FALLS PREVENTION

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Learning Objectives

1. Explain the epidemiology, complications, and prognosis of falls in the elderly.
2. Identify factors that increase an elderly person's risk for a fall.
3. Apply recommendations regarding assessment of fall risk to elderly people.
4. Develop an appropriate plan to prevent falls in elderly people.
5. Identify drugs that increase an older adult's risk for falling.

Introduction

Falls are one of the most common and disabling problems facing older adults. A primary concern in this population is not only the increased incidence of falls, but the high susceptibility to injury secondary to factors such as osteoporosis and age-related physical and functional decline that predispose older adults to potentially serious falls. Falls and fall-related complications, such as fractures, are associated with a decline in functional status, poor quality of life, increased hospitalizations and nursing home admissions, increased health care costs, and increased mortality. Falls in older adults arise from a combination of risk factors and situations that often are preventable or easily resolved. Unfortunately, assessment of fall risk often is not addressed in the routine medical history and physical examination. Thus, further evaluation typically is not conducted until patients experience a fall.

Osteoporosis is the leading cause of serious morbidity and functional loss in old age. Osteoporosis develops in older adults when the normal processes of bone formation and resorption become unbalanced, resulting in bone loss. The result of this decreased bone mass and strength is a fracture, which, in the case of wrist and hip fractures, usually results from a fall in women.

Preventing and treating osteoporosis do not reduce the falling rate, but do reduce the risk of a fracture secondary to a fall, which is significant considering the increased morbidity and mortality associated with falls and fractures. Osteoporosis is a silent disease that can progress undetected until a fracture occurs. Therefore, early identification of osteopenia and osteoporosis and routine assessment of fall risk are essential to reduce the morbidity and mortality that accompany a fall or fall-related fracture.

This chapter focuses on assessing fall risk and preventing falls. However, in the context of discussing falls prevention, algorithms for managing osteoporosis in both women and men as a means to reduce fractures that may occur secondary to falls are provided in Figures 1-1 and 1-2. In addition, Table 1-1 provides the World Health Organization's diagnostic criteria for osteopenia and osteoporosis.

Epidemiology

A fall can be defined as a "sudden, unintentional change in position causing an individual to land at a lower level, on an object, the floor, or the ground, other than as a consequence of sudden onset of paralysis, epileptic seizure, or overwhelming external force." This definition is taken

Ettinger MP. Aging bone and osteoporosis. Arch Intern Med 2003;163:2237–46.

National Osteoporosis Foundation. 2004 Physician's Guide to Prevention and Treatment of Osteoporosis. Available at *www.nof.org*. Accessed April 30, 2004.

Abbreviations in this Chapter

BZD	Benzodiazepine
CNS	Central nervous system
CI	Confidence interval
HR	Hazard ratio
MOR	Multivariate odds ratio
OR	Odds ratio
SSRI	Selective serotonin reuptake inhibitor

from the Guidelines Development Group for the Prevention of Falls in People over 65. Falls are a major public health concern. In the United States, falls are the seventh leading cause of death and the leading cause of injury-related death in people older than 65 years of age. The cost of falls is expected to reach almost $35 billion by the year 2020. Each year, 30–60% of community-dwelling older adults (older than 65 years of age) fall. The incidence of falls and the severity of fall-related complications increase as people age, with rates rising steadily after 70 years of age. Falls typically are more common in women than men. The majority of falls in community-dwelling older adults occur at home indoors (kitchen, bathroom, and bedroom) and when individuals are walking or during other usual activities. Only about 10% of falls occur on stairs; descending often is more dangerous than ascending. Falls that occur outdoors typically involve street curbs and steps.

More than 50% of older adults who fall will sustain multiple falls. More than 50% of falls in older adults result in some minor injury, with 10% of falls resulting in a fracture. Falls account for more than 5% of hospitalizations and 10% of emergency department visits. During the month after hospital discharge, the risk of falling is highest, particularly among the elderly requiring home health care. The incidence of falls in hospitals and nursing homes is almost 3 times higher than the rate seen in community-dwelling older adults, with an average rate of falls in the nursing home of 1.5 per bed per year. This increased rate of falling in an institutionalized setting is thought to be because of the increase in frailty of those individuals. Frailty refers to "the loss of physiologic reserve that makes a person susceptible to disability from minor stresses." Frailty includes weakness, weight loss, muscle wasting, incontinence, immobility, and unstable chronic diseases. The most common sites of falls are at the bedside on rising to use the bathroom or when returning to the bed. About 10–25% of falls that occur in an institution setting will result in a serious injury, such as a hip or other fracture, laceration, subdural hematoma, other serious tissue injury, or head injury, and often require medical care.

Etiology

Overview

The majority of falls are attributed to an interaction between multiple factors often referred to as predisposing and environmental factors or sometimes intrinsic and extrinsic factors. Predisposing factors include age-related changes in neuromuscular and cardiac homeostatic mechanisms that affect balance, such as sensory, neurologic, musculoskeletal, postural hypotension, drugs, and other factors. Predisposing factors accompany aging, but when a person loses a significant amount of physiological reserve to the point where he or she is susceptible to disability, then frailty ensues. The primary contributor often is the underlying condition rather than the environmental factor; however, environmental factors likely contribute to the majority of falls in community-dwelling older adults. Therefore, interventions to prevent and reduce falls must be multifaceted. Table 1-2 provides an overview of common predisposing factors. Environmental or home hazards are summarized in Table 1-3.

The frequency of falling is related to a combination of multiple factors superimposed on age-related changes. As the number of risk factors increases, the likelihood of falling increases. The most common risk factors identified in various studies include muscle weakness and decreased muscle strength, a history of falls, gait and/or balance instability, use of an ill-fitting or inappropriate assistive device, visual impairment, arthritis, decline in functional status (activities of daily living), depression, postural hypotension (which affects 20–30% of community-dwelling older adults), cognitive impairment, age older than 80 years, and the use of four or more drugs. Individual drug classes have contributed to falls and, in some cases, nonspine fractures. More recently, the number of chronic diseases has increased the fall risk. Chronic diseases may increase the fall risk directly or indirectly. For example, some medical conditions may decrease functional status, decrease muscle weakness, impair mobility, reduce physical activity, and contribute to poor gait and balance.

Drugs

Table 1-4 provides an overview of drug classes contributing to risk of falls.

A meta-analysis was conducted in adults older than 60 years of age to examine the relationship between falls and drugs. A significant increase in fall risk was associated with psychotropic drugs (odds ratio [OR] = 1.7), phenothiazine or butyrophenone neuroleptics (OR = 1.5), hypnotic drugs (OR = 1.5), all antidepressant drugs (OR = 1.7), tricyclic antidepressant drugs (OR = 1.5), benzodiazepines (BZDs) (OR = 1.5), class 1A antiarrhythmic drugs (OR = 1.6), digoxin (OR = 1.2), and diuretics (OR = 1.1). Nineteen studies classified all psychotropic drugs together, regardless of specific class, so

Feder G, Cryer C, Donovan S, et al. Guidelines for the prevention of falls in people over 65. BMJ 2000;321:1007–11.

Lawlor DA, Patel R, Ebrahim S. Association between falls in elderly women and chronic diseases and drug use: cross sectional study. BMJ 2003;327:712–7.

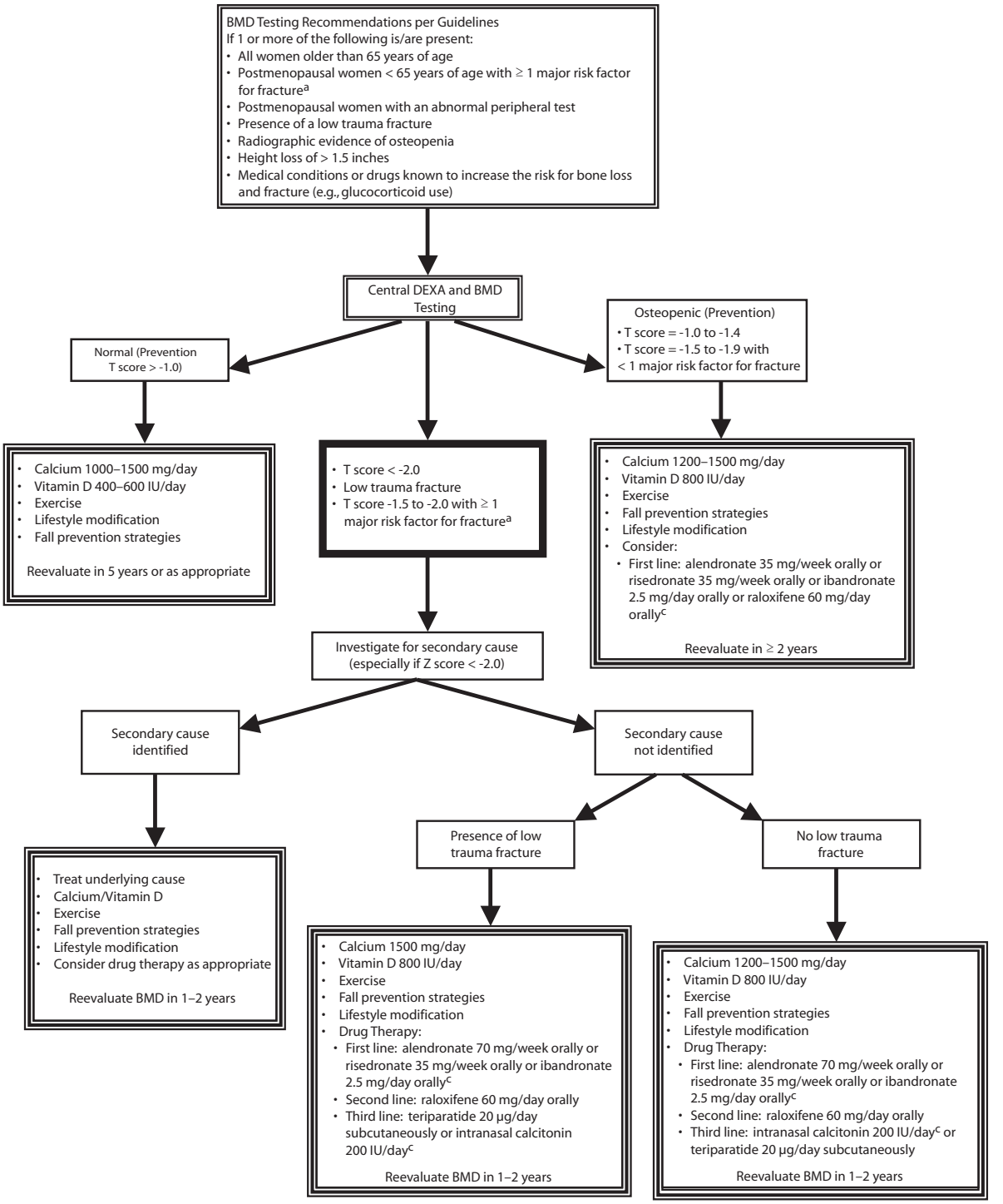

Figure 1-1. Management of osteoporosis in postmenopausal women.

[a]Major risk factors (independent risk factors for fracture): current smoker, low body weight (less than 127 pounds), history of osteoporotic fracture in a first-degree relative, and personal history of fracture as an adult (after 40 years of age)

[b]Examples of secondary causes: (medical conditions: rheumatoid arthritis, multiple myeloma, hyperparathyroidism, Cushing's syndrome, chronic obstructive pulmonary disease, hyperthyroidism, inflammatory bowel disease, chronic kidney disease, and organ transplantation); (drugs: glucocorticoids, anticonvulsants, heparin, neuroleptics, gonadotropin-releasing hormone agonists, and methotrexate).

[c]The biphosphonates (alendronate, risedronate, and ibandronate) should not be used if creatinine clearance is less than 30 ml/minute.

[d]Can be used short term in combination with a first- or second-line therapy for managing pain in patients with an acute vertebral fracture.

BMD = bone mineral density; DEXA = dual-energy x-ray absorptiometry; IU = international units.

Reprinted with permission from American College of Clinical Pharmacy. Follin SL. Update in Osteoporosis. In: Mueller BA, Bertch KE, Dunsworth TS, et al, eds. Pharmacotherapy Self-Assessment Program, 4th ed. Men's Health Module. Kansas City, MO: ACCP, 2003:349.

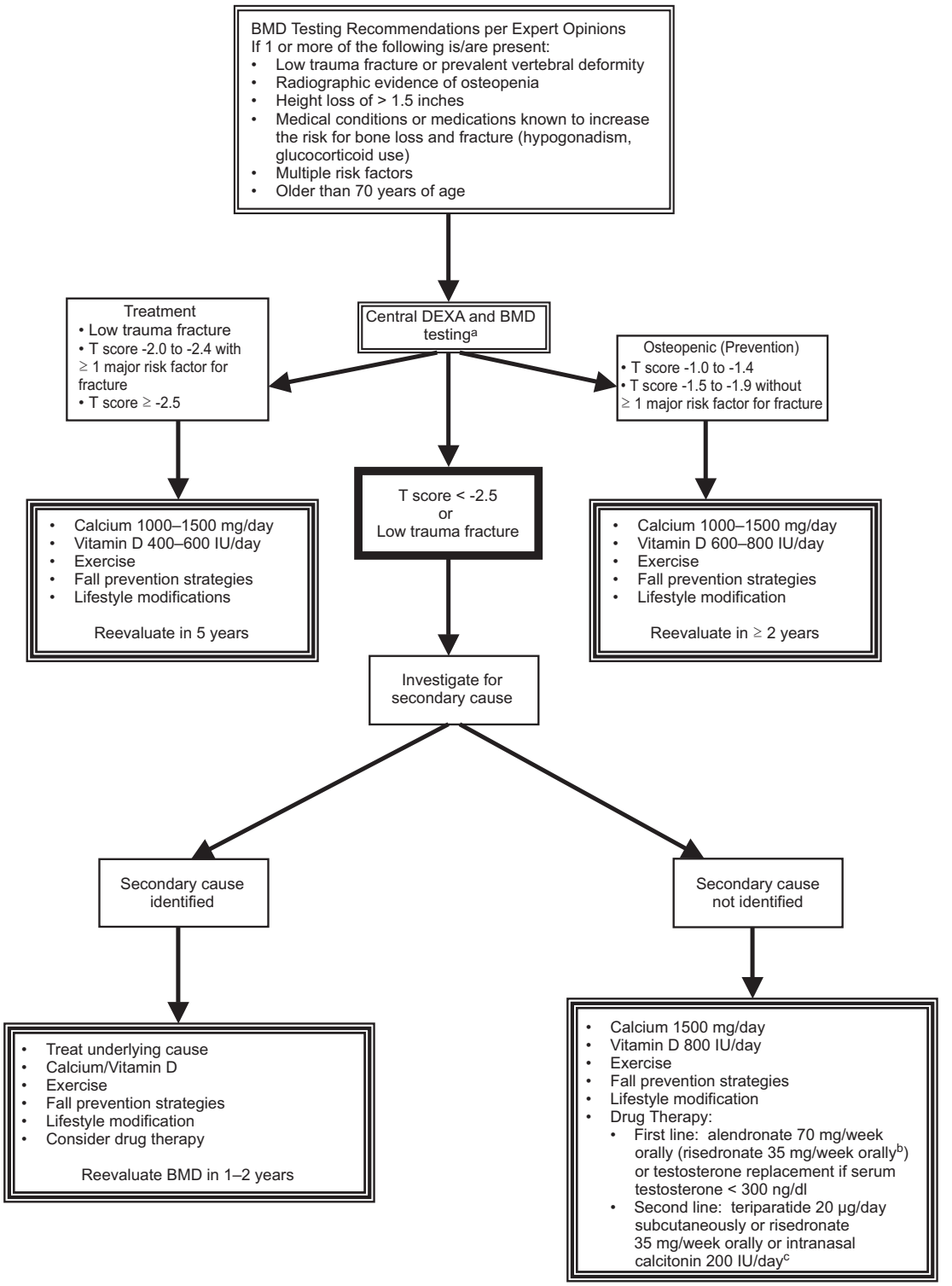

Figure 1-2. Management of osteoporosis in men.
[a]Based on a normal male reference database.
[b]Examples of secondary causes: (medical conditions: rheumatoid arthritis, multiple myeloma, hyperparathyroidism, Cushing's syndrome, chronic obstructive pulmonary disease, hyperthyroidism, inflammatory bowel disease, chronic kidney disease, and organ transplantation); (drugs: glucocorticoids, anticonvulsants, heparin, neuroleptics, gonadotropin-releasing hormone agonists, and methotrexate).
[c]Risedronate may be considered if alendronate is not available or cannot be tolerated.
[d]Can be used short term in combination with a first- or second-line therapy for managing pain in patients with an acute vertebral fracture.
BMD = bone mineral density; DEXA = dual-energy x-ray absorptiometry; IU = international units.
Reprinted with permission from American College of Clinical Pharmacy. Follin SL. Update in Osteoporosis. In: Mueller BA, Bertch KE, Dunsworth TS, et al, eds. Pharmacotherapy Self-Assessment Program, 4th ed. Men's Health Module. Kansas City, MO: ACCP, 2003:349.

the designation "psychotropic drugs" refers to this more global classification. In this meta-analysis, no association was found between narcotic drugs and fall risk. One limitation of these data is that they were collected between 1975 and 1993 and do not reflect newer, more commonly used drugs. In addition, the studies examined were observational and did not account for potential confounders at the time of the fall, which may contribute to the overestimation of risk.

A prospective, cohort study was conducted between 1992 and 1994 in four clinical centers across the United States to determine the risk of falls in older (older than 65 years of age), community-dwelling women taking central nervous system (CNS)-active drugs. Drugs included BZDs (8% of women), antidepressant drugs (6% of women), anticonvulsant drugs (2% of women), and narcotic drugs (5% of women). Seventy percent of women used tricyclic antidepressant drugs, 21% used selective serotonin reuptake inhibitors (SSRIs), and 11% used trazodone. Of the women using anticonvulsant drugs, 95% were daily users; of those taking narcotic drugs, 55% were daily users. Falls were assessed as one fall or more than one fall (frequent falling). Women (n = 8127) were, on average, 77 years old and about 40% had fallen in the past year. During an average follow-up of 1 year, 28% of the women reported falling at least once (11% had more than one fall). After adjusting for multiple confounders, women using BZDs were 34% more likely to fall at least once and 51% more likely to experience frequent falling compared to nonusers (Table 1-5). Both findings were statistically significant. For both falling and frequent falling, this increase in risk was noted in women using short- and long-acting BZDs, but the increase reached significance only in women taking long-acting BZDs. Among women with a previous fall, users of BZDs had 1.6 times the risk of falling at least once as nonusers (multivariate odds ratio [MOR] = 1.62; 95% confidence interval [CI] = 1.17–2.24) and twice the risk of frequent falling (MOR = 2.13; 95% CI = 1.45–3.14), thereby placing them at the greatest risk for falling. In contrast, in women without a prior fall, users of BZDs had a nonsignificant increase in the risk of falling.

In the same study, women taking antidepressant drugs had a slightly higher risk of falling at least once; however, after adjusting for multiple confounders, this finding was not significant (MOR = 1.22; 95% CI = 0.97–1.53; p=0.096) (Table 1-5). In contrast, women taking antidepressant drugs had an increased risk of frequent falling that was significant (MOR = 1.54; 95% CI = 1.14–2.07) (Table 1-5). The falling risk did not differ between women with or without a prior fall history. Antidepressant drug use remained a risk factor for falls even after controlling for confounders, including depression. Despite suggestions that SSRIs may not be associated with an increase in fall risk because of fewer anticholinergic adverse effects, there was no evidence that this drug class was associated with significantly less risk than tricyclic antidepressant drugs. Women using anticonvulsant drugs were 75% more likely than nonusers to fall at least once (MOR = 1.75; 95% CI = 1.13–2.71) and more than 2 times more likely to experience frequent falls (MOR = 2.56; 95% CI = 1.49–4.41) (Table 1-5). However, this significant finding was only noted in women who had a history of falls. When adjusted for multivariate confounders, there were no significant increases in fall risk in women using narcotic drugs with one fall or frequent falls. When adjusted for age alone, women taking narcotic drugs were more likely than nonusers to fall (OR = 1.44; 95% CI = 1.17–1.77) (Table 1-5). After adjusting for gait speed, the effects were reduced by more than 40%, yet remained significant. The increased fall risk in users of narcotic drugs appears to be explained, in large part, by poor neuromuscular function. However, after adjusting for multiple factors related to narcotic drug use and falling, there was no association between narcotic drugs and falls.

Overall, the study found that after controlling for multiple variables, current use of BZDs, antidepressant drugs, and anticonvulsant drugs were associated with an increased risk of frequent falling in community-dwelling older women. This finding was significant and most pronounced only in women with a prior history of falling, with the exception of women using antidepressant drugs. As described in other studies, use of SSRIs does not appear to offer any advantage over other antidepressant drugs with respect to minimizing fall risk. Of note, this study was the first prospective study that assessed fall risk secondary to drugs that attempted to control for multiple confounders, including confounding by indication. Other studies that

Table 1-1. The World Health Organization Diagnostic Criteria for Women with Fragility Fractures[a]

Normal	BMD is within 1 SD of a young normal adult (T score above -1.0)
Osteopenia	BMD is between 1 and 2.5 SD below that of a young normal adult (T score between -1.0 to -2.5)
Osteoporosis[b]	BMD is 2.5 SD or more below that of a young normal adult (T score at or below -2.5)

[a]Although these definitions are necessary to establish the prevalence of osteoporosis, they should not be used as the sole determinant of treatment decisions.
[b]Severe or established osteoporosis is defined as the presence of one or more low trauma fractures.
BMD = bone mineral density; SD = standard deviation.
Reprinted with permission from the World Health Organization. National Osteoporosis Foundation. 2004 Physician's Guide to Prevention and Treatment of Osteoporosis. Available at *http://www.nof.org/*. Accessed April 30, 2004.

Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis. I. Psychotropic drugs. J Am Geriatr Soc 1999;47:30–9.

Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis. II. Cardiac and analgesic drugs. J Am Geriatr Soc 1999;47:40–50.

Ensrud KE, Blackwell TL, Mangione CM, et al. Central nervous system-active medications and risk for falls in older women. J Am Geriatr Soc 2002;50:1629–37.

Table 1-2. Predisposing Factors Associated With Fall Risk

Risk Factors	Interventions		
	Medical	Rehabilitative	Environmental
Predisposing			
Acute and Chronic Diseases	Manage the underlying condition or refer to specialist		
Examples			
Urinary tract infection			
Nocturia (CHF, BPH)			
Hypoglycemia			
Electrolyte disorders			
Anemia			
Emphysema			
Sensory			
Vision	Refraction	Balance and gait training	Good lighting with no glare
Acuity < 20/60	Cataract extraction		Home safety assessment
Cataracts			Architectural design minimizing distortions and illusions
			Referral to ophthalmologist
Hearing	Cerumen removal	Training in hearing aid use	Decrease background noise
	Audiologic evaluation with hearing aid, if appropriate		
Vestibular dysfunction	Avoid vestibulotoxic drugs	Habituation exercises	Good lighting (increased reliance on visual input)
	Surgical ablation		Architectural design minimizing distortions and illusions
Proprioceptive	Diagnose and treat specific diseases (e.g., spondylosis vitamin B_{12} deficiency)	Balance exercises	Good lighting (increased reliance on visual input)
Peripheral neuropathy		Correct walking aid	Appropriate footwear
		Physical therapy assessment	Home safety assessment
Balance and gait	Assess/treat cause	Balance and gait training	Home safety assessment
	Remove offending drugs	Physical therapy assessment	
CNS			
CNS diseases	Diagnose and treat specific diseases	Physical therapy	Home safety assessment
Parkinson's disease		Balance and gait training	Appropriate adaptations (e.g., high, firm chairs, raised toilet seats, grab bars in bathroom)
Stroke		Correct walking aid	
Dementia/cognitive impairment	Minimize sedating or centrally acting drugs	Supervised exercise and ambulation	Safe, structured, supervised environment
Depression	Cautious use of antidepressant drugs		
Musculoskeletal			
Muscle weakness			
Arthritis	Diagnose and treat specific diseases	Balance and gait training	Home safety assessment
Foot disorders (bunions, callouses)		Range of motion training	Appropriate assistive devices
		Muscle strengthening exercises	
		Tai Chi	
		Back exercises	
		Correct walking aid	
		Correct foot wear	
		Good foot care (nails, bunions)	
		Refer to podiatrist	

Table 1-2. Predisposing Factors Associated With Fall Risk (continued)

Risk Factors	Interventions		
	Medical	Rehabilitative	Environmental
Cardiovascular Syncope Arrhythmia	Referral to cardiologist		
Postural hypotension (drop in SBP of 20 mm Hg)	Diagnose and treat underlying cause Avoid offending drugs Rehydrate Replenish salt Rise slowly	Tilt table if severe reconditioning if component of deconditioning Graded pressure stockings Dorsiflexion and hand flexion Exercises prior to arising	Elevate head of bed Rise slowly
Drugs[a] High-risk drugs or four or more medications	Education Withdrawal or lowest effective dose of high-risk drugs Avoid alcohol		
Circumstances of previous falls			Changes in environment and activity to reduce likelihood of recurrent falls

[a]See Table 1-4.
BPH = benign prostatic hyperplasia; CHF = chronic heart failure; CNS = central nervous system; DM = diabetes mellitus; SBP = systolic blood pressure.
Reprinted with permission from Springer-Verlag Gmblt & Company and Helen K. Edelberg, M.D. Thomas DC, Edleberg HK, Tineth ME. Falls. In: Assel CK, Leipzig R, Chen H, et al, eds. Geriatric Medicine: An Evidence-Based Approach, 4th ed. Heidelberg, Germany: Springer-Verlag, 2003.

controlled for confounders have only included a few variables or used administrative databases to determine the variables of interest, thereby limiting those variables that could be tested.

A follow-up study was conducted with the same women to determine whether the use of these CNS-active drugs increased a woman's risk for fracture. Ninety percent of the women in the original study were still using the drugs: 7% BZDs, 8% antidepressant drugs, 2% anticonvulsant drugs, and 5% narcotic drugs. Thirty-seven percent of BZD users were taking long-acting preparations. Of those taking antidepressant drugs, 57% were taking tricyclic antidepressant drugs and 35% were taking SSRIs. For the outcome of fractures, the women were followed for an average of 4.4 years to determine the incidence of nonspine fractures, including hip fractures. Almost 15% of women using CNS-active drugs experienced at least one nonspine fracture (4% of women had hip fracture) compared with nonusers. After adjusting for age alone, a 54% increased risk of hip fracture was seen in women using BZDs; however, this relationship was reduced in magnitude and no longer significant after adjusting for multiple confounders. The increase in risk seemed to be explained largely by femoral neck bone mineral density. There was no evidence of an independent association between use of (short- or long-acting) BZDs and risk for fracture. Antidepressant drug use, when adjusted for multiple confounders, had a 1.7-fold increase in the risk for hip fracture (multivariate hazard ratio [HR] = 1.65; 95% CI = 1.05–2.57). Effects on nonspine fractures were not significant. Both tricyclic antidepressant drugs and SSRIs appeared to increase the fracture risk, but this effect was only significant for women using tricyclic antidepressant drugs. Although SSRIs were not independently associated with an increased risk of nonspine fracture, a nonsignificant increase in fracture risk was seen. It is possible that a statistically significant increase in fracture risk was not seen in patients treated with SSRIs because of a small sample size in the SSRI group (more patients were taking tricyclic antidepressant drugs than SSRIs). Therefore, additional prospective studies are needed before it can be concluded that SSRIs do not contribute to fracture risk. After adjusting for multiple confounders related to narcotic drug use, an increased risk for nonspine fracture was noted in women using narcotic drugs (multivariate HR = 1.40; 95% CI = 1.06–1.83); however, the association was largely explained by slower gait speed. Anticonvulsant drug use was not associated with risk of fracture when adjusted for multiple confounders. Overall, the study reported a small increase in risk of nonspine fracture and a moderate increase in the risk of hip fracture for women using antidepressant drugs and a small increase in the risk of nonspine fracture for women using narcotic drugs; however, the latter effect could be explained by slower gait speed as discussed in the original study. The study concluded that antidepressant drug use and narcotic drug use are independent risk factors for nonspine fractures

Ensrud KE, Blackwell T, Mangione CM, et al. Central nervous system active medications and risk for fractures in older women. Arch Intern Med 2003;163:949–57.

Table 1-3. Environmental Hazards and Interventions

Potential Hazards	Suggested Interventions
Lighting	• Install adequate lighting by doorways and along walkways leading to all doors • Install switches that are immediately accessible upon entering a room • Provide ample lighting in all areas, especially on path from bedroom to bathroom, while reducing the glare with evenly distributed or indirect lighting
Floors	• Repair or replace torn items to reduce risk of tripping and tack down rugs with nonstick backs to prevent curling or remove rugs • Keep floors clear by removing all papers, books, magazines, blankets, towels, wires, etc • Use rubber mats and nonslip or nonskid wax or buff paste wax to reduce risk for slipping • Coil or tape cords and wires next to the wall to prevent tripping or have an electrician install another outlet
Furniture	• Eliminate or replace chairs that are too low to sit in or too difficult to get out of • Provide high-back chairs with armrests that extend to give proper leverage when sitting/standing • Place furniture so that pathways are not obstructed and hallways are not cluttered • Keep commonly used items at waist level or install shelves/cupboards at an accessible height • Install tables with even, sturdy legs to increase support for persons with gait disturbances
Bathroom	• Install skid-resistant strips or rubber mats, wear rubbers shoes, or use a bath seat • Install portable grab bar on side of tub to aid in transfers • Use elevated toilet seat; install grab bars on sides of toilet
Stairways	• Correct step height to less than 6 inches • Install and anchor handrails on both sides to extend beyond top and bottom step • Install adequate lighting to extend entire length of stairway while placing nonskid treads on all steps to prevent slipping
Miscellaneous	• Install proper lighting around medicine cabinet and label all drugs so they can be identified easily • Ensure that shoes fit well and are not prone to slipping and sliding • Repair cracked sidewalks and curbs leading to house

in community-dwelling older women, and antidepressant drug use increases a woman's risk for hip fracture.

In summary, the meta-analyses and selected studies discussed here provide the best evidence to date that the strongest links to falls occur with the following drugs: antidepressant drugs (both SSRIs and tricyclic antidepressant drugs), BZDs, anticonvulsant drugs, and class 1A antiarrhythmic drugs. Regardless of the setting (community, long-term care, assisted living, and hospital), psychotropic drugs (antipsychotic drugs, BZDs, and antidepressant drugs) consistently demonstrate an association that approximates a 2-fold increase in fall risk. Diuretics have been linked in some studies to an increased risk for falls, but data are conflicting and more recent reports indicate little to no risk. Furthermore, studies conducted to date suggest that the strongest link between CNS-active drugs and fracture risk are with antidepressant drugs and narcotic drugs. What is perplexing is that the previously discussed large, prospective study in 8127 older women found no association between narcotic drugs and fall risk when adjusting for multiple confounders, but did report an association between narcotic drug use and nonspine fractures. The findings showing no association between narcotic drugs and fall risk are consistent with the majority of reports in the literature. However, multiple studies suggest a significant association between narcotic drugs and nonspine fractures, although in some studies this association was reduced to a level of nonsignificance when adjusted for multiple confounders, including gait speed. It would be expected that effects of narcotic drugs, such as impaired neuromuscular function, sedation and dizziness, and reduced alertness, likely contribute to falls that lead to fractures. However, results of studies examining the association between narcotic drug use and falls do not suggest this. A possible limitation of the studies may be the way in which the data were analyzed and adjusted using multiple confounders and gait speed. Whether adjusting for all of these variables is a strength or weakness of the analyses is unknown. Nevertheless, an association between narcotic drug use and nonspine fractures in the absence of an association between narcotic drug use and falls is perplexing. Prospective data are needed to clarify these conflicting and confusing reports.

Weiner DK, Hanlon JT, Studenski SA. Effects of central nervous system polypharmacy on falls liability in community-dwelling elderly. Gerontology 1998;44:2217–21.

Table 1-4. Drug Classes Contributing to Risk of Falls

Drug Classes	Possible Mechanism
Analgesics, especially opioids NSAIDs, especially indomethacin	• Reduce alertness, impair neuromuscular (some) function, induce sedation and dizziness, impair cognition functioning
Antihypertensives, antiarrhythmics	• Impair cerebral perfusion, induce orthostasis
Diuretics (more likely if patient is dehydrated)	• Induce orthostasis, increase ambulation
Anticonvulsants	• Induce sedation and dizziness, impair balance • May be a marker of the occurrence of seizures resulting in falls • May be directly detrimental to bone by resulting in osteomalacia or secondary hyperparathyroidism
Benzodiazepines Sedative hypnotics (e.g., zolpidem and zaleplon)	• Cause sedation, dizziness, and postural disturbances • May be a marker of conditions known to increase fall risk, such as depression, impaired cognition, poor health status, and neuromuscular impairment
Antidepressants	• Cause sedation and postural disturbances • May be indirectly associated with fall risk attributed to factors as poor health status, depression, and weight loss
Antipsychotics	• Reduce alertness, impair neuromuscular functioning, induce sedation and possibly dizziness, induce postural hypotension, alter gait and balance, induce extrapyramidal symptoms
Anticholinergics, phenothiazines	• Reduce alertness, impair neuromuscular functioning, induce sedation and possibly dizziness, induce postural hypotension, alter gait and balance, induce extrapyramidalsymptoms

NSAID = nonsteroidal anti-inflammatory drug.

Complications and Prognosis

The consequences of a fall-related fracture include restrictions in mobility, diminished functional status, diminished quality of life, loss of independence, increased risk of nursing home placement, and increased mortality. After a fracture, some people may experience full recovery, but in many cases, people experience complications, such as chronic pain, functional impairment, disability, loss of independence, or even death. The deterioration in functional ability that may follow a fracture can affect many activities of daily living, such as an older person's ability to bathe, dress, or ambulate independently. This loss of functional status and independence often leads to psychological symptoms and diminished quality of life and contributes to caregiver burden. Fractures can lead to depression as patients cope with pain, functional decline, physical limitation, and impaired mobility. Patients also may experience anxiety, frustration, and fear, which can further impede recovery. The most severe consequence of a fracture is increased mortality.

More than 55% of falls will result in some type of minor injury, with almost 10% of falls resulting in a fracture. Serious injuries, such as head and internal injuries, can occur in up to 10% of older adults who fall, leading to even greater complications. Almost 2% of falls result in fracture of the hip and about 5% result in fractures of the humerus, wrist, and pelvis. More than 90% of hip fractures result from a fall from standing height or less. Wrist fractures occur more commonly in younger people as a result of bracing the fall with a hand. Vertebral fractures typically are not because of falls, but occur spontaneously with minimal to no trauma and depend highly on such factors as bone strength.

Hip fractures are the most serious type of fracture because they are associated with the greatest increase in morbidity, mortality, and health care costs. Hip fracture rates increase exponentially with age, and are 4 times more frequent in women than men. The incidence of hip fracture in men, and the associated mortality, rise considerably as men approach 80 years of age. After a hip fracture, only about 40% of patients regain the level of mobility they had before the fracture, and only 25% regain their former functional status. Twenty percent are nonambulatory and 10–60% are unable to return to independent living. Up to 25% of patients with hip fracture may require nursing home

Shorr RI, Griffen MR, Daugherty JR, et al. Opioid analgesics and the risk of hip fracture in the elderly: codeine and propoxyphene. J Gerontol 1992;47:M111–M5.

Guo Z, Willis P, Vittanen M, et al. Cognitive impairment, drug use, and the risk of hip fracture in people over 75 years old: a community-based prospective study. Am J Epidemiol 1998;148:887–92.

Table 1-5. Association Between Current Use of Drugs and Falls

Drug	Age-adjusted Odds Ratio (95% CI)		Multivariate Odds Ratio (95% CI)	
	One Fall	Frequent Falls	One Fall	Frequent Falls
Benzodiazepines	1.56 (1.31–1.86)	1.72 (1.36–2.16)	1.34 (1.09–1.63)	1.51 (1.14–2.01)
Antidepressants	1.70 (1.40–2.05)	2.40 (1.90–3.02)	1.22 (0.97–1.53)	1.54 (1.14–2.07)
Anticonvulsants	2.49 (1.73–3.58)	3.15 (2.08–4.77)	1.75 (1.13–2.71)	2.56 (1.49–4.41)
Narcotics	1.44 (1.17–1.77)	1.69 (1.29–2.21)	1.02 (0.79–1.31)	0.99 (0.68–1.43)

CI = confidence interval.

care. More than 50% of those older than 90 years of age admitted to the hospital for a hip fracture are discharged from the hospital to a nursing home. About 4% of patients will die during the initial hospitalization for hip fracture, and about 20% will die within 1 year because of complications.

Therapeutic Goals and Outcomes

The primary goal of falls prevention is to reduce the risk of falls and fall-related fractures, thereby preserving quality of life and functional status. To achieve this goal, older adults must first be screened for fall risk. Once an assessment of fall risk has been made, clinicians must weigh the risks and benefits of various interventions to reduce falls and work to target the identified risk factors of the patient. Preventing falls can be complicated because of the multiple factors that may be present and the multiple interventions that may need to be initiated. Although some of the interventions are relatively straightforward (e.g., removing rugs), others, such as adjusting drugs, can be difficult to implement.

Quality Patient Care

Falls Prevention

Assessment

Because most older adults do not report falls, it is important to include a falls assessment as part of the routine medical history and physical examination. The American Geriatrics Society in collaboration with the British Geriatrics Society and the American Academy of Orthopedic Surgeons recommends that all older adults (or their caregivers) who are under the care of a health care professional be asked at least once a year about falls. The medical history and physical examination should inquire about any falls, and assess gait and balance as well as both predisposing and environmental factors so that appropriate targeted interventions can be made. Multifactorial assessments are key, but are not effective if targeted interventions are not applied in response to the assessments. If predisposing factors are identified, strategies to better manage the underlying disease, minimize impairment, or reduce or eliminate offending drugs is important. Examples of such interventions include initiating appropriate treatment for Parkinson's disease, minimizing orthostatic hypotension, correcting visual deficits, initiating physical therapy to improve gait and balance, and stopping or gradually withdrawing drugs that may be increasing the patient's risk of falling. Similarly, assessment of the home environment with targeted intervention is key to reducing the fall risk that may be because of environmental factors. Tables 1-2 and 1-3 provide a summary of common predisposing and environmental factors, respectively, that contribute to falls.

In 2001, the American Geriatrics Society in collaboration with the British Geriatrics Society and American Academy of Orthopedic Surgeons published clinical practice guidelines for preventing falls in older people. The underlying premise of this guideline was that assessing fall risk and intervening to prevent falls is likely to reduce the risk of future falls. Currently, there is no consensus on the age to begin screening for falls, but, according to the guidelines, the rate of falls and the prevalence of risk factors for falls increases at 70 years of age; therefore, efforts should clearly target this age group.

Screening tests, such as the brief and simple "Get-Up-and-Go" test, assesses the unsteadiness of patients as they get up from a chair without using their arms, walk 10 feet, turn around (without grabbing a railing or wall), walk back, and sit down. The "Get-Up-and-Go" test is used frequently because it can be administered easily in any setting by trained individuals, including pharmacists, and provides an initial subjective assessment of fall risk. The test administrator essentially "observes" the patient and makes a note of any gait or balance problems. The American Geriatrics Society guidelines recommend that all older people who report a single fall should be assessed with the "Get-Up-and-Go" test. Those demonstrating no difficulty or unsteadiness need no further assessment, but those who cannot complete the test or demonstrate unsteadiness require further assessment. The "Up and Go" test, which is a timed test, also evaluates gait and balance. The patient performs the same procedure as the "Get-Up-and-Go" test, but this test is timed. In both tests, patients wear their regular footwear and can use any assistive device that they regularly and routinely use (e.g., cane or walker). In the timed test, the observer uses a stopwatch or second hand to time the activity. Patients can score less than 10 seconds (freely mobile), less than 20 seconds (mostly independent), 20–29 seconds (variable mobility), and 30 seconds or more (impaired mobility, indicating the highest risk of falling).

The Brief Physical Performance Assessment, conducted by a trained professional (e.g., physical therapist), can be

useful in assessing balance, ability to rise from a chair, and walking speed. Other scales include the Tinetti Gait and Balance Scale, the Berg Balance Scale, the Dynamic Gait Index for patients with vestibular dysfunction, and the Clinical Gait and Balance Scale. Evidence suggests that any older adult with abnormalities in gait and/or balance should be referred to a physical therapist for a comprehensive evaluation with targeted rehabilitation. A more comprehensive fall evaluation, followed by targeted, multifactorial interventions, is recommended in older people presenting for medical attention with one or more falls, demonstrating abnormalities of gait and/or balance, or reporting recurrent falls in the past year. The recommendations for fall assessment and intervention stem from both epidemiological and experimental studies that have demonstrated benefit. If an older adult has fallen previously, it can be helpful to inquire about circumstances surrounding the previous fall to eliminate any obvious situations or barriers. An algorithm summarizing the approach to assessing and managing falls in older adults, as outlined by the American Geriatrics Society and collaborating organizations, is presented in Figure 1-3.

For older adults who are otherwise healthy, have never fallen, report no difficulties in gait and/or balance, and have no identifiable risk factors, community-based group exercise programs that focus on balance and strength training may be beneficial in reducing fall risk. However, other exercise programs and interventions, such as home safety assessment and modification, have not proven beneficial in this particular population.

Some laboratory tests that may be useful in ruling out underlying causes or risk factors associated with falling include a complete blood cell count (anemia), thyroid function tests (thyroid dysfunction), serum electrolytes (electrolyte abnormalities), blood urea nitrogen and creatinine (dehydration), glucose (hypo- or hyperglycemia), and vitamin B_{12} (cobalamin deficiency). These tests are fairly inexpensive and, if abnormal results are found, treatment can be easily initiated. Other laboratory tests and diagnostic procedures are not routinely recommended at this time and should be obtained on an individual basis where necessary.

Assessing additional factors that contribute to falls is essential so that targeted interventions can be implemented to reduce the patient's risk of falling. Pharmacists must be cognizant of the multiple risk factors and identify means to accurately and thoroughly assess patients' overall risk. Overall, drugs present a clear target for pharmacist assessment and intervention to reduce falls. A thorough evaluation of a patient's drug regimens will lead to identifiable drugs to target. Some drugs are easy to discontinue, whereas others require careful consideration of the risks and benefits of withdrawing therapy. Although the drug classes known to pose the greatest risk (e.g., antidepressant drugs, anticonvulsant drugs, BZDs, and class 1A antiarrhythmic drugs) provide an excellent starting point for targeted drug interventions, it is important to consider other drugs that may contribute to falls through similar mechanisms, but that have not yet been fully evaluated and shown to increase patient risk for falls or fractures. Table 1-4 provides an overview of drug classes that should be considered carefully for their potential to contribute to falls based on known mechanisms of action and adverse effects. In addition, the Beer's criteria provide a list of potentially inappropriate drugs in the elderly that pharmacists also should carefully consider because of their potential to induce CNS adverse effects, including sedation, dizziness, and confusion, as well as impair balance. Some of these drugs include propoxyphene-containing analgesics (e.g., Darvon and Darvocet), indomethacin, trimethobenzamide, most muscle relaxants and antispasmodics, flurazepam, amitriptyline, doxepin, BZDs, chlorpropamide or other long-acting hypoglycemic drugs, disopyramide, short-acting dipyridamole, reserpine, anticholinergics and antihistamines, and clonidine. The Beer's criteria contain specific drug listings as well as proposed reasons for concern regarding use of these drugs in the elderly.

Management

Preventing falls requires consideration and management of multiple risk factors. The most effective interventions typically are multifaceted in nature. Although many of the approaches to preventing falls are relatively straightforward, many require clinicians to weigh risk and benefit. For example, one of the most challenging components of fall prevention strategies involves reducing high-risk drugs, such as BZDs and antidepressant drugs. Many drugs that are associated with a high risk of falls are appropriately recommended to treat and manage disease; therefore, careful consideration of the risks and benefits is necessary before deciding to gradually withdrawal therapy. An algorithm summarizing the approach to assessing and managing falls in the older adults is presented in Figure 1-3.

Single Interventions

Single-intervention strategies to minimize fall risk are effective and include in-home supervised balance and gait training, in-home muscle strengthening and balance retraining, home hazard assessment and modification by a trained professional (especially after hospital discharge), cardiac pacing for individuals with cardioinhibitory carotid sinus hypersensitivity, a Tai Chi group exercise program, vitamin D supplementation at 800 units/day, and gradual discontinuation of psychotropic drugs. In a small randomized, double-blind, controlled, clinical trial with a 2 x 2 factorial design, a single-intervention strategy focusing on psychotropic drug withdrawal or a home-based exercise program was implemented to assess the effectiveness of each approach in reducing falls in older people. Gradual discontinuation of psychotropic drugs, including BZDs,

Podsiadlo D, Richardson S. The timed "Up and Go": a test of basic functional mobility for frail elderly people. J Am Geriatr Soc 1991;39:142–8.

Fick DM, Cooper JW, Wade WE, Waller JL, Maclean JR, Beers MH . Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. Arch Intern Med 2003;163:2716–24.

hypnotics, and antidepressant drugs, occurred over a 14-week period and was associated with a 66% reduction in fall risk (assessed at 44 weeks) in patients who were a mean of 75 years of age (HR = 0.34; 95% CI = 0.16–0.74). However, within 1 month of completing the study, almost 50% of the participants who had successful drug withdrawal restarted their psychotropic drugs. This underscores the difficulty in successfully withdrawing offending drugs. In the same study, a home-based exercise program did not significantly reduce falls (HR = 0.87; 95% CI = 0.36–2.09), a finding similar to previous reports on the use of exercise in reducing fall risk.

Other interventions that have produced questionable efficacy include group-delivered exercise programs, treatment with a vasoactive drug (i.e., raubasine-dihydroergocristine), calcium supplementation, cognitive-behavioral therapy alone, home hazard assessment and modification for older adults without a history of falling, hormone replacement therapy, and correction of visual problems. Interventions that are unlikely to be beneficial include brisk walking in women with a prior upper limb fracture.

Although modifying or eliminating high-risk drugs has been a key component of many effective fall prevention studies and has demonstrated efficacy as a sole intervention, it is important for pharmacists to keep in mind that sustaining such effects can be difficult. Likewise, multiple factors often are interacting to increase patient risk for falls,

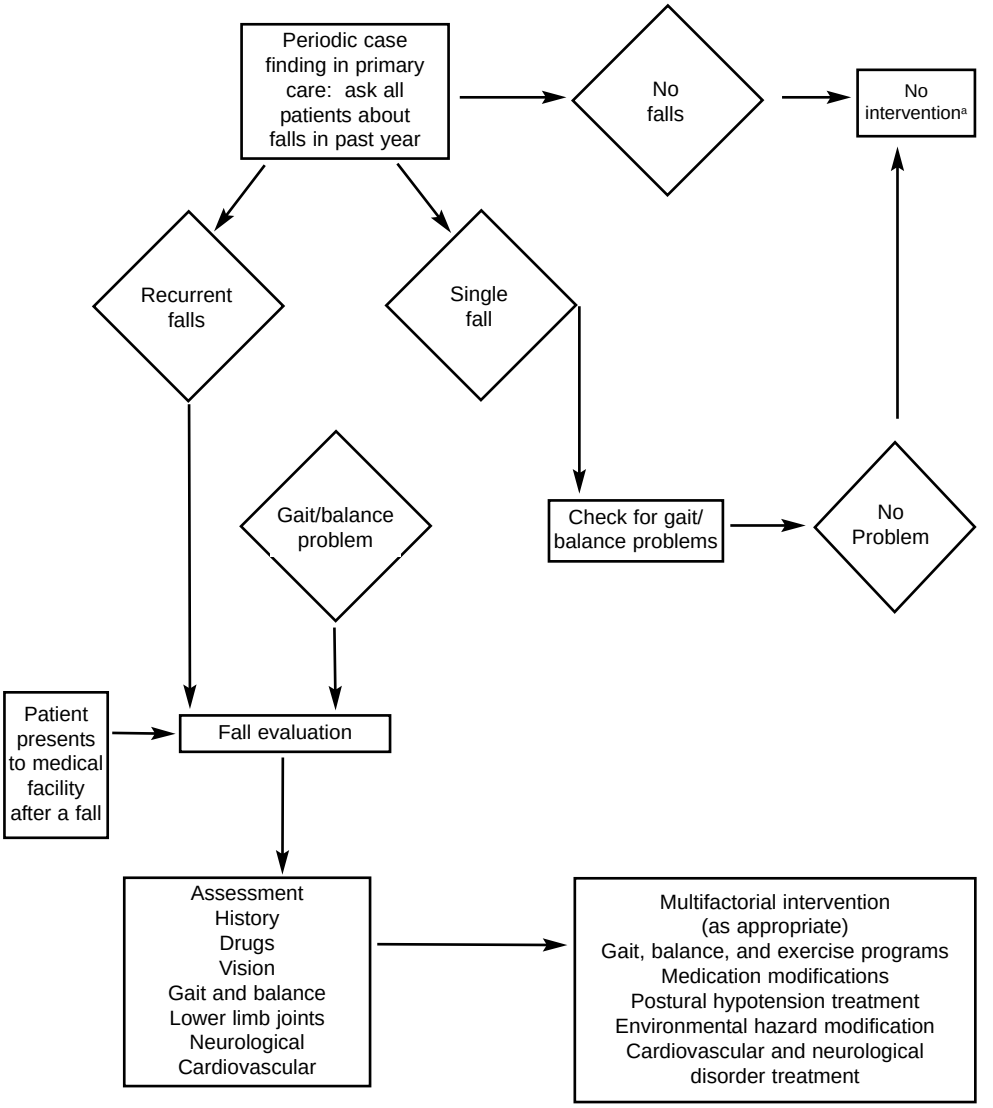

Figure 1-3. Algorithm for assessing and managing falls in older persons
[a]Some experts recommend participation in an exercise program that includes balance and strength training rather than no intervention.
Adapted with permission from Blackwell Publishing. American Geriatrics Society, British Geriatrics Society, American Academy of Orthopedic Surgeons Panel on Falls Prevention. Guideline for the prevention of falls in older persons. J Am Geriatr Soc 2001;49(5):664–72.

Campbell AJ, Robertson MC, Gardner NM, et al. Psychotropic medication withdrawal and home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999;47:850–3.

and recognition of these multiple factors is important in designing an effective intervention.

Multifaceted interventions

The most effective strategy for preventing falls has been a multidisciplinary, multifaceted screening and intervention program that is targeted at individualized risk factors. In at least three trials, multifaceted fall assessments with targeted interventions have reduced the risk of falling by 25–39%. The interventions used in these studies vary, but they include previously discussed strategies that have shown success as single interventions (e.g., muscle strengthening and balance retraining, home hazard assessment and modification conducted by professionals, withdrawal of psychotropic drugs, and a 15-week Tai Chi group exercise intervention). Multifaceted interventions are recommended for all older adults, including those residing in the community, long-term care facilities, and assisted-living settings. A systematic review currently is under way to assess programmatic development of population-based screening and intervention strategies in communities, including nursing homes and assisted-living facilities. There is a lack of evidence to support specific intervention recommendations at this time in an acute hospital setting.

Hip Protectors

A recent systematic review evaluated the effects of hip protectors in reducing the incidence of hip fractures in older adults after a fall. Thirteen randomized, controlled trials were included in the analysis. Five studies were clustered by care unit, nursing home, or nursing home ward rather than by patient. Alone, each study reported a reduced incidence of hip fractures within units allocated to receive the hip protectors. When randomization occurred via patient, there was no evidence that hip protectors reduced fractures secondary to a fall. Drawbacks to the use of hip protectors include nonadherence (especially at night when they may be most effective for older adults), cost, lack of patient acceptability, and product variability. Hip protectors are not a universal recommendation at this time for older people at risk for falling. Their use typically is reserved for patients who are at high risk and willing to wear a hip protector, who reside in nursing homes or institutions with a program in place for using hip protectors, or who have a fear of falling and would welcome the added protection provided by hip protectors.

Vitamin D and Calcium Supplementation

The relationship of vitamin D and/or calcium supplementation to fall-related fractures has largely been attributed to effects on bone mineral density. Until recently, it was thought that the primary role of vitamin D and/or calcium was related to the reduction in fracture risk rather than any direct effect on fall risk. However, studies have suggested a possible effect of supplementation on muscle strength and physical performance, which thereby reduces fracture risk through fall prevention. A recent meta-analysis assessed the effectiveness of vitamin D in preventing a fall in older people. The meta-analysis included only randomized, controlled, clinical trials that assessed fall risk because of vitamin D use in typically healthy older adults. Five studies involving 1237 older adults (mostly women) in both ambulatory and institutionalized settings showed that vitamin D reduced the risk of falls by more than 20%. Additional studies are needed to confirm these findings and provide more detailed guidance on the use of vitamin D supplementation to reduce the risk of falls in both men and women. Current guidelines for osteoporosis prevention recommend that both older men and women receive at least 400 units/day vitamin D, but most recommendations suggest a dose of 800 units/day vitamin D in patients at high risk of vitamin D deficiency, such as older adults. Calcium supplementation is recommended at 1200–1500 mg/day for both older men and women. Efforts should be made to ensure that all older adults are receiving the necessary supplementation not only for known effects in reducing fracture risk, but for the possible added effects in reducing fall risk.

Osteoporosis Prevention and Treatment

Finally, a key component to managing fall risk and subsequent injury in both men and women is to prevent and treat osteoporosis. The National Osteoporosis Foundation recommends that all postmenopausal women undergo bone mineral density screening to assess their risk for fracture and determine whether drug therapy is indicated. Recommendations in men are less clear because of limited data at the present time; however, findings from women often are applied to men as much needed studies in men are awaited. A discussion of osteoporosis prevention and treatment in women and men is beyond the scope of this chapter, but Figures 1-1 and 1-2 provide an overview of the prevention and treatment of osteoporosis in women and men, respectively.

Close J, Ellis M, Hooper R, et al. Prevention of Falls in the Elderly Trial (PROFET): a randomised controlled trial. Lancet 1999;353:93–7.

Wagner EH, LaCroix AZ, Grothaus L, et al. Preventing disability and falls in older adults: a population-based randomized trial. Am J Public Health 1994;84:1800–6.

Tinetti ME, Baker DI, McAvay G, et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med 1994;331:821–7.

Parker MJ, Gillespie LD, Gillespie WJ. Hip protectors for preventing hip fractures in the elderly. Cochrane Database Syst Rev 2004;3:CD001255.

Bischoff HA, Stahelin HB, Dick W, et al. Effects of vitamin D and calcium supplementation on falls: a randomized controlled trial. J Bone Miner Res 2003;18:343–51.

Bischoff-Ferrari HA, Dawson-Hughes B, Willet WC, et al. Effect of vitamin D on falls: a meta-analysis. JAMA 2004;291:1999–2006.

Patient Education

Education remains a universal recommendation to prevent falls in all older people in all settings. Though ineffective as a sole strategy, combined with other targeted interventions, it can be effective. Patients and their families and/or caregivers must be educated about the multiple risk factors associated with falling, complications associated with falls, and personalized strategies that can help reduce patient risk of falling. Often, patients, families, and/or caregivers are not aware of common risks in the home that can be easily modified to reduce patient risk for falling. For individuals who have fallen, home safety assessments and targeted interventions by trained individuals, such as physical or occupational therapists, reduce the risk of falling by up to 20%. Older adults who live alone should be educated on what steps to take in the event that they do fall, such as an emergency response system that would be accessible from the floor. Assessing older adults on an annual basis and raising awareness of risk factors for falls is an important strategy to prevent falls and subsequent fractures. Patient education regarding osteoporosis is especially important because it is a silent disease that often is only seen with the initial fracture. Thus, appropriate assessment and prevention of falls together with identification and management of those at risk for osteoporosis may have an even greater impact on reducing the risk of significant morbidity and mortality associated with falls and fall-related fractures.

In keeping with the principles of evidence-based medicine, a management plan that is based on the best research evidence combined with clinical expertise and patient values should be developed. Including patients and their family in the decision-making process and providing continuity of care to ensure the safety and effectiveness of the plan are key.

Many useful resources about preventing falls in the older adults are available for both health care professionals and patients. The Centers for Disease Control and Prevention has published a guide titled, US Fall Prevention Programs for Seniors: Selected Programs Using Home Assessment and Modification, available at *http://www.cdc.gov/ncipc/falls/default.htm#PDF*. This guide is intended for state and local health departments; state and area agencies on aging; nonprofit organizations; health maintenance organizations; community-level injury prevention programs; and others who work with seniors and are planning, implementing, or expanding fall prevention strategies. Descriptions of fall prevention programs across the country are included. Likewise, the Centers for Disease Control and Prevention has outlined recommendations for reducing falls and resulting hip fractures among older women in a 2000 Morbidity and Mortality Weekly Report. A Tool Kit to Prevent Senior Falls, available on the Centers for Disease Control and Prevention Web site (*http://www.cdc.gov/ncipc/pub-res/toolkit/toolkit.htm*), contains "useful information and materials about falls and fall-related injuries that can be used on an individual basis or incorporated into health promotion activities aimed at reducing falls among older adults." Patient education material, such as brochures to help prevent falls in older people and informative home assessment checklists for seniors, are included. The National Institute on Aging (*http://www.nia.nih.gov*) and the American Geriatrics Society (*http://www.americangeriatrics.org/education/forum*) also provide educational resources on preventing falls in the older adults.

Effectiveness and Future Directions

Assessments must be conducted routinely and targeted interventions must be applied. Although an interdisciplinary approach is preferred, the pharmacist can play a primary role in both assessing risk and managing falls. Despite data demonstrating a variety of strategies that are effective in reducing the incidence of falls, it is unclear whether this decreased incidence of falls clearly translates into a reduction in complications, such as fractures. Observational data suggest an association between a decreased incidence of falls and a reduction in fractures but no studies have had sufficient power to adequately test this association. Additional areas of uncertainty regarding future research include the results of long-term studies (i.e., whether patients are able to adhere to multifaceted interventions over time); the risk-to-benefit ratio regarding the tapering and removal of high-risk drugs to minimize falls and resultant injury; the efficacy and cost-effectiveness of recommended interventions; the assessment and management of falls in special populations, such as patients with dementia; and the relationship between falling and syncope. With respect to drug withdrawal, approaches that examine the totality of drugs taken by a patient as opposed to a discrete set of drugs (e.g., psychotropic drugs) may prove to be a more rationale approach to minimizing fall risk in a patient. Many more areas of uncertainty remain as studies continue to explore the most effective methods for minimizing falls and subsequent injuries in older people.

Conclusion

Despite the availability of evidence-based clinical practice guidelines for preventing and treating falls, the assessment and management strategies set forth in the American Geriatrics Society guidelines have not been adequately applied to clinical practice in the United States. The reasons are largely modifiable and pharmacists in a variety of clinical settings can play a primary role in addressing the deficiencies in both assessment and management. Although all health care professionals working with older adults must assume responsibility, pharmacists are ideally positioned to identify, assess, and manage patients' fall risk. This is accomplished by providing education to patients and health care professionals about falls and fall risk; assessing patients' risk for falls, especially through a thorough review of drugs; referring patients to appropriate health care professionals for further assessment (e.g., physical therapy); ensuring that older adults receive adequate vitamin D and calcium supplementation to strengthen bones and reduce falls and fractures; identifying management options to reduce fall risk, especially avoiding drugs known to increase fall risk and, where possible, gradual withdrawal of drugs that increase fall risk; identifying treatment options to reduce

fracture risk where applicable; and implementing targeted strategies to reduce fall risk. Involving patients in the treatment plan is essential. Patients also must be followed over time to ensure that current approaches are safe and effective. Pharmacists can play a key role in ensuring this continuity of care around falls assessment and management. Significant opportunities exist to reduce the morbidity and mortality from falls and fall-related fractures in older adults. The time is now for health care professionals, including pharmacists, to assume greater responsibility for the significant impact of falls on the health, function, and well-being of older adults.

Annotated Bibliography

1. American Geriatrics Society, British Geriatrics Society, American Academy of Orthopedic Surgeons Panel on falls prevention. Guideline for the prevention of falls in older people. J Am Geriatr Soc 2001;49(5):664–72.

   This publication guides clinicians in assessing fall risk and managing older adults who are at risk for falls or who have fallen. These guidelines provide excellent overview with specific algorithms and recommendations. A review of the literature was performed to assemble the best evidence. Recommendations are graded based on the quality of evidence, and the level of evidence for each recommendation is provided. Recommendations cover the following areas: approach to assessing older people as part of routine care who do not present with a fall; approach to assessing older people with one or more falls, or who report recurrent falls or abnormalities of gait and/or balance; multifactorial interventions for managing falls in various settings; and single interventions for managing falls.

2. Brown JP, Josse RG; Scientific Advisory Council of the Osteoporosis Society of Canada. 2002 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada. CMAJ 2002;167:S1–S33.

   The clinical practice guidelines from the Osteoporosis Society of Canada provide perhaps the most thorough, evidence-based, and practical overview of the management of osteoporosis of all those available. These guidelines have used one of the more rigorous methods for grading scientific evidence. The criteria used to assign a level of evidence to articles and to grade the overall recommendations for the guidelines are systematic. Readers are referred to the clinical practice guidelines for a more in-depth discussion of the levels and grades of evidence. All recommendations were graded according to the strength of evidence, and where the evidence was not sufficient, recommendations were based on consensus opinion. These guidelines are comprehensive and describe management in women, men, and special populations. Furthermore, these guidelines provide detailed evidence-based literature reviews, summary statements, and overall graded recommendations for each diagnostic or treatment strategy discussed. The guidelines are considered a "work in progress" and will be updated periodically.

3. Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions for preventing falls in elderly people. Cochrane Database Syst Rev 2003;(4):CD000340.

   This excellent and recent systematic review on interventions to prevent falls in the elderly includes recommendations for community-dwelling older adults as well as those in institutions or hospitals. The review is structured around three main areas: 1) interventions likely to be beneficial, 2) interventions of unknown effectiveness, and 3) interventions unlikely to be beneficial. This is a comprehensive, yet succinct, overview of available evidence of interventions to reduce falls in the elderly.

4. Tinetti ME. Preventing falls in elderly people. N Engl J Med 2003;348(1):42–9.

   This review article is an easy-to-follow and informative overview on preventing falls in the elderly. The author is one of the leading researchers and clinicians in the area of falls. The review begins with a clinical problem or short patient case that describes an elderly woman with multiple risk factors for falls, including two recent falls. The question is framed in the context of what clinicians can do to prevent this woman from suffering subsequent falls. The article provides an overview of the risk factors for falls, recommended assessment strategies, a summary of available evidence on what works and what requires further study, and a brief introduction to the two available sets of guidelines on the topic. The article concludes with the author's approach to preventing falls for the woman introduced in the case. Overall, the article is informative and recommended reading for anyone caring for older adults.

5. McClure R, Turner C, Peel N, Spinks A. Population-based interventions for the prevention of fall-related injuries in older people. Cochrane Database Syst Rev 2004.

   The protocol for this systematic review has been released, but the final report is still pending. The review will be quite informative and is designed to assess the effectiveness of community-based interventions to prevent falls and fall-related injury in community-dwelling older adults. The systematic review hypothesizes that interventions targeted at the population level do not reduce incidence of fall-related injury in people 65 years of age and older. The review discusses population-based interventions to reduce falls in older adults using multifaceted strategies in an entire community or a large part of a community. The review includes residents of nursing homes and assisted-living facilities because these facilities are considered community-based. This systematic review provides evidence to guide decisions regarding programmatic development to reduce falls in communities.

Abbreviations

SELF-ASSESSMENT QUESTIONS

1. A 70-year-old Caucasian man sustained a fall 6 months ago while getting up to use the bathroom. He currently is taking diphenhydramine every night to help him sleep and alprazolam every night for anxiety. He has been using diphenhydramine for almost 1 year and alprazolam for more than 2 years. Home safety measures have already been taken to clear the path from his bed to the bathroom. Which one of the following approaches is most likely to reduce his risk of falls?

   A. Discontinue diphenhydramine.
   B. Discontinue alprazolam.
   C. Discontinue diphenhydramine and gradually withdraw alprazolam.
   D. Continue both drugs because home safety modifications have been made.

2. Which one of the following drug classes has consistently demonstrated an increase in fall risk in older adults?

   A. Diuretics.
   B. Narcotics.
   C. Benzodiazepines.
   D. β-blockers.

3. Which one of the following drugs used to prevent and treat osteoporosis has the strongest evidence for also reducing falls?

   A. Calcium.
   B. Vitamin D.
   C. Alendronate.
   D. Calcitonin.

4. An 84-year-old woman who lives in an assisted-living facility has had several falls since she was discharged from the hospital 6 months ago. She has hypertension that is well controlled with average blood pressures of 135/80 mm Hg (sitting and standing), atrial fibrillation, insomnia, dementia, and anxiety. She currently takes hydrochlorothiazide, digoxin, warfarin, donepezil, and diazepam. Which one of the following drugs is most likely to contribute to her falls?

   A. Hydrochlorothiazide.
   B. Digoxin.
   C. Warfarin.
   D. Diazepam.

5. A 76-year-old Caucasian woman who resides in a nursing home is ambulatory with a slow gait, and rarely leaves her bed. Which one of the following drug therapy interventions is most likely to reduce her falling risk?

   A. Calcium.
   B. Vitamin D.
   C. Alendronate.
   D. Raloxifene.

Questions 6–8 pertain to the following case.

J.T. is a 74-year-old Caucasian woman who comes to the clinic for her annual visit. She has no significant past medical history other than depression, but occasionally experiences hot flashes that she is able to tolerate and manage without drugs. In the past year, she has experienced dizziness, but it "comes and goes." Her current drugs are a multivitamin, calcium citrate plus vitamin D (she is taking 1200 mg/day elemental calcium and 800 units of vitamin D), and citalopram. She smokes, but does not drink alcohol. She walks about 30 minutes 4 times/week. Her family history is significant for osteoporosis. On central dual-energy x-ray absorptiometry scanning, the diagnosis of osteoporosis was confirmed in J.T. with T scores of -2.9 at the spine and -2.6 at the hip. Secondary cause of osteoporosis have been ruled out. She is eager to start treatment.

6. Using Figure 1-1, which one of the following regimens is best for J.T. at this time?

   A. Calcitonin 200 international units/day.
   B. Alendronate 35 mg orally once weekly.
   C. Risedronate 35 mg orally once weekly.
   D. Hip protector.

7. Which one of the following is the best approach to assessing falls in J.T.?

   A. J.T. should undergo a comprehensive fall evaluation today and then again in 5 years because she has no history of falling.
   B. J.T.'s fall risk assessment should include a comprehensive fall evaluation, with advanced gait and balance assessment and home safety education.
   C. J.T.'s fall risk assessment should focus predominantly on her use of citalopram because antidepressant drugs are clearly linked to increasing fall risk.
   D. Because J.T. has not fallen, fall risk assessment at this time involves asking her about a history of falls and assessing predisposing and environmental factors.

8. J.T. is aware that she has osteoporosis, which places her at risk for a fracture; however, she is concerned about other risk factors that may increase her chance of sustaining a fracture, specifically her risk for falling. She wants to know how prevalent falls are in patients who reside at home and if she needs to take extra caution, such as wearing a hip protector. Which one of the following responses is the best?

   A. About 30–60% of community-dwelling older adults fall each year. To reduce J.T.'s risk of fracture, it is a good idea for her to wear a hip protector.
   B. Less than 10% of community-dwelling older adults fall each year. To reduce J.T.'s risk of fracture, it is a good idea for her to wear a hip protector.
   C. About 30–60% of community-dwelling older adults fall each year; however, hip protectors have not been effective, so it is not necessary for J.T. to wear one at this time.
   D. Less than 10% of community-dwelling older adults fall each year and hip protectors have not been effective; therefore, it is not necessary for J.T. to wear one at this time.

Questions 9–11 pertain to the following case.

A 79-year-old woman comes to the clinic. She has mild dementia, hypertension, insomnia, gastroesophageal reflux disease, and incontinence. Her conditions are fairly stable. She takes donepezil, alprazolam, hydrochlorothiazide, and a β-blocker. She lives alone in a trailer with a small dog. Her family is concerned about her safety because she has fallen twice in the past year while walking from one room to another, and she does not always appear steady on her feet. Her trailer is full of clutter.

9. Which one of the following sets of factors increases her risk for falls?

   A. Donepezil, having a pet, and gastroesophageal reflux disease.
   B. Diuretic use, residing in a trailer, and hypertension.
   C. Living alone, insomnia, and β-blocker use.
   D. Age, history of falls, and dementia.

10. Which one of the following single-strategy, drug-withdrawal interventions is likely to have the greatest impact on reducing her fall risk?

    A. Gradual withdrawal of donepezil.
    B. Gradual withdrawal of alprazolam.
    C. Gradual withdrawal of hydrochlorothiazide.
    D. Gradual withdrawal of the β-blocker.

11. Which one of the following multifaceted approaches is likely to have the greatest impact on reducing her fall risk?

    A. Gait and balance training, home safety modification, and group exercise program.
    B. Home safety modification, 15-week Tai Chi exercise program, and use of hip protector.
    C. Gait and balance training, home safety modification, and adding a bisphosphonate, such as alendronate.
    D. Gait and balance training, home safety modification, and gradual removal of alprazolam.

12. Falls are one of the leading causes of injury in the United States. Which one of the following injuries secondary to a fall has the greatest impact on morbidity and mortality in the elderly?

    A. Vertebral fracture.
    B. Hip fracture.
    C. Wrist fracture.
    D. Humerus fracture.

13. A 74-year-old woman who lives in a nursing home has fallen several times since she was admitted 3 years ago. She has a history of depression with psychoses, chronic back pain, and constipation. She is taking citalopram, oxycodone, lorazepam, and risperidone. According to the available evidence, which one of the following drugs is least likely to contribute to her falls?

    A. Citalopram.
    B. Oxycodone.
    C. Diazepam.
    D. Risperidone.

14. Which one of the following single-strategy interventions is most effective in reducing falls in community-dwelling older adults who have a prior history of falls?

    A. Home safety assessments and modifications.
    B. Calcium supplementation.
    C. Hormone replacement therapy.
    D. Correction of visual problems.

Question 15 and 16 pertain to the following case.
M.L. is a 70-year-old woman who has fallen while doing yard work twice in the past 6 months. She fractured her vertebrae with her most recent fall 2 months ago. She has no known medical problems other than osteoporosis for which she takes calcium, vitamin D, and a bisphosphonate. She is at the clinic today for her annual visit. She reports no problems other than feeling a little unsteady on her feet, which she states has been a problem for about 1 year.

15. Which one of the following is the best step for evaluating M.L.'s fall risk?
    A. Perform a home safety assessment, check gait and balance using the "Get-Up-and-Go" test, and assess drugs.
    B. Conduct an assessment of fall risk, including information on vision, gait and balance, lower limb joints, drugs, and underlying medical conditions.
    C. Arrange for a home safety assessment, order a computed tomography of the head to rule out neurological causes, and assess drugs.
    D. Conduct a home assessment to evaluate lighting, obstructed pathways, accessibility to bathroom, and conditions of floors, carpets, and rugs.

16. Which one of the following interventions is most likely to reduce M.L.'s risk for future falls?
    A. Calcitonin.
    B. Gait and balance training.
    C. Weight-bearing exercises.
    D. Education regarding fall risk.

17. Which one of the following statements represents the best overall approach and rationale for assessing a patient's fall risk?
    A. Fall risk should be routinely assessed once a patient reaches 60 years of age because the incidence and complications of falls increase at this age.
    B. Assessing fall risk is complex and challenging in this population and, therefore, should be reserved for patients who present with a fall.
    C. Fall risk should be anticipated and addressed as early as possible in older adults to reduce morbidity and mortality.
    D. Annual assessment of fall risk is recommended in the nursing home setting, but annual assessment in the community is optional at this time.

18. Which one of the following statements represents the best strategy for preventing and treating of falls?
    A. Osteoporosis should be addressed to reduce a patient's risk for falling.
    B. The number of drugs a patient is taking should be the primary target.
    C. A multifactorial approach to address known risk factors should be applied.
    D. A home safety intervention should be the primary target in older adults.

19. An 82-year-old woman has sustained two falls in the past month while getting up during the night to go to the restroom in her home. She has vascular dementia, hyperlipidemia, chronic back pain, and glaucoma. Her current drugs include donepezil, aspirin, atorvastatin, oxycodone, docusate, and latanoprost. Which one of the following single-strategy interventions is most likely to reduce her risk for falls at night?
    A. Perform a thorough review of her drugs to eliminate any unnecessary drugs that may be increasing her falling risk.
    B. Ensure that lighting is adequate in the pathway between the bedroom and bathroom and there are no obtrusive items in the walkway.
    C. Complete a thorough laboratory evaluation to rule out any undiagnosed conditions that may be contributing to her falls.
    D. Recommend that she wear a hip protector at night.

20. A 69-year-old man goes to the geriatric clinic for a follow-up evaluation of his chronic medical conditions. He experienced one fall (with no injuries) about 3 months ago when carrying groceries into the house. He also fell about 1 week ago in his bathroom. Which one of the following represents the best strategy to evaluate and reduce his fall risk?
    A. A multifaceted assessment of fall risk with targeted interventions should be conducted at this time.
    B. Laboratory testing and neuroimaging studies should be performed to evaluate possible etiologies for his falls.
    C. An in-home assessment should be performed to evaluate possible safety hazards at home that may be contributing to his falls.
    D. The patient should be encouraged to engage in exercises that increase muscle tone and improve gait stability in patients experiencing falls.

21. J.I. is an 80-year-old woman who resides in a nursing home. She has osteoporosis, hypertension, and cataracts. She suffers from visual impairment from the cataracts. She is taking six drugs. In addition to residing in a nursing home and having visual impairment, which one of the following factors is most likely to contribute to J.I.'s increased risk for falls?
    A. Osteoporosis.
    B. Taking six drugs.
    C. Hypertension.
    D. Gender.

22. Which one of the following has consistently demonstrated efficacy in clinical studies and is the preferred approach to reduce fall risk?
    A. A single-intervention strategy that involves supervised balance and gait training with a trained professional.
    B. A single-intervention strategy that involves gradual discontinuation of psychoactive drugs.

C. A multifaceted approach that targets identifiable risk factors in individuals at risk for falling.
D. A multifaceted approach that involves the family in the education and training of the individual at risk for falling.

23. Which one of the following factors is the most likely etiology of falls in the nursing home setting?

A. Inadequate staffing.
B. Number of drugs.
C. Prevalence of visual impairment.
D. Increase in frailty.

24. Which one of the following groups of psychological effects typically is seen in older adults who have experienced a fall and resultant fracture?

A. Memory loss, fear, and anxiety.
B. Loss of independence, anxiety, and depression.
C. Depression, fear, and psychosis.
D. Fear, psychosis, and anxiety.

25. An 82-year-old woman comes to the clinic today for her annual visit. She has hypertension, insomnia, anxiety, and arthritis. Her drugs include hydrochlorothiazide, diazepam, and acetaminophen. During the interview, you learn she lives alone and has never fallen. Which one of the following statements presents the best strategy to decrease her risk for falls and fractures?

A. Review her drugs but do not make any changes because she has not fallen.
B. Educate the patient on the falling risks, perform the “Get-Up-and-Go” test, and discuss the risk of falls associated with diazepam.
C. Recommend a group meeting on home safety strategies because such measures are effective.
D. Recommend hip protectors because they reduce the risk of fractures due to falls.