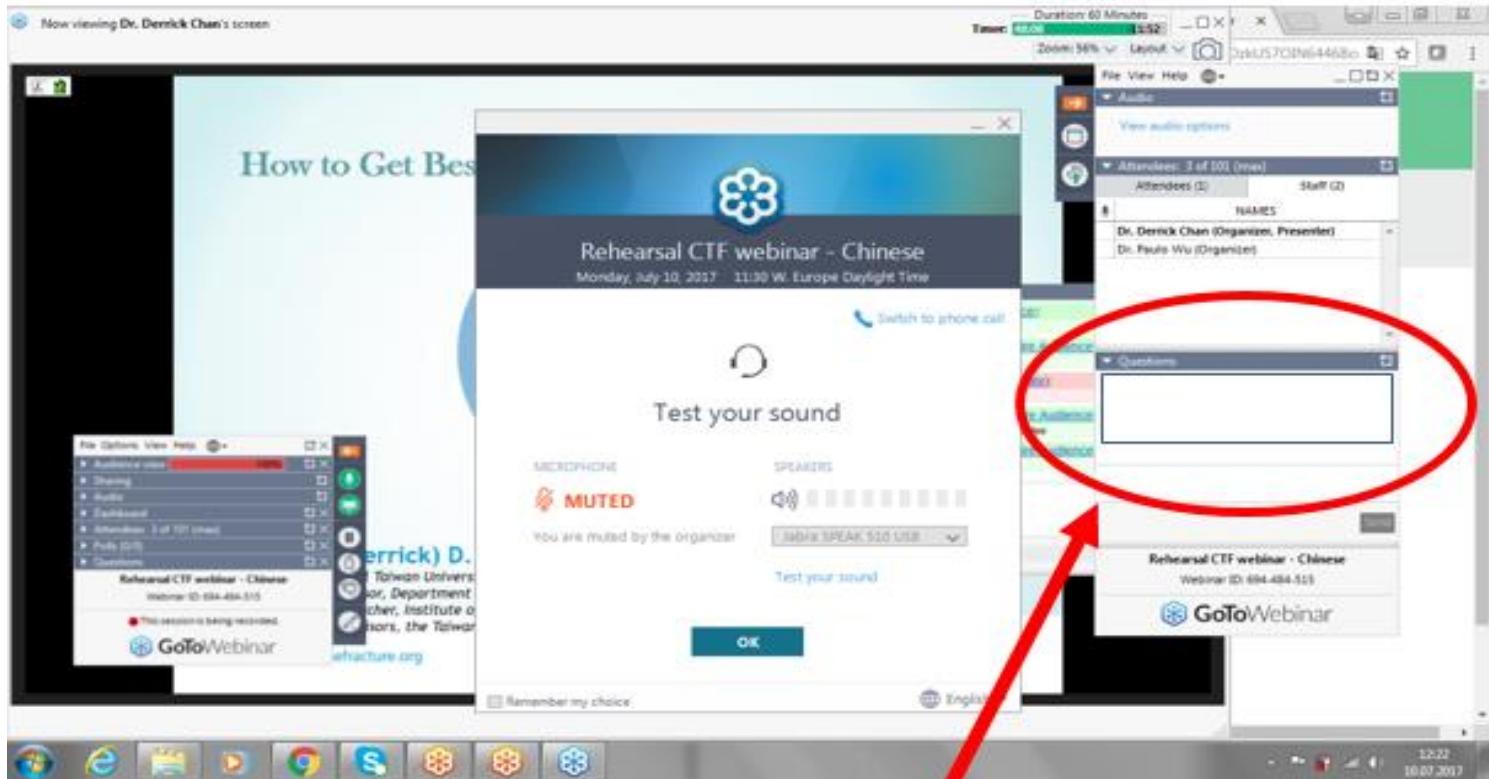


Fracture cascade and secondary fracture prevention

Thierry Thomas
INSERM 1059, Rheumatology Department
University Hospital of Saint-Etienne, France



Please make sure to type your questions into the Questions Box!

Fracture cascade and secondary fracture prevention

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INSERM 1059, Rheumatology Department
University Hospital of Saint-Etienne, France

Disclosures

- **Fees for lectures and consultancy**

Abbvie, Amgen, BMS, Chugai, Expanscience, Gilead, HAC-Pharma, LCA, Lilly, Medac, MSD, Pfizer, Thuasne, TEVA and UCB

- **Research grants or investigator fees**

Amgen, Bone Therapeutics, Chugai, HAC-Pharma, MSD, Novartis, Pfizer, and UCB

Risk factors in osteoporosis



- Risk factors are numerous: BMD, previous treatment with glucocorticoids, gender, shape of bone...
- Interaction between them is complex
- Risks of low BMD and risk of fragility fracture

Prevalent fracture increases the risk of incident fracture



Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: **France** Name/ID: [About the risk factors](#)

Questionnaire:

1. Age (between 40-90 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 No Yes

6. Parent fractured hip No Yes

7. Current smoking No Yes

8. Glucocorticoids No Yes

9. Rheumatoid arthritis No Yes

10. Secondary osteoporosis No Yes

11. Alcohol 3 or more units per day No Yes

12. Femoral neck BMD (g/cm²)
Select DXA

BMI 23.4

The ten year probability of fracture (%)

without BMD

■ Major osteoporotic	12
■ Hip fracture	6.6

Prevalent fracture increases the risk of incident fracture



Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: **France** Name/ID: [About the risk factors](#)

Questionnaire:

1. Age (between 40-90 years) or Date of birth
Age: Y: M: D:

2. Sex Male Female

3. Weight (kg)

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

10. Secondary osteoporosis No Yes

11. Alcohol 3 or more units per day No Yes

12. Femoral neck BMD (g/cm²)
Select DXA

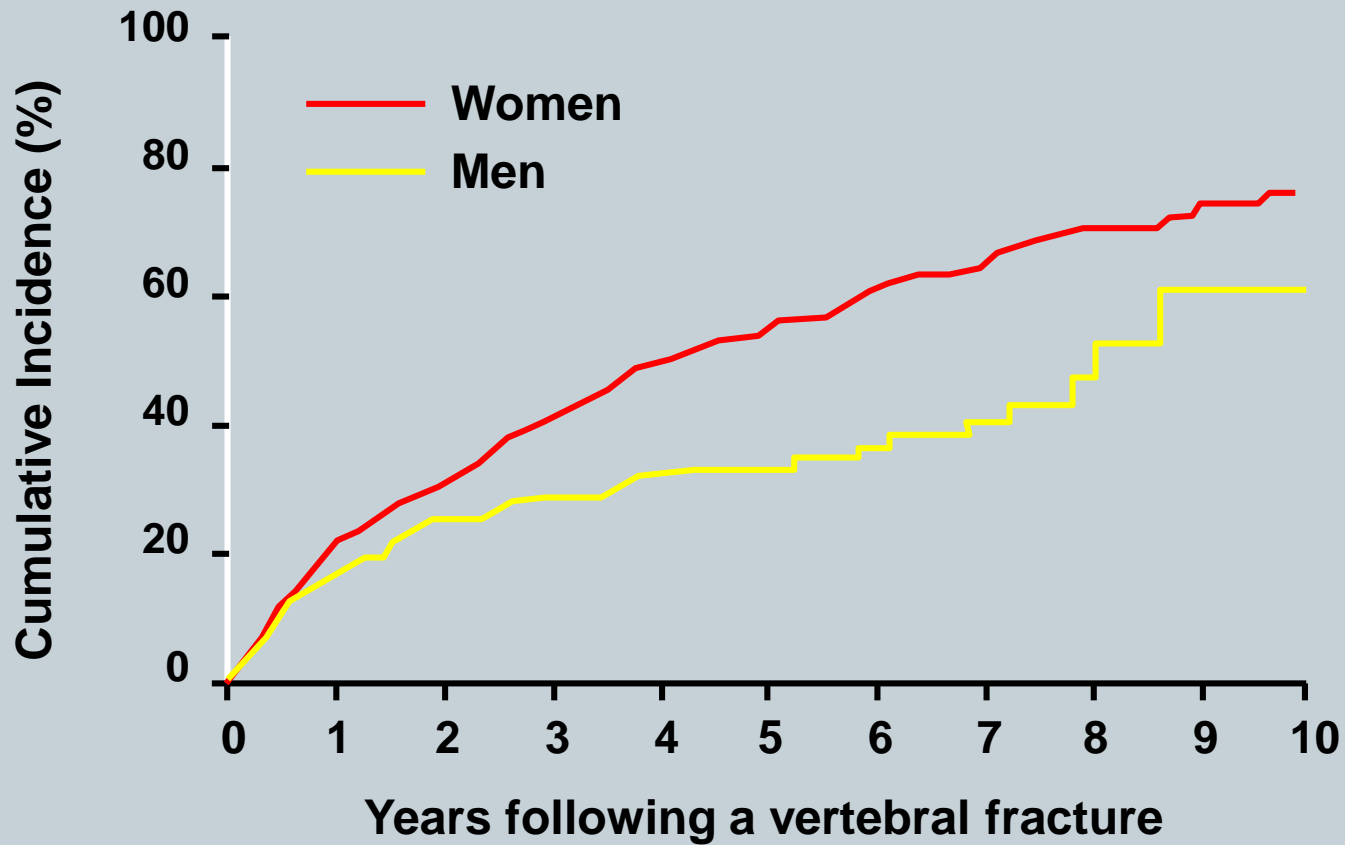
BMI 23.4

The ten year probability of fracture (%)

without BMD

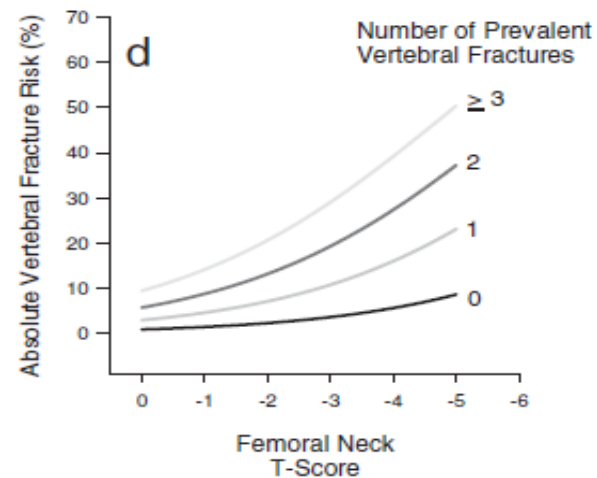
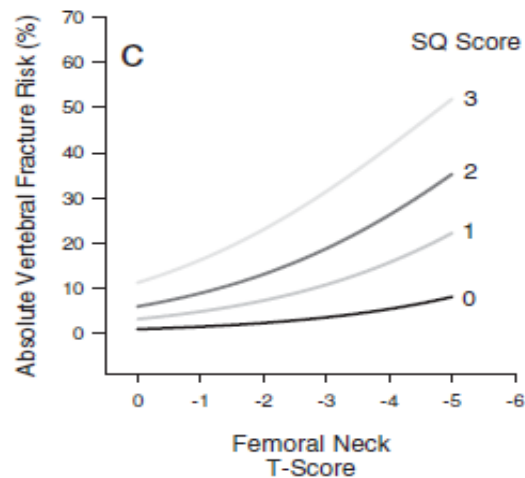
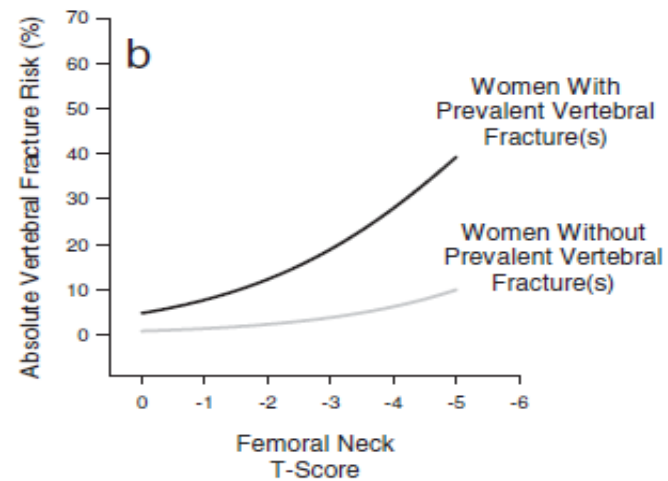
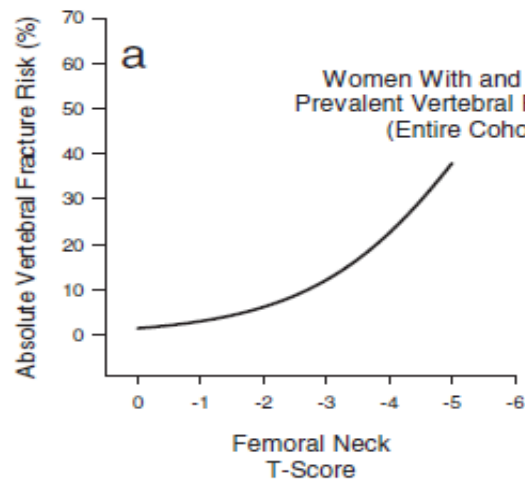
■ Major osteoporotic	22
■ Hip fracture	12

Risk of incident vertebral fracture in women with prevalent vertebral fracture over time



Fracture cascade

Risk according to prevalent vertebral fractures number

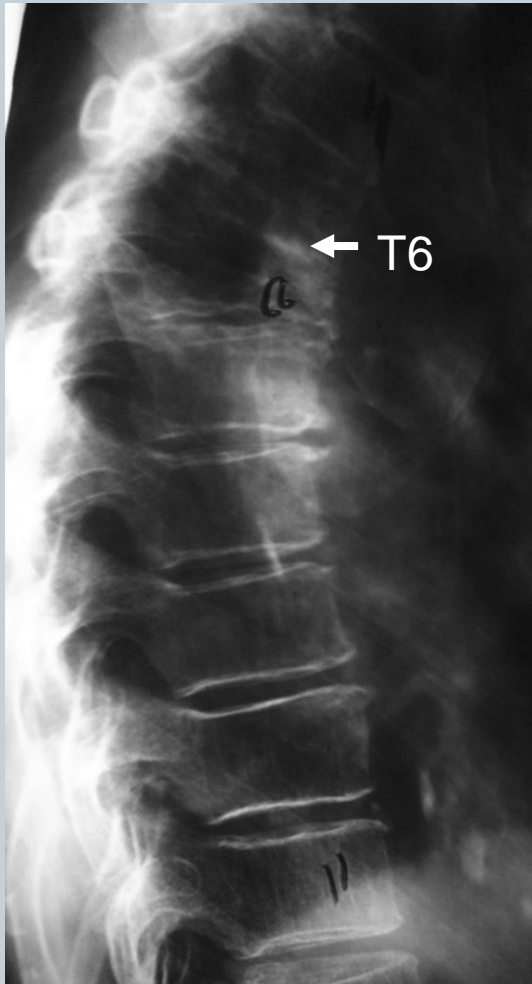


Clinical case 1

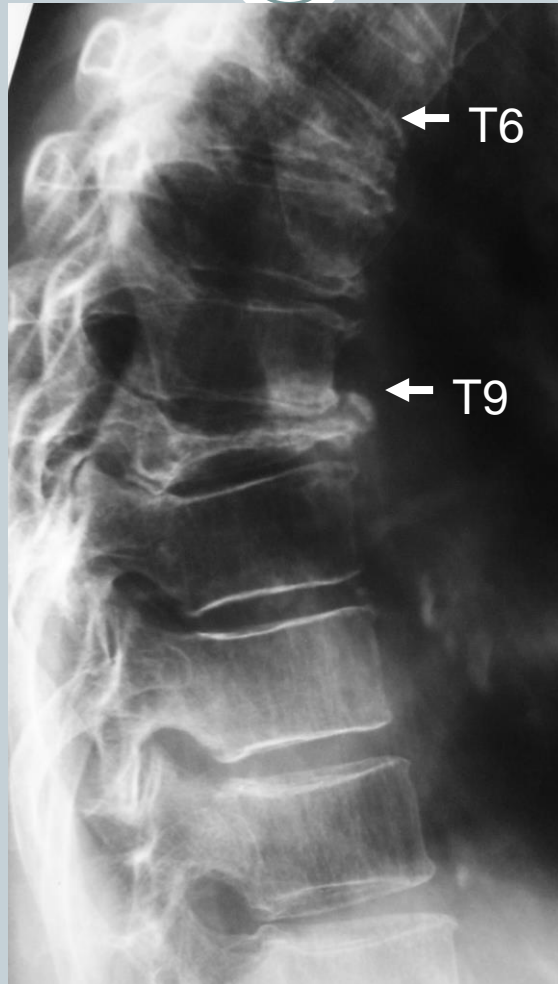


- Mrs Smith
- 70 years – some back pain last year
- She complains of severe pain between the shoulder blades while carrying her shopping bag
- No improvement after having taken acetomiphen
- 4 weeks later, pain decreased. 2 months later, full pain recovery. She lost 3 centimeters in height.
- She received calcium and vitamin D.
- 1 year later, she complains of acute back pain of the lower thoracic spine. Clinical examination: severe pain at the T11-T12 level
- X-Rays showed 3 vertebral fractures : T6-T9 and T11

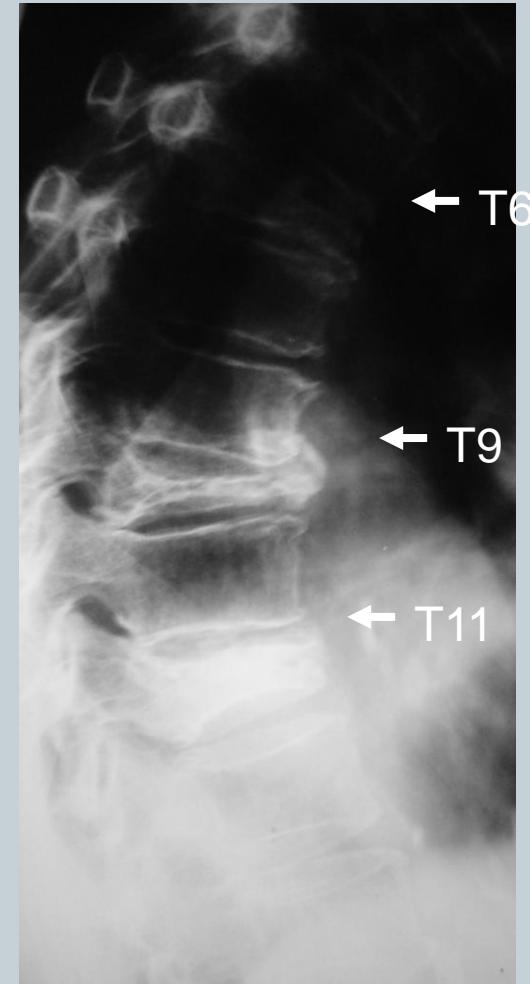
Clinical case 1



T - 1 year



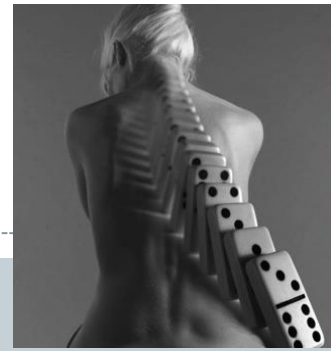
T0



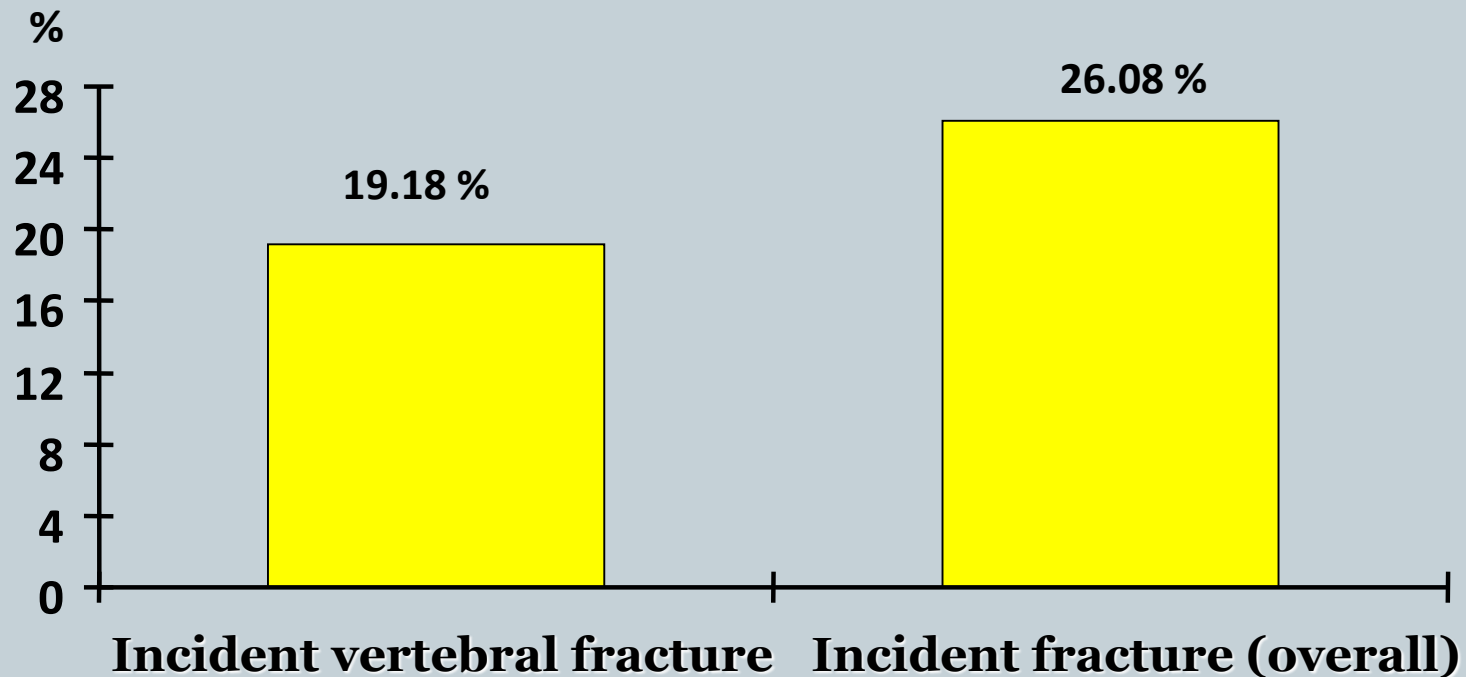
T + 1 year

Fracture cascade

An imminent risk of another fracture

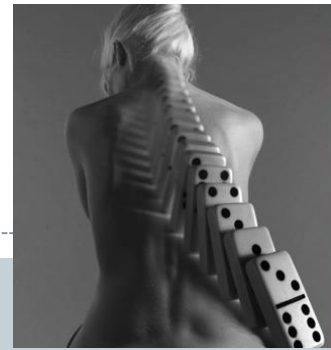


In the year following a vertebral fracture about **20 %** of women will have a new vertebral fracture and about **25%** will have a new fracture (VF+NVF)



Fracture cascade

An imminent risk of another fracture



The risk of both vertebral and non vertebral fracture is increased in the year following a fracture

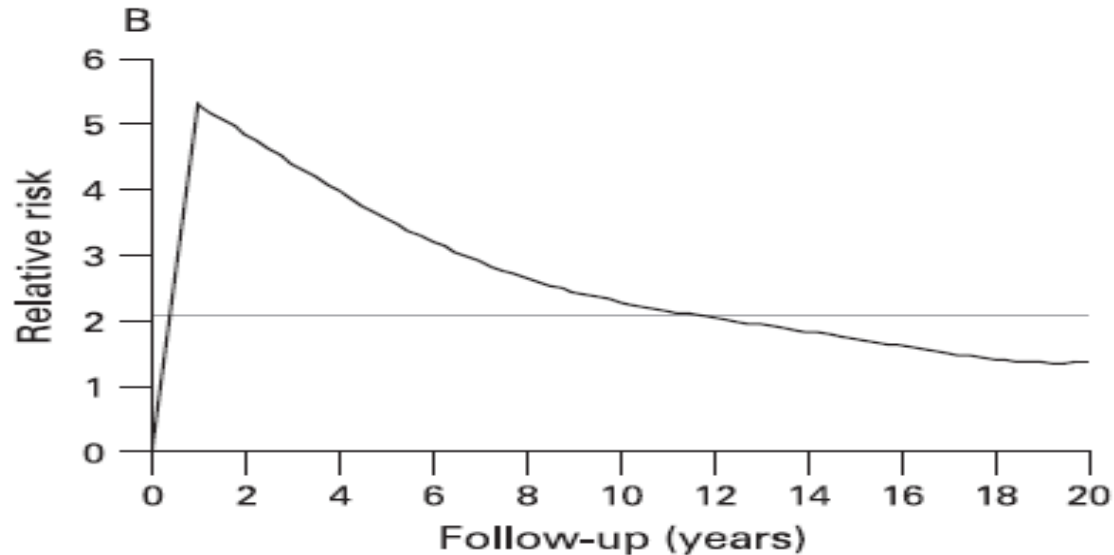
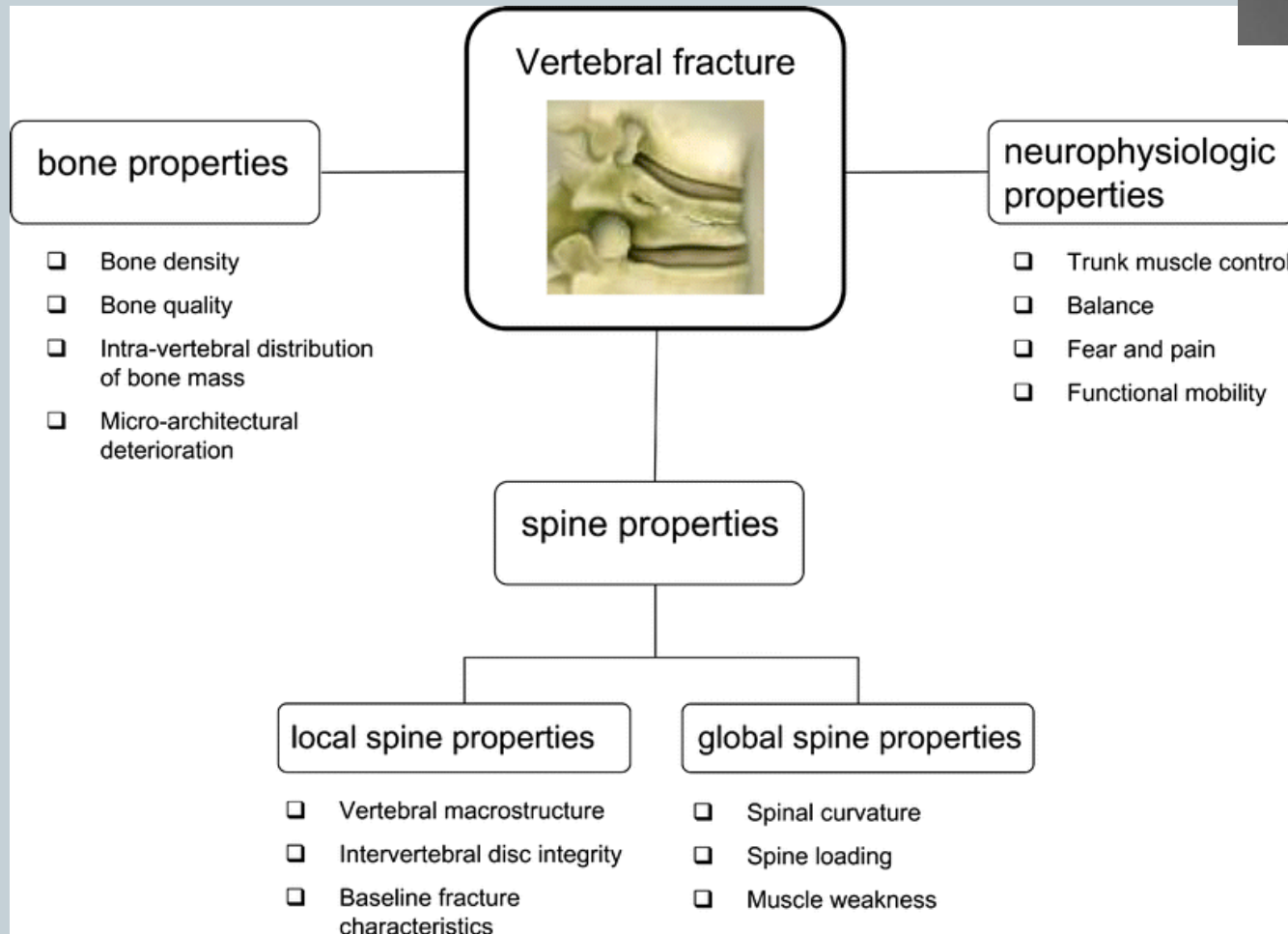
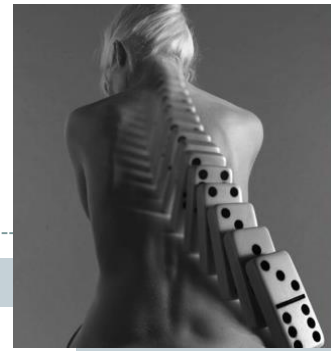


Figure 1 (A) Percentage of all first (grey line) and subsequent (black line) fractures. (B) Relative risk of all subsequent fractures calculated as a mean from the first fracture (grey line) and per separate year of follow-up (black line).

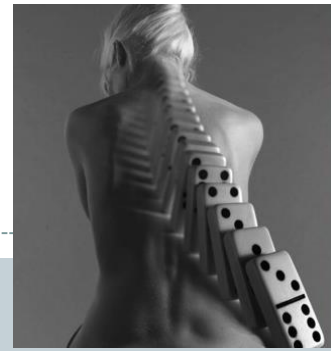
Fracture cascade

Multifactorial mechanisms



Fracture cascade

The role of hyperkyphosis

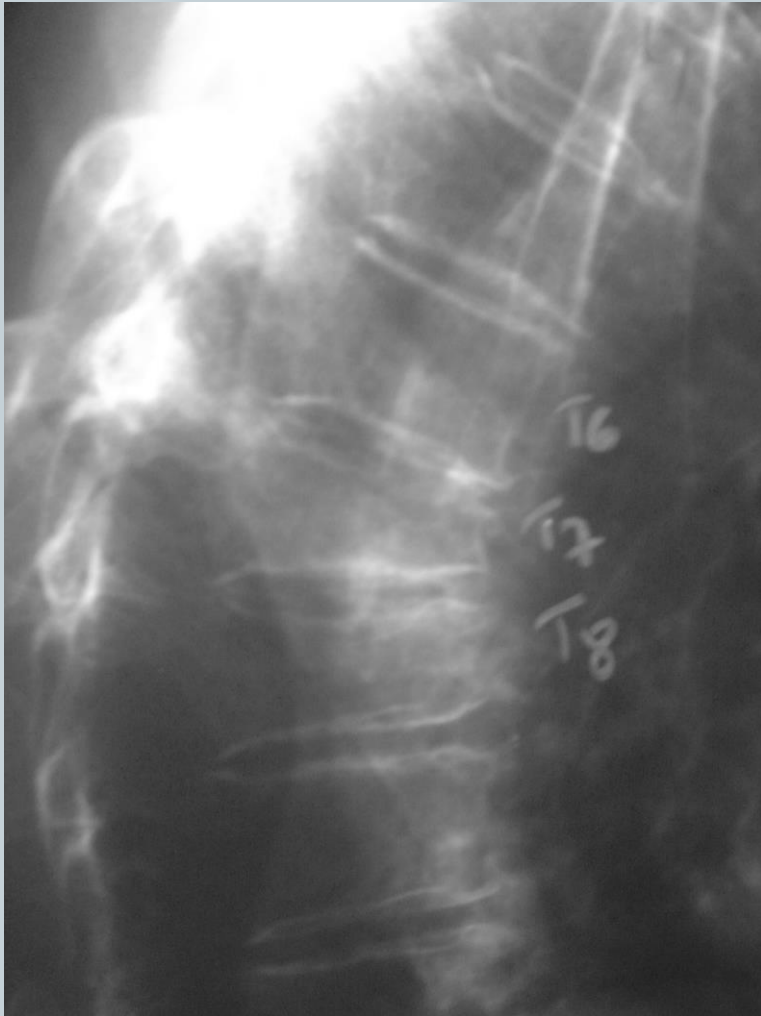


Hyperkyphosis of any etiology has been associated with:

- decreased thoracic extensor muscle strength,
- unstable gait,
- increased body sway,
- decreased physical and pulmonary functions,
- chronic pain,
- increased spinal loads contributing to the vertebral fracture cascade



Clinical case 2



T0



T + 1 year

Non vertebral fracture increases the risk of vertebral fracture

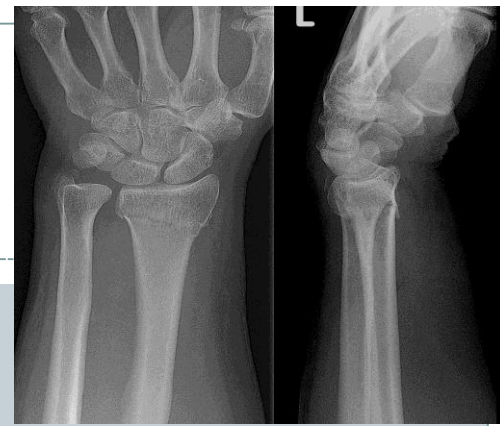


The risk of vertebral fracture is increased after a prevalent NVF in women over 65 years¹

First fracture	Women 65 – 74 years	Women 75 - 84 years	Women > 85 years
Radius / Ulna	2.2 (1.6-3.0)	1.6 (1.2-2.1)	1.6 (1.0-2.4)
Hip	3.8 (2.3-5.8)	2.5 (1.9-3.2)	1.7 (1.2-2.3)

¹Standardised incidence ratio (SIR) and 95% confidence interval in patients > 65 ans. (data from General Practice Research Database GPRD, UK).

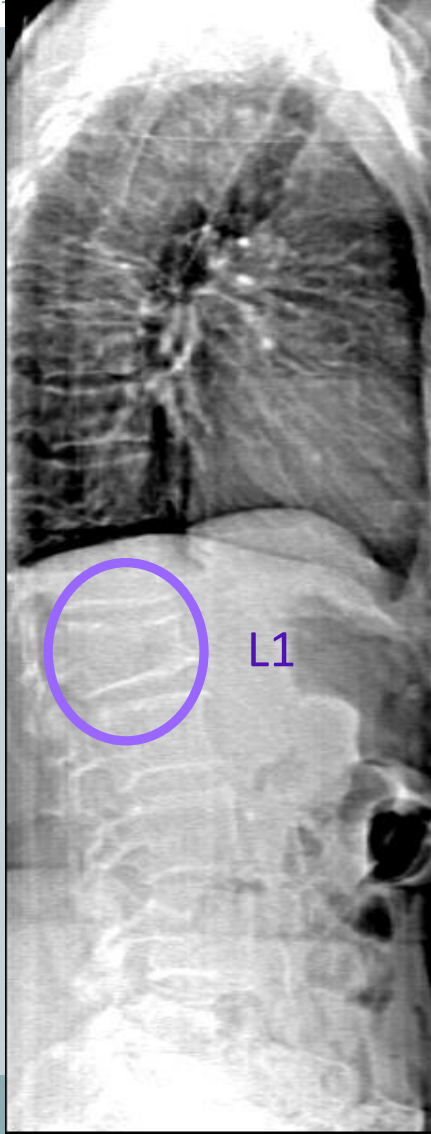
Clinical case 3



- Mrs Monk
- 65 years – wrist fracture after a fall from her height
- Risk factors
 - Her mother had a hip fracture
 - Smoker (10 units/day from 18 years)
 - Low BMI: 18kg/m²
- 3 years later, she felt again on her buttocks with back pain at the lower part of the thoracic level
- X-rays :

Clinical case 3

Vertebral fracture assessment by X-rays or VFA



Increased risk related to a previous non-vertebral fracture



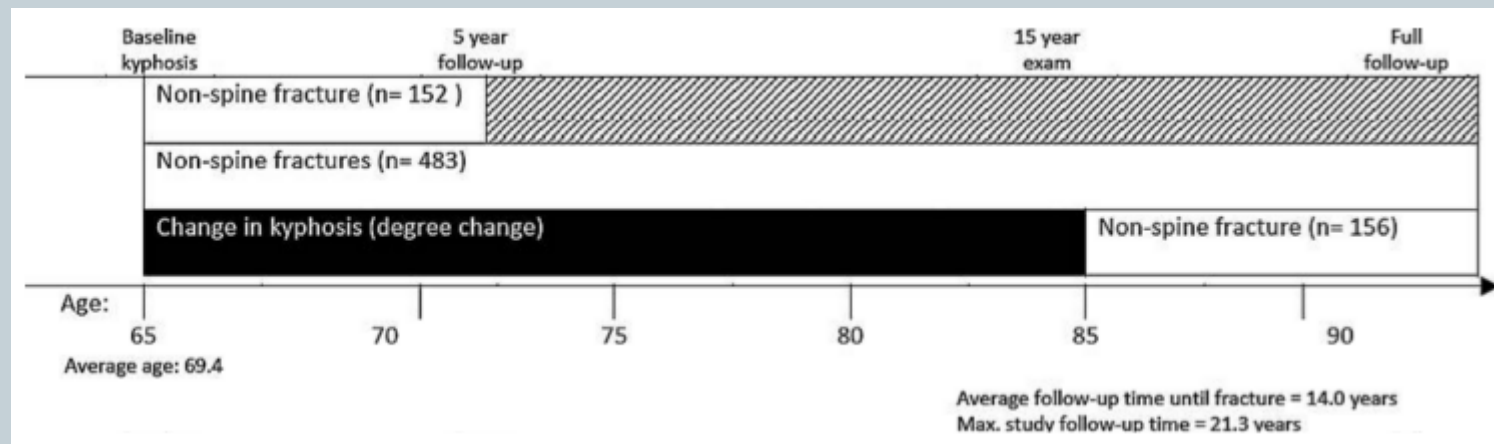
- Fall plays a major role



Hyperkyphosis and risk of non-spine fractures in older community dwelling women



Timeline study in SOF



Adjusted HRs for Non-Spine Fracture Over 5 Years in Women Stratified by Prevalent Vertebral Fracture

Kyphosis	Vertebral fracture status	Model 1 ^a	Model 2 ^b	Model 3 ^c
		Hazard ratio (95% CI)		
Cobb angle (per SD unit change)	No prevalent vertebral fracture	1.28 (1.08–1.53)	1.25 (1.04–1.49)	1.21 (1.02–1.45)
Cobb angle (per SD unit change)	One or more prevalent vertebral fractures	1.39 (1.05–1.85)	1.48 (1.09–2.01)	1.53 (1.11–2.11)

^aModel 1 adjusted for clinical site and age.

^bModel 2 = Model 1 + prior history of fracture, BMI, BMD, height and weight.

^cModel 3 = Model 2 + maximum grip strength, any falls in the past year, self-reported health, smoking, drinking and physical activity.

Clinical case 3 (contd.)



- Conservative treatment allowed to control pain evolution
- Patient was discharged from the hospital 1 week later
- 3 years later
- Fall from her height induced a trauma to the greater trochanter
- Hip fracture diagnosed



Risk of hip fracture after vertebral fracture



TABLE 1. POOLED ASSOCIATIONS OF PRIOR AND SUBSEQUENT FRACTURES

Location of prior fracture	Population	Location of subsequent fractures				
		Wrist	Vertebral	All (or nonspine)	Hip	Pooled
Wrist	Peri/postmenopausal	3.3 (2.0, 5.3) ^a	1.7 (1.4, 2.1) ^a	2.4 (1.7, 3.4) ^{a,d}	1.9 (1.6, 2.2)	2.0 (1.7, 2.4) ^d
	Other	3.6 (1.9, 6.7)	7.2 (3.6, 14.6)	2.0 (1.7, 2.4)	1.5 (1.3, 1.7)	2.6 (1.9, 3.5)
Vertebral	Peri/postmenopausal	1.4 (1.2, 1.7) ^a	4.4 (3.6, 5.4) ^d	1.8 (1.7, 1.9)	2.3 (2.0, 2.8)	1.9 (1.7, 2.3) ^b
	Other	1.4 (1.1, 1.9)	19.0 (6.5, 55.3)	2.7 (1.8, 3.9)	2.1 (1.6, 2.7)	2.3 (1.8, 2.9) ^b
Other (all, or specific sites)	Peri/postmenopausal	1.8 (1.3, 2.4)	1.9 (1.3, 2.8) ^d	1.9 (1.3, 2.7) ^d	2.0 (1.7, 2.3)	1.9 (1.7, 2.2) ^d
	Other	— ^c	— ^c	1.4 (1.2, 1.7)	2.1 (1.2, 3.5)	1.7 (1.4, 2.2) ^d
Hip	Peri/postmenopausal	— ^c	2.5 (1.8, 3.5)	1.9 (NA) ^a	2.3 (1.5, 3.7) ^a	2.4 (1.9, 3.2)
	Other	— ^c	— ^c	2.1 (1.3, 3.4)	1.6 (1.3, 1.9) ^a	1.7 (1.4, 2.0)
Pooled	Peri/postmenopausal	1.9 (1.3, 2.8)	2.0 (1.6, 2.4) ^{b,d}	1.9 (1.6, 2.2) ^d	2.0 (1.9, 2.2)	2.0 (1.8, 2.1) ^{b,d}
	Other	2.3 (1.7, 3.3)	7.2 (3.6, 14.6) ^b	1.8 (1.6, 2.2)	1.8 (1.6, 2.2)	2.2 (1.9, 2.6) ^b

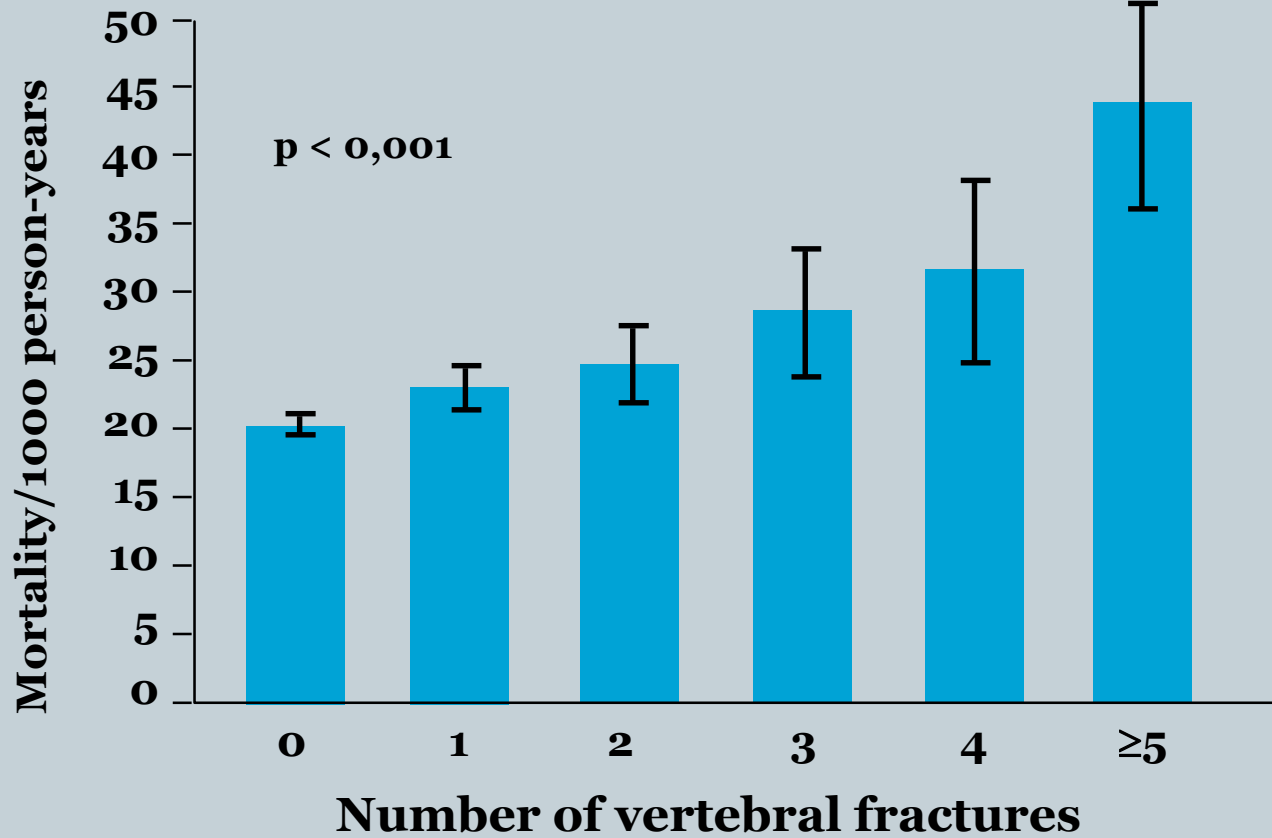
Vertebral or hip fracture risk after any fracture independent of age



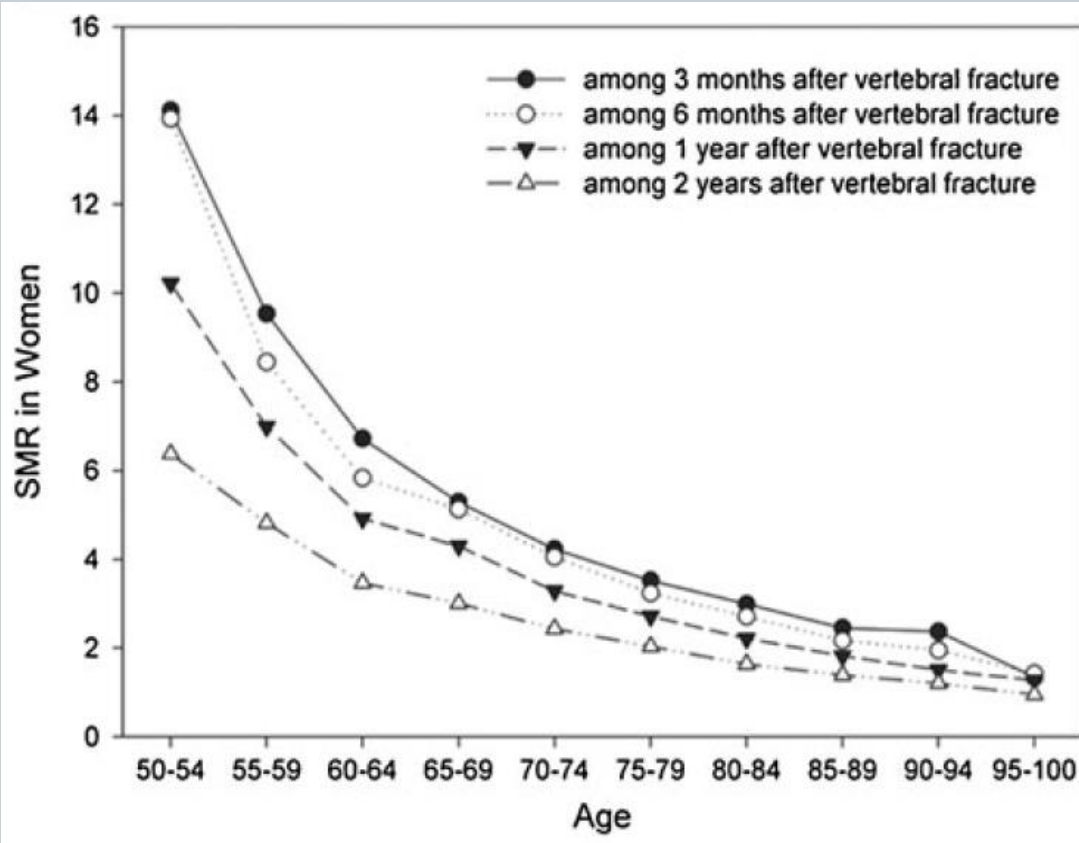
Table 3. Standardized incidence ratio (SIR) of subsequent fractures stratified by age in patients aged 65 years or older

Original fracture	Later fracture	65–74 years		75–84 years		85+ years	
		Men SIR (95% CI)	Women SIR (95% CI)	Men SIR (95% CI)	Women SIR (95% CI)	Men SIR (95% CI)	Women SIR (95% CI)
Any fracture	Radius/ulna	6.5 (5.2–8.0)	2.8 (2.5–3.0)	4.7 (3.6–6.0)	2.6 (2.4–2.8)	2.6 (1.6–4.0)	1.8 (1.6–2.0)
	Femur/hip	5.2 (4.2–6.5)	3.6 (3.3–4.0)	4.4 (3.7–5.2)	2.8 (2.7–1.9)	2.8 (2.2–3.5)	1.9 (1.7–2.0)
	Vertebral	5.3 (3.8–7.1)	2.8 (2.4–3.3)	3.5 (2.5–4.8)	2.2 (1.9–2.5)	2.5 (1.3–4.1)	1.9 (1.5–2.2)
Radius/ulna	Any fracture	6.4 (5.2–7.8)	3.6 (3.3–3.8)	4.5 (3.6–5.7)	2.9 (2.7–3.1)	3.6 (2.5–5.1)	2.1 (1.9–2.3)
	Femur/hip	6.0 (3.4–9.9)	3.3 (2.8–3.9)	2.7 (1.5–4.5)	2.7 (2.4–3.0)	2.8 (1.5–4.9)	1.8 (1.6–2.1)
	Vertebral	4.0 (1.3–9.4)	2.2 (1.6–3.0)	1.9 (0.4–5.7)	1.6 (1.2–2.1)	0	1.6 (1.0–2.4)
Femur/hip	Any fracture	8.1 (6.4–10.1)	3.9 (3.5–4.4)	4.3 (3.5–5.3)	3.1 (2.9–3.4)	2.8 (2.0–3.8)	2.1 (2.0–2.3)
	Radius/ulna	10.0 (5.7–16.2)	2.5 (2.0–3.2)	4.3 (2.3–7.2)	2.8 (2.4–3.2)	1.1 (0.2–3.3)	1.6 (1.4–1.9)
	Vertebral	11.4 (5.5–21.0)	3.8 (2.3–5.8)	3.3 (1.4–6.5)	2.5 (1.9–3.2)	2.7 (0.9–6.3)	1.7 (1.2–2.3)
Vertebral	Any fracture	7.8 (5.8–10.3)	3.9 (3.4–4.6)	3.8 (2.7–5.3)	3.3 (2.9–3.7)	3.3 (2.0–5.2)	2.0 (1.7–2.4)
	Radius/ulna	4.2 (1.1–10.8)	1.9 (1.3–2.8)	3.3 (0.9–8.6)	2.1 (1.6–2.7)	1.4 (0.0–7.9)	0.9 (0.5–1.6)
	Femur/hip	13.4 (7.3–22.5)	5.8 (4.1–8.1)	4.5 (2.4–7.5)	4.2 (3.5–4.9)	2.3 (0.8–5.0)	2.1 (1.6–2.7)

Mortality rate related to number of vertebral fracture



Mortality rate related to time after vertebral fracture

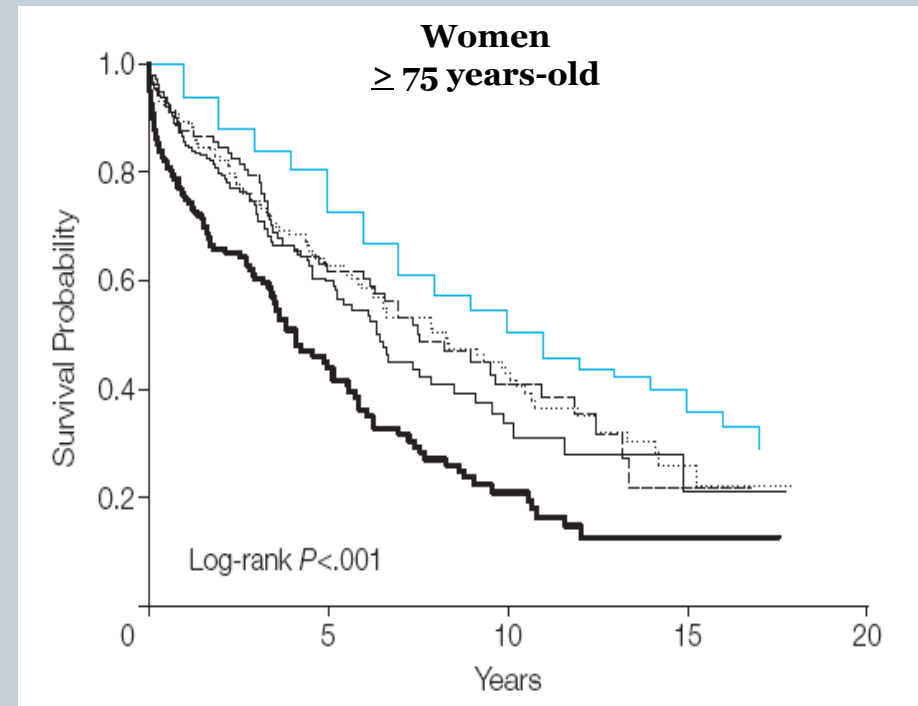
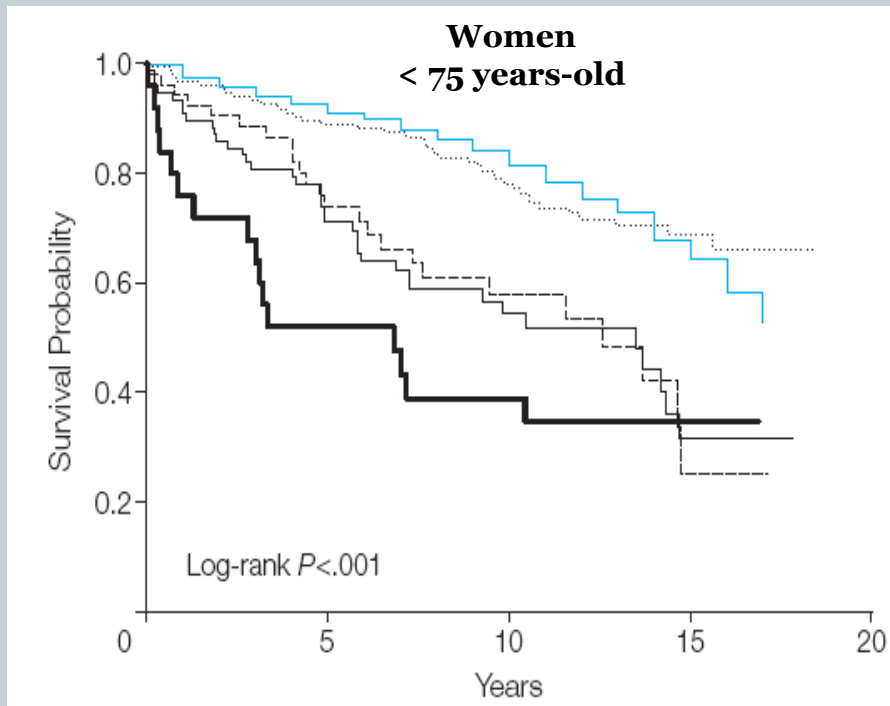


Incidence of vertebral fracture and subsequent mortality in South Korea, using nationwide data from the Health Insurance Review and Assessment from 2005 et 2008

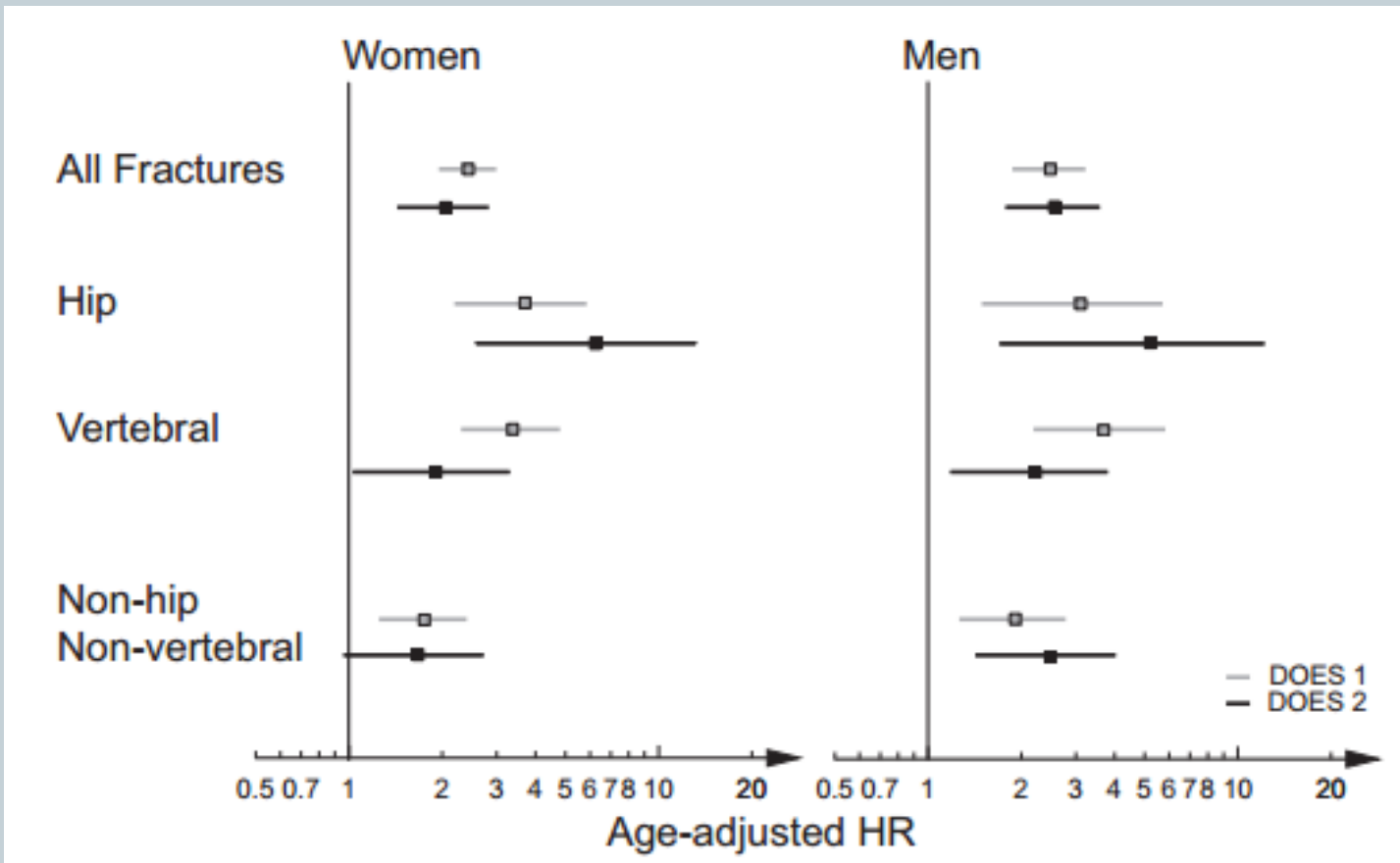
This database covers 97 % of Korean population
High number of patients with VF : 111 304 VF (2005) à 126 446 (2008)

Mortality after major fractures :

Hip, vertebrae, humerus, pelvis



No improvement in standardized mortality rate after major fractures over time



Dubbo Osteoporosis Epidemiology Study 1 (DOES 1; born before 1930) : **1989 – 2004**

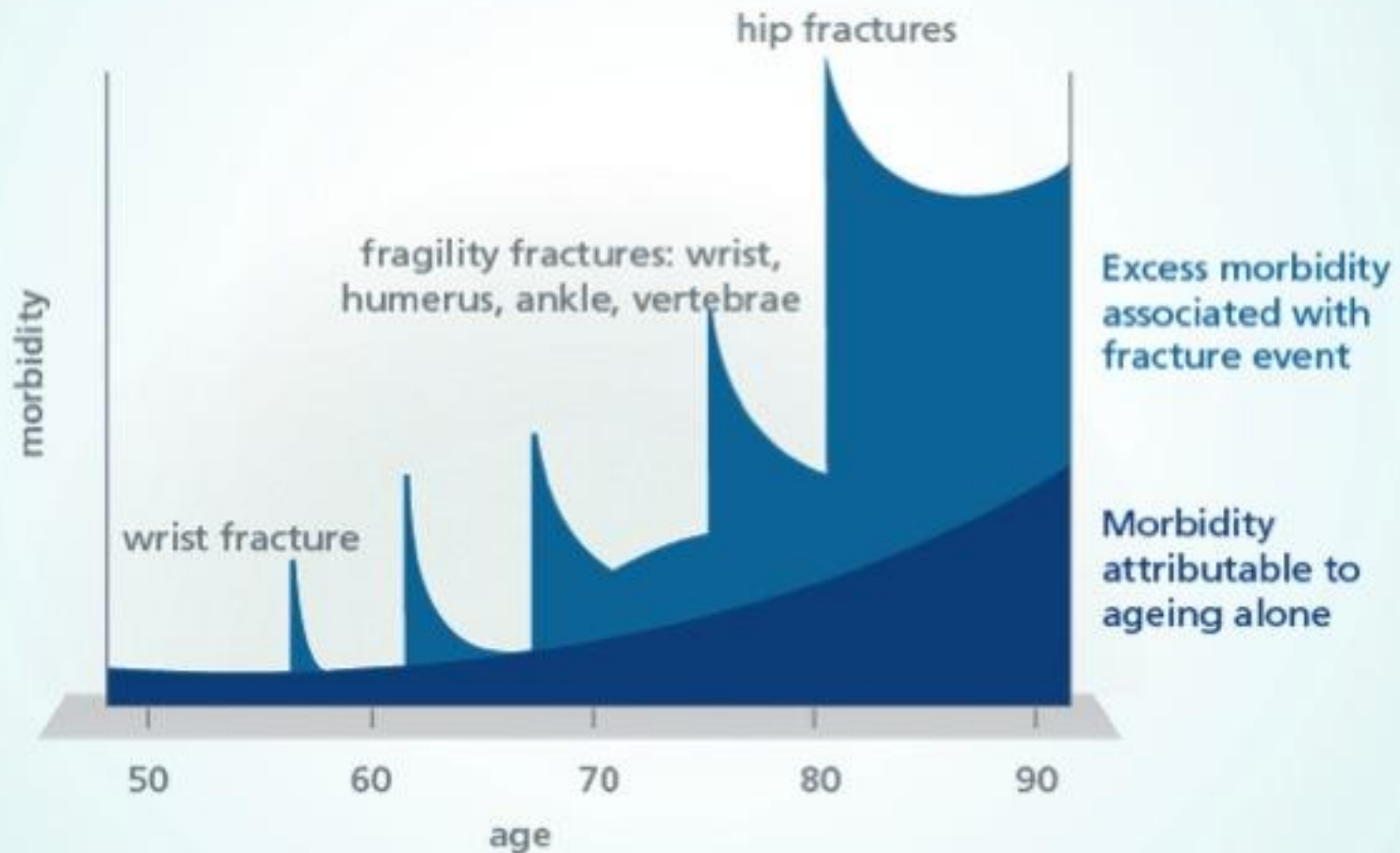
Dubbo Osteoporosis Epidemiology Study 2 (DOES 2; born after 1930) : **2000 – 2014**

Hip Fracture Significantly Affects Quality of Life

- Functional decline was 32% at discharge and remained at 16% at 1 year
- After 12 months, 30% of patients were still unable to walk independently compared to 7% of controls
- 19% of patients were institutionalized over 1 year compared to 4% of controls
- Mortality was 19% over 1 year compared to 3% in age and residence matched controls

Boonen S, Aubier P, Barette M, Vanderschueren D, Lips P, Haentjens P (2004) Functional outcome and quality of life following hip fracture in elderly women: a prospective controlled study. *Osteoporos Int* 15:87-94

Excess Morbidity Caused by Fragility Fractures

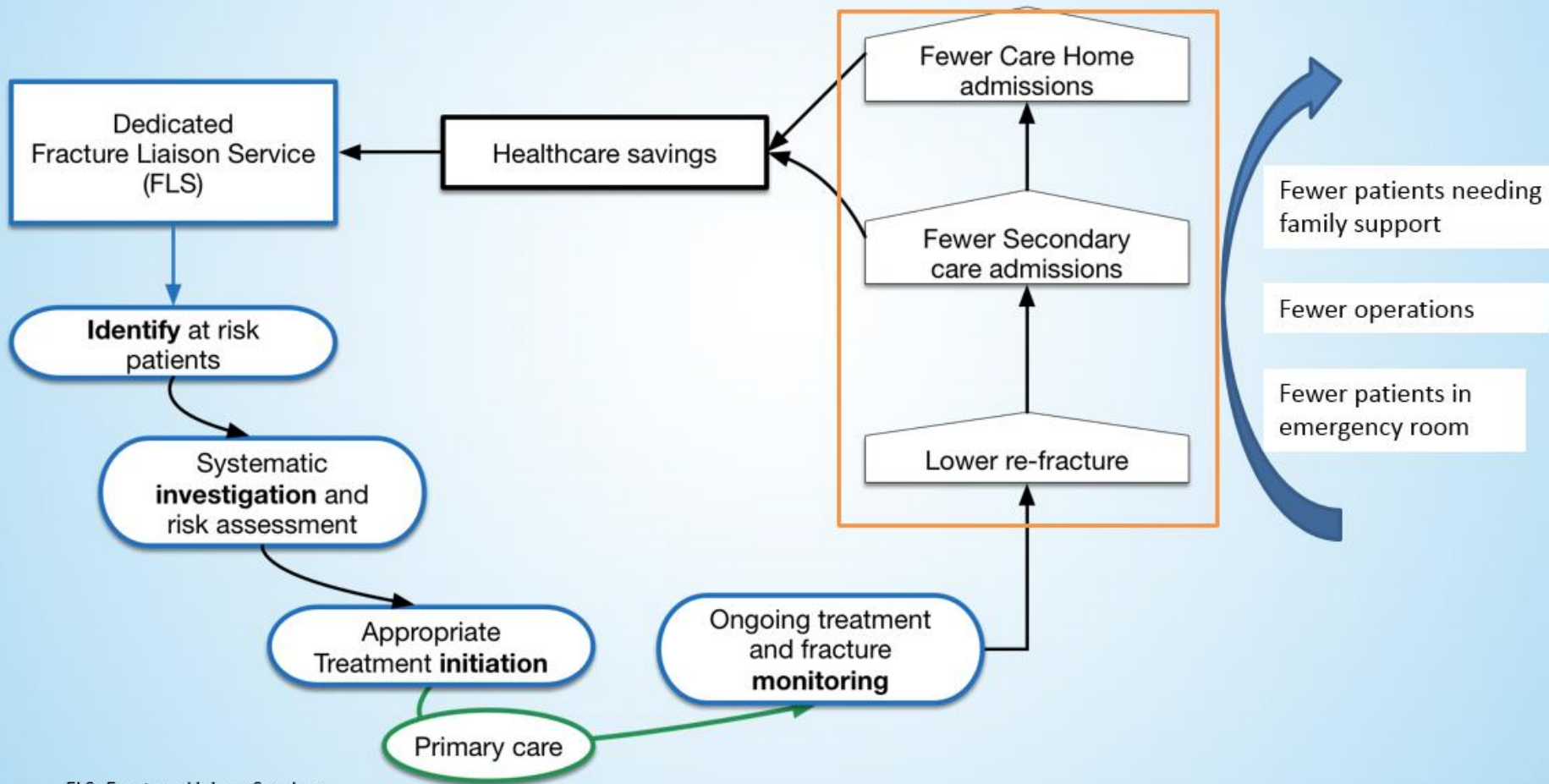


A Missed Opportunity to Prevent Secondary Fractures

- Half of patients presenting with hip fractures have suffered a prior fracture.

Wrist and vertebral fractures are common first fractures





FLS. Fracture Liaison Service.

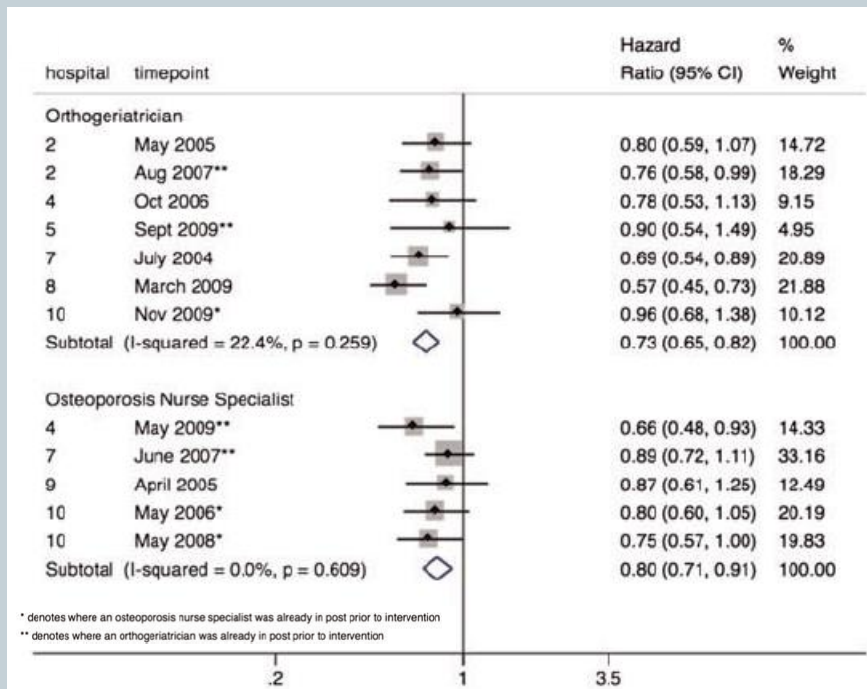
Orthogeriatric and FLS models effect on subsequent mortality post-hip fracture in UK



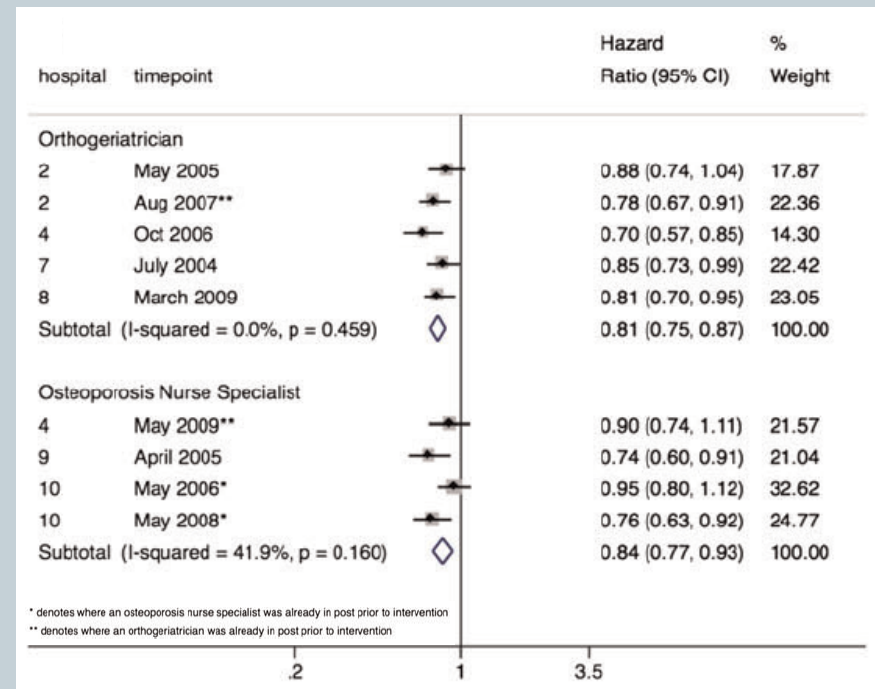
Forest plot of hazard ratios for outcomes within each hospital, comparing the time period after relative to the time period before orthogeriatric or FLS service model interventions

33,152 primary hip fracture patients, **1,288** with a second hip fracture within 2 years (age and sex standardized ratio 4.2%)

Mortality within 30 days



Mortality within 1 year



Capture the Fracture®



A global programme for the prevention of secondary fractures by facilitating the implementation of Fracture Liaison Services (FLS)

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Key Aims



Be the global voice



Drive national/international policy

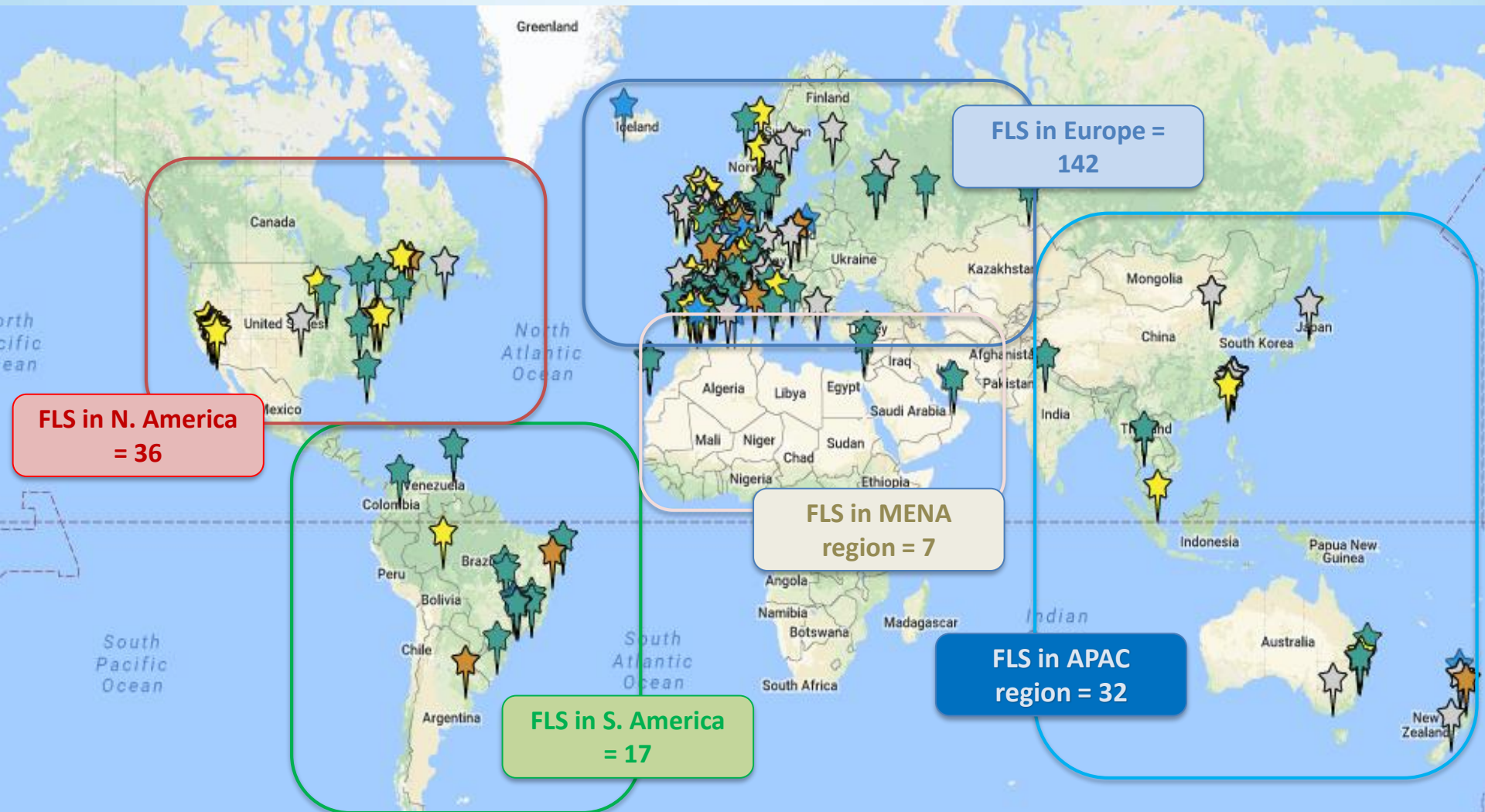


Ensure quality



Provide support for FLS implementation, getting started & improving

234 FLS, 35 countries, 6 continents



Running an FLS?

Join the Capture the Fracture Programme®

Why join?

- Showcase your achievements
- Learn from the best practice framework to improve your service
- Get international recognition with a Gold, Silver, or Bronze star
- Be part of a global initiative to prevent secondary fractures



Who can participate?

- Coordinator-based models of care
- All type of facilities
- At any stage in development
- Any size worldwide



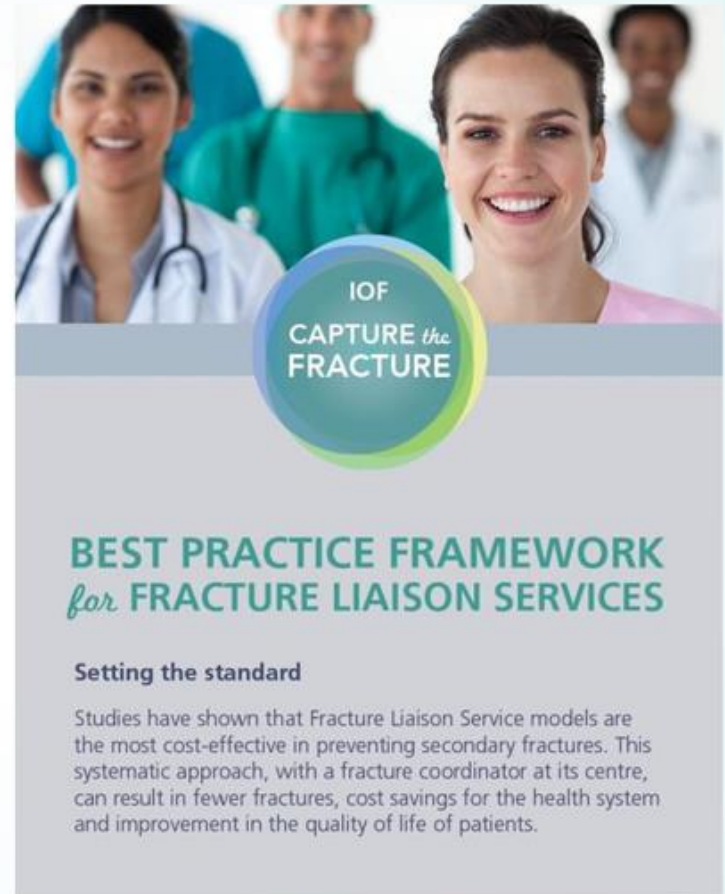
Purpose of the Best Practice Framework

Aim:

1. Set the standard for FLS
2. Guidance
3. Benchmarking and fine-tuning

5 domains, 13 standards

- Hip fracture patients
- Inpatient
- Outpatient
- Vertebral fracture patient
- Organization



13 BPF Criteria and Standards

1. Patient Identification

2. Patient Evaluation

3. Post Fracture Assessment Timing

4. Vertebral Fracture (VF) ID

5. Assessment Guidelines

6. Secondary Causes of OP

7. Falls Prevention Services

8. Multifaceted Assessment

9. Medication Initiation

10. Medication Review

11. Communication Strategy

12. Long-term Management

13. Database



Standard 1 definition:

Fracture patients are identified to enable delivery of secondary fracture prevention

Standard	Bronze	Silver	Gold
Patient Identification	Patients identified, <i>not</i> tracked	Patients identified, <i>are</i> tracked	Patients identified, tracked & <i>independently reviewed</i>

BPF Criteria and Standards

Standard 2 definition:

Identified patients are assessed for future fracture risk

Standard	Bronze	Silver	Gold
Patient Evaluation	50% are assessed	70% are assessed	90% are assessed

Standard 3 definition:

Post-fracture assessment is conducted in a timely fashion after clinical fracture presentation

Standard	Bronze	Silver	Gold
Post Fracture Assessment Timing	Within <u>13-16 weeks</u>	Within <u>9-12 weeks</u>	Within <u>8 weeks</u>

BPF Criteria and Standards

Standard 4 definition:

System to identify vertebral fractures

Standard	Bronze	Silver	Gold
Vertebral Fracture (VF) identification	<u>Known</u> VF identified	<u>Routinely</u> identified for VF	<u>Radiologists</u> identify VF

Standard 5 definition:

Secondary fracture prevention assessment is consistent with guidelines

Standard	Bronze	Silver	Gold
Assessment Guidelines	<u>Local</u>	<u>Regional</u>	<u>National</u>

The optimal fracture liaison service (FLS)

Emergency Room

All patients > 50
with clinical fracture

**Orthopedic
department**

Radiology department

All patients > 50
with VF on any imaging



Daily
Identification of
patients

**Home
or
Rehabilitation**

Inpatient visits

Database

Phone calls

**DXA
Bone specialist visit**

Risk of falls
assessment and prevention



Information and coordination with GP

Treatment initiation
& Follow up

Conclusion



- The fracture cascade is a clinical reality
- When a first fracture occurs, the risk of recurrence is maximal in the next first months
- The first fracture should be the last one
 - Appropriate measures
 - Pharmacological treatments have to be considered when the risk is high
- FLS is a model of cost-effective management

Q&A session

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Driven by **science.**

Acknowledgements

On behalf of IOF and the CTF steering committee, we thank you for your participation in this webinar.

If you have any additional questions, comments or feedback please email capturethefracture@iofbonehealth.org

