# Guideline for the Prevention of Falls in Older Persons

*American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention*

**Key words: falls; risk of falling; fall assessment; fall intervention; fall prevention**

## BACKGROUND AND SIGNIFICANCE

Falls are among the most common and serious problems facing elderly persons. Falling is associated with considerable mortality, morbidity, reduced functioning, and premature nursing home admissions.[1–5] Falls generally result from an interaction of multiple and diverse risk factors and situations, many of which can be corrected. This interaction is modified by age, disease, and the presence of hazards in the environment.[6] Frequently, older people are not aware of their risks of falling, and neither recognize risk factors nor report these issues to their physicians. Consequently opportunities for prevention of falling are often overlooked with risks becoming evident only after injury and disability have already occurred.[7–9]

Both the incidence of falls and the severity of fall-related complications rise steadily after age 60. In the age 65-and-over population as a whole, approximately 35% to 40% of community-dwelling, generally healthy older persons fall annually. After age 75, the rates are higher.[10,11]

Incidence rates of falls in nursing homes and hospitals are almost three times the rates for community-dwelling persons age ≥65 (1.5 falls per bed annually). Injury rates are also considerably higher with 10% to 25% of institutional falls resulting in fracture, laceration, or the need for hospital care.[12] Fall-related injuries recently accounted for 6% of all medical expenditures for persons age 65 and older in the United States.[12,13]

A key concern is not simply the high incidence of falls in older persons (young children and athletes have an even higher incidence of falls) but rather the combination of high incidence and a high susceptibility to injury. This propensity for fall-related injury in elderly persons stems from a high prevalence of comorbid diseases (e.g., osteoporosis) and age-related physiological decline (e.g., slower reflexes) that make even a relatively mild fall potentially dangerous. Approximately 5% of older people who fall require hospitalization.[14]

Unintentional injuries are the fifth leading cause of death in older adults (after cardiovascular, neoplastic, cerebrovascular, and pulmonary causes), and falls are responsible for two-thirds of the deaths resulting from unintentional injuries. More pointedly, 75% of deaths due to falls in the United States occur in the 13% of the population age 65 and over.[15] In addition to physical injury, falls can also have psychological and social consequences. Recurrent falls are a common reason for admission of previously independent elderly persons to long-term care institutions.[16,17] One study found that falls were a major reason for 40% of nursing home admissions.[14] Fear of falling and the post-fall anxiety syndrome are also well recognized as negative consequences of falls. The loss of self-confidence to ambulate safely can result in self-imposed functional limitations.[1,18]

## RISK FACTORS FOR FALLING

As detailed in Table 1, a number of studies have identified risk factors for falling. These can be classified as either intrinsic (e.g., lower extremity weakness, poor grip strength, balance disorders, functional and cognitive impairment, visual deficits) or extrinsic (e.g., polypharmacy (i.e., four or more prescription medications) and environmental factors such as poor lighting, loose carpets, and lack of bathroom safety equipment). Although investigators have not used consistent classifications, a recent review of fall risk factor studies ranked the risk factors and summarized the relative risk of falls for persons with each risk factor (Table 1).[11] In addition, a meta-analysis that studied the relationship of falls and medications, which included studies that examined both multiple and single risk factors, found a significantly increased risk from psychotropic medication (odds ratio (OR) = 1.7), Class 1a antiarrhythmic medications (OR = 1.6), digoxin (OR = 1.2), and diuretics (OR = 1.1).[32]

Perhaps as important as identifying risk factors is appreciating the interaction and probable synergism between multiple risk factors. Several studies have shown that the risk of falling increases dramatically as the number of risk factors increases. Tinetti et al. surveyed community-dwell-

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Address correspondence and reprint requests to: Nancy Lundebjerg, Senior Director, Professional Education and Publications, American Geriatrics Society, 350 Fifth Avenue, Suite 801, New York, NY 10118.



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**Table 1. Results of Univariate Analysis* of Most Common Risk Factors for Falls Identified in 16 Studies* That Examined Risk Factors**

| Risk Factor | Significant/Total† | Mean RR-OR‡ | Range |
|---|---|---|---|
| Muscle weakness | 10/11 | 4.4 | 1.5–10.3 |
| History of falls | 12/13 | 3.0 | 1.7–7.0 |
| Gait deficit | 10/12 | 2.9 | 1.3–5.6 |
| Balance deficit | 8/11 | 2.9 | 1.6–5.4 |
| Use assistive device | 8/8 | 2.6 | 1.2–4.6 |
| Visual deficit | 6/12 | 2.5 | 1.6–3.5 |
| Arthritis | 3/7 | 2.4 | 1.9–2.9 |
| Impaired ADL | 8/9 | 2.3 | 1.5–3.1 |
| Depression | 3/6 | 2.2 | 1.7–2.5 |
| Cognitive impairment | 4/11 | 1.8 | 1.0–2.3 |
| Age >80 years | 5/8 | 1.7 | 1.1–2.5 |

*References: 3, 5, 19–31.
†Number of studies with significant odds ratio or relative risk ratio in univariate analysis/total number of studies that included each factor.
‡Relative risk ratios (RR) calculated for prospective studies. Odds ratios (OR) calculated for retrospective studies.
ADL = activities of daily living.

ing elderly persons and reported that the percentage of persons falling increased from 27% for those with no or one risk factor to 78% for those with four or more risk factors.[30] Similar results were found among an institutionalized population.[5] In another study, Nevitt et al. reported that the percentage of community-living persons with recurrent falls increased from 10% to 69% as the number of risk factors increased from one to four or more.[27] Robbins et al. used multivariate analysis to simplify risk factors so that maximum predictive accuracy could be obtained by using only three risk factors (i.e., hip weakness, unstable balance, taking ≥4 medications) in an algorithm format. With this model, the predicted 1-year risk of falling ranged from 12% for persons with none of the three risk factors to 100% for persons with all three.[3]

There is emerging evidence of an overlap between the symptoms of falls and syncope in some older adults. This is due either to amnesia for loss of consciousness or to hypotension-induced imbalance in persons with existing gait and balance instability. To date, the overlap has been reported in selected populations with bradycardiac disorders such as carotid sinus syndrome. The prevalence of cardiovascular causes of falls in the general population is as yet unknown.

## GUIDELINE DEVELOPMENT PROCESS AND METHODS

The aim of this guideline is to assist health care professionals in their assessment of fall risk and in their management of older patients who are at risk of falling and those who have fallen. The Panel on Falls Prevention assumes that health care professionals will use their clinical knowledge and judgment in applying the general principles and specific recommendations of this document to the assessment and management of individual patients. Decisions to adopt any particular recommendation must be made by the practitioner in light of available evidence and resources.

The literature search attempted to locate systematic reviews and meta-analyses, randomized trials, controlled before-and-after studies, and cohort studies using a combination of subject heading and free text searches. The panel made extensive use of high-quality recent review articles and bibliographies, as well as contact with subject area experts. New searches were concentrated in areas of importance to the guideline development process, for which existing systematic reviews were unable to provide valid or up-to-date answers. The expert knowledge and experience of panel members also reinforced the search strategy. It is important to note that the literature upon which the guideline is based includes only those articles that were available to the Panel during its September 2000 meeting.

A literature search conducted by researchers at the RAND Corporation (RAND Corporation, Santa Monica, CA) for the purpose of identifying quality of care indicators for falls and mobility problems for two ongoing national projects provided the initial set of articles reviewed for the guideline. "Included" articles were meta-analyses and systematic literature reviews, randomized controlled trials, nonrandomized clinical trials, case control studies, and cohort studies in which outcomes involved data related to fall risk or fall prevention as well as articles that provided epidemiological or other background information. For each included article, data were extracted. Reference lists of included articles were scanned for any additional relevant studies, and further relevant articles were identified.

The Panel identified and synthesized relevant published evidence to allow recommendations to be evidence-based, whenever possible, using the grading criteria shown in Table 2. The grading criteria distinguish between category of evidence and strength of the associated recommendation. It was possible to have methodologically sound (Class I) evidence about an area of practice that was clinically irrelevant or had such a small effect that it was of little practical importance and would, therefore, attract a lower strength of recommendation. More commonly, a statement of evidence would only cover one part of an area in which a recommendation had to be made or would cover it in a way that conflicted with other evidence. Therefore, to produce comprehensive recommendations, the Panel had to extrapolate from the available evidence. This may lead to weaker levels of recommendation (B, C, or D) based on evidence Class I statements.[33] This is inevitably a subjective process.

It was accepted that there would be areas without evidence where recommendations should be made and that consensus would be required to address such areas. For a number of the interventions, there was not sufficient evidence to make recommendations and "Comment" sections were written. Throughout the guideline development process, the Panel identified important unanswered research questions that are listed in the "Research Agenda" section at the end of this guideline.

## ASSESSMENT OF PERSONS WHO HAVE FALLEN OR ARE AT RISK OF FALLING

### General Principles

It is a fundamental tenet of this guideline, based on a number of controlled studies, that detecting a history of falls and performing a fall-related assessment are likely to reduce future probability of falls when coupled with intervention (see Interventions to Prevent Falls, below). Because

**Table 2. Categories of Evidence and Strength of Recommendation**

Categories of Evidence

Class I: Evidence from at least one randomized controlled trial or a meta-analysis of randomized controlled trials.
Class II: Evidence from at least one controlled study without randomization or evidence from at least one other type of quasi-experimental study.
Class III: Evidence from nonexperimental studies, such as comparative studies, correlation studies and case-control studies.
Class IV: Evidence from expert committee reports or opinions and/or clinical experience of respected authorities.

Strength of Recommendation

A: Directly based on Class I evidence.
B: Directly based on Class II evidence or extrapolated recommendation from Class I evidence.
C: Directly based on Class III evidence or extrapolated recommendation from Class I or II evidence.
D: Directly based on Class IV evidence or extrapolated recommendation from Class I, II, or III evidence.

of this dependence of the assessment on subsequent intervention for effectiveness, it was more difficult to ascribe strength of recommendation to assessment recommendations alone. Therefore, specific recommendations for assessment have been left ungraded. Likewise, prior to any intervention, assessment of an individual's risks and deficits is required to determine specific needs and, if necessary, to deliver targeted interventions.

The recommendations for assessment came from epidemiological studies demonstrating an association between risk factors and falls (see Background and Significance) and from experimental studies in which assessment followed by intervention demonstrated benefit (see Interventions to Prevent Falls, below). Thus, the suggested assessment describes what needs to be done to understand an individual's risk factors and apply an effective intervention(s). An algorithm summarizing the assessment and management of falls is shown in Figure 1.

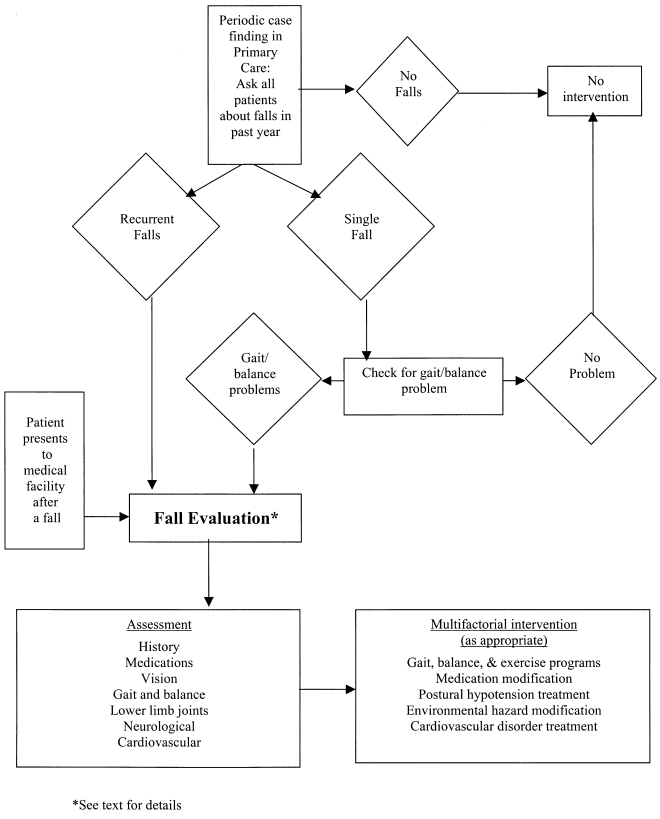


**Figure 1.** Algorithm summarizing the assessment and management of falls.

The intensity of assessment varies by target population. For example, fall risk assessment as part of routine primary health care visits with relatively low-risk senior populations would involve a brief assessment. In contrast, high-risk groups—such as persons with recurrent falls, those living in a nursing home, persons prone to injurious falls, or persons presenting after a fall—would require a more comprehensive and detailed assessment. The essential elements of any fall-related assessment include details about the circumstances of the fall (including a witness account), identification of the subject's risk factors for falls, any medical comorbidity, functional status, and environmental risks. A comprehensive assessment may necessitate referral to a specialist (e.g., geriatrician).

Although development of this guideline is a joint project of two American organizations (the American Geriatrics Society and the American Academy of Orthopaedic Surgeons) and the British Geriatrics Society, the epidemiology of falls is largely based on North American data, and there are little data to inform the appropriate configuration of services within the United Kingdom National Health Service. In particular, the balance between the benefits of assessment and intervention, set against the workload and cost implications of a potential increase in referral for specialist assessment, is unclear and would need to be carefully planned when implementing this guideline within any local setting.

The risk factors identified in the assessment may be modifiable (such as muscle weakness, medication side effect, or hypotension) or nonmodifiable (such as hemiplegia or blindness). However, knowledge of all risk factors is important for treatment planning. Essential components of the fall-related patient assessment were identified whenever possible from successful controlled trials of fall-prevention interventions. The justification for assessment to identify a specific risk factor is strongest when successful treatment or other risk-reduction strategies have been explicitly based on this specific risk factor. In some cases, the link between identified risk factors and the content of interventions is not clear. When conclusive data on the importance of specific aspects of the assessment (either to prediction of falls or to responsiveness of these risk factors to the intervention) were not available, consensus from the Panel was sought.

### Specific Recommendations: Assessment

#### *Approach to Older Persons as Part of Routine Care (Not Presenting After a Fall)*

1. All older persons who are under the care of a health professional (or their caregivers) should be asked at least once a year about falls.
2. All older persons who report a single fall should be observed as they stand up from a chair without using their arms, walk several paces, and return (i.e., the "Get Up and Go Test").[34,35] Those demonstrating no difficulty or unsteadiness need no further assessment.
3. Persons who have difficulty or demonstrate unsteadiness performing this test require further assessment.

#### *Approach to Older Persons Presenting with One or More Falls or, Have Abnormalities of Gait and/or Balance, or Who Report Recurrent Falls*

1. Older persons who present for medical attention because of a fall, report recurrent falls in the past year, or demonstrate abnormalities of gait and/or balance should have a fall evaluation performed. This evaluation should be performed by a clinician with appropriate skills and experience, which may necessitate referral to a specialist (e.g., geriatrician).
2. A fall evaluation is defined as an assessment that includes the following: a history of fall circumstances, medications, acute or chronic medical problems, and mobility levels; an examination of vision, gait and balance, and lower extremity joint function; an examination of basic neurological function, including mental status, muscle strength, lower extremity peripheral nerves, proprioception, reflexes, tests of cortical, extrapyramidal, and cerebellar function; and assessment of basic cardiovascular status including heart rate and rhythm, postural pulse and blood pressure and, if appropriate, heart rate and blood pressure responses to carotid sinus stimulation.

## INTERVENTIONS TO PREVENT FALLS

### General Principles

The literature identified for this part of the guideline was heterogeneous across most dimensions. This heterogeneity precluded the use of meta-analytic techniques and dictated the use of narrative summary. Again, the Panel identified and synthesized relevant published evidence according to the grading criteria shown in Table 2.

The populations included in the studies varied from fit older persons who had not fallen, those at risk for falls, and those experiencing single or frequent falls. The cognitive status of the study population was not reported consistently. Study environments included community settings (the majority), long-term care facilities, and acute hospital units. The method of reporting the effect of interventions on falls also varied across studies. The system used most commonly reported the total number of falls during a given interval following randomization. Other methods included reporting the number of fallers or the time to the first fall event. Evidence for compliance with the intervention(s) was not always reported. Methods for documenting fall outcomes also varied. The most frequently used method was calendar/diary cards. Other methods included telephone or personal interviews.

Most studies evaluating multifactorial interventions were conducted in community settings. The individual elements of the interventions were described inconsistently and, as a consequence of the study designs, it was not possible to determine which components were effective. However, by examining at the components of studies with and without an overall positive effect, it was possible to identify specific interventions that were used more commonly in positive studies. The multifactorial intervention studies were considered for the different settings in which participants resided: community-based, long-term care, and in-hospital studies.

The intervention strategies that were evaluated for their effectiveness in preventing falls were classified as single or multifactorial strategies and as generic or individually designed. The recommendations are presented for multifactorial interventions followed by single interventions because this sequence reflects the underlying evidence.

### Specific Recommendations: Multifactorial Interventions

1. Among *community-dwelling* older persons (i.e., those living in their own homes), multifactorial interventions should include: gait training and advice on the appropriate use of assistive devices (B); review and modification of medication, especially psychotropic medication (B); exercise programs, with balance training as one of the components (B); treatment of postural hypotension (B); modification of environmental hazards (C); and treatment of cardiovascular disorders, including cardiac arrhythmias (D).
2. In *long-term care and assisted living settings*, multifactorial interventions should include: staff education programs (B); gait training and advice on the appropriate use of assistive devices (B); and review and modification of medications, especially psychotropic medications (B).
3. The evidence is insufficient to make recommendations for or against multifactorial interventions in *acute hospital settings*.

#### *Community-Based Studies*

There were 11 randomized controlled studies of community-dwelling older adults.[36–46] The elements of the multifactorial interventions included education programs, self-management programs, home environment modifications, advice about medication use (with or without subsequent modification of medications), exercise, medical assessment, and management of cardiovascular disorders (such as postural hypotension and carotid sinus syndrome).

Reductions in the number and dosages of prescribed medications were associated with benefit in all three studies that included this intervention (Class I).[36,37,43] However, medication review without subsequent direct efforts to modify medications was of no benefit in three[38,39,45] of four[46] studies (Class I).

Exercise programs were associated with benefit in all three studies that included this intervention (Class I).[36,41,43]

Medical assessment followed by specific interventions for any medical problems that were identified (including

cardiovascular disorders and visual problems) was beneficial in one study (Class I).[37] Referral for medical assessment was of benefit in two[37,46] of three[45] studies (Class I). In addition, the management of postural hypotension was part of the effective intervention in two studies (Class I).[37,44]

Evidence of benefit from modification of home environmental hazards was equivocal in one[43] study and of no benefit in a second[45] (Class I).

Staff education programs were not effective in reducing falls (Class I).[38] Self-management programs were not beneficial in the five studies in which they were reported (Class I).[38–41,45]

Advice alone about fall risk factor modification (without measures to implement recommended changes) was of equivocal benefit in three[37,41,46] and of no benefit in two[39,40] studies (Class I).

### *Long-Term Care-Based Studies*

There were two randomized controlled studies in long-term care settings.[47,48] Both showed overall benefit from multifactorial interventions, although only one[47] study documented significant reductions in subsequent falls. (Class I). The effective components appeared to be comprehensive assessment, staff education (in contrast to community settings), assistive devices, and reduction of medications.

### *In-Hospital-Based Studies*

Although the strategy is widely implemented, there are no adequate randomized controlled trials of multifactorial intervention studies to reduce falls among hospital inpatients.[49]

## Specific Recommendations: Single Intervention

### *Exercise*

1. Although exercise has many proven benefits, the optimal type, duration and intensity of exercise for falls prevention remain unclear (B).
2. Older people who have had recurrent falls should be offered long-term exercise and balance training (B).
3. Tai Chi C'uan is a promising type of balance exercise, although it requires further evaluation before it can be recommended as the preferred balance training (C).

The Panel made a number of general observations about exercise. There is good evidence of benefit from exercise in falls prevention. However, the Panel was unable to determine which configuration of exercise program to recommend. The Panel identified a number of key findings: the evidence is strongest for balance training; there is less evidence for resistance and aerobic training; there are little data regarding the intensity or type of exercise. Successful programs have consistently been over 10 weeks duration. Exercise needs to be sustained for sustained benefit. There is only preliminary evidence to support the use of Tai Chi C'uan. There is a dearth of studies involving men. In long-term care settings, there is no evidence of benefit for exercise alone.

Among relatively healthy, community-dwelling older people, a program of very intensive strength and endurance training reduced the risk of subsequent falls and the proportion of fallers (Class I).[50] In another study involving community-dwelling women, there was no evidence that a generic exercise program reduced falls (Class I).[51] In young elderly, community-dwelling women, frequent low-impact weight-bearing exercises, and calcium supplementation over a 2-year period did not significantly reduce falls (Class I).[52] In community-dwelling older women, individually designed exercise programs in the home that incorporated strength and balance training reduced both falls and injuries; for those who continued to exercise, the benefits were evident after a 2-year period (Class I).[53] In the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) meta-analysis of seven studies that featured exercise as a prominent part of multifactorial interventions, there was an overall significant reduction in falls among intervention subjects, although only three of the seven individual trials showed significant reductions (Class I).[54] In a randomized trial of a group exercise program held thrice weekly for fall-prone older men, there was improvement in strength, endurance, gait, and function as well as reduced fall rates adjusted for increased levels of activity (Class I).[55]

In community-dwelling women at moderate risk of falls, Tai Chi C'uan reduced the rate of falls during a short follow-up period of 4 months (Class I).[56] In the same population, a computerized balance training program did not reduce falls (Class I).[56]

Among older women who had recurrent falls, a course of physical therapy targeting strength and balance was effective in reducing falls,[57] while a community-based generic exercise program in older men was of no benefit in falls reduction (Class I).[55,58] An individually designed exercise program for nursing home patients with moderate dementia did not reduce falls (Class I).[59]

### *Environmental Modification*

1. When older patients at increased risk of falls are discharged from the hospital, a facilitated environmental home assessment should be considered (B).

In a subgroup of older patients, a facilitated home modification program after hospital discharge was effective in reducing falls (Class I).[60] Otherwise, modification of home environment without other components of multifactorial intervention was not beneficial (Class I).[61–65]

### *Medications*

1. Patients who have fallen should have their medications reviewed and altered or stopped as appropriate in light of their risk of future falls. Particular attention to medication reduction should be given to older persons taking four or more medications and to those taking psychotropic medications. (C)

For all settings (i.e., community, long-term care, hospital, and rehabilitation), there is a consistent association between psychotropic medication use (i.e., neuroleptics, benzodiazepines, and antidepressants) and falls. Although there are no randomized controlled studies of manipulation of medication as a sole intervention, reduction of medications was a prominent component of effective fall-reducing interventions in community-based and long-term care multifactorial studies (Class I).[36,37,43,46,47] Multifacto-

rial studies suggest that a reduction in the number of medications in patients who are taking more than four preparations is beneficial. There is no clear difference in the risk for falls between long- and short-acting benzodiazepines (Class II).[32] Compliance with intervention needs to be sustained to be effective.

### *Assistive Devices*

1. Studies of multifactorial interventions that have included assistive devices (including bed alarms, canes, walkers (Zimmer frames), and hip protectors) have demonstrated benefit. However, there is no direct evidence that the use of assistive devices alone will prevent falls. Therefore, while assistive devices may be effective elements of a multifactorial intervention program, their isolated use without attention to other risk factors cannot be recommended (C).

There are few studies evaluating the effect of assistive devices (such as canes and walkers) as an intervention for preventing falls (Class IV).[66] Among hospitalized patients there is insufficient evidence for or against the use of bed alarms (Class I).[67]

Hip protectors do not appear to affect the risk of falling (Class I).[68] However, there are a number of studies, including three randomized trials, that strongly support the use of hip protectors for prevention of hip fractures in high-risk individuals. The Panel refers the reader to the published guidelines on the treatment and prevention of osteoporosis.[69,70]

### *Behavioral and Educational Programs*

1. Although studies of multifactorial interventions that have included behavioral and educational programs have demonstrated benefit, when used as an isolated intervention, health or behavioral education does not reduce falls and should not be done in isolation (B).

A structured group educational program among community-dwelling older people did not reduce the number of falls but did achieve short-term benefits in attitudes and self-efficacy (Class I).[71] Practice guidelines in the emergency department did not alter documentation of falls risk factors, causes of falls, consequences of falls, or the implementation of practice guidelines (Class I).[72,73]

## Comments on Other Potential Interventions

### *Bone Strengthening Medications*

A number of medications used widely to prevent or treat osteoporosis (e.g., hormone replacement therapy (HRT), calcium, vitamin D, antiresorptive agents) reduce fracture rates. However, these agents do not reduce rates of falls per se. Given the wealth of information concerning HRT and vitamin D in osteoporotic fractures, including ample prior analyses and practice guidelines, the Panel refers the reader to published guidelines on HRT for osteoporosis.[69,70,74]

### *Cardiovascular Intervention*

There is emerging evidence that some falls have a cardiovascular cause that may be amenable to intervention strategies often directed to syncope, such as medication change or cardiac pacing. The role of these cardiac investigations and treatments is not yet clear.

Case series report an overlap of symptoms of falls and syncope and a causal association between some cardiovascular disorders and falls, particularly orthostatic hypotension, carotid sinus syndrome, and vasovagal syndrome.[75–80] In particular, up to 30% of older patients with carotid sinus syndrome present with falls and have amnesia for loss of consciousness when bradyarrhythmia is induced experimentally.[81,82] Preliminary studies suggest that patients with recurrent unexplained falls and a bradycardiac response to carotid sinus stimulation experience fewer falls after implantation of a permanent cardiac pacemaker. However, pending the results of an ongoing randomized trial, pacemaker therapy for the treatment of recurrent falls cannot be recommended at this time.

### *Visual Intervention*

Patients should be asked about their vision and if they report problems, their vision should be formally assessed, and any remediable visual abnormalities should be treated.

There are no randomized controlled studies of interventions for individual visual problems despite a significant relationship between falls, fractures, and visual acuity.[83] Fall-related hip fractures were higher in patients with visual impairment.[84] Visual factors associated with two or more falls included poor visual acuity, reduced contrast sensitivity, decreased visual field, posterior subcapsular cataract, and nonmiotic glaucoma medication.[83–85]

### *Footwear Interventions*

Because there are no experimental studies of footwear examining falls as an outcome, the Panel is not able to recommend specific footwear changes to reduce falls. However, some trials report improvement in intermediate outcomes, such as balance and sway from specific footwear intervention. In women, results of functional reach and timed mobility tests were better when subjects wore walking shoes than when they were barefoot.[86] Static and dynamic balance were better in low-heeled rather than high-heeled shoes or than the patient's own footwear.[87] In men, foot position awareness and stability were best with high mid-sole hardness and low mid-sole thickness.[88] Static balance was best in hard-soled (low resistance) shoes.[89]

### *Restraints*

The Panel found no evidence to support restraint use for falls prevention. Restraints have been traditionally used as a falls prevention approach. However, they have major, serious drawbacks and can contribute to serious injuries. There is no experimental evidence that widespread use of restraints or, conversely, the removal of restraints, will reduce falls.[90–93]

## RESEARCH AGENDA

In the process of developing these guidelines, the Panel identified a number of issues related to falls prevention that it believes should be given high priority for future research and analysis. The Panel believes that further research will be necessary to gather sufficient evidence that

will lead to meaningful conclusions about the following concerns:

1. What is the cost effectiveness of recommended strategies?
2. Can fall-prone individuals be risk stratified in terms of whom will most benefit from assessment and interventions?
3. What are the effective elements for falls prevention among hospital inpatients?
4. How can falls best be prevented in patients with cognitive impairment and dementia?
5. What are the effective elements of exercise programs (such as type, duration, intensity, and frequency)?
6. What are the effective elements of cardiovascular programs for fall prevention?
7. For whom and when is home assessment by an occupational therapist or other home care specialist effective?
8. What is the effectiveness of assistive devices (e.g., canes and walkers/Zimmer frames) used alone as a strategy for preventing falls?
9. What is the effect of restraint removal, coupled with other specific interventions, on falls and serious injuries?
10. Does treatment of visual problems prevent falls?
11. What is the safest footwear for people who have fallen or are at risk of falling?
12. What is the role of hip protectors in persons who have fallen or are at risk of falling and what are the most effective designs?

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The primary authors of the *Guideline for the Prevention of Falls in Older Persons* are Rose Anne Kenny, MD, FRCPI, FRCP; Laurence Z. Rubenstein, MD, MPH, FACP; Finbarr C. Martin, MD, FRCP, Medicine and Elderly Care, Guy's and St. Thomas Hospitals Trust, London, UK; and Mary E. Tinetti, MD, Yale University School of Medicine, New Haven, CT, USA.

The remaining members of the panel are: David F. Apple Jr., MD, Shepherd Center, Atlanta, GA, USA; Judith Anne Cantrill, BSc, MSc, FpharmS, School of Pharmacy and Pharmaceutical Sciences, University of Manchester, Manchester, UK; John T. Chang, MD, MPH, Division of General Internal Medicine and Health Services Research, UCLA School of Medicine, Los Angeles, CA, USA; Pamela W. Duncan, PhD, PT, Kansas University Medical Center on Aging, Kansas City, KS, USA; Margaret Ellis, PhD, OT, West Square Associates, London, UK; Teresita Hogan, MD, FACEP, Emergency Medicine, Resurrection Medical Center, Chicago, IL, USA; Kenneth J. Koval, MD, Hospital for Joint Diseases, New York, NY, USA; Lewis A. Lipsitz, MD, Harvard Medical School, Beth Israel Deaconess Medical Center, Hebrew Rehabilitation Center for the Aged, Boston, MA, USA; Michael W. Rich, MD, Cardiovascular Division, Washington University School of Medicine, St. Louis, MO, USA; Neville E. Strumpf, RN, PhD, FAAN, University of Pennsylvania School of Nursing, Philadelphia, PA, USA; William Angus Wallace, MB, ChB, FRCS, FRCSEd, Orthopaedic and Accident Surgery, Queens Medical Centre, University of Nottingham, UK; and Archie Young, MD, FRCP, Department of Clinical and Surgical Sciences, University of Edinburgh, UK.

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