

Osteoporosis and Spine Health During the Coronavirus Pandemic

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Nothing to Disclose

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Nothing to Disclose

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Objectives

- Describe the scope of the problem and morbidity and mortality associated with vertebral compression fractures (VCF)
- Review treatment options for patients with vertebral compression fractures (VCF)
- Discuss the effects of COVID-19 on osteoporosis and fracture care, including vertebral fracture management
- Discuss vertebral augmentation procedures and the recommendations for utilization during the coronavirus pandemic

The Scope of the Problem

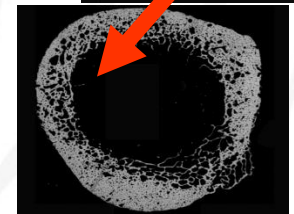
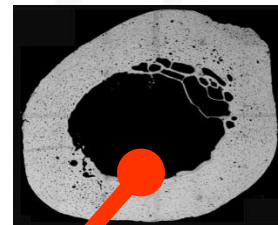
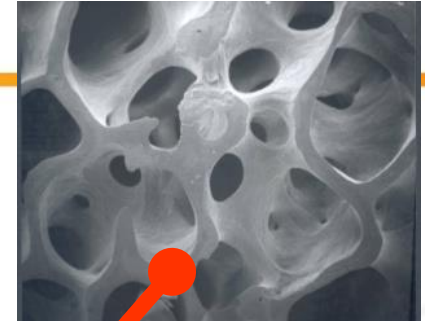


Osteoporosis

Definition:

Osteoporosis is a systemic disease characterized by weakened and fragile bone tissue, leading to an increased risk of fracture

- Osteoporosis is underdiagnosed and undertreated
- Osteoporosis is a chronic disease requiring prolonged treatment
- It is important to develop a strategy for long-term management to reduce the risk for fracture
- Osteoporosis medications effectively reduce fracture risk in patients with osteoporosis



Images Courtesy of
Drs. David Dempster & Roger Zamboni

The Silver Tsunami: Prevalence of Osteoporosis and Low Bone Mass

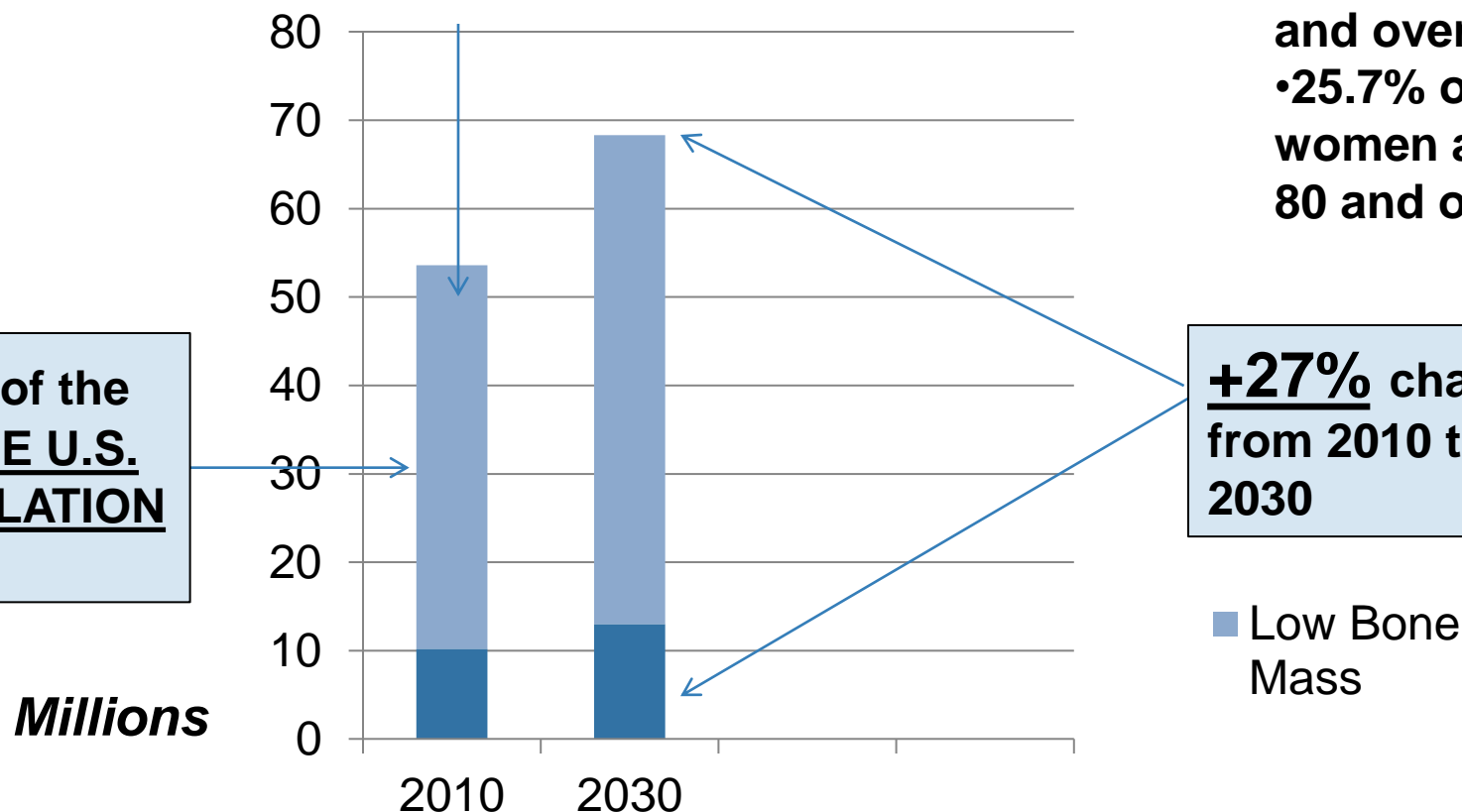
**Americans Age 50 and Above Affected
by Osteoporosis/Low Bone Mass, 2010 to 2030 (projected)¹**

**54 million of 99 million
Americans age 50+ (2010)**

Osteoporosis:
•16.2% of
adults aged 65
and over²
•25.7% of
women aged
80 and over²

**17% of the
ENTIRE U.S.
POPULATION
(2010)**

**+27% change
from 2010 to
2030**



Lifetime Risk of Fracture at the Age of 50

Type of Fracture	Women	Men
Osteoporotic Fracture ^{1,2}	46-53%	21-22%
Hip Fracture ^{2,3}	15-23%	5-11%
Radiographic Vertebral Fracture⁴	27%	11%
Clinical Vertebral Fracture²	15%	8%

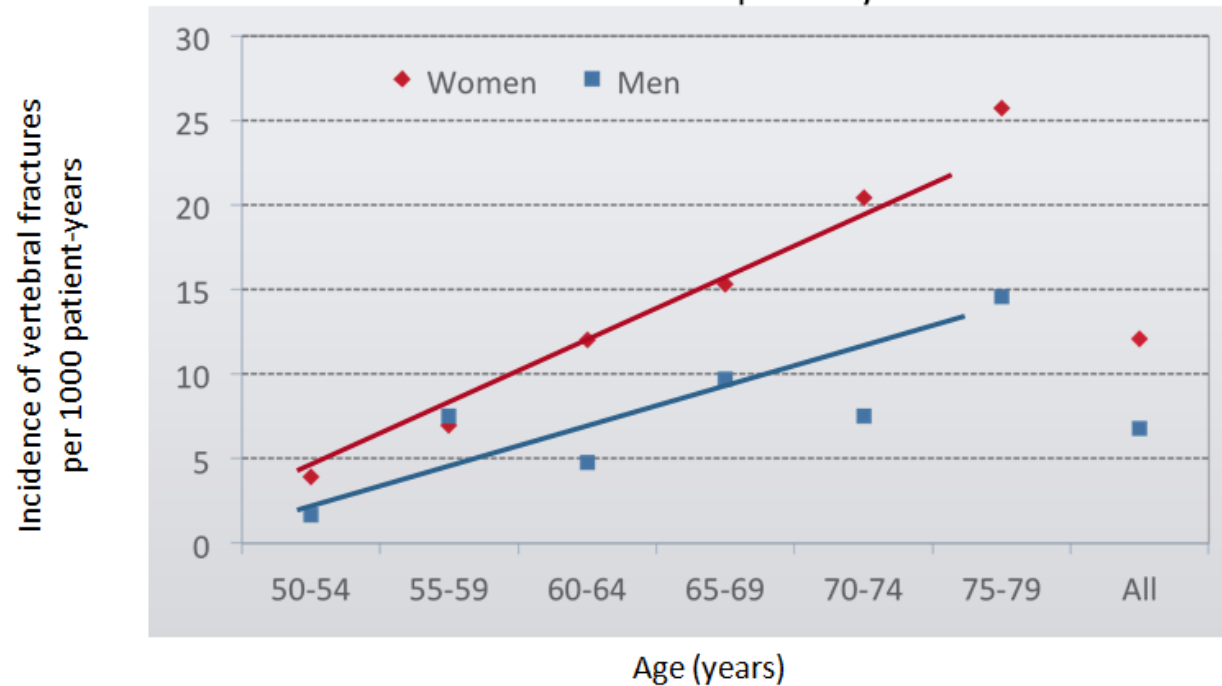
NHANES VFA Study 2017⁵

Vertebral Fracture Prevalence:
5% in the 60s
10% in the 70s
20% in the 80s

1. Van Staa TP, et al. (2001) Bone 29:517
2. Kanis JA, et al. (2000) Osteoporosis Int 11: 669
3. Samelson EL, et al. (2007) J Bone Miner Res 22:1449.
4. Samelson EL, et al. (2006) J Bone Miner Res 21:1207.
5. Cosman F, et al (2017) Osteoporos Int

Vertebral Fractures are Common in Both Men and Women

European Prospective Osteoporosis Study (EPOS)
mean follow-up 3.8 years



Milliman Report: Human Cost of Osteoporotic Fractures

In 2015,
2 MILLION
Medicare patients
suffered
2.3 MILLION
fractures

- 30% of hip fracture patients die within 1 year
- 21% of spine fracture patients die within 1 year
- ~20% of all fracture patients die within 1 year
- 15% of spine fracture as well as all patients suffer one or more additional fractures
 - Hip and spine fractures were most common subsequent fractures



Prior Fracture Increases the Risk of Subsequent Fracture

Prior rib fracture
can increase risk of new
vertebral fracture by 2.3-fold

Prior vertebral fracture
can increase risk of

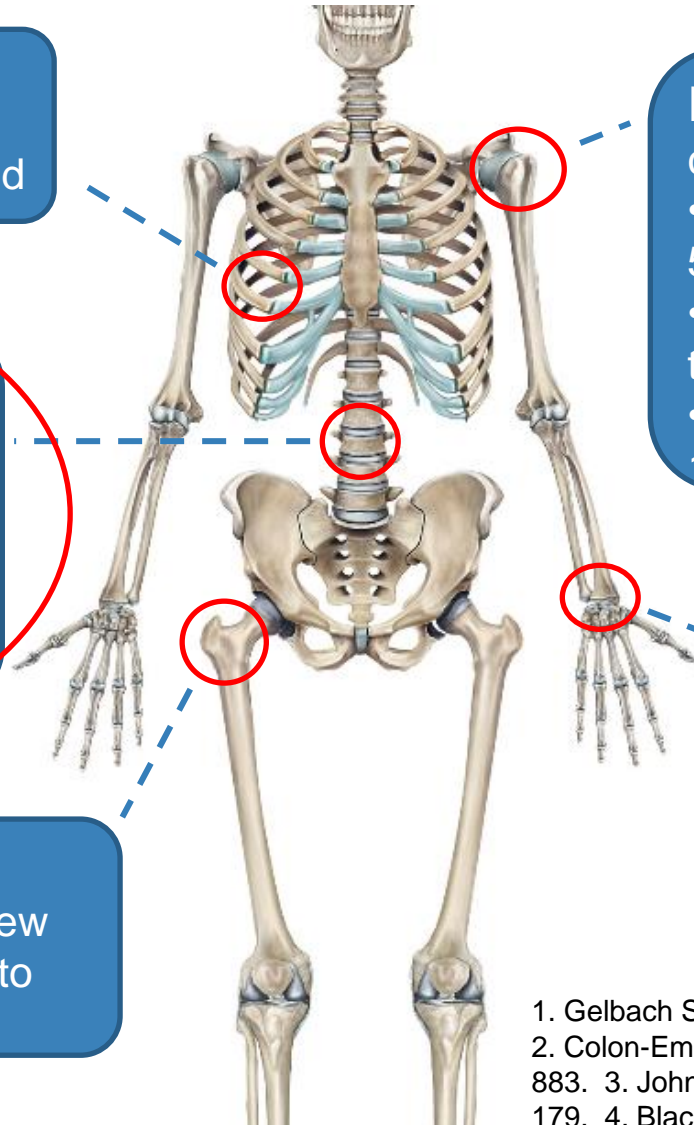
- New vertebral fracture 9.1-fold
- New hip fracture 7.1-fold
- New wrist fracture 2.3-fold

Prior hip fracture
can increase risk of new
vertebral fracture 1.6 to
5.9-fold

Prior shoulder fracture
can increase risk of

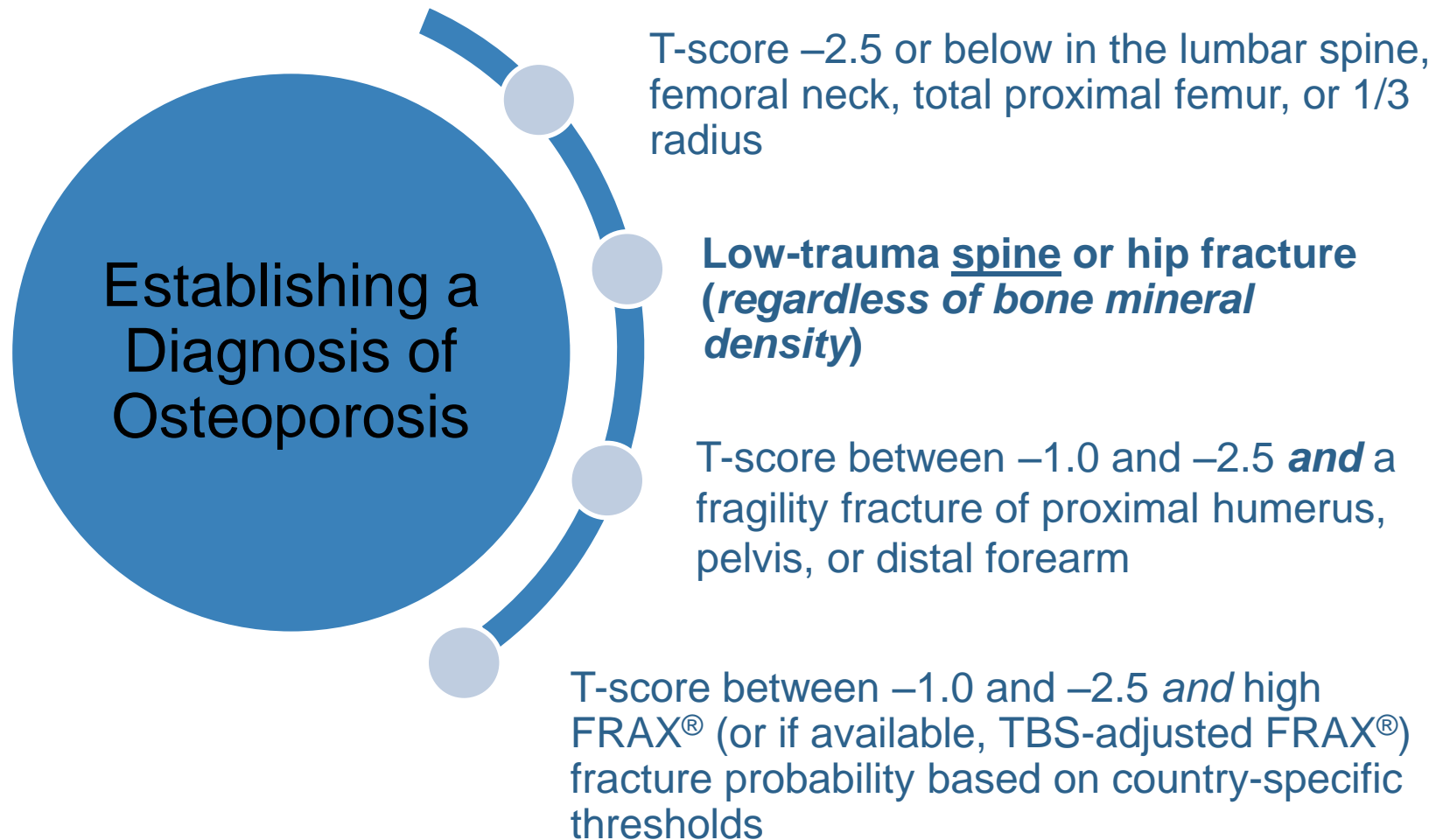
- New wrist fracture by up to 5-fold
- New vertebral fracture by up to 10-fold
- New hip fracture by up to 18-fold

Prior wrist fracture
can increase risk of
new vertebral fracture
by 37%



1. Gelbach S, et al. J Bone Min Res. 2012;27(3):645-653.
2. Colon-Emeric C, et al. Osteoporos Int.2003;14(11):879-883.
3. Johnell O, et al. Osteoporos Int. 2004;15(3):175-179.
4. Black DM, et al. J Bone Min Res. 1999;14:821-828

2020 AACE Diagnosis of Osteoporosis



Importance of Vertebral Fractures

- Most common osteoporotic fracture
- Can diagnose osteoporosis
- Indication for pharmacologic treatment
 - “A vertebral fracture is consistent with a diagnosis of osteoporosis even in the absence of a bone density diagnosis and is an indication for pharmacologic treatment”^{1,2}
- Marker of bone fragility – predicts future fracture risk
- Associated with significant morbidity and mortality

Morbidity and Mortality



Fractures Are Associated With Disability and Loss of Independence

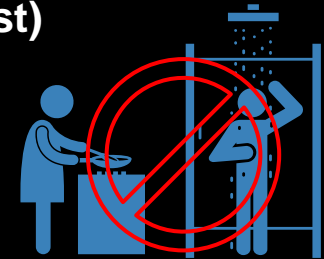
Impact of Fragility Fractures at Various Sites (Including Hip, Vertebral, Pelvis, Humerus, Wrist)



Admission to nursing home or long-term care facilities¹



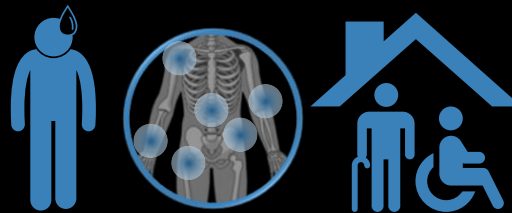
Non-skeletal clinical sequelae, such as chronic pain, depression, and complications from hospitalization^{2,3}



Inability to perform activities of daily living^{1,3,4}



Reductions in quality of life, including frailty⁵⁻⁸



Worry about falls, future fracture, and potential for nursing home care, which erodes confidence and damages relationships^{9,10}



Burden on patients and caregivers, including lost workdays and wages^{9,11,12}

1. Bentler SE, et al. *Am J Epidemiol*. 2009;170:1290-1299. 2. Inacio MCS, et al. *Perm J*. 2015;19:29-33. 3. Cosman F, et al. *Osteoporos Int*. 2014;25:2359-2381. 4. Mulcahy A, et al. Presented at: ASBMR annual meeting; October 16-18, 2016; Atlanta, GA. Abst MO0243. 5. Palacios S, et al. *Climacteric*. 2014;17:60-70. 6. Abimanyi-Ochom J, et al. *Osteoporos Int*. 2015;26:1781-1790. 7. Dyer SM, et al. *BMC Geriatr*. 2016;16:158. 8. Fechtenbaum J, et al. *Osteoporos Int*. 2005;16:2175-2179. 9. National Osteoporosis Society. Life with osteoporosis. October 2014. <https://nos.org.uk/media/1859/life-with-osteoporosis.pdf>. 10. Vass CD, et al. *Age Ageing*. 2014;43:i29. 11. Tajeu GS, et al. *J Gerontol A Biol Sci Med Sci*. 2014;69:346-353. 12. Tarride JE, et al. *Osteoporos Int*. 2012;23:2591-2600.

Significant Morbidity From Vertebral Fractures

- Restrictive lung disease
 - Each vertebral fracture can decrease pulmonary function as much as 9%^{3,4}
 - Lung function (FVC, FEV1) is significantly reduced in patients with thoracic and lumbar fractures⁵
- GI: constipation, abdominal distention, early satiety, weight loss
- Psychosocial – depression, loss of self-esteem^{1,6}

¹Lyles KW *Am J Med* 1993;94:595-60

²Brunton S, et al. *J Fam Pract.* 2005;54(9):781-788.

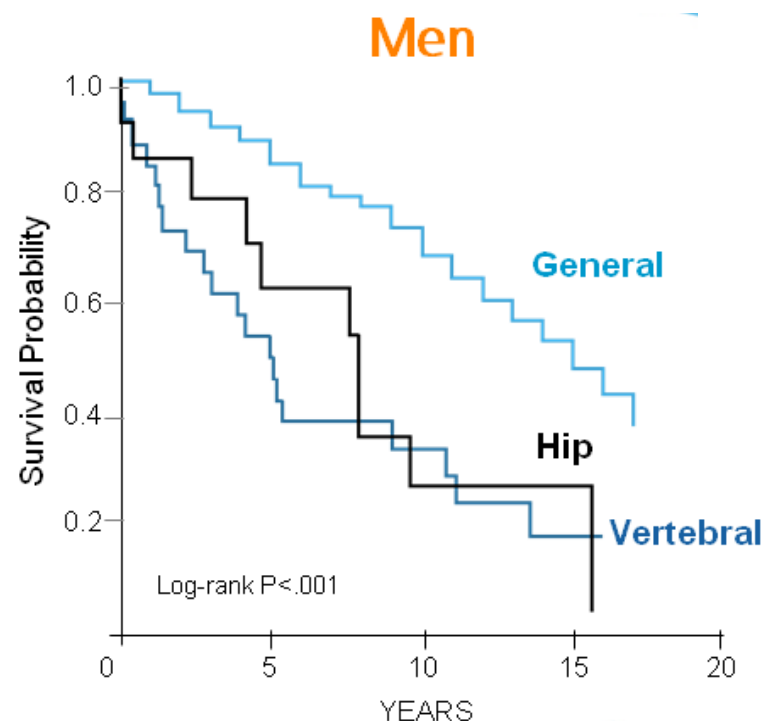
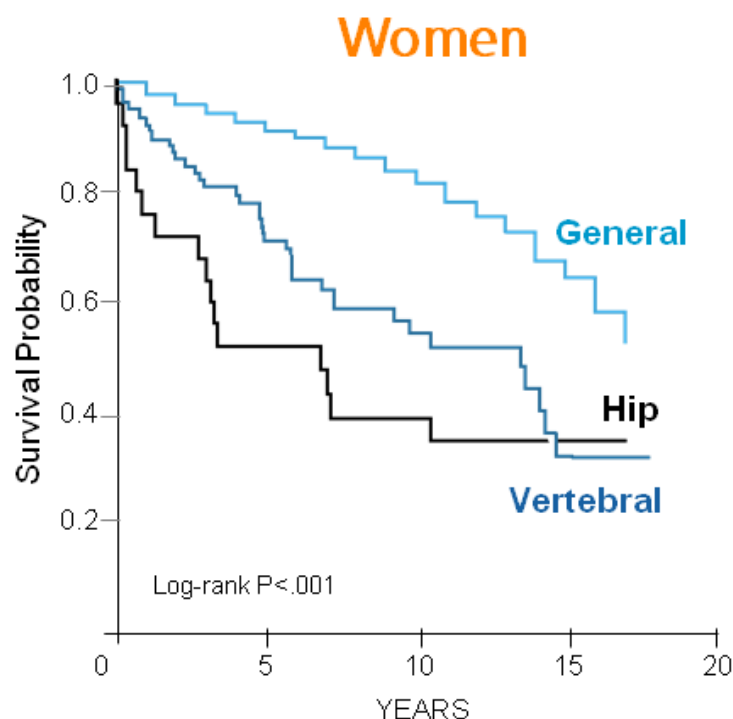
³Harrison RA *J Bone Miner Res* 2007;22(3):447-57

⁴Leech JA *Am Rev Respir Dis* 1990;141(1):68-71

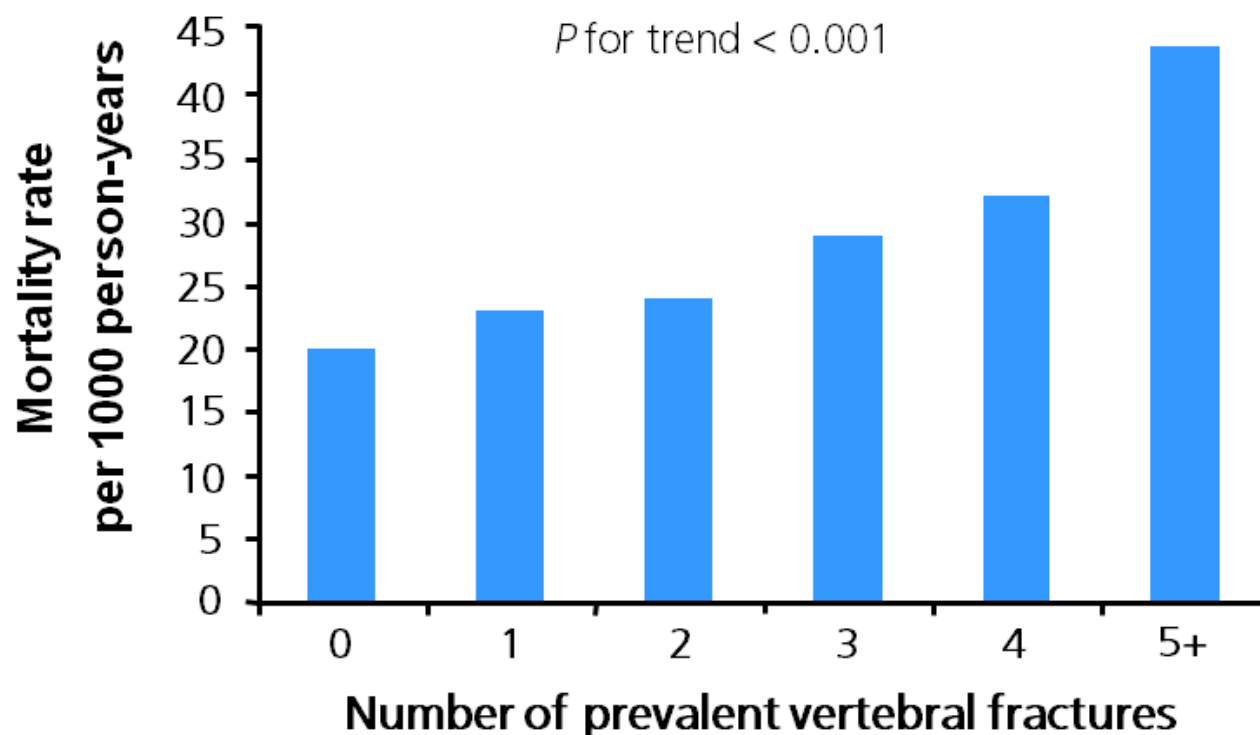
⁵Schlaich, *Osteoporosis Int*, 1998, 8: 261-67

⁶Gold DT *Rheum Dis Clin* 1992;27:255-62

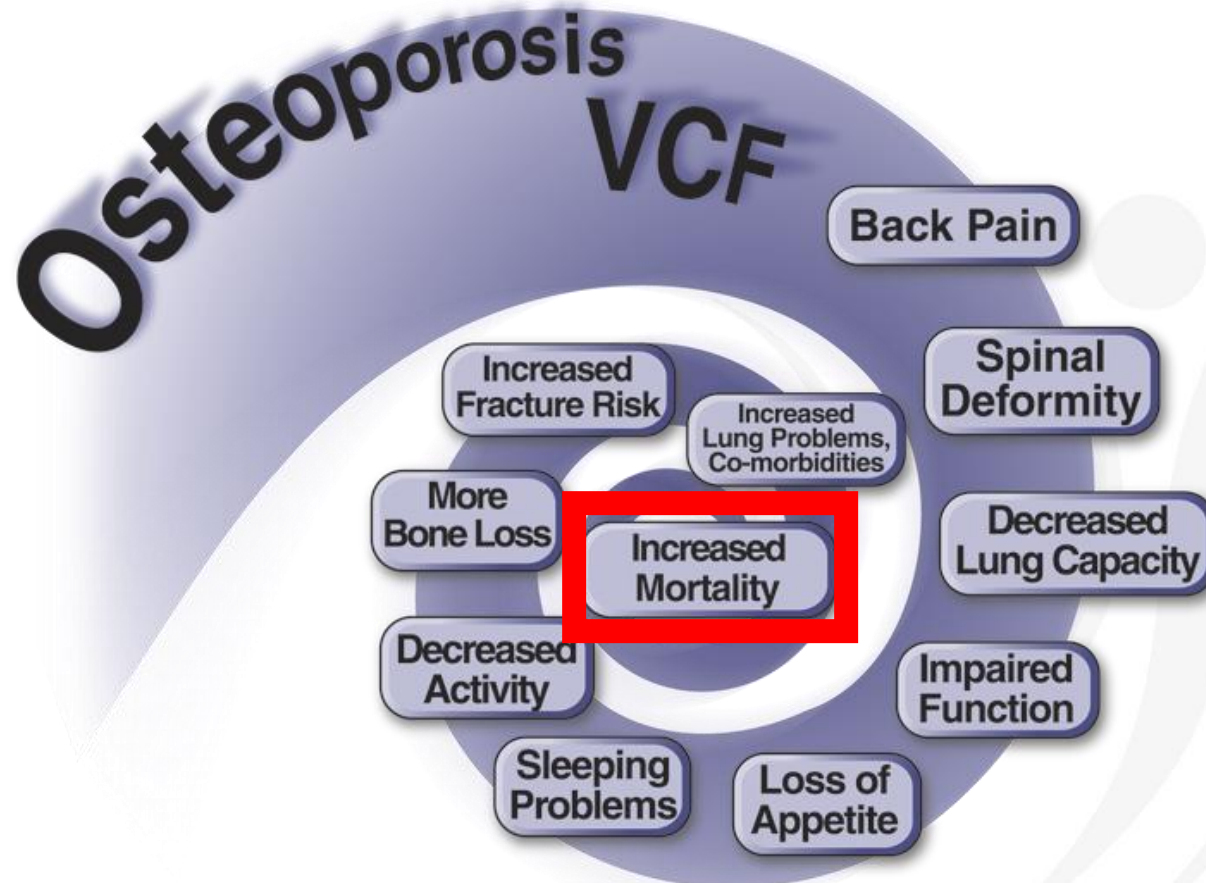
Vertebral Fractures Are Associated With Increased Mortality



Mortality Rate Increases with the Number of Prevalent Vertebral Fractures



Untreated VCFs Result in A Downward Spiral Associated with Increased Morbidity and Mortality



Consequences are independent of acute fracture pain

Evaluation and Management



COVID-19 and Osteoporosis/Fracture Care

- COVID-19 has impacted multiple aspects of osteoporosis care
- Access issues – clinical care, medication administration
- Change in the paradigm of face-to-face visits
- Telehealth transformed into an essential service
- Rapid expansion of virtual care for diagnosis, intervention, ongoing management

Osteoporosis/Post-Fracture Care During COVID-19

- Importance of continuing therapy in patients with established bone health plans
- In patients with new fracture who “require” DXA and lab tests to initiate therapy – consider alternate options to ensure delivery of care
- DXA may not be needed depending on type of fracture (Hip, Spine) or may be delayed
- Use of online risk calculators to aid in decision making (FRAX, Garvan, others)

VCF Treatment Goals

- Overall treatment goals:
 - Pain relief/management
 - Maintenance of independence and mobility
 - Early mobilization, including bed transfers, ambulation, ADLs
 - Prevention of future fractures

Treatment of Symptomatic Vertebral Compression Fractures

- Non-surgical Management (NSM): medical management
 - Bed rest (for severe pain)
 - Avoid long-term immobilization and recommend partial bed rest (with periodic sitting and ambulating) only when required and for the shortest periods possible.
 - Leads to bone loss and muscle loss
 - Potential complications – DVT/PE, pressure ulcers, infection
 - Pharmacologic treatment
 - Analgesics
 - Opioids
 - Calcitonin
 - Trunk orthoses/Posture support
 - Use of back braces, corsets, or posture training support devices may provide pain relief by reducing the loads on the fracture sites and aligning the vertebra
 - Long-term bracing may lead to muscle weakness and further de-conditioning
 - Physical Therapy

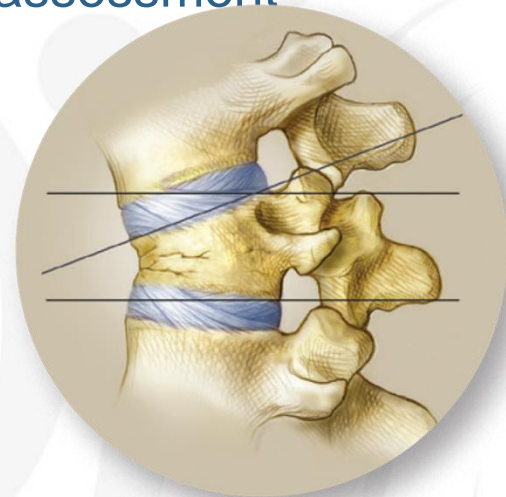
Comprehensive Management Includes Evaluation and Treatment of Osteoporosis

Patients diagnosed with a VCF must also be evaluated for the underlying condition (osteoporosis)

- Bone density testing (DXA) and/or fracture risk assessment
- Evaluation for secondary causes

A comprehensive treatment plan includes:

- Risk reduction counseling
- Calcium and vitamin D
- Pharmacologic therapy
 - Effective therapies are widely available and can reduce vertebral fractures by ~30-80%
- Physical therapy
- Appropriate exercise once mobility returns



TREAT THE UNDERLYING DISEASE: Osteoporosis Treatment Options

- **Anti-remodeling agents** (*inhibit bone turnover*)
 - Estrogen
 - Estrogen agonist/antagonists (raloxifene)
 - Tissue specific estrogen complex (estrogen/bazedoxifene)*
 - Bisphosphonates (oral and IV)
 - RANK ligand inhibitor (denosumab)
- **Remodeling stimulators** (*increase formation and resorption*)
 - Parathyroid hormone receptor activators
 - (teriparatide, abaloparatide)
- **Modeling stimulator** (*increase formation, decrease resorption*)
 - Sclerostin inhibitor (romosozumab)

ALL SIGNIFICANTLY REDUCE THE RISK OF VERTEBRAL FRACTURES*

The Impact of COVID-19 on Interventional Treatment Protocols

Disclosures

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Consultant: Relievant; Medtronic

Grant/Research Support: Neiman Health
Policy Institute

VCF and COVID-19

Retrospective cohort study in Milan, Italy

Methods

- Retrospective cohort study in Milan, Italy
- Assess vertebral fracture (VF) prevalence and clinical impact in COVID-19 patients
- N = 114
 - Patients ≥ 18 years with a confirmed diagnosis of COVID-19 admitted to ER
 - Patients for whom lateral chest x-rays at ED admission were available
 - Only those that allowed high quality assessment were used for analyses
 - Only x-rays in which T4 to T12 was visible
- 65 VCFs detected in 41 patients

Results

- Patients with VFs were older and more frequently affected by hypertension and coronary artery disease ($P < 0.001$, $P = 0.007$, $P = 0.034$; respectively).
- Thirty-six (88%) patients in VFs+ group compared to 54 (74%) in VFs- group were hospitalized ($P = 0.08$).
- Patients with VFs more frequently required noninvasive mechanical ventilation compared with those without VFs ($P = 0.02$).
- Mortality was 22% in VFs+ group and 10% in VFs- group ($P = 0.07$). In particular, mortality was higher in patients with severe VFs compared with those with moderate and mild VFs ($P = 0.04$).

Limitations

- Retrospective study, does not allow us to evaluate the timing of VFs
- Limited number of enrolled patients due to the huge pressure on EDs, which did not allow lateral chest x-rays to be performed in many patients
- Lack of a BMD evaluation or vitamin D level assessment to better characterize bone metabolic status.

EVOLVING Elective procedure environment due to COVID19

- Many state governors have issued executive orders and/or put forth guidance relative to elective procedures
- CMS has published elective procedures recommendations
- Several societies have published elective procedure recommendations

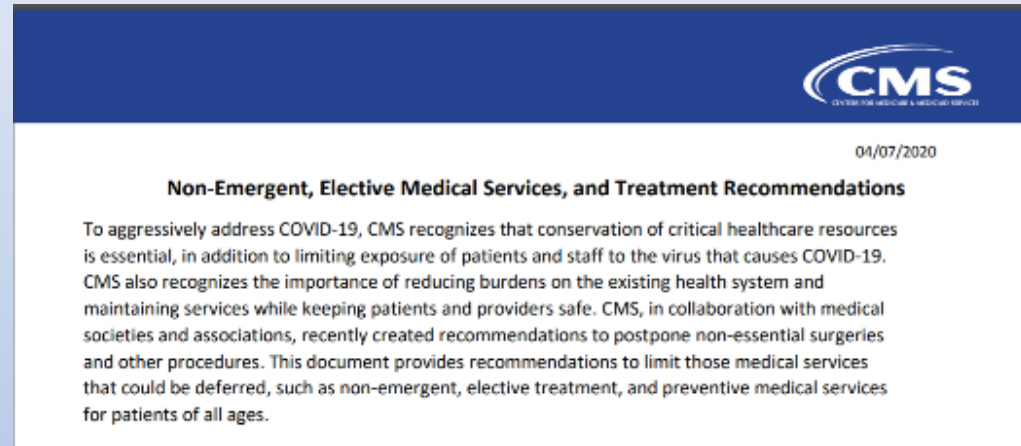
*** Healthcare providers determine what procedures are considered elective.

**Regulations & recommendations among the states,
CMS, and societies are constantly evolving!**

CENTER FOR MEDICAID AND MEDICARE SERVICES (CMS)

On April 7th, 2020 published its modified recommendations for:

- Non-Emergent Services
- Elective Services
- Treatment Recommendations



CMS Recommendation TIERED FRAMEWORK

Decisions remain the responsibility of local healthcare delivery systems, including:

- state and local health officials,
- those clinicians who have direct responsibility for their patients.

*Federally Qualified Health Care/ Rural Health Clinics

**Hospital Outpatient Department

***If a practice can provide only limited well child visits, healthcare providers are encouraged to prioritize newborn care and vaccination of infants and young children (through 24 months of age) when possible (see also CDC guidance for further information:) <https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/index.html>

1. Centers for Medicare & Medicaid Services. CMS Adult Elective Surgery and Procedures Recommendations. <https://www.cms.gov/files/document/cms-non-emergent-elective-medical-recommendations.pdf>. Accessed February 19, 2021.

CMS Adult Elective Surgery and Procedures Recommendations¹

Tiers	Definition	Locations	Examples	Action
Tier 1	Low acuity treatment or service	<ul style="list-style-type: none"> • Medical office • FQHC/RHC* • HOPD** • Ambulatory care sites 	<ul style="list-style-type: none"> • Routine primary or specialty care • Preventive care visit/screening • Annual Wellness or Welcome to Medicare Initial Preventive Visit • Supervised exercise therapy • Acupuncture 	<p>Consider postponing service</p> <p>Consider follow-up using telehealth, virtual check-in, or remote monitoring</p>
Tier 2	Intermediate acuity treatment or service Not providing the service has the potential for increasing morbidity or mortality	<ul style="list-style-type: none"> • Medical office • FQHC/RHC • HOPD • Ambulatory care sites 	<ul style="list-style-type: none"> • Pediatric vaccinations • Newborn/early childhood care*** • Follow-up visit for management of existing medical or mental/behavioral health condition • Evaluation of new symptoms in an established patient • Evaluation of non-urgent symptoms consistent with COVID-19 	<p>Consider initial evaluation via telehealth; triage to appropriate sites of care as necessary</p> <p>If no current symptoms of concern, consider follow-up with virtual check-in</p>
Tier 3	High acuity treatment or service Lack of in-person treatment or service would result in patient harm	<ul style="list-style-type: none"> • Medical office • FQHC/RHC • HOPD • Ambulatory care sites • Emergency department 	<ul style="list-style-type: none"> • Evaluation of new symptoms in a new patient • Evaluation of symptoms consistent with COVID-19, with warning signs including shortness of breath, altered mental status, or other indications of severe disease 	<p>We would not recommend postponing in person evaluation; consider triage to appropriate facility/level of care as necessary</p>

AMERICAN SPINE SOCIETY OF RADIOLOGY(ASSR)

ASSR Adult Interventional Procedure Triage Recommendation during COVID-19 Pandemic & PPE Shortage¹

Tiers/Description	Definition	Locations	Procedure Suggestions	Action
Tier 1a	Low acuity procedure/healthy patient Outpatient Procedure Not Life-threatening illness	OBL HOPD ASC Hospital with low/no COVID census	Trigger point, epidural/facet, Sympathetic nerve, and MSK injections, Myelogram, Discogram, MSK radiofrequency ablation procedures, Arthrogram studies	Postpone procedure
Tier 1b	Low acuity procedure/unhealthy patient	OBL HOPD ASC Hospital with low/no COVID census	Interventional headache procedures	Postpone procedure

*Repeated office calls, 1 ED visit, or prolonged Inpatient Admission.

+ After multi-disciplinary consensus

OBL= Office-Based Laboratory, HOPD = Hospital Outpatient Department, ASC = Ambulatory Surgery Center

Adapted and modified from Sameer Siddiqui MD, FACS, St. Louis University at American College of Surgeons and CMS.

For more information, visit : <https://www.theassr.org/>

1. American Society of Spine Radiology. ASSR Covid-19 Resources. <https://www.theassr.org/covid19>. Accessed February 19, 2021

AMERICAN SPINE SOCIETY OF RADIOLOGY(ASSR)

ASSR Adult Interventional Procedure Triage Recommendation during COVID-19 Pandemic & PPE Shortage¹

Tiers/Description	Definition	Locations	Procedure Suggestions	Action
Tier 2a	Intermediate acuity procedure/healthy patient Not life threatening but potential for future morbidity and mortality. Requires in hospital stay	HOPD ASC Hospital with low/no COVID census	Spinal cord / Peripheral Nerve stimulator trial/implantation, Lumbar spinal stenosis decompression/implantation, Basivertebral nerve ablation, SIJ fusion	Postpone procedure/surgery
Tier 2b	Intermediate acuity procedure/unhealthy patient	HOPD ASC Hospital with low/no COVID census	Pain pump trial/implantation	Postpone procedure/surgery, if possible

*Repeated office calls, 1 ED visit, or prolonged Inpatient Admission.

+ After multi-disciplinary consensus

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AMERICAN SPINE SOCIETY OF RADIOLOGY(ASSR)

ASSR Adult Interventional Procedure Triage Recommendation during COVID-19 Pandemic & PPE Shortage¹

Tiers/Description	Definition	Locations	Procedure Suggestions	Action
Tier 3a	High acuity procedure/healthy patient	OBL HOPD ASC Hospital	Kyphoplasty/Vertebroplasty/Sacroplasty, Intrathecal pump refill, Epidural/Facet/Interventional Headache injections*	Do not postpone
Tier 3b	High acuity procedure/unhealthy patient	Hospital	Intrathecal pump / implant infection, Infection drainage, Tumor biopsy/ablation ⁺	Do not postpone

*Repeated office calls, 1 ED visit, or prolonged Inpatient Admission.

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1. American Society of Spine Radiology. ASSR Covid-19 Resources. <https://www.theassr.org/covid19>. Accessed February 19, 2021.

American College of Surgeons (ACS)

Local Resumption of Elective Surgery Guidance

The American College of Surgeons issued guidelines and a checklist to help manage elective procedures

“Knowing your community’s COVID-19 numbers, including prevalence and incidence rates, as well as local isolation mandates, will help dictate timing of ramp up.”

North American Spine Society (NASS)

NASS convened a multidisciplinary task force of orthopedic surgeons, neurosurgeons and PM&R/pain specialists to provide spine- care specific guidance for procedures.

NASS Guidance Document during COVID-19 Injections, Interventional Procedures, and Surgeries

Category	Clinical Considerations	Recommendation
Emergent	<ul style="list-style-type: none">• Progressive or severe neurologic deficit due to neurologic compression from any cause (eg, infection, tumor, fracture, disc herniation)• Spinal instability at risk of causing neurologic injury from any cause (eg, fracture, tumor, infection)• Epidural abscess requiring surgical decompression• Postoperative wound infection	Do not postpone the procedure/treatment
Urgent	<ul style="list-style-type: none">• Cervical or thoracic myelopathy due to spinal stenosis, with recent progression• Spinal infection (eg, discitis, osteomyelitis, epidural abscess) that fails to respond to medical management• Persistent significant neurologic deficit due to neurologic compression with or without deformity (distinguished from "severe neurologic deficit" that is listed under emergent)• Spinal conditions causing intractable pain that result in ED presentation, severe functional limitations and/or excessive opioid use despite non- procedural attempts at management (eg, painful disc herniation, painful fracture, progressive fracture related deformity).	Proceed with procedure/treatment if the local situation and resources allow (see above)
Elective	<ul style="list-style-type: none">• Spinal conditions where pain and dysfunction can be reasonably managed without procedural intervention during the crisis (eg, chronic conditions, degenerative spinal disorders such as degenerative disc disease, some disc herniations, spinal stenosis or spondylolisthesis without significant neurologic deficit)• Scoliosis and/or kyphosis correction• Symptomatic hardware or pseudoarthrosis	Consider postponing the procedure/treatment

American Society of interventional pain physicians (ASIPP)



Evidence-Based Risk Mitigation and Stratification During COVID-19 for Return to Interventional Pain Practice: American Society of Interventional Pain Physicians (ASIPP) Guidelines - PubMed

pubmed.ncbi.nlm.nih.gov

Chronic pain patients require continuity of care but during the time of the COVID-19 pandemic, steps must be taken to stratify risks and protect patients from possible infection to safeguard them from COVID-19-related illness and transmitting the disease to others. Pain specialists should optimize t ...

Triaging Interventional Pain Procedures During COVID-19 or Related Elective Surgery Restrictions: Evidence-Informed Guidance from the American Society of Interventional Pain Physicians (ASIPP) - PubMed

pubmed.ncbi.nlm.nih.gov

The COVID-19 pandemic has created unprecedented challenges in IPM creating needless suffering for pain patients. Many IPM procedures cannot be indefinitely postponed without adverse consequences. Chronic pain exacerbations are associated with marked functional declines and risks with alternative tre ...

1. Shah S, Diwan S, Soin A, et al. Evidence-Based Risk Mitigation and Stratification During COVID-19 for Return to Interventional Pain Practice: American Society of Interventional Pain Physicians (ASIPP) Guidelines. *Pain Phys.* 2020 Aug;23(4S):S161-S182. <https://pubmed.ncbi.nlm.nih.gov/32942784/>
2. Gharibo, C, Sharma A, Soin A, et al. Triaging Interventional Pain Procedures During COVID-19 or Related Elective Surgery Restrictions: Evidence-Informed Guidance from the American Society of Interventional Pain Physicians (ASIPP). *Pain Phys.* 2020 Aug;23(4S):S182-204. <https://pubmed.ncbi.nlm.nih.gov/32942785/>

VCF MORTALITY RISK

NUMBERS NEEDED TO TREAT

This study was a retrospective database analysis using U.S. Medicare claims data (2005-2014). NNTs were calculated by comparing propensity-score adjusted survival rates for balloon kyphoplasty (BKP), vertebroplasty (VP), and nonsurgical management (NSM) groups between 1 to 5 years following the VCF diagnosis.

Link to AJNR:

<http://www.ajnr.org/content/early/2019/12/26/ajnr.A6367>

Hirsch JA, Chandra RV, Carter NS, Beall D, Frohbergh M, Ong K. Number Needed to Treat with Vertebral Augmentation to Save a Life. *AJNR Am J Neuroradiol*. 2020;41(1):178–182.

Published December 19, 2019 as 10.3174/ajnr.A6367

ORIGINAL RESEARCH
SPINE

Number Needed to Treat with Vertebral Augmentation to Save a Life

JA. Hirsch, RV. Chandra, NS. Carter, D. Beall, M. Frohbergh, and K. Ong



ABSTRACT

BACKGROUND AND PURPOSE: Evidence from randomized controlled trials for the efficacy of vertebral augmentation in vertebral compression fractures has been mixed. However, claims-based analyses from national registries or insurance datasets have demonstrated a significant mortality benefit for patients with vertebral compression fractures who receive vertebral augmentation. The purpose of this study was to calculate the number needed to treat to save 1 life at 1 year and up to 5 years after vertebral augmentation.

MATERIALS AND METHODS: A 10-year sample of the 100% US Medicare data base was used to identify patients with vertebral compression fractures treated with nonsurgical management, balloon kyphoplasty, and vertebroplasty. The number needed to treat was calculated between augmentation and nonsurgical management groups from years 1–5 following a vertebral compression fracture diagnosis, using survival probabilities for each management approach.

RESULTS: The adjusted number needed to treat to save 1 life for nonsurgical management versus kyphoplasty ranged from 14.8 at year 1 to 11.9 at year 5. The adjusted number needed to treat for nonsurgical management versus vertebroplasty ranged from 22.8 at year 1 to 23.8 at year 5.

CONCLUSIONS: Both augmentation modalities conferred a prominent mortality benefit over nonsurgical management in this analysis of the US Medicare registry, with a low number needed to treat. The calculations based on this data base resulted in a low number needed to treat to save 1 life at 1 year and at 5 years.

ABBREVIATIONS: BKP = balloon kyphoplasty; NNT = number needed to treat; NSM = nonsurgical management; VCF = vertebral compression fracture; VP = vertebroplasty.

VCF MORTALITY RISK

The study reported that to avoid risk of one additional death, the estimated number needed to treat (NNT*) varied, as shown below:

BKP vs NSM	VP vs NSM
14.8 (Year 1) 11.9 (Year 5)	22.8 (Year 1) 23.8 (Year 5)
~ 15 patients would need to be treated with BKP to avoid one additional death at the end of 1-year follow up relative to those treated with NSM.	~ 23 patients would need to be treated with VP to avoid one additional death at the end of 1-year follow up relative to those treated with NSM

LIMITATIONS

This population may not be representative of an individual provider's case mix and therefore may not represent survival probabilities and associated NNTs for that specific practice.

* NNT is a biostatistical term, representing the number of patients that need to be treated to avoid one additional adverse outcome as compared to the control treatment. Mathematically, the NNT is calculated as: $NNT = 1 / (\text{Control Event Rate} - \text{Experimental Event Rate})$

Hirsch JA, Chandra RV, Carter NS, Beall D, Frohbergh M, Ong K. Number Needed to Treat with Vertebral Augmentation to Save a Life. *AJNR Am J Neuroradiol*. 2020;41(1):178–182.

Q & A