Objectives

- Identify evidence – based documents and resources for the identification, prevention, and treatment for falls in community-dwelling older adults.

- Describe the screening process for fall risk identification and prevention of falls using CDC STEADI and AGPT screening algorithms.

- Discuss the results and recommendations from the AGPT/APTA Clinical Guidance Statement on the management of falls in community-dwelling older adults.

- Effectively interpret and apply best evidence when choosing and performing history questions, pen/pencil paper tools, and performance-based measures to screen for future fall risk.

- Discuss advantages and disadvantages of using cut-off points from common performance measures.

- Discuss best intervention parameters for exercise to prevent falls.

2016 CONFERENCE & EXPO

Material presented at IPTA 2016 REVITALIZE Conference
Why do older adults fall?

- Poor postural control, especially their ability to execute **protective responses**
- **Weakness**, deconditioning, inactivity
- Changes in **cardiovascular** functioning
- Diminished function of **sensory** systems
- **Polypharmacy**
- Environmental hazards
- Low balance **confidence** and depression

PHYSICAL / BEHAVIORAL / MEDICAL / ENVIRONMENTAL

The Challenge

- **Screening tools**
  - To identify risk and direct the process
- **Examination methods**
  - To capture the relevant factors
  - Predict future risk
  - Provide directives for treatment

- **Individualized Interventions**
  - Targeting risk factors
  - Providing the right dosage
  - Utilizing professionals and services efficiently and effectively
Evidence-based Documents

Use of Evidence

- Background Theory/Expert Opinion
- Case Series
- Cohort Studies
- RCT
- Systematic Review
- CPG
- CDS
- Syntheses
- Summaries
- Systems
- Single studies

Material presented at IPTA 2016 REVITALIZE Conference
• Accessed 2/25/16
• CDC Compendium of Effective Fall Interventions: What works for community-dwelling older adults. 3rd edition.
  ▪ Exercise-based interventions
  ▪ Home modification interventions
  ▪ Multifaceted interventions


• Preventing Falls: A Guide to Implementing Effective Community-based Fall Prevention Programs

Material presented at IPTA 2016 REVITALIZE Conference


Purpose: quickly identify risk and who requires further in-depth assessment
• Physical therapists should routinely ask older adult patients if they have fallen in the last 12 months
  ▪ (CGS Grade C: Strong recommendation based on Level III evidence).

• Screening should include:
  ▪ History and context of falls over the last 12 months
  ▪ At least one question about the patient’s perception of difficulty with balance or walking

• Generally don’t have both high specificity and sensitivity for fall risk
• The strength of typical questions:
  ▪ Previous falls
  ▪ Difficulty walking
  ▪ Need assistance during ADLs
  ▪ Medications (psychoactive)
  ▪ Fear
  ▪ Needing an assistive ambulatory device
  ▪ Polypharmacy
  ▪ Limited physical activity
  ▪ Age
Psychoactive Medications

- Psychotropic medication
  - Antipsychotics – Abilify, Haldol, promethazine
  - Antidepressants - SSRIs
  - Sedatives; anti-anxiety – benzodiazepenes*
  - Sleep aids – Ambien

* ativan, xanax, paxal, klonopin, valium, versed, restoril, halcion

Asking about the fall....

- Where were you when you fell?
  - Home versus outdoors
- What were you doing before you fell?
- Did you feel dizzy or lose consciousness?
- Did you feel confused before or after you fell?
- Why do you think you fell?
- Do certain activities make you feel like you are going to fall?
Algorithms for Screening

CDC STEADI Toolkit (based on AGS/BGS Guidelines)

AGPT Guidance Statement

Screen for falls or risk for falling

Use these questions

1. 2 or more falls in prior 12 months?
2. Presents with acute fall?
3. Difficulty with walking or balance?

Yes?

Multifactorial fall risk assessment

No?

But 1 fall

Screen gait and balance

Material presented at IPTA 2016 REVITALIZE Conference
Material presented at IPTA 2016 REVITALIZE Conference

http://www.cdc.gov/steadi/materials.html

Stay Independent Brochure

<table>
<thead>
<tr>
<th>Please circle “Yes” or “No” for each statement below.</th>
<th>Why it matters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (2) No (0) I have fallen in the past year.</td>
<td>People who have fallen once are likely to fall again.</td>
</tr>
<tr>
<td>Yes (2) No (0) I use or have been advised to use a cane or walker to get around safely.</td>
<td>People who have been advised to use a cane or walker may already be more likely to fall.</td>
</tr>
<tr>
<td>Yes (1) No (0) Sometimes I feel unsteady when I am walking.</td>
<td>Unsteadiness or needing support while walking are signs of poor balance.</td>
</tr>
<tr>
<td>Yes (1) No (0) I steady myself by holding onto furniture when walking at home.</td>
<td>This is also a sign of poor balance.</td>
</tr>
<tr>
<td>Yes (1) No (0) I am worried about falling.</td>
<td>People who are worried about falling are more likely to fall.</td>
</tr>
<tr>
<td>Yes (1) No (0) I need to push with my hands to stand up from a chair.</td>
<td>This is a sign of weak leg muscles, a major reason for falling.</td>
</tr>
<tr>
<td>Yes (1) No (0) I have some trouble stepping up onto a curb.</td>
<td>This is also a sign of weak leg muscles.</td>
</tr>
<tr>
<td>Yes (1) No (0) I often have to rush to the toilet.</td>
<td>Rushing to the bathroom, especially at night, increases your chance of falling.</td>
</tr>
<tr>
<td>Yes (1) No (0) I have lost some feeling in my feet.</td>
<td>Numbness in your feet can cause stumbles and lead to falls.</td>
</tr>
<tr>
<td>Yes (1) No (0) I take medicine that sometimes makes me feel light-headed or more tired than usual.</td>
<td>Side effects from medicines can sometimes increase your chance of falling.</td>
</tr>
<tr>
<td>Yes (1) No (0) I take medicine to help me sleep or improve my mood.</td>
<td>These medicines can sometimes increase your chance of falling.</td>
</tr>
<tr>
<td>Yes (1) No (0) I often feel sad or depressed.</td>
<td>Symptoms of depression, such as not feeling well or feeling slowed down, are linked to falls.</td>
</tr>
<tr>
<td>Total_____</td>
<td>Add up the number of points for each “yes” answer. If you scored 4 points or more, you may be at risk for falling. Discuss this brochure with your doctor.</td>
</tr>
</tbody>
</table>

Conservative
Risk Factors and Function

- Risk factors interact with overall function. Some risk factors may have a stronger influence on falls in lower-functioning older adults than independent community-dwelling older adults.
  - Urinary incontinence
  - Cognitive impairment
  - Fear

Material presented at IPTA 2016 REVITALIZE Conference

http://www.cdc.gov/steadi/materials.html
• Timed Up & Go
  ▪ Mobility
  ▪ > 12 s

• 30s Chair Stand
  ▪ Leg strength
  ▪ Scores by age

• 4-Stage Balance Test
  ▪ Balance
  ▪ Tandem (< 10 s)
    • conservative

• BP

---

**AGPT Recommendation: Screening**

• For each patient who reports a fall or falls or reports difficulty with balance or walking, the PT **should** screen by observing for gait or balance impairment
  ▪ (CGS Grade C: Strong recommendation based on Level III evidence).

• A screening is **positive** when either of the following conditions is found:
  ▪ The patient reports multiple falls regardless of balance and gait impairments
  ▪ The patient reports one fall and a balance or gait impairment is observed
Assessment

Anyone with a positive fall history should receive a multi-factorial assessment
AGPT Recommendation: Assessment

- Physical therapists should provide an individualized assessment within the scope of PT practice that contributes to a multifactorial assessment of falls and fall risk.

- Additional potential risk factors may need to be addressed by the appropriate provider as indicated
  - (CGS Grade A: Strong recommendation based on Level II evidence).

AGS/BGS: Multifactorial Fall Risk Assessment

- Physical Exam
- Cognitive Exam
- Functional mobility

- Determine fall risk
  - History of falls
  - Medications
  - Gait balance mobility
  - Visual acuity
  - Neuro impairments
  - Muscle strength
  - Heart rate and rhythm
  - Postural hypotension
  - Feet / footwear
  - Environmental hazards
Questionnaires:

- Balance Confidence
  - FES - I
- ADLs
  - Barthel
- Cognition
  - MMSE
- Depression
  - GDS – not very sensitive; better specificity
    - 15 – item may be a bit better than 4 - item in predicting future falls
- Physical Activity
  - SF-36 physical activity subscale

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Questionnaires: Balance Confidence

- Falls Efficacy Scale (international)
  - Two good prospective studies
  - In one study (Taiwanese older adults), a score of \( \geq 24 \) substantially increased the probability of a future fall and a lower score substantially decreased the likelihood.
  - In the second, a score of > 21 increased the probability of a future fall moderately, while a lower score moderately decreased the likelihood.
    - Delbaere et al 2010, Br Med J

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FES - I

- Cleaning the house
- Getting dressed or undressed
- Preparing simple meals
- Taking a bath or shower
- Going shopping
- Getting in and out of a chair
- Going up or down stairs
- Walking around in the neighborhood
- Reaching for something above your head or on the ground
- Going to answer the telephone before it stops ringing
- Walking on slippery surfaces (wet, icy)
- Visiting a friend or relative
- Walking in a place with crowds
- Walking on an uneven surface (rocky ground, poorly maintained pavement)
- Walking up or down a slope
- Going out to a social event (religious service, family gathering, or club meeting)

<table>
<thead>
<tr>
<th>Not at all concerned</th>
<th>Somewhat concerned</th>
<th>Fairly concerned</th>
<th>Very concerned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Barthel Index

- Bowel/bladder, grooming, toilet use, feeding, transfer, mobility (may use aid), dressing, stairs, bathing
- One good prospective study
  - Less than 19
  - 48% sensitivity
  - 94% specificity
  - +LR 7.8
  - -LR 0.6
  - Post-test probability if positive 77%; if negative 20%
MMSE

- 0-30 points; low = more impairment
- One good prospective study
  - < 25
  - 63% Sn
  - 52% Sp
  - Post-test probability if positive 36%, if negative 23%

Assessment of Body Structures/
Body Functions and Activities

- Strength of extremities
  - LE
- Balance
  - No specific procedures or methods for balance assessment are provided within the CPGs
  - Individual professional should identify appropriate measures for each older adult
- Gait - Thorough and detailed
  - No specific procedures / methods recommended
  - Use of walking aid
Assessment: Items not covered today

Health Conditions – Cardio, Osteoporosis

Body Function/Structure - Vision, Urinary function/incontinence, Feet

Activities – ADLs, Physical inactivity

Contextual Factors - Social support, Home safety, Alcohol use, Footwear

30s Chair Stand/ 5x STS

• 5 x STS
  ▪ One prospective study with ≥ 12s
  ▪ 50-60% range for Sn, Sp
  ▪ Post-test probability if positive/negative = 34%/25%
  ▪ N=>300

• 30s Chair Stand
  ▪ One retrospective study (level III) with 15 times cut-off
  ▪ Post-test probability if positive/negative = 63%/15%
  ▪ N=86
DETAILS: Assessment of Gait, Mobility, Balance

• Gait
  ▪ Comfortable gait speed
  ▪ Dynamic Gait Index

• Balance
  ▪ Berg Balance Scale
  ▪ BESTest / MiniBESTest
  ▪ 4 Square Step Test
  ▪ POMA

• Mobility
  ▪ Timed Up and Go

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<table>
<thead>
<tr>
<th>age</th>
<th>Mean</th>
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<tbody>
<tr>
<td>60-69</td>
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<tr>
<td>70-79</td>
<td>1.25</td>
</tr>
<tr>
<td>80-89</td>
<td>0.82</td>
</tr>
<tr>
<td>90-101</td>
<td>0.71</td>
</tr>
</tbody>
</table>


Material presented at IPTA 2016 REVITALIZE Conference
Gait Speed

- Two good prospective studies with cut-off scores of < 1.0 and <0.6 m/s
  - Tiedemann et al., 2008, Age Aging;
  - Vicarro et al., 2011 J Am Geriatr Soc

- At <0.6 m/s the post-test probability if positive is higher (54-55%) than if at < 1.0m/s (32-40%). Not much change in predictability between the two cut-off scores if test is negative.

- Grey zone between 0.6 and 1.0 m/s?

4 or 8- item Dynamic Gait Index

- Gait*
- Change speed*
- Horizontal head turns*
- Vertical head turns*
- Gait and pivot turn
- Step over obstacle
- Step around obstacle
- Steps

- 8-item
  - Less than or equal to ≤ 19/24

- Some level III retrospective studies give wildly variable Sn and Sp values for cut-off at 19
Berg Balance Scale

- 0-56 points: lower score correlates with higher fall risk.
  - Range of cut-off scores used: 30, 45, 49, 50
  - Sn ranges 19%-77%; Sp ranges 60-100%

- Level I prospective study (Muir et al, 2010) (≤50)
  - Post-test probability if positive/negative = 38%/26%

- Level III retrospective study (Shumway-Cook et al, 1997) (≤49)
  - Post-test probability if positive/negative = 71%/11%

Timed Up & Go

- Probably measures the construct “mobility”
- Numerous studies
  - Higher Sp than Sn: better for ruling in than ruling out
  - When using the 13.5s threshold
  - Better quality studies exist that used ≥12s
- Schoene et al., 2013 JAGS
  - “pooled mean difference between fallers and non-fallers depended on the functional status of the cohort”
  - 0.63s for high functioning and 3.59s for those in institutional settings.
  - Probably more valuable for screening in lower-functioning persons
• Balance and Gait component
• Balance = 16
• Gait = 12
• Several Level I studies

BESTest

• Based on a systems approach to balance
  ▪ Biomechanical
  ▪ Stability limits
  ▪ Postural responses
  ▪ Anticipatory postural adjustments
  ▪ Sensory orientation
  ▪ Dynamic balance during gait and cognitive effects
14-item Mini BESTest

MAX SCORE = 32

- Sit to stand
- Rise to toes
- Stand on one leg
- Compensatory step
  - Forward
- Compensatory step
  - Backward
- Compensatory step
  - lateral
- Eyes open, firm
- Eyes closed, foam
- Incline eyes closed
- Change gait speed
- Walk with horizontal head turns
- Walk with pivot turns
- Step over obstacles
- TUG

Material presented at IPTA 2016 REVITALIZE Conference

MiniBESTest

- Recommendations for a Core Outcome Set for measuring standing balance in adult populations: A consensus-based approach.

- PLOS ONE | DOI:10.1371/journal.pone.0120568
  March 13, 2015

- MiniBESTest and BBS

Material presented at IPTA 2016 REVITALIZE Conference
Four Square Step Test

- Start in square 1, facing square 2.
- Step as fast as possible into 2, 3, 4, 4, 3, 2, and 1.
- Instructed to maintain body facing same direction at all times
  - Forces forward, side, backward, side, side, forward, side, backward stepping.
- 80% Sn and Sp
  - Retrospective study

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How assessment should probably drive intervention (the VIP trial)

- Older adults over 75 years with severe visual impairment
- RCT
  - home exercise (OTAGO)
  - Home safety program
- Home safety program reduced more falls despite evidence that OTAGO can reduce falls in this population (without severe visual deficits)
- What is the best procedure here?
  - Visual assessment/treatment; safety; exercise

Material presented at IPTA 2016 REVITALIZE Conference
Interventions

Just as the assessment is multi-factorial, so too is the management of falls: Target all risk factors with individually-prescribed interventions.

- Stubbs et al., PT, 2015

Umbrella Review of Meta-analyses

- Strong evidence that exercise is effective in preventing falls
- Exact type, duration, frequency, and setting of interventions do show some variations
- Endurance, balance, and strength training.
- Cochrane still the largest and most complete SR available.

- PTs have a central role in the prevention of falls in community-dwelling older adults.
AGS/BGS: Interventions

- Multifactorial Interventions to address identified risks and prevent falls
  - Multifactorial – participants are only offered the adjusted subset of interventions that target the risk factors that have been identified through a fall risk assessment.
  - A level

AGS/BGS: Initiation of Customized Exercise

- Individual or group (B level)

- Balance, strengthening, flexibility, tai chi, cardiovascular endurance,

- Strengthening, balance, gait and coordination sometimes considered as a “single intervention”

- 1-3x/wk for 12 weeks or more.

- A level
AGS/BGS: Persons with limited mobility

• May be more at risk as balance training begins.

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AGS/BGS: Home Modification

• Home environment assessment and intervention carried out by a health care professional

• Mitigation of identified hazards; promotion of safe performance of ADLs

• A level

Material presented at IPTA 2016 REVITALIZE Conference
AGS/BGS: Minimization of Medications

- Withdrawal or reduction of psychotropic medication
  - Antipsychotics – Abilify, Haldol
  - Antidepressants - SSRIs
  - Sedatives; anti-anxiety - benzodiazepenes
  - Mood stabilizers
  - Sleep aids – Ambien
  - B level

Multifactorial Interventions: Targeting Risk Factors

- Review/modification of medications
- Treatment for postural hypotension
- Treat vision impairment
- Manage foot /footwear
- Vitamin D suppl
- Treatment of cardiovascular disorders
- Alcohol use
- Gait training
- Advice on use of assistive device
- Exercise - balance training and strengthening
- Modifications of environmental hazards
- Provide education- resources, DME, ex programs, wellness, home hazards, footwear
Physical therapists **must** provide individualized interventions that address all positive risk factors within the scope of PT practice

- (CGS Grade A: Strong recommendation based on Level I evidence).

Components of the intervention should include:

- a. **Strength training** that is individually prescribed, monitored, and adjusted (CGS Grade A: Strong recommendation Level I evidence)
- b. **Balance training** that is individually prescribed, monitored, and adjusted (CGS Grade A: Strong recommendation Level I evidence)
- c. **Gait training** (CGS Grade A: Strong recommendation Level I evidence)
- d. **Correction of environmental hazards** (CGS Grade A: Strong Recommendation Level I evidence)
- e. **Correction of footwear or structural impairments of the feet** (CGS Grade B: Recommendation Level II evidence)
Exercise Parameters

- Frequency?
- Intensity?
- Time?
- Type?
  - Let’s start here: Strengthening, balance and gait (stability) training, home modification, feet and footwear

Mode (Type)

- Must include balance training
- Strength training alone has small effect
- Add gait training (stability requirement)
  - Walking programs alone have small effect
  - Advise against brisk walking for post-menopausal women with fracture history.

- Advice alone (health education) about fall risk factors, untargeted exercise alone, and modification of home environment alone may not help.
Frequency

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

Intensity

- Interventions that explicitly stated that they were not of sufficient intensity failed to decrease fall rates.
- Strengthening: follow established guidelines.
- 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
Time

- Duration of bout?
  - Range: 15-120 minutes
  - No relation between duration and effect, though most were 60 minutes.
- Duration of intervention?
  - 5 weeks to 2 years
  - Length of follow-up bias makes interpretation difficult
- Total exercise volume? 40-50 hours
- Must investigate continuing exercise behavior

ACSM / AHA Physical Activity Recommendations

- Muscle strengthening
  - 8-10 exercises performed on 2-3 non-consecutive days/wk.
  - 10-15 repetitions
  - Mod-high effort
  - Which muscles? Functional? Traditional?

- Aerobic exercise
  - Mod intensity – 30 min/day 5x / wk
  - Vigorous 20 min/day 3x / wk
Strengthening muscles that play a significant role in balance function

• Gluteal muscle composition differentiates fallers from non-fallers in community-dwelling older adults
  ▪ Inacio et al., BMC Geriatrics 2014, 14:37
  ▪ Retrospective study; small N

• Greater intramuscular adipose tissue in gluteal muscles and lower peak hip abductor torque generating capability in those who fell in the past 12 months compared to those who did not.

Balance Training

• What works
  ▪ Leaning beyond BOS and reaching
  ▪ Shifting the COM
  ▪ Minimizing UE support
  ▪ Narrowing base of support
  ▪ Changing the BOS by stepping

• What doesn’t work
  ▪ Lack of balance training component
  ▪ Lack of functional relevance
  ▪ Lack of exercise progression
Balance Progression

- Movements
  - Eyes/head --> limbs --> whole body
- Base of Support
  - Sitting --> Standing
  - Wide base --> Narrower base
  - 2 feet --> 1 foot
  - With UE support --> without UE support
- Sensory Input
  - Eyes open --> eyes closed
  - Good lighting --> poor lighting (dark)
  - Firm surface --> compliant surfaces
- Challenges to Center of Mass
  - Holding objects close --> out to side/in front
  - Actually perturbing the body from an external source

Material presented at IPTA 2016 REVITALIZE Conference

Graded Balance Ex.

- Graded reaching
  - Narrower BOS
  - Further and different directions
  - Down
  - Heavier objects
  - Stepping while reaching
  - Foam surfaces

- Stepping and Walking
  - Longer, faster steps, over obstacles
  - Tandem, speed, directions, obstacles

A. Tiedemann et al.
Journal of Science and Medicine in Sport 14 (2011) 489–495

Material presented at IPTA 2016 REVITALIZE Conference
Perturbation force thresholds are associated with falls

- Prospective cohort study by Sturnieks et al, 2013 PLOS ONE

- Participants received waist-pull perturbations in multiple directions to determine force thresholds for stepping.

- Prospectively monitored falls for one year after that.
  - 44% of subjects reported a fall.

Force thresholds continued

- Those older adults who reported a fall had significantly reduced posterior stepping force thresholds.

- At home falls (fallers) were associated with reduced posterior and lateral force thresholds.
  - 68% increased risk when there was a below median force threshold for posterior pulls.
Perturbation Training

- Training group received 24 slips in a laboratory
- Control group received 1 slip

- Recorded falls in preceding year (retrospective self-report).
- Recorded falls for the following year (diary, phone calls).

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Pai et al

- Training group went from 34% of the subjects reporting a fall prior to the training to 15% reporting a fall a year after training.

- Average BBS score = 53-54
- Average TUG score = 7-8 s

Material presented at IPTA 2016 REVITALIZE Conference
The Challenge of Matching Interventions to Risk

• For those at LOWER RISK: Tai chi and Stepping On are programs that are available in the community (e.g., senior centers, YMCAs), delivered by trained lay leaders, and are most appropriate for higher-functioning older adults.

• For those at HIGHER RISK: Outpatient PT and/or the Otago Exercise Program
  ▪ Otago is delivered by a PT and is most appropriate for frail, community-dwelling older adults at high risk for falls.
  ▪ Otago is designed to be delivered in 6 to 9 visits over a one-year period and has demonstrated a 35% reduction in falls in randomized controlled trials.
Who is Otago Good For?

- Older adults who have fallen and who have moderate to severe deficits in strength and balance
- And
  - Living in community, can walk on their own, w/ w/out device
  - Older than 80 years
- Too frail to do standing balance exercises? = PT
- Only mild strength and balance deficits? = try a more challenging program (Tai Chi?)
- Falls due to syncope, vestibular dysfunction, poor vision, neurologic condition, more than mild cognitive impairment? = refer to primary health provider and specialist.

Otago Exercise Program

- Can reduce falls by 35% in right population.
- Improves strength and balance.
- Stand – alone, home – based intervention.
- Could be used as part of a multifactorial falls prevention program.
Insuring Adherence to Exercise

• Convenient location
  ▪ Accessible by transportation
• Supervision and format
  ▪ Social support and social outlet
  ▪ Self-regulated behavior change
  ▪ Supervised group exercise supplemented by HEP
• Exercise bout duration
  ▪ Trade-off with adherence

Intervention: Environmental and Personal Factors

• Home hazard modification
• Treatment of foot and footwear problems identified in multi-factorial assessment
• Advise use of low heels and high surface contact area
• Hip protectors

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Summary: Global Recommendations

- Screening: all older adults should be screened for fall risk annually

- Multifactorial assessment: targeting an individual’s risk factors on those who screen positive

- Intervention: tailored, evidence-based interventions implemented

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