

# Upper Extremity Fractures and Secondary Fall Prevention: Opportunities to Improve Management and Outcomes Across Disciplines

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## Acknowledgements

- The Dartmouth Institute for Health Policy & Clinical Practice
  - National Institute of Arthritis and Musculoskeletal and Skin Diseases at the National Institutes of Health (P60-AR062799; Tosteson A, PI)
- APTA and the Academy of Geriatric Physical Therapy
- Boston University, TREAT, NEPDC



Boston University



## Objectives

- Present current evidence related to UE Fx through the lens of secondary prevention
  - Selected studies from TDI MCRC Research Fracture Care Project
    - Study 1: Epidemiology of Second Fracture
    - Study 2: Prescription Drug Use Before and After Fx
    - Study 3: Evaluation and Treatment of Balance & Gait after UE Fx
    - Study 4: Opioid Use after Fx
  - Recommendations based on American Physical Therapy Association
    - Fall Risk Management Guideline
    - Systematic Review of Measures

## Sample & Data Sources

- Fee-for-service Medicare beneficiaries age 66–99 years old who sustained a hip, shoulder, or wrist fragility fracture
- Enrolled in Medicare
- Without managed care enrollment for one year before and one year after the index fracture or until death
- Identified fracture types using claims

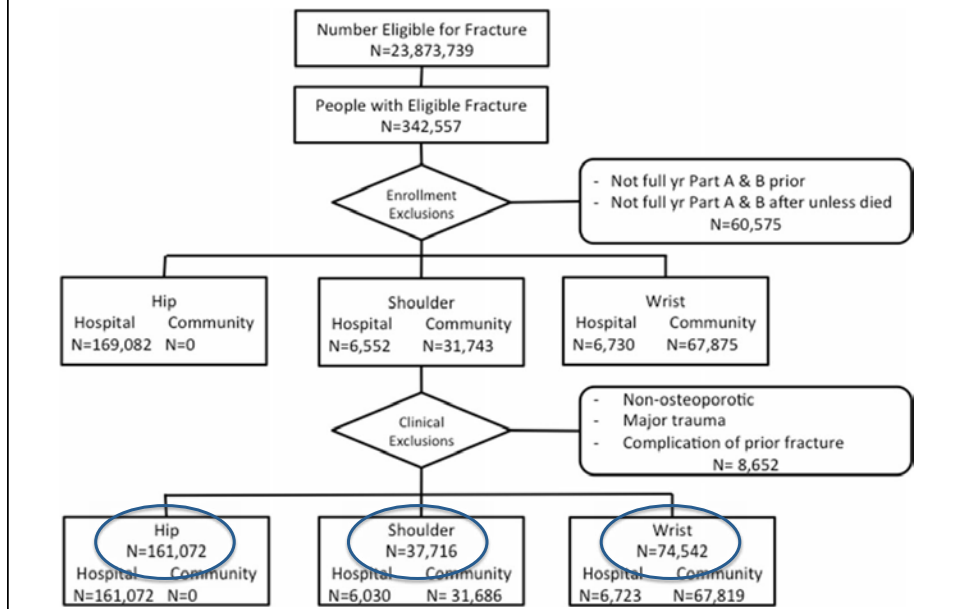
# Study 1: Fracture Epidemiology

ORIGINAL ARTICLE

## Second fractures among older adults in the year following hip, shoulder, or wrist fracture

J. P. W. Bynum<sup>1,2</sup> · J.-E. Bell<sup>3</sup> · R. V. Cantu<sup>3</sup> · Q. Wang<sup>1</sup> · C. M. McDonough<sup>1,4</sup> · D. Carmichael<sup>1</sup> · T. D. Tosteson<sup>2,3</sup> · A. N. A. Tosteson<sup>1,2,3</sup>

### Cohort Description



## Results

- Hip fracture patients: older, had higher comorbidity.
  - Older more likely to die by 1 yr after index Fx
    - Hip: 27%
    - Shoulder: 13%
    - Wrist: 7%
- Women more likely than men to sustain any Fx
  - Gender imbalance > for UE than hip Fx
    - Wrist: 14 % male
    - Shoulder: 19 % male
    - Hip: 26 % male

## Second Fracture Results

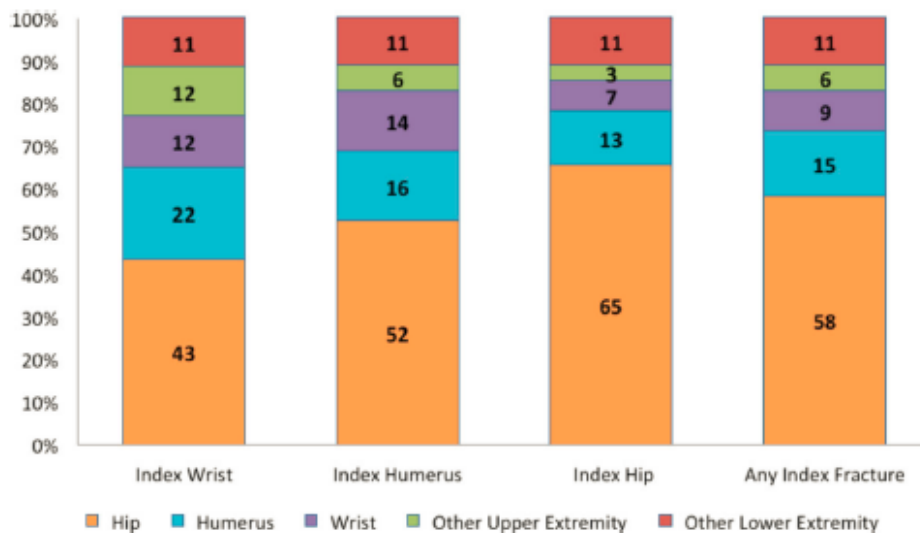


Fig. 2 Distribution of second fracture type among beneficiaries who sustained a second fracture within 1 year of index hip, shoulder, or wrist fracture

## Second Fracture Results & Conclusions

- Overall 11,885 people (4.3%) had second within one year
- Age and comorbidity have strong effects on risk of second fracture
- Little difference in risk by index fracture type or gender (hip: 7.3k; shoulder: 5.8k; wrist: 5.5k per 100k)

Results reveal that fracture prevention is as important after humerus and wrist fracture as for hip and for men as much as women

## Study 2: Prescription Drug Use

Research

JAMA Internal Medicine | [Original Investigation](#)

### Patterns of Prescription Drug Use Before and After Fragility Fracture

Jeffrey C. Munson, MD, MSCE; Julie P. W. Bynum, MD, MPH; John-Erik Bell, MD, MS; Robert Cantu, MD, MS; Christine McDonough, PT, PhD; Qianfei Wang, MS; Tor D. Tosteson, ScD; Anna N. A. Tosteson, ScD

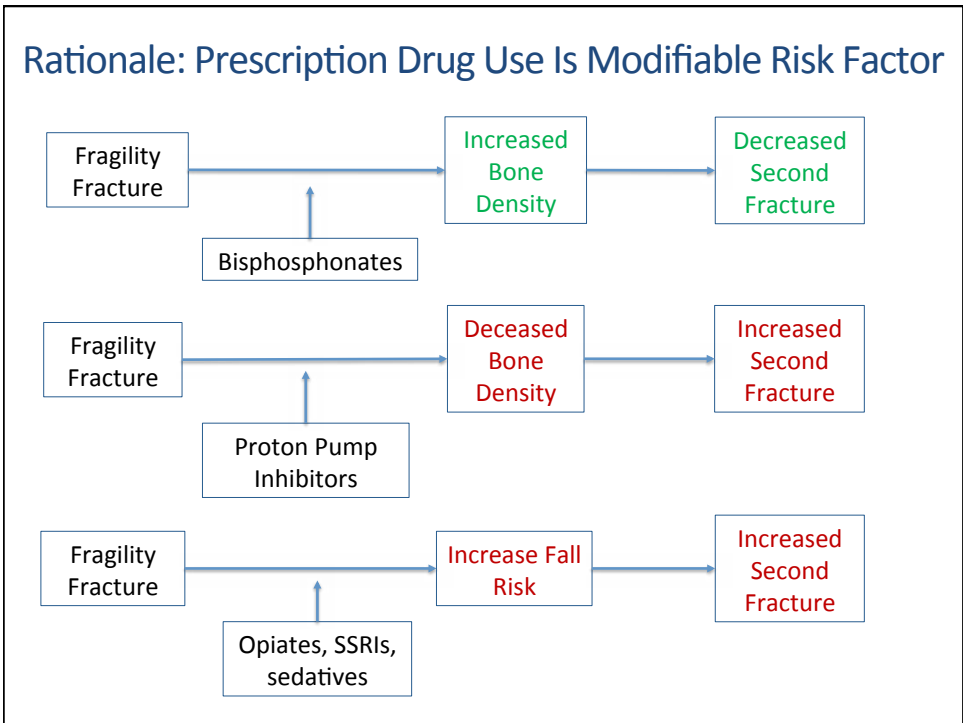
JAMA Internal Medicine October 2016 Volume 176, Number 10

**Table 1. Drugs Associated With Increased Risk of Fracture by Proposed Mechanism**

Proposed Mechanism of Increased Fracture Risk	Cohort Use Prior to Fracture, %
<b>Increased Risk of Falls</b>	
Benzodiazepines	2.8
Barbiturates	1.2
Sedative-hypnotics (nonbenzodiazepine) <sup>a</sup>	10.8
Opiates	35.5
Selective serotonin reuptake inhibitors <sup>a</sup>	26.4
Tricyclic antidepressants	4.8
Anti-Parkinson disease drugs	5.6
Centrally acting antihypertensives	3.9
Nitrates	8.6
Nonnitrate anti-anginal agents	1.4
Thiazide diuretics	23.4
Thiazide-like diuretics	2.9
<b>Decreased Bone Density</b>	
Inhaled glucocorticoids	7.0
Oral glucocorticoids <sup>a</sup>	9.8
Proton pump inhibitors <sup>a</sup>	25.6
H2 receptor antagonists	5.6
Thiazolidinediones <sup>a</sup>	5.7
Anticonvulsants	9.3
<b>Unclear Primary Mechanism</b>	
Atypical antipsychotics <sup>a</sup>	5.2
Early-generation antipsychotics	1.8
Loop diuretics	21.0

<sup>a</sup> Subset of drugs with a risk of fracture most literature.

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## Study 2: Prescription Drug Use

- Background:
  - Prescription drugs are modifiable risk factor for second fracture
  - Bisphosphonate use after fracture low
  - Small study showing high rate of use of drugs associated with fall risk
- Aim: To characterize prescription drug use and associated fracture risk before and after fragility fracture

## Study 2 Results & Conclusions

- There was very little reduction in exposure to prescription drugs associated with fracture risk after fragility fracture
  - some patients discontinued drugs associated with fracture
  - an equal number started new risk-related drugs
- ~ 25% used bone-building drugs



Post-fracture care is an opportunity to ↓ medication-related risk of second fracture risk

## Study 3

### Original Research

C.M. McDonough, PT, PhD, Department of Orthopaedic Surgery, 565 Ruben Clinical Research Section, Geisel School of Medicine at Dartmouth, Dartmouth-Hitchcock Medical Center, One Medical Center Drive, Lebanon, NH 03756 (USA), and Boston University School of Public Health, Boston, Massachusetts. Address all correspondence to Dr McDonough at: christine.m.mcdonough@dartmouth.edu.

C.H. Colla, PhD, The Dartmouth Insti-

### Falling Down on the Job: Evaluation and Treatment of Fall Risk Among Older Adults With Upper Extremity Fragility Fractures

Christine M. McDonough, Carrie H. Colla, Donald Carmichael, Anna N. A. Tosteson, Tor D. Tosteson, John-Erik Bell, Robert V. Cantu, Jonathan D. Lurie, Julie P. W. Bynum

## Study 3 Methods

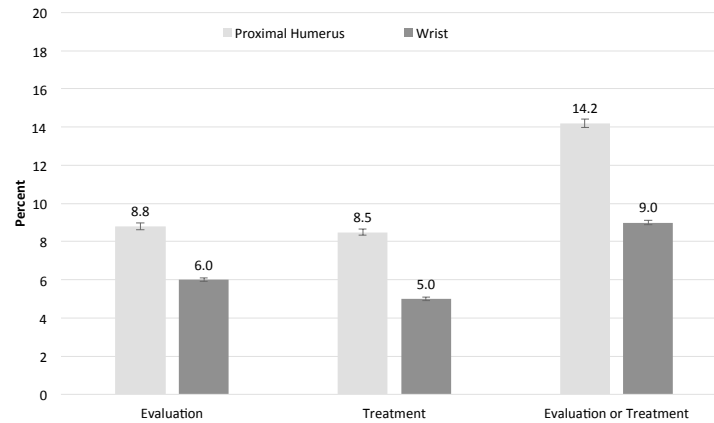
**Subjects:** Fee-for-service beneficiaries age 66 to 99 treated as outpatients for proximal humerus or distal radius/ulna ("wrist") fragility fractures

### Outcomes

- % evaluated or treated for fall risk up to 6 months after proximal humerus or wrist fracture from 2007-2009
- Predictors of receiving evaluation or treatment (logistic regression)



## Percent Receiving Assessment or Treatment for Extremity Fracture Study Results



Percent of Medicare Beneficiaries who Received Evaluation or Treatment up to 6 Months after Index Proximal Humerus or Wrist Fracture (n=309,947).

### Study 3 Results

- 10.7% received evaluation or treatment for fall risk or gait issues
- Using the broader definition the percentage increased to 18.5%
- Higher likelihood of services after fracture were: evaluation or treatment for falls or gait prior to fracture, more comorbidities, prior nursing home stay, older age, humerus fracture (versus wrist), female sex and white race

## Study 3 Conclusions/Next Steps

This low rate of assessment and treatment after an upper extremity fracture is the most important finding of this study, marking a large missed opportunity to reduce future falls and associated functional loss



### Next step

Rerun the analysis from 2010-2013 to address more recent incentives and policies (AGS/BGS CPG, APTA CGS, PQRS, Medicare annual wellness visit, etc.)

## Opportunities to Improve Management and Outcomes Across Disciplines

Fragility fractures should be sentinel events triggering

- Assessment of medication-based risk & reduction
- Evaluation & treatment of balance and mobility deficits
- Consider humerus, wrist, and hip fracture as equally predictive of second fracture

Take appropriate action as soon as possible after fracture

# Physical Therapy

Journal of the American Physical Therapy Association



Management of Falls in Community-Dwelling Older Adults: Clinical Guidance Statement From the Academy of Geriatric Physical Therapy of the American Physical Therapy Association  
 Keith G. Avin, Timothy A. Hanke, Neva Kirk-Sanchez, Christine M. McDonough, Tiffany E. Shubert, Jason Hardage and Greg Hartley  
*PHYS THER.* 2015; 95:815-834.  
 Originally published online January 8, 2015  
 doi: 10.2522/ptj.20140415

The online version of this article, along with updated information and services, can be found online at: <http://ptjournal.apta.org/content/95/6/815>

## Methods: Identification of Clinical Practice Guidelines (CPGs)

- Systematically search (11 databases)
- Search terms: falls, geriatric, older adult
- Inclusion
  - Published between 2000 and 2013
  - English and
  - Adults over the age of 65 living in the community or in assisted-living settings
- Exclusion
  - Specific to a neurological condition (e.g., stroke, Parkinson disease, multiple sclerosis)
  - Fracture management
  - Clinical practice statements excluded

## Methods

- 4028 CPGs identified
- 5 met inclusion criteria
- Critically appraised by  $\geq 3$  reviewers: AGREE II
  - AGS/BGS (American & British Geriatrics Societies)
  - NICE (National Institute for Health & Care Excellence)
  - FSGG (French Society of Geriatrics & Gerontology )
  - AGILE (UK Society for PTs working with older adults)
  - Moreland J et al. 2003

## Recommendations

- The recommendations were written for physical therapists
- Based on multi-disciplinary CPGs, therefore may be relevant for other disciplines
- Levels of Evidence
  - Level I: Strong (RCTs, SR)
  - Level II: Moderate (small RCTs, quasi-experimental)
  - Level III: Weak (observational studies)

## Screening

[Physical therapists] **should** routinely ask older adult patients if they have fallen in the previous 12 months (Strong Recommendation based on Level III evidence).

Screening should include:

- History and context of falls over previous 12 months
- At least one question about the patient's perception of difficulty with balance or walking

## Screening

For each patient who reports a fall or falls or reports difficulty with balance or walking, [the physical therapist] **should** screen by observing for gait or balance disturbance (Strong Recommendation based on Level III Evidence). Positive screening result is when either is found:

- Multiple falls
- One fall + balance or gait impairment

## Assessment Evidence: Health Conditions

### Cardiac conditions

- √√ Cardiac exam (NICE, AGS/BGS)
  - HR, rhythm, postural pulse, BP, hypotension (AGS/BGS)
- √ Anti-arrhythmia medication (NICE)
- √ Cardiac drugs and postural hypotension (Moreland)
- √√ Osteoporosis (NICE, AGS/BGS)
  - Risk assessment or diagnosis

## Assessment Evidence: Health Conditions

- √ Depression (Moreland)
  - Assess for risk
  - Geriatric Depression Scale
- √√√ Medication review
  - Number of meds with dosage
  - Cardiac
  - Psychotropic (benzodiazepines, hypnotics, antidepressants, tranquilizers)

## Assessment Evidence: Body Functions and Structures

### √√√ Strength of the extremities

- Lower extremity strength (AGS/BGS)

### √√√ Balance

- No specific procedures or methods for balance assessment are provided within the CPGs
- Frequently used tests: BBS, TUG, POMA

## Assessment Evidence: Body Functions and Structures

### √√√ Vision

- Visual acuity (AGS/BGS)

### √√√ Urinary function/ incontinence

### √√√ Cognitive assessment/ neurologic function

- Cognitive evaluation (AGS/BGS, NICE)
- Peripheral nerve function, proprioception, reflex testing, and cortical, extrapyramidal, cerebellar function (AGS/BGS)

## Assessment Evidence: Activity and Participation

### √√√ Gait (thorough and detailed)

- Gait deficits or abnormalities are a risk factor for falls
- No specific procedures or methods were recommended
- Individual professional should identify appropriate measures for the assessment of gait for each older adult (NICE)
- Use of walking aids (Moreland)

## Assessment Evidence: Activity and Participation

### √√ Activities of daily living and mobility

- ADL skill including use of adaptive equipment
- Mobility aids (AGS/BGS)
- Transfers (Moreland)

### √ Physical activity

- Given that moderate activity levels may be protective to balance and falls, assess levels of physical activity (Moreland)



## Assessment Evidence: Environmental and Personal Factors

- √√√ Since home safety and hazards are risk factors, assess the home for hazards
  - Example: Tripping hazards: attention to loose rugs and mats
  
- √√ Fear and health perception
  - Assess perceived functional ability and fear of falling

## Assessment: Environmental and Personal Factors

- √ Social support
  - Identification of the older adult's social support network (Moreland)
  
- √ Alcohol use
  - Assessment of consumption and inappropriate alcohol use (Moreland)
  
- √ Feet and footwear
  - Assess feet and footwear (AGS/BGS)

## Intervention Evidence: Health Conditions

- √√√ Conduct medication review; modify/withdraw psychotropic meds if possible
- √√ Treat cardioinhibitory carotid sinus hypersensitivity (NICE, AGS/BGS)
- √√ Treat postural hypotension (AGS/BGS, Moreland)
- √ Treat vitamin D insufficiency (AGS/BGS)
- √ Treat impaired cognitive status (Moreland)
- √ Treat depression (Moreland)

## Intervention Evidence: Body Functions and Structure

- √√√ Individualized balance training
- √√ Individualized strength exercises (NICE, AGS/BGS)
- √√ Monitored by appropriately trained health care professional (NICE, AGS/BGS)
- √ Coordination training (AGS/BGS)
- √ Flexibility and endurance should be offered; not as stand alone intervention (AGS/BGS)

## Intervention Evidence: Body Functions and Structure

For persons who have fallen, but with no specific findings on assessment

- ✓ Tai chi or other balance control ex (e.g. on foam surfaces) (Moreland)
- ✓ For women over 80 yrs, individualized home physical therapy program for strengthening, balance, and flexibility (Moreland)

## Intervention Evidence: Body Functions and Structure

Delivery

- ✓ Referral to physical therapy (Moreland)
- ✓ Tai chi or physical therapy (AGS/BGS)
- ✓ Group exercise or individual (AGS/BGS)

### Intervention Evidence: Body Functions and Structure

- ✓ Expedite first cataract surgery when indicated (AGS/BGS)
- ✗ Advise against multifocal lenses for walking on level and stairs (AGS/BGS)
- ✓ Treat vision and hearing impairment (Moreland)
- Insufficient evidence to recommend vision correction as stand-alone falls intervention (NICE, AGS/BGS)

### Intervention Evidence: Activity & Participation

- ✓✓ Individualized gait training combined with balance and strength training (AGS/BGS, Moreland was specific to older women)
- ✗ Advise against brisk walking for post-menopausal women with fracture history (Moreland)
- Insufficient evidence for brisk walking (NICE)

## Intervention Evidence: Activity & Participation

- √ √ ADL training for those with difficulty performing ADL activities. (AGS/BGS, Moreland)

## Intervention Evidence: Education

### Education and information giving

- √ Verbal and written re: prevention, effective measures, motivation to exercise, benefits of engagement in risk reduction activities (NICE)
- √ Tailored education within multi-factorial intervention (AGS/BGS)
- √ Insufficient evidence for targeted or untargeted educational programs as stand-alone interventions (AGS/BGS)

## Intervention Evidence: Alcohol and Physical Activity

For those with inappropriate alcohol use

- ✓ Educate and refer for treatment (Moreland)

For those with risky activity level

- ✓ Educate and refer for treatment (Moreland)

## Intervention Evidence: Environmental Factors

Home hazard modification

- ✓✓✓ Home hazard assessment combined with modifications. Home hazard assessment should not be conducted without follow-up and modifications

## Intervention Evidence: Personal Factors

### Footwear

- ✓ Treatment of foot and footwear problems identified in multi-factorial assessment (AGS/BGS)
- ✓ Advise low heels and high surface contact area (AGS/BGS)

## Intervention Evidence: Personal Factors

### Hip protectors

- ✓ Insufficient evidence to recommend hip protectors for fall prevention (NICE)
- \*\* Note that hip protectors may be effective in preventing fractures associated with falls

## Assessment Recommendations

[Physical therapists] **should** provide individualized assessment within scope of practice that contributes to multi-factorial assessment of falls and fall risk. Additional risk factors may need to be addressed by the appropriate provider (Strong Recommendation based on Level II evidence). This assessment should include:

- Medication review
  - Polypharmacy & psychoactive drugs

## Assessment Recommendations

- Medical History
  - Osteoporosis
  - Depression
  - Cardiac disease
    - Signs & symptoms of cardioinhibitory carotid sinus hypersensitivity



## Assessment Recommendations

- Body functions and structure, activity and participation, environmental & personal factors
  - Strength
  - Balance
  - Gait
  - Activities of Daily Living
  - Footwear
  - Environmental Hazards
  - Cognition
  - Neurological Function
  - Cardiac function, including postural hypotension
  - Vision
  - Urinary incontinence

## Intervention Recommendations

- Broadly, recommendations were similar for older adults at risk of falls
  - Individualized exercise program including:
    - Balance training
    - Strength training
    - Referral to physical therapy (Moreland)
  - There were differences...

## Intervention Recommendations

[Physical therapists] **should** provide individualized interventions within the scope of practice (Strong Recommendation based on Level I evidence). Components of the intervention should include:

- Strength training that is individually prescribed, monitored, and adjusted (Strong recommendation based on Level I evidence)

## Intervention Recommendations

- Balance training that is individually prescribed, monitored, and adjusted (Strong recommendation based on Level I evidence)

## Intervention Recommendations

- Gait training (Strong recommendation based on Level I evidence)

## Intervention Recommendations

- Correction of environmental hazards (Strong recommendation based on Level I evidence)

## Intervention Recommendations

- Correction of footwear or structural impairments of the feet (Recommendation based on Level II evidence)

## Which tests to Use to Determine Fall Risk



### Systematic Reviews

OPEN

#### **Determining Risk of Falls in Community Dwelling Older Adults: A Systematic Review and Meta-analysis Using Posttest Probability**

Michelle M. Lusardi, PT, DPT, PhD<sup>1</sup>; Stacy Fritz, PT, PhD<sup>2</sup>;  
Addie Middleton, PT, DPT, PhD<sup>3</sup>; Leslie Allison, PT, PhD<sup>4</sup>;  
Mariana Wingood, PT, DPT, GCS<sup>5</sup>; Emma Phillips, PT, DPT, GCS<sup>6</sup>;  
Michelle Criss, PT, GCS<sup>7</sup>; Sangita Verma, PT, DPT, GCS<sup>8</sup>;  
Jackie Osborne, PT, DPT, GCS<sup>9</sup>; Kevin K. Chui, PT, DPT, PhD, GCS, OCS<sup>10</sup>

Journal of GERIATRIC Physical Therapy DOI: 10.1519/JPT.0000000000000099

## Summary of Clinically Useful Indicators of Fall Risk

Category	Measure
Medical History Questions	Any previous falls
	Psychoactive medication
	Requiring any ADL assistance
	Ambulatory assistive device use
Self-report Measures	Geriatric Depression Scale-15
	Falls Efficacy Scale International
Performance-based Measures	Timed Up & Go Test
	Single-limb stance eyes open
	Five Times Sit-to-Stand Test
	Self-selected walking speed

Journal of GERIATRIC Physical Therapy DOI: 10.1519/JPT.0000000000000099

## More details...

Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2012, Issue 9.

Sherrington C, Whitney JC, Lord SR, et al. Effective exercise for the prevention of falls: A systematic review and meta-analysis. *J Amer Geriatr Soc.* 2008; 56(12): 2234-43.

Power V, Clifford AM. Characteristics of optimum falls prevention exercise programmes for community-dwelling older adults. *Eur Rev Aging Phys Act* 2013; 10:95-106.

## Mode

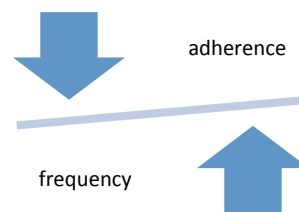
- Must include balance training
- Strength training only has small effect
- Multifactorial home or community-based interventions
- Walking programs alone have small effect

## Intensity

- Intensity of training
  - Balance training
    - “demanding”
    - “challenging”
    - “appropriate and increasing levels of difficulty”
  - Highest possible level of difficulty without falling or near-falling
  - Mastery of each exercise before progressing

## Frequency

- Minimum effective frequency twice per week
- Most consistently effective frequency three times per week
- Higher frequencies reduce fall risk, but adherence was poor



## Time

- Total exercise volume?
  - At least 40\* or 50\*\* hours over the course of the intervention

\*Power et al

\*\* Sherrington et al

## Exercise components

- What works
  - Leaning beyond BOS
  - Shifting the COM
  - Minimizing UE support
  - Narrowing base of support
  - Dual-task movement
  - Altering sensory feedback
  - Functional activities
  - TJQMBB
- What doesn't work
  - Lack of balance training component
  - Lack of functional relevance
  - Lack of exercise progression

Questions?



Thank You!