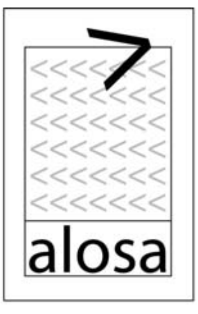
Preventing falls and enhancing mobility in the community dwelling elderly

What the primary care physician needs to know to help frail older patients live independently



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Balanced data about medications
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The burden and consequence of falls

Introduction

Falls are not an inevitable part of aging. Instead, falls and mobility problems in the elderly usually reflect frailty and/or underlying pathology and result from the interplay of multiple risk factors. Falls are a common and preventable cause of morbidity, functional decline, and nursing home placement in elderly adults, but only about a third of elderly patients are adequately evaluated for their risk of falling.

Much has been learned in recent years in several areas:[1]

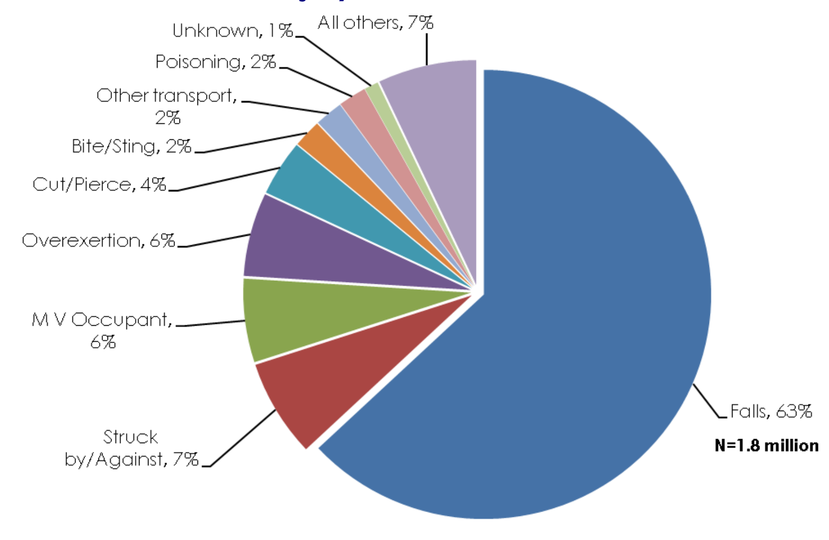
- identifying older patients at particularly high risk of falling
- implementing practical interventions to help prevent falls at home
- spotting and addressing other preventable causes of impaired mobility

This monograph summarizes the current medical literature concerning falls and mobility problems in elderly patients living at home, and offers pragmatic strategies for diagnosing and managing these common issues. Incorporating this information into clinical practice could make a large difference in the well-being of many older patients.[1] In some cases, this could mean the difference between the need for institutional care and the ability to continue living independently in the community.

Epidemiology

Falls are the leading causes of fatal and non-fatal injuries in people ≥ 65 years in the United States.[2] Nearly a third of people over 65 years of age who live in the community fall at least once a year, and 50% of those who fall do so repetitively.[3-6] Half of patients over 80 years of age fall at least once each year.[5, 7] In 2005, of the 2.9 million non-fatal injuries to older adults, almost two-thirds were attributed to falls (see Figure 1 below).[8]

Figure 1. Causes of non-fatal injury in older adults.[8]



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A fifth of fall incidents require medical attention.[3] In the elderly:

- Falls are responsible for approximately 10% of emergency rooms visits and 6% of urgent hospitalizations.
- Approximately 10% of falls in people result in a serious injury such as a hip fracture. Falls are the leading cause of injury-related death in this group.[5,7]
- In those over age 70, 20% of patients who receive home health care after hospitalizations will fall during the first month at home, and half will have problems getting up without help after they have fallen.[9]

Consequences of falls

Injuries and death

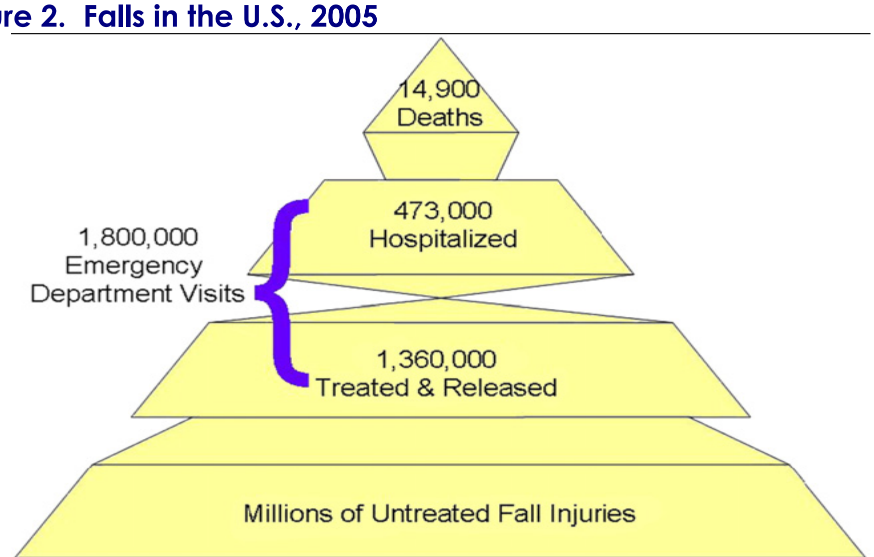
Falls and fall injuries are more common than strokes, and their consequences can be just as serious. They are the most preventable cause of nursing home placement.[9]

Injuries resulting from falls are also one of the most common causes of long-term pain, functional impairment, disability and death in elderly people.[4,10-14] About a quarter of people who fall suffer injuries such as bruising, hip fractures or head traumas, which can threaten their independent living and increase the risk of death. Falls are the most common cause of traumatic brain injuries (TBI).[2]

The risk of being seriously injured in a fall increases with age and most injury-related deaths in elderly adults are related to falls.[4,15-18] The rates of fall injuries for adults ≥ 85 years of age are 4-5 times higher than for adults 65-74 years of age, and almost 85% of deaths from falls occur in people age ≥ 75 years.[2] With the aging of the U.S. population, by 2020 17% of Americans will be ≥ 65 years of age. As the number of older adults increases, the number of fall-related injuries and deaths will also increase.[8]

In 2005, approximately 1.8 million older adults were treated in hospital emergency departments for fall-related injuries, and almost 500,000 of those were hospitalized. Almost 15,000 died (see Figure 2 below).[8]

Figure 2. Falls in the U.S., 2005



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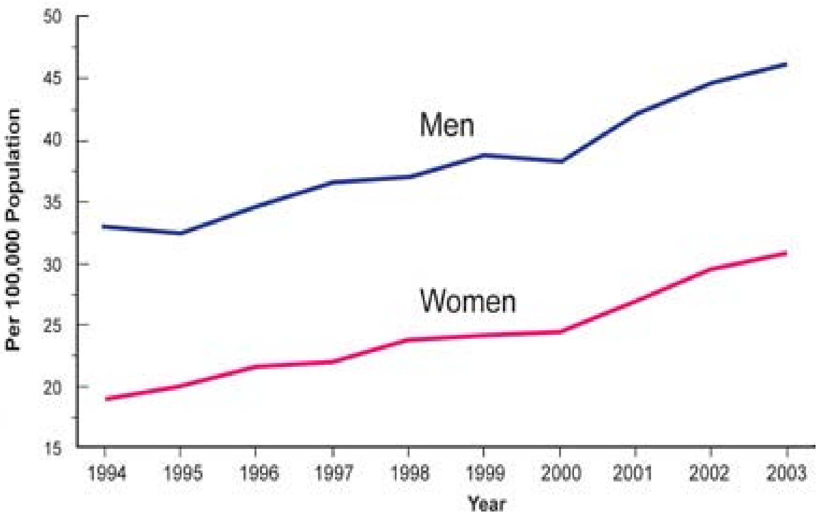
Women are more likely than men to have a non-fatal injury, but men are more likely to die from a fall (see Figure 3 and Figure 4 below).[19] The underlying causes for this disparity between genders are unclear.[8]

Figure 3. Age adjusted <u>nonfatal</u> fall injury rates in those age ≥ 65, 2001–2005

Women
Men
Per 100,000 Population
6000
5500
5000
4500
4000
3500
3000
2001
2002
2003
2004
2005
Year

Figure 4. Age adjusted <u>fatal</u> fall injury rates in those age ≥ 65, 1994–2003



Figures reproduced from National Center for Injury Prevention and Control. Falls Among Older Adults: Figures and Maps. Accessed at <u>http://www.cdc.gov/ncipc/duip/adultfallsfig-maps.htm.</u>

From 1994 to 2003, the fall death rates for both men and women increased significantly ($p < 0.01$). In 2003, the rate for men was 49% higher than for women.

BOTTOM LINE – Morbidity and mortality: Falls and mobility problems are common in the elderly and often reflect frailty or underlying pathology. They can cause fractures, long-term pain, restricted activity, functional decline, disability, traumatic brain injury, nursing-home placement, and death in elderly people.

Quality of life and fear of falling

The after-effects of falls go far beyond their immediate medical consequences. They can lead to fear of further falls (which can itself severely limit mobility), social withdrawal, loss of independence and confidence, admission to a long-term care facility, depression, and anxiety.[13, 20, 21] Many people who have had a fall-related fracture feel isolated, helpless, and depressed from the fear of further falls.[5]

About half of the community-living older population experiences fear of falling.[22] An actual fall is one obvious cause, but fear of falling also occurs in non-fallers.[22] This can lead to a debilitating downward spiral of loss of confidence, restriction of physical activities, functional decline, reduced quality of life, social withdrawal, physical frailty, new falls, and loss of independence.[22] The restriction of physical activity can itself cause reduced mobility and physical fitness, thereby further increasing fall risk.[2] Fear of falling can also cause impairments in gait such as reduced gait speed and reduced stride length, increasing the risk of falls.

Fractures

Falls contribute to most types of fractures, and approximately 90% of hip fractures in people over age 70 years result from falls.[9] Falls account for approximately 25% of vertebral fractures that come to clinical attention. Only about half of older people who break their hip will recover their pre-fracture mobility status.[9]

Most hip fractures in the elderly are caused by falling laterally onto the hip. Each year, about 300,000 older adults fall and fracture their hip.[8] Most are hospitalized for about a week, but about one in four of such patients who lived independently before their hip fracture will stay in a nursing home for at least a year after their injury.[2] Approximately 15% will die in the hospital and a third die within a year.[23]

About three quarters of hip fractures occur in women, and the risk increases exponentially with age. People age ≥ 85 years are 10-15 times more likely to sustain hip fractures than people age 60-65 years.

Disability

A recent study evaluated the causes of new disability in community-dwelling persons (defined as the need for personal assistance in bathing, dressing, walking inside the house, or transferring from a chair).[14] Hospitalization for fall-related injury conferred the highest risk of subsequent disability: 79% of admissions for a fall-related injury led to any disability, 45% to persistent disability, and 59% to disability requiring nursing home admission. In addition, restricted activity from a fall or injury conferred the highest risk of disability, with 11% of fall-related restricted mobility leading to any disability, 5% to persistent disability, and 2% to disability with nursing home admission.

Thus, falls prevention is an important strategy for reducing the total burden of disability among community-dwelling older people and preventing admission to nursing homes.

Costs of falls

In 2000, the total direct cost of all fall injuries for people age 65 and older exceeded $19 billion. By 2020, the annual cost (direct and indirect) of fall injuries is expected to reach $54.9 billion (in 2007 dollars).[2]

BOTTOM LINE – Fractures and fear: Falls contribute to most types of fractures in the elderly, and approximately 90% of hip fractures result from falls. Falls and fall-related injury can also cause fear of future falls, depression, anxiety, social withdrawal, and loss of independence and confidence. Fear of future falls may limit mobility and physical fitness, and further increase fall risk.

Reducing the risk

Risk factors

It is helpful to divide risk factors into two categories:

- Intrinsic - age and medical conditions
- Extrinsic - environmental hazards, medications (prescribed, OTC, and recreational – including alcohol)

An elderly person with no risk factors has only a 10% chance of falling each year, compared to an 80% likelihood of falling for a person with four or more risk factors.[5] Although some falls result from a single cause, most falls result from interactions between multiple predisposing risk factors.[24]

Figure 5. Risk factors and causes of falls[4, 25]

General	-Use of four or more medications	-Age > 70 years -Female gender	-Previous history of a fall (~60% of people who fall during the previous year will fall again)
Medical Conditions	-Impaired muscle strength -Gait, mobility and balance disorders (p 10) -Visual impairment (reduced acuity, impaired depth perception, glaucoma, cataracts, age-related macular degeneration)	-Incontinence -Diabetic neuropathy -Post-hospitalization -Depression -Cognitive impairment - Wandering	-Cardiovascular risk for syncope (vasovagal, orthostatic hypotension, arrhythmia) -Stroke -Epilepsy -Episodes of acute illness and exacerbations of chronic illness
Environ-ment	-Poor or ill-fitting footwear -Steps or slopes -Slippery surfaces	-Absence of safety equipment such as handrails or walking aids -Poor lighting -Loose floor coverings	-Clothing touching the ground -Ladders -Poor manual handling technique
Medications/drugs	*Neuro-psychiatric agents* -antipsychotics (conventional and atypical) -benzodiazepines -anti-Parkinsonian medications (*anticholinergics, dopaminergic agents, dopamine receptor agonists)* -anticonvulsants (= antiepileptics) -antidepressants (all classes) -sleep medications (OTC and prescription)	*Cardiovascular agents* -antiadrenergic agents -antihypertensives -antiarrhythmics *Other* -alcohol -opioids -recreational drugs	-antihistamines -decongestants -diuretics -H2-blockers and proton pump inhibitors -polypharmacy (four or more medications) -skeletal muscle relaxants -urinary anticholinergics

The rate of falling rises after 70. The more risk factors an individual has, the more likely he or she is to fall.[24] In general, multiple interventions are more successful than a single intervention, because falls are usually caused by more than one risk factor.[5, 26]

As shown below, the risk of falling increases with an increasing number of health problems.[9]

Figure 6. Health problems and annual fall risk

More Health Problems* = greater chance of falling *this year*	
If your number of health problems is:	**Your chance of falling is:**
0	**(1 person in 10 will fall)**
1	**(2 people in 10 will fall)**
2	**(3 people in 10 will fall)**
3	**(6 people in 10 will fall)**
4 or More	**(8 people in 10 will fall)**

*The common health problems for falling are:

- problems walking or moving around
- 4 or more medications
- foot problems, unsafe footwear
- blood pressure drops too much on standing up/dizzy
- problems with seeing
- tripping hazards in your home

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Gait and mobility

Many patients have difficulty moving around in their environment. Changes to gait pattern occur in normal aging, with slowed walking speed and shortened stride length.[27] There is no gold standard of normal gait in older adults, so assessment can be difficult. An abnormal gait or impaired mobility does not always increase the risk of falling.

However, gait and mobility disorders should not be assumed to be an inevitable or benign consequence of normal aging.[28] Gait and mobility disorders affect between 1 in 12 and 1 in 5 non-institutionalized older adults[29] and are strong predictors of fall risk.[30] A loss of mobility can also cause social isolation and depression.[30]

Common conditions that can lead to gait and mobility disorders include:

- Osteoarthritis
- Stroke
- Parkinson's disease
- Acquired peripheral neuropathy (e.g., from diabetes)
- Myopathy
- Muscular dystrophy
- Multiple sclerosis
- Peroneal nerve damage (foot drop)
- Spinal stenosis
- Cerebral palsy
- Normal pressure hydrocephalus
- Spinal muscular atrophy
- Amyotrophic lateral sclerosis (Lou Gehrig's disease)

Gait and mobility impairment in the early stage of degenerative conditions may be subtle and occur early. Basic tests of gait and mobility are described on pages 14 and 15. A more detailed assessment of gait and mobility is described on page 16.

A classification system of gait disorders, together with typical findings on examination, is provided in Figure 7 below.[29]

Figure 7. Classification of gait disorders

Classification of disorders	*Condition*	*Typical gait findings*
Peripheral sensory	Sensory ataxia (posterior column, peripheral nerves)	Unsteady, uncoordinated
	Vestibular ataxia	Unsteady, weaving ("drunken")
	Visual ataxia	Tentative, uncertain
Peripheral motor	Arthritis	Avoids weight bearing on affected side Antalgic Shortened stance phase
	Myopathy or neuropathy	Waddling gait (pelvic girdle weakness) Waddling gait and foot slap (proximal motor neuropathy) Steppage gait and foot slap (distal motor neuropathy) with ankle dorsiflexion and foot drop
Spasticity	Hemiplegia/paresis	Leg swings outward and in semicircle from hip; knee may hyperextend, ankle may excessively plantar flex and invert
	Paraplegia/paresis	Both legs circumduct, steps are short, shuffling, and scraping; legs scissor
Parkinsonism	—	Small shuffling steps, hesitation, festination Propulsion, retropulsion, en bloc turns Arm swing absent
Cerebellar ataxia	—	Wide-based with increased trunk sway and irregular stepping, especially on turns
Cautious gait	—	Fear of falling with appropriate postural responses Normal to widened base, shortened stride Decreased velocity, en bloc turns
Frontal-related gait disorders	Cerebrovascular disease	Gait ignition failure, frontal gait disorder, frontal disequilibrium
	Normal pressure hydrocephalus	May also have cognitive, pyramidal, and urinary disturbance

Adapted with permission from 'Ambulatory Devices for Chronic Gait Disorders in the Elderly,' April 15, 2003, *American Family Physician*. Copyright © 2003 American Academy of Family Physicians. All Rights Reserved.

BOTTOM LINE: Risk factors for falling have been well defined, and include age > 70, frailty, medical & psychiatric conditions, cognitive impairment, environmental hazards, and medications. The more risk factors, the more likely a fall will occur. The most important risks in community-dwelling older people are:[17, 30]

- **Medications, previous fall, fear of falling, home hazards, visual impairment, cognitive impairment, urinary incontinence, and gait, mobility, and balance disorders**

Falls management: screening, assessment, intervention

Background

Many falls are preventable and a wide variety of falls risk factors are treatable (e.g., problems with gait/balance/mobility, foot problems or unsafe footwear, physical hazards at home, visual impairment, orthostatic hypotension, and medications).[9]

A comprehensive 2003 Cochrane review concluded that home hazard identification and correction for people with prior falls is an effective means of reducing future falls.[3] Public environment-modifying initiatives such as provision of handrails and adequate lighting for fall risk reduction have not been studied as extensively as more individualized home interventions.[31]

Systematic reviews and meta-analyses have likewise concluded that treating and correcting specific risk factors can reduce the risk of falling by 30% to 50%.[32] The reduction in fall risk in an older woman that can be achieved by addressing modifiable risk factors is shown in Figure 8 below.

Figure 8. Fall risk reduction with treatment of modifiable risk factors

If she has:	The chance she will suffer a serious fall in the next year is:	Treating risk factors reduces this risk by about 1/3 to:
Fallen in past year	50% (5 in 10)	30% (3 in 10)
No falls in past year but even minor problems with walking or movements	30% (3 in 10)	20% (2 in 10)
Any 1 of the 6 risk factors below	20% (2 in 10)	10% (1 in 10)
Any 2 of the 6 risk factors below	30% (3 in 10)	20% (2 in 10)
Any 3 of the 6 risk factors below	60% (6 in 10)	40% (4 in 10)
4 or more of the 6 risk factors	80% (8 in 10)	50% (5 in 10)

The known treatable risk factors include:

1. any problems with walking or movements
2. orthostatic hypotension
3. use of 4 or more medications or any psychoactive medications
4. unsafe footwear or foot problems
5. visual problems
6. environmental hazards

Figure adapted from the Connecticut Collaboration for Fall Prevention. Available at http://www.fallprevention.org/pages/clinicians.htm

The most consistently successful approach to reducing fall risk is multifactorial assessment of patients at high risk of falling, followed by interventions targeting identified risk factors. Such targeted assessment and interventions can reduce the occurrence of falling by 25-39%.[24] On the other hand, multifactorial assessments that have not been followed by targeted interventions have been ineffective in preventing falls.

A 2004 systematic review and meta-analysis found that a multifactorial falls risk assessment and management program was the most effective component in reducing the risk of falling at least once in older adults (RR 0.82, 95% CI 0.72-0.94). The intervention had a "number needed to treat" of just 11, meaning that only 11 patients needed the intervention to prevent a fall in one of them – a very favorable ratio.[33] The intervention worked equally well in community dwelling people and nursing home residents.

A number of U.S. and international guidelines for fall risk assessment and management have been published. These include:

- American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopedic Surgeons: Guideline for the Prevention of Falls in Older Persons.[17] A 2005 update is available at: http://www.americangeriatrics.org/education/2006Falls_guidelines.shtml.
- National Institute of Clinical Excellence (UK) Clinical Practice Guideline for the Assessment and Prevention of Falls in Older People.[30]
- Connecticut Collaboration for Fall Prevention.[9]

Current evidence-based clinical practice for the management of falls in the elderly involves the following actions:

- **Screening** to identify people at high risk of falling
- **Assessing** all risk factors for individuals identified as being at high risk of falling (multifactorial assessment)
- **Intervention** based on targeting identified risk factors (multifactorial, multidisciplinary interventions)

The following material describes these 3 actions in detail, and an algorithm of overall management uniting these processes is provided on page 35.

Screening for falls risk

Fall-risk screening aims to identify which people are at high risk of falling and require a detailed multifactorial fall risk assessment.[17,24] One approach is as follows:

- Asking all people age > 70 years at least once a year if they have had a fall or are afraid of falling. *If the answer to either question is yes, more detailed assessment is necessary* (see page 15).
- Asking all people age > 70 years about gait, mobility and balance problems, and assessing these problems using a simple, easily administered, and quick test such as 'Get Up and Go' (see below). *People who have difficulty with the test or demonstrate unsteadiness will need more detailed assessment* (see page 15).

Basic tests of gait, mobility and balance

Get Up and Go

All older persons who report a single fall should be observed as they stand from a sitting position without using their arms for support, then walk several paces, turn, and return to the chair and sit again without using their arms for support. Patients who have difficulty or demonstrate deficits in gait, mobility or balance when performing this test require further assessment.

Timed Up and Go

The Timed Up and Go (TUG) Test is a test of basic mobility function and is a modified version of the Get Up and Go Test. The patient is asked to get up from a chair, walk 3 meters, turn, walk back to the chair and sit down. The TUG test can help predict the ability to walk safely outside alone.[34] The cut-off time for predicting an increased risk of fall with this test is 13-24 seconds.

The value of the TUG test (like that of the Get Up and Go) is as a screening test. The importance lies in any inability to complete the test, and the reasons for this inability, rather than the actual time taken. An inability to complete either test should prompt a more detailed assessment aimed at recognizing underlying fall risk factors, to guide targeted interventions.[35]

Risk assessment (profile) tools

A number of risk profile tools assessing multiple risk factors for falling have been proposed to identify community-dwelling elderly with a high risk of falling[36-42]. There is a need to conduct further testing of these risk assessment tools to establish the validity and reliability of such tools for general use.[43]

BOTTOM LINE - Screening for fall risk: Simple screening can help identify a patient's fall risk. Those at high risk of falling require more detailed assessment of individual risk factors.

In its simplest form, for people age > 70 years:

- **Ask at least once a year if they have had a fall or have a fear of falling.**
- **Ask about gait, mobility and balance deficits, and assess these parameters using a simple test such as 'Get Up and Go'.**

People with any of the following features have a high risk of falling, and should be further assessed for individual risk factors:

- **presenting with a fall or fall-related injury**
- **a fall in the previous 12 months**
- **gait, mobility, or balance deficits (self-reported or on examination)**
- **fear of falling**

Multifactorial assessment

Background

Patients identified by the screening process as being at high risk of falls should have a multifactorial risk assessment. The history and physical examination are especially important in assessing falls risk,[25] so **think HIP:**

- **H**istory
- **I**nspection (physical examination)
- **P**rescription

History

- Take a detailed history of current and past falls, falls in the last 12 months, and falls indoors/outdoors. If possible, obtain a history from any witness to a fall.
- Review all drugs (prescriptions, OTC, alcohol, recreational drugs).
- Assess fear of falling.
- Assess pain.
- Ask about drowsiness, dizziness on standing, syncope, fatigue, insomnia, muscle weakness, and reduced energy.

Inspection (physical examination)

- Inspect and assess balance, mobility, and gait in detail.
- Assess ability to get up from lying on the ground.
- Conduct physical examination focusing on musculoskeletal, cardiovascular (including orthostatic hypotension), vision, neurological, and cognition.

Prescription (medications)

- Medications are among the most modifiable of fall risk factors and warrant special attention. All patients at high risk of fall should have a comprehensive medication review. Any modification of medication to reduce fall risk must be weighed against the benefit of the drug for the condition prescribed, and any deleterious effect that modification may have on that condition.

Further details of the physical examination and medication review follow.

Balance assessment

- Check if posture leans off center, sideways, or front/back.
- Check if patient loses balance when standing with feet together, on a single leg or tiptoes, or when bending down or reaching up.
- Neurological examination may reveal potentially treatable causes of balance or gait impairment. Impaired proprioception from a neuropathy is a common cause of balance impairment in the elderly.
- A schematic representation of some balance tests is provided in Figure 9 below. Additional balance tests are described in Appendix 1. Berg Balance Test, and Appendix 2. Tinetti Balance Tool on pages 36 and 37.

Mobility and gait assessment

While transferring from sitting to standing, check:[9, 25]

- for difficulty moving from sitting to standing
- for standing from a position too close to chair edge
- if person requires momentum or assistance to move
- if trunk posture is abnormal

While walking, check:[9, 25]

- that walk path is straight
- that turns are steady
- that the swing foot always passes the stable foot by at least a foot length (normal step length)
- that the heel of the swing foot always hits the floor first (heel-toe sequencing)

- for uneven steps
- for shuffling feet
- for short step length
- for momentary loss of control
- if person steadies by holding onto walls or furniture
- for unsafe use of assistive device

Figure 9. Physical tests of mobility and balance

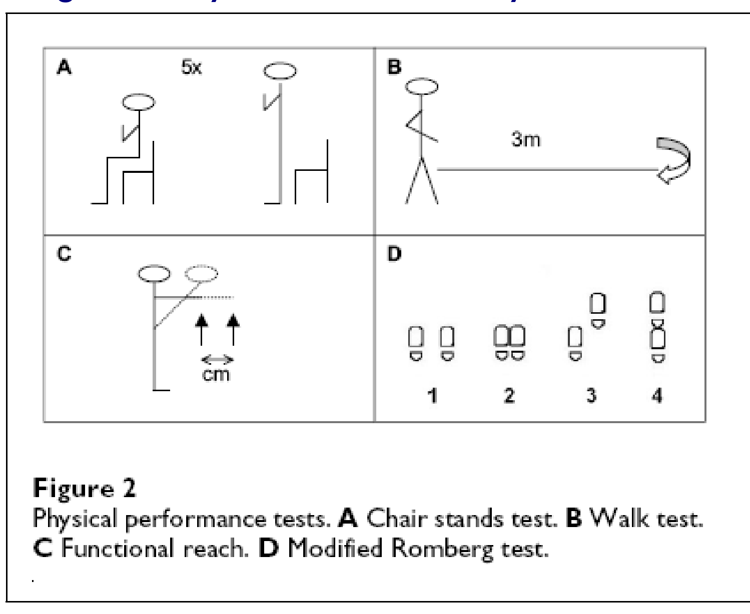


Figure 2
Physical performance tests. **A** Chair stands test. **B** Walk test. **C** Functional reach. **D** Modified Romberg test.

Figure reproduced with permission from: Peeters GM, de Vries OJ, Elders PJ, Pluijm SM, Bouter LM, Lips P. Prevention of fall incidents in patients with a high risk of falling: design of a randomised controlled trial with an economic evaluation of the effect of multidisciplinary transmural care. *BMC Geriatrics* 2007;7:15-23.

A. In the **chair stands test,** the patient stands up and sits down five consecutive times as fast as possible with arms folded in front of the chest.[6]

B. During the **walk test,** the patient walks 10 feet (3 meters) along a line, turns 180 degrees and walks back along the line. Time is recorded from start to finish.[6]

C. The **functional reach test** is a standardized test to measure the ability to maintain balance while reaching forward. The test is used to detect balance impairment and changes in balance performance over time that may contribute to the risk of falling. The patient stands parallel to a wall with one arm horizontally stretched and then leans forward while keeping the arm stretched and horizontal. The distance between the start and end position of the index finger is measured in inches. A reach of ≤ 15 cm (6 inches) predicts an increased risk of fall.[44]

D. The **modified Romberg test** is used as a measure for standing balance. The patient stands with the feet apart at shoulder width, then with the feet side to side, then with one foot in front of the other but not in one line, and finally with the feet in one line and heel against toe (tandem stand). All positions are performed first with the eyes open and then with the eyes closed. One point is given per position continued for at least 10 seconds (range 0 [poor balance] to 4 [good balance]).[6]

Orthostatic hypotension

Clinically significant orthostatic hypotension is present in up to 30% of elderly persons.[24] Check blood pressure after five minutes supine, then immediately after patient stands upright, and again standing two minutes later. Orthostatic hypotension is present if the systolic blood pressure drops by ≥ 20 mm Hg *or* if the patient is symptomatic on standing.

All older adults should have their postural blood pressure measured at least annually. Simply asking about dizziness or light-headedness upon standing may not be enough to detect orthostatic hypotension, as patients may not have obvious symptoms.[25]

Causes of orthostatic hypotension include:

- drugs (nitrates, diuretics, antihypertensives, antidepressants, psychotropics, sedatives, medications for Parkinson's disease)
- dehydration
- heart failure
- autonomic neuropathy (e.g., from diabetes)
- leg vein insufficiency

Feet

Check for pain, numbness, and loose or ill-fitting footwear.

Vision

Poor visual acuity from refractive error or cataracts nearly doubles the risk of hip fracture, and almost triples the risk of multiple falls. Other visual deficits including poor contrast sensitivity, poor depth perception, and reduced visual fields (as in glaucoma) also increase fall risk.[43]

Annual eye examinations should be performed and environmental factors affecting vision, such as lighting, should be assessed. Patients should be advised not to wear multi-focal lenses particularly when taking stairs.[17]

Assess or refer for:

- visual acuity
- depth perception
- cataracts
- glaucoma
- macular degeneration

Gross cognitive function

Perform mini-mental state examination. A template for the Folstein Mini-Mental Status Examination is provided in Appendix 3 on page 39.

Musculoskeletal examination

Focus on the site and nature of any trauma, and functional limitation, in the lower limbs. Diagrammatic and video presentations of the knee and hip examinations are available from the University of California San Diego School of Medicine website:

- Knee examination: http://meded.ucsd.edu/clinicalmed/joints.htm
- Hip examination: http://meded.ucsd.edu/clinicalmed/joints5.htm

Medication review/modification/withdrawal

A summary of the key clinical issues relating to medication-associated falls is provided in Figure 10. A more detailed discussion of these issues is provided below.

Figure 10. Summary of clinical issues with medication associated falls

- A number of medications have been associated with an increased risk of falls. Polypharmacy may further increase this risk. However, the association between medication and falls may be confounded by indication, i.e., an association between medication use and increased fall risk may be caused, or contributed to, by the illness being treated.
- Medication review should be part of any fall risk assessment in older patients. Often, a similar drug can be substituted that will achieve the same clinical goal but with lower fall risk.
- Dose reduction or withdrawal of drugs which increase the risk of falls may be effective. Attempt to balance the clinical need for a drug with falls risk reduction.
- Psychotropics, CNS-acting drugs, cardiovascular drugs, narcotics, and anticholinergics have been associated with an increased risk of falls. The use of drugs with longer half-lives may increase the risk of falls. For example, there has been a documented 80% increase in falls among older people using certain psychotropic medications with half-lives > 24 hours compared to medications with shorter half-lives (OR 1.8, 95% CI 1.3-2.4).[8] However, this has not been unequivocally demonstrated with all classes of drugs. For example, there are conflicting data for benzodiazepines in this regard.[45]
- Non-pharmacological interventions such as relaxation, exercise, avoidance of large meals before sleep and avoidance of daytime naps may help reduce the need for psychotropic medications and lessen fall risk.[43]

Overview of medication-related strategies

The most complex component of a multifactorial intervention strategy to reduce fall risk will often be the review and reduction/withdrawal of medications. Unlike some more straightforward interventions, medication adjustment will often involve tradeoffs of risks and benefits.[24] Medications appropriately prescribed for the treatment of a disease may increase fall risk, but reduction/withdrawal of medication may increase (particularly) neuropsychiatric and/or cardiovascular risk. Furthermore, elderly patients often have multiple conditions for which many medications are prescribed, further increasing associated risks.[24]

The risk of falls can be increased by both desired and undesired effects of medications, as well as interactions between drugs. Medication misuse and overuse may also increase fall risk. Adverse effects such as confusion, orthostatic hypotension, sedation, dizziness, blurred vision, and motor effects may increase fall risk. The medications most likely to contribute to falls are psychotropics (antipsychotics, sedatives/hypnotics, antidepressants, and benzodiazepines), anticholinergics, antihypertensives, and narcotics (see below). Psychotropic agents need special attention, since there is strong evidence that these medications increase the risk of falling.[24]

Older people are at increased fall risk from adverse effects, because of altered pharmacokinetics and pharmacodynamics. An adverse effect may only manifest with increasing age or during acute illness. Medication usage and fall risk increase with age. The patients at highest risk of falling often have the largest medication load, and improving the drug regimen may be an effective means of reducing fall risk, especially in the frail elderly.[46] A variety of medications have been associated with increased fall risk, and these are listed in Figure 5 on page 9. Medications are important risk factors for falls in both community and institutional environments.[30] When considering medication-associated fall risk, it is important to consider the totality of medication load, not just individual medications for individual diseases.[47] For example, many drugs have anticholinergic properties, and cumulative "anticholinergic load" should be considered.

Many studies examining the effect of medications on fall risk have been limited by their ability to control for potential confounding factors.[48] For example, an association between antidepressant use and fall risk in an observational study could result from confounding by reduced psychomotor performance caused by a depressive illness. Finally, results from studies of older persons living in care facilities may not apply to community-dwelling older individuals.[49] The results of 2 studies examining psychotropic drugs and fall risk in community-dwelling older people are provided below. In each of these studies, multivariate analysis was performed to try to adjust for some of the potential confounders.

Psychotropic and other CNS-acting drugs

Results of a systematic review and meta-analysis suggest that people taking psychotropic medications (antipsychotics, sedatives/hypnotics, antidepressants, and benzodiazepines) have an increased risk of falling.[30] Geriatric patients may be most vulnerable to harm from psychotropic medications because of increased incidence of use, co-morbidities which are risk factors for falls, reduced metabolic clearance, and reduced physiologic reserve.[50] Fall risk increases with increasing number of psychotropic drugs.

Possible mechanisms of actions for psychotropic and other CNS-acting drugs are shown in Table 1 below, together with agents that have been suggested as preferred medications in various drug classes.[51] However, the preferred drugs are not without risk. For example, lamotrigine commonly causes dizziness, diplopia, and blurred vision, which may contribute to fall risk. It can also cause serious non-fall-related adverse effects such as hematological disorders and rashes. Selection of any drug should always be individualized and take into account patient co-morbidities and concomitant medications.

Table 1. Psychotropics and CNS-acting drugs associated with falls

Drug Class	Mechanism for falls	Agents to use with caution or avoid	Preferred agent(s) or action
Anticonvulsants	Sedation and dizziness resulting in gait and balance disturbances	• Phenytoin • Phenobarbital • Divalproex • Carbamazepine	• Lamotrigine
Antidepressants (excluding tricyclic antidepressants – see below)	Agents with anticholinergic effects may cause sedation, dizziness, confusion, weakness, and gait/balance disturbances	• Paroxetine • Fluoxetine • Fluvoxamine • Mirtazapine • Nefazodone • Isocarboxazid • Phenelzine • Tranylcypromine	• Citalopram • Sertraline • Escitalopram • Bupropion • Venlafaxine • Duloxetine
Tricyclic Antidepressants	Sedation, dizziness, orthostatic hypotension, reduced alertness, impaired neuromuscular function, impaired gait and balance, and confusion	• Amitriptyline • Amoxapine • Doxepin • Imipramine • Protriptyline • Trimipramine	• Nortriptyline • Desipramine • Other antidepressant (see above) • Gabapentin, pregabalin, or duloxetine for neuropathic pain
Antipsychotics	Sedation, dizziness, orthostatic hypotension, reduced alertness, impaired neuromuscular function, impaired gait and balance, and extrapyramidal adverse effects.	• Thioridazine • Mesoridazine • Chlorpromazine • Atypical antipsychotics in dementia	Atypical agent at dose recommended for the elderly (but avoid in dementia)
Benzodiazepines	Sedation, confusion, dizziness, gait and balance impairment, and weakness	All agents increase risk of falls	Use lowest dose possible for a short time
Sedatives/ Hypnotics	Sedation, confusion, dizziness, gait and balance impairment, and weakness	All agents increase risk of falls	Use lowest dose possible for a short time

A 2002 prospective cohort study of community-dwelling older women (N = 8127, age ≥ 65 years) examined the effect of benzodiazepines, antidepressants, anticonvulsants, and narcotics on fall risk.[48] The average follow-up period was 12 months. Benzodiazepines, antidepressants, and anticonvulsants (but not narcotics) were associated with significantly increased risk of 2 or more falls relative to non-users (increase in risk of 51%, 54%, and 156% respectively). Fall risk in women taking benzodiazepines was only marginally (if at all) decreased by use of short-acting agents. The data also suggested that use of SSRIs in preference to TCAs is unlikely to reduce fall risk in older women taking antidepressants.

A 2005 observational study on data from community-dwelling elderly people (N = 2854, average age 77 years) examined the effect of psychotropic medications (antipsychotics, benzodiazepines, non-benzodiazepine sedative-hypnotics, and antidepressants) on fall risk.[45] Antipsychotics and benzodiazepines, were associated with an increased risk of falling (increased risk of 47% and 36% respectively). In contrast to other studies, antidepressants were not associated with increased risk of falling. Also, the data did not support the thought that prescribing of short-acting benzodiazepines instead of long-acting agents, or atypical antipsychotic medications instead of typical agents, will substantially reduce fall risk. The results for benzodiazepines were similar to that of a meta-analysis which found that the use of benzodiazepines increased the risk of falling in older persons independently of drug half-life. Benzodiazepines with a short half life have also been associated with an increased risk of falls in hospitalized patients.[52]

Cardiovascular agents

Antihypertensives may contribute to hypotension and orthostatic hypotension, causing dizziness and thereby increasing fall risk. Type 1 anti-arrhythmics have also been associated with an increased risk of falls.

Anticholinergic load

Many drugs have anticholinergic adverse effects which are usually dose-related and may be additive in increasing fall risk. Anticholinergic adverse effects contributing to an increased fall risk include sedation, dizziness, reduced alertness, blurred vision, impaired neuromuscular function, impaired gait and balance, and confusion. Even if the contribution of each individual agent is small, a patient's total anticholinergic load may be sufficient to increase fall risk. Anticholinergic drugs include antipsychotics, atropine, antihistamines, antiemetics, drugs used for urinary incontinence, tricyclic antidepressants (see above), anti-Parkinsonian medications, skeletal muscle relaxants, and antispasmodics.

Narcotics

Alleviating pain is an important goal in older patients, and the judicious use and slow titration of narcotics can be very effective for pain management in the elderly. However, narcotics can also increase fall risk by reduced alertness, impaired neuromuscular function, sedation, dizziness, and impaired cognition.

BOTTOM LINE - medications: A number of medications have been associated with an increased risk of falls, and polypharmacy may further increase this risk. The effectiveness of using drugs with shorter rather than longer half-lives to reduce fall risk has not been unequivocally demonstrated for all drug classes.

Dose reduction or withdrawal of drugs that increase the risk of falls may be effective. However, there is a need to balance falls risk reduction outcomes and other health outcomes, because dose reduction or withdrawal of certain drugs may reduce fall risk but worsen the condition(s) for which they are being prescribed.

Clinical questions

Can the relative contributions of various medications to fall risk be assessed?

The association between medications and falls may be mediated by the underlying medical conditions.[53] For example, falls in a hypertensive diabetic could be due to antihypertensive medication-induced orthostasis and/or orthostatic hypotension resulting from diabetic autonomic neuropathy. The situation may be further complicated by the potential for drug-induced hypoglycaemia-related falls.

While there is no universally accepted evidence-based list of specific medications that clinicians can use to evaluate risk contribution of medications in a fall risk assessment, it is well established that some medications do increase the risk of falls (see Figure 5 on page 9). A widely known compilation of potentially inappropriate drugs in the elderly is the Beers criteria. However, the Beers criteria are not an adequate tool for fall risk assessment, as many of these drugs are no longer in common use, and the majority of the medications on the Beers criteria do not directly affect fall risk.[54]

The Canadian Safety Council's Fall Risk Assessment Tool provides a list of drugs that specifically affect fall risk in the elderly and is available at http://www.safety-council.org/info/seniors/medicati.htm.[55] The list is consistent with other studies of drugs likely to be associated with increased fall risk.[54]

Does multiple drug use increase the risk of falls irrespective of the specific medications involved?

Results of a systematic review and meta-analysis suggest that older people taking more than four medications may be at risk of recurrent falls.[30]

A 2006 study examined the association between multiple drug use (polypharmacy) and falls in the elderly.[56] Polypharmacy was defined as the use of ≥ 4 medications per day. The study was a population-based cross-sectional study involving 6,928 participants age ≥ 55 years. The prevalence of falls strongly increased with age, and falls were more common in women. The risk of falling increased significantly with the number of drugs used per day ($p < 0.0001$). After adjustment for a number of co-morbid conditions and disability, polypharmacy remained a significant risk factor for falling. The risk of falls was associated with the use of polypharmacy only when at least one established fall-risk-increasing medication was part of the regimen.

Will withdrawal/modification of the medication(s) reduce the risk of falls?

A 1999 study reported that the gradual withdrawal of psychotropic medication (benzodiazepine, any hypnotic, antidepressant or major tranquilizer) over a 14-week period in patients over 65 years reduced the risk of falling.[30]

A 2005 study evaluated a system of guided prescribing for elderly *hospitalized* patients receiving psychotropic medications, with fall rate as one of the primary outcome measures. Patients in the intervention cohort had a >50% reduction in falls, suggesting that guided prescribing of psychotropic medication may help reduce the fall risk of an elderly hospitalized population.[50]

A 2007 study examined the change in the incidence of falls in the community-dwelling elderly after withdrawal (discontinuation or dose reduction) of fall-risk-increasing drugs as a single intervention.[57] The reductions in risk of a fall for intervention groups compared to the control group are shown in Table 2 below.

Table 2. Percentage risk reductions for a fall in the intervention group relative to continued treatment

overall drug withdrawal	cardiovascular drug withdrawal	psychotropic drug withdrawal
52%	65%	44%

Thus, withdrawal of fall-risk-increasing drugs was effective as a single intervention for falls prevention in a geriatric outpatient setting. Somewhat surprisingly, the effect was greater for the withdrawal of cardiovascular drugs than for psychotropics, but overall numbers in the study were low: other studies have shown an increased risk of falls with psychotropics compared to cardiovascular medications.

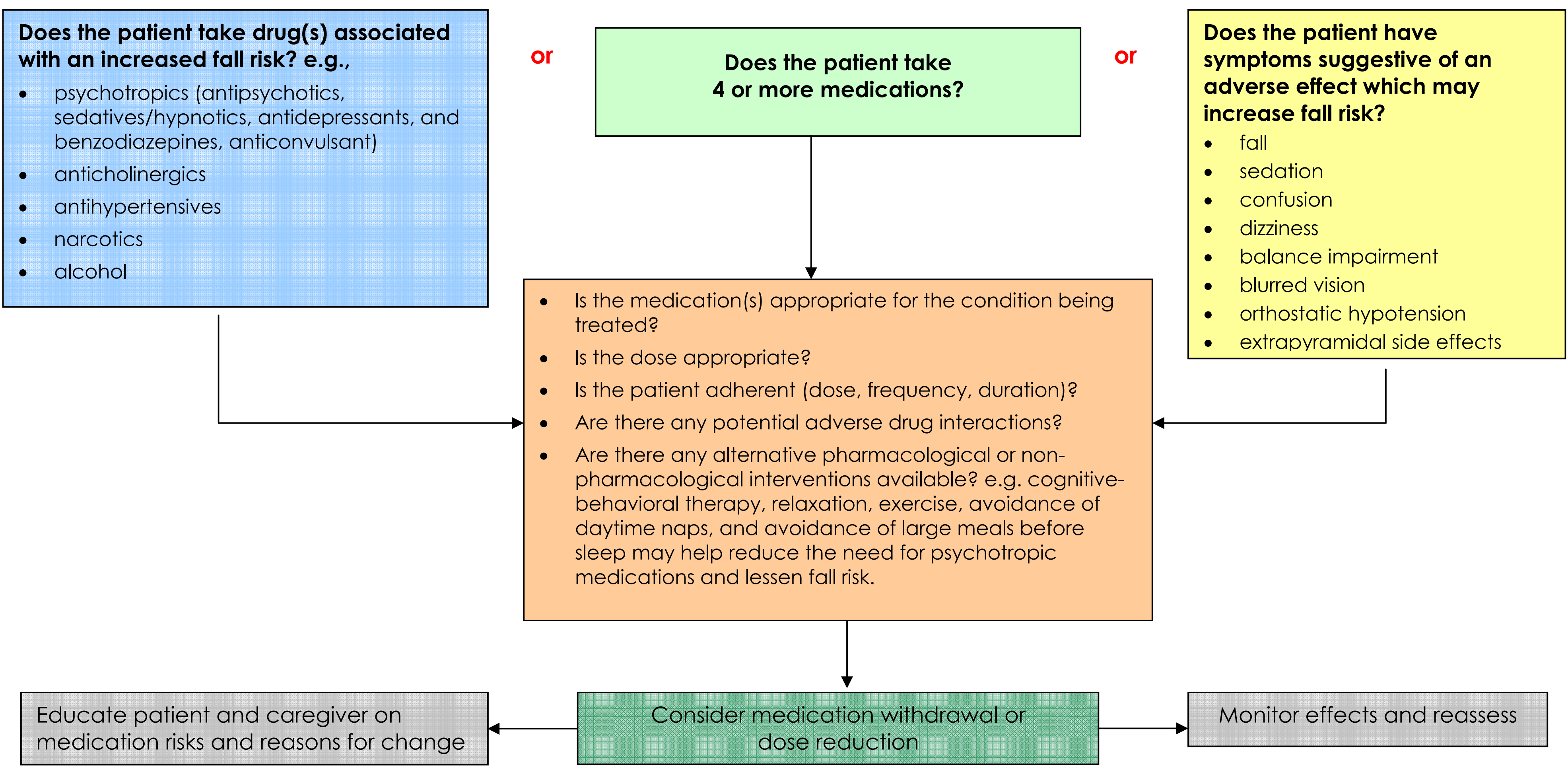
A 2007 study found that the withdrawal of drugs which increase fall risk improved some (but not all) tests of mobility. The effect was strongest for the withdrawal of psychotropic drugs.[58]

Importantly, the above studies have not evaluated the impact of dose reductions or withdrawals on overall health status of patients.

Algorithm for medication management

An algorithm for medication assessment and intervention in the management of falls is provided below.

Review and reduction/withdrawal of medications to reduce fall risk



Laboratory testing

Screening laboratory tests that are plausible as part of a falls workup include:

- electrolytes, creatinine and urea
- glucose
- complete blood count
- thyroid function test
- liver function tests
- Vitamin B12 level

Referral and specialized testing

Cardiac assessment

If a cardiac cause of falls is suspected (atrial fibrillation, heart failure, other arrhythmia), consider an ECG. Consider specialist referral for a transthoracic echocardiogram (TTE). A pacemaker may be needed to treat syncope due to arrhythmias or carotid sinus hypersensitivity.

Neuroimaging

Neuroimaging is indicated if there is a head injury, focal neurological findings on physical examination, or if a CNS abnormality is suspected on the basis of the history or examination results.[24]

Other assessments

A tilt table test is sometimes used to evaluate the cause of unexplained fainting or severe light-headedness. Tilt table testing is not a routine part of family practice and requires specialist referral.

Electroencephalography is indicated if there is a clinical suspicion of seizure.

BOTTOM LINE - Assess all fall risk factors in patients at high fall risk: Think HIP

History. **Take a detailed history of current and past falls, falls in the last 12 months, and falls indoors/outdoors. If possible, obtain a history from any witnesses to the fall. Assess pain and fear of falling.**

Inspection. **Examine patient standing and walking to assess balance, mobility and gait. Assess ability to stand from sitting, and ability to get up from the floor. Conduct physical examination focusing on musculoskeletal, cardiovascular (including orthostatic hypotension), vision, neurological, and cognitive assessments.**

Prescription. **Review use of all prescribed and OTC drugs, particularly psychotropics (antidepressants, benzodiazepines, antipsychotics), antihypertensives, anticonvulsants, anti-Parkinsonian drugs, narcotics, and anticholinergics. Review level of alcohol consumption.**

Multifactorial interventions

Background

Data from clinical trials show that the risk of falling in older people can be reduced by as much as 50% with multifactorial intervention programs.[32] The goal of interventions in the community dwelling elderly is to:

- reduce the risk of a fall
- reduce the risk of fall-related injury
- enable people to continue independent living at home

One of the strongest risk factors for a fall is a history of prior fall(s), and patients who fall frequently often have multiple risk factors and typically need multiple interventions to reduce fall risk. Similarly, patients with cognitive impairment and/or movement disorders often fall multiple times, and need multiple interventions.[43]

Osteoporosis and falls are inextricably linked as risk factors for fractures. Pharmacological therapy, typically with calcium, vitamin D, and an anti-resorptive agent such as a bisphosphonate, should be considered in established osteoporosis. However, the pharmacological treatment of osteoporosis, with the possible exception of vitamin D (see page 34), does not reduce the risk of falls. Falling is the strongest single risk factor for fractures in the elderly, with an impact greater than the presence or absence of osteoporosis itself.[32] Although bone mineral density is commonly used to determine the need for osteoporosis medications, it is not a strong predictor of fracture risk.[32] Drug treatment alone, although important, will not prevent most fractures.[32] Since preventing fractures and reducing the risk of precipitating events such as falls are complementary aims, drug treatment to reduce fracture risk in osteoporosis and fall risk reduction are both valuable when implemented in appropriately selected patients.[31] Clinicians therefore need to undertake a broad-based set of measures to prevent falls, rather than relying exclusively on drug treatment of osteoporosis to reduce the risk of fractures.

Changing clinical practice to reduce fall risk

In 2008, Tinetti et al at Yale Medical School reported the results of a landmark falls-prevention intervention. They presented clinicians in one region with a series of educational interventions designed to reduce fall risk; another region was used as a control.[26]

The interventions included outreach visits (academic detailing) involving one-on-one contact between an educator and a practitioner. Although time and personnel intensive, this was a highly effective strategy. During outreach visits, the academic detailer:

- provided a rationale for why fall risk assessment and management should be incorporated into the routine care of elderly persons
- presented provider-specific activities
- disseminated information on incentives and methods for addressing barriers
- related risk assessment and management to ongoing practice activities
- provided simple point-of-care fall risk assessment and management materials and discussed how they could be adapted to provider style, resources, and expertise

Office and professional staff were included in these outreach visits.

The study outcomes were rates of serious fall-related injuries (fractures, head injuries, and joint dislocations) and fall-related use of medical services among persons who were 70 years or older.

Over half the targeted clinicians and facilities in the intervention region received visits during the intervention period. The program achieved a reduction of 9% in serious fall-related injuries and 11% in fall-related use of medical services in the intervention region compared to the control region. The key strategies for success appeared to be working groups of local clinicians, and repeating face-to-face (outreach) contacts over time.

The 11% relative reduction in the use of fall-related medical services translated into about 1,800 fewer emergency department visits or hospital admissions over the 2 year evaluation period, a potential savings of more than $21 million in health care costs. The study findings suggest that effectively disseminating evidence about fall prevention to clinicians, coupled with interventions aimed to change clinical practice, can be a useful tool for reducing falls and injuries among older patients living in the community.

Specific interventions

All older people who have fallen or who have been identified as being at an increased risk of falling should be considered for a multifactorial individualized intervention. Successful multifactorial intervention programs often include the following components (set against a background of patient-specific medical conditions and risk factors):[17, 24, 30]

- patient and care-giver involvement and education
- strength and balance training (e.g., by walking or with Tai Chi, see below)
- mobility and gait improvement
- home hazard assessment and intervention
- strategies to minimize orthostatic hypotension
- strategies to reduce fear of falling
- medication review with modification/withdrawal

These interventions are described below (medication review has been previously covered).

Patient and care-giver involvement and education

Although ineffective as a single intervention, education is an important aspect of overall management. Patients and care-givers should be educated about the multifactorial nature of most falls, patient-specific risk factors, and interventions. Patients who live alone should be taught how to get up from a fall, what to do if they fall and cannot get up, and if they should have a personal emergency-response system or a telephone that is accessible from the floor.[24]

The patient and care-giver should be encouraged to participate in fall and injury prevention, emphasizing the following messages:[43]

- fall-prevention is aimed at allowing the person to stay independent for longer
- the importance of medication use and adherence (dose, frequency, duration), and the availability of adherence aids such as pill boxes
- relevant and useable information to enable informed decision-making by older people and their care-givers
- explore the changes an older person is willing to make to prevent falls, so that appropriate and acceptable recommendations can be achieved
- explore potential barriers that may prevent action to reduce falls
- if appropriate, offer information in languages other than English
- develop fall-prevention programs that are flexible enough to accommodate older people's needs, circumstances and interests

Strength and balance training

Strength and balance training can benefit older community-dwelling people with a history of recurrent falls and/or balance and gait deficits.[17, 30, 59-61] A muscle strengthening and balance program should be individually prescribed and monitored by an appropriately trained health care worker.[30]

Strength training (also called resistance training) is exercise where the resistance against which a muscle generates force is progressively increased over time, to increase the power and size of skeletal muscles. It is primarily an anaerobic activity that can improve the power of ligaments, tendons, muscles, and bones. Strength training involves incremental increases of weight, elastic tension, or other resistance. Elaborate gym equipment may be used but is not essential, and simple hand weights or body weight can be used to generate resistance.

The aim is to use an appropriate weight or resistant force that will cause muscle fatigue over 8-12 repetitions of an exercise. Exercises to strengthen leg muscles are particularly important for reducing fall risk, and are usually performed 2 to 3 times every week. Strength training should not be done on consecutive days unless different muscle groups are worked, to allow time for muscle recovery. A comprehensive guide to strength training in older adults is available at http://www.cdc.gov/nccdphp/dnpa/physical/growing_stronger/resources.htm. Some specific exercises to strengthen the legs are provided in Appendix 4. Leg strengthening exercises on page 42.

Tai Chi is a low-impact form of exercise that focuses on balance and co-ordination. Its aim in older adults is to improve muscle strength and balance in an effort to reduce the risk of falls.[5] Exercise should be performed on average three times per week for 30–45 minutes per session, for at least three months, for balance benefits to become evident. Exercise should be continued indefinitely for benefits to be maintained.[5]

Meta-analyses and clinical trials have found that Tai Chi may reduce fall risk in older community-dwelling people by improving balance and co-ordination, and reducing fear of falling.[3, 62-68]

Tai Chi teachers in Pennsylvania can be found at: http://www.taichinetwork.org/searchpages/Philadelphia-Pennsylvania-Tai-Chi-teachers.html or, by searching by city or state at http://www.taichinetwork.org/list_result.cfm

Mobility and gait improvement

Physical activity can help improve mobility, while inactivity can cause deconditioning and accelerate loss of mobility. A regular walking program of 30 minutes daily on a safe walking course can help maintain mobility. Several studies have demonstrated that exercise programs can improve mobility and reduce the risk of falls in community dwelling elderly people.[69-72] The optimal type, duration and intensity of exercise for falls prevention must be individualized.[17] A one-page fact sheet on physical activity for Americans (including older people) is available at http://www.health.gov/paguidelines/pdf/fs_prof.pdf. A comprehensive guide to exercise in the elderly is available from the National Institute on Aging at http://www.nia.nih.gov/HealthInformation/Publications/ExerciseGuide/.

Although assessment of gait is important, interventions to alter gait are not always needed. A slow, abnormal gait may still allow an older person to achieve adequate mobility safely and without assistance. Gait may improve with regular walking or resistance exercises.

Treatment of gait disorders often necessitates the use of ambulatory devices such as canes, crutches, and walkers.[29] To use an ambulatory device, a patient must have sufficient cognitive function, judgment, vision, vestibular function, upper body strength, and physical endurance. The patient should be assessed as to whether one or both upper extremities are required to achieve balance or weight-bear. People needing only one upper extremity to bear weight can use a cane, while patients requiring both upper extremities will need forearm crutches or walkers. A physical therapist can help choose an appropriate device and provide training for patients to use these devices.[29]

Home hazard assessment and modification

Home hazard assessments have been developed for use by community nursing personnel, occupational therapists, and physical therapists to identify hazards that may contribute to falling. Home hazard modifications have been shown to reduce the incidence of falls in older people with a history of falling.[17, 30]

Older people who have had a fall-related injury should be offered a home hazard assessment and modifications by a suitably trained health care worker. Many home evaluations are covered by Medicare. Home hazard assessment is only effective with follow-up modification, not in isolation.[30]

Most serious falls occur in and around the home, frequently in bathrooms and on stairways. For an in-home safety assessment, contact an occupational therapist (OT). OT services may be covered under medical benefit plans. Installing a wireless Home Monitoring system can allow a patient to seek help even if they cannot reach a telephone. Family members and neighbors can be alerted immediately. Some simple precautions and adaptations can prevent falls:[73]

- Install adequate lighting throughout the home, particularly in bathrooms and stairs, with a light switch at each end.
- Use night-lights in hallways, particularly between the bedroom and bathroom.
- Keep floor and stairs free of clutter.
- Avoid using scatter rugs.
- Each stairway and set of steps should have at least one handrail, securely attached and in good repair.
- Steps and stairs should be in good repair and be slip resistant.
- Attach strips in a contrasting color to the edge of each step.
- Arrange to have leaves, snow and ice removed on a regular basis. Use salt or sand throughout the winter months.
- Wear proper footwear. Shoes, boots and slippers should provide good support and have good soles. Avoid loose slippers or stocking feet.
- Install grab bars in all bathrooms, by the toilet and in the bathtub or shower. It's a good idea to have two bars in the tub, one on a side wall and one on the back wall. Consider a seat or bench to shower sitting down.
- Use a rubber mat along the full length of the bath tub, and a non-skid bath mat on the floor beside the tub.
- Use walking aids and other safety devices for extra safety. If you use a cane or a walker, check that it is the right height and that the rubber tips are not worn. Install stainless steel prongs (ice picks) on canes for safe walking in the winter.

Strategies to treat orthostatic hypotension

Options include:[24]

- Review medications which can exacerbate orthostatic hypotension (diuretics, tricyclic antidepressants, alpha blockers, nitrates (including when taken prn), levodopa, bromocriptine, and antipsychotics).
- Modify salt restriction.
- Ensure adequate hydration.
- Lifestyle strategies such as elevation of bed-head, standing slowly, or dorsiflexion exercises.
- Pressure stockings.
- Pharmacological therapy. There are obvious and inherent hazards in using pharmacotherapy to correct orthostatic hypotension in the elderly. Such an approach should only be implemented where all else has failed, co-morbidities must be considered, and response carefully monitored. Agents approved for this indication include midodrine, fludrocortisone, and ephedrine.

Strategies to reduce fear of falling

A 2007 systematic review assessed interventions to reduce fear of falling in community-living older people.[22] Interventions that showed benefit were community-based group Tai

Chi (see page 29), home-based exercise, and wearing a hip protector (see below). Interventions in community-dwelling elderly people to reduce fear of falling can also improve confidence, and have positive effects on balance and strength.[74]

Hip protectors aim to minimize the impact of falls and reduce the risk of fractures by cushioning the force of a fall.[5] They vary widely in design and materials used, many consisting of plastic shields or foam pads, which are kept in place by pockets within specially designed underwear. Hip protectors are ineffective against hip fractures resulting from shearing forces generated before impact with the ground (e.g., twisting of the torso around a fixed foot).[75]

Figure 11. Hip protectors to reduce fracture risk

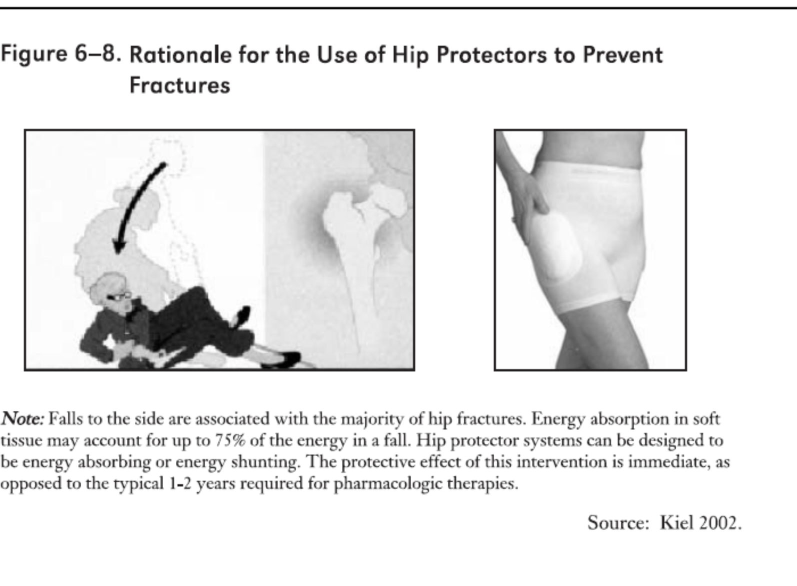


Figure reproduced from: U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General.* Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, 2004.[5]

Hip protectors do not reduce the risk of falls. They aim to reduce the risk of hip fractures by cushioning the impact of a fall, and may significantly reduce the risk of hip fracture if worn at the time of a fall. However, poor adherence rates might result in a failure to demonstrate a benefit across an entire study population.[76-81]

Barriers to using hip protectors include discomfort, inconvenience, change in appearance, concern that wearing hip protectors is a sign of old age, and a lack of perceived need or benefit.[8]

BOTTOM LINE - Multifactorial interventions: Because falls and mobility problems often have several causative factors, multiple interventions involving the patient and care-giver, and addressing medications, mobility/gait/balance, home/environmental hazards, vision, fear of falling, and orthostatic hypotension may be required to reduce fall risk.

Other aspects of falls management

Interactions between interventions

Most falls occur because of multiple risk factors and randomized trials have examined the use of either a single intervention strategy (such as exercise) or multifactorial assessment and interventions addressing medical and situational risk factors. The multifactorial approach has been increasingly adopted in clinical practice.

There is conflicting evidence whether multiple interventions might interact unfavorably with each other from a compliance perspective.[82-84]

A 2007 meta-analysis found that multifactorial fall prevention interventions are effective for individual patients, but for community-dwelling people, targeted single interventions are as effective as multifactorial interventions and may be more acceptable and cost effective. [85] The authors acknowledge that clinicians seeing individual patients will advise intervention in a number of areas, and they suggest that multiple interventions should be introduced only as rapidly as acceptance and adherence allow.[84]

Falls clinics

Falls clinics typically offer a multifactorial assessment to identify an individual's medical and environmental risk factors for falls, and recommend or implement multidisciplinary targeted interventions based on these risk factors. There have been few falls clinic outcome studies, with relatively small samples. Overall, these studies have indicated substantial reductions (between 35% and 77%) in falls in high risk populations, as well as improvements in other outcomes such as balance and mobility, physical functioning, and fear of falling.[86]

A 2008 study evaluated outcomes associated with falls clinic programs in 13 outpatient falls clinics.[86] Participants were 454 people with a mean age of 78 years who had been referred for clinic assessment. Patients had a high risk of falls, with 78% having had falls in the preceding 6 months (63% multiple fallers, 10% experiencing fractures from the falls). An average of 8 risk factors per individual was identified at assessment, and multifactorial interventions were implemented to address identified risk factors. Each patient received an average of 5.7 interventions, with the most commonly recommended interventions being:

- home visits to determine the need for home modifications
- home aids (e.g., shower stool or bath seat) or modifications (e.g., change to lighting, rails installed, changes to steps)
- exercise programs
- further medical investigations or medical management of disorder
- gait aid change
- foot care or footwear change
- hip protectors
- vision management
- medication reduction
- reduction of risky behaviors

Follow up at 6 months showed a > 50% reduction in falls, multiple falls, and fall injuries compared to the same group of participants in the 6 months preceding clinic assessment ($p \leq 0.004$).[86] The study showed the high falls risk of older people referred to falls clinics; identified the multifactorial nature of their presenting problems; and provides evidence of positive outcomes after falls clinic management.[86]

Vitamin D and falls

A number of clinical trials and meta-analyses have examined the effect of vitamin D deficiency and/or supplementation on fall risk, although the mechanism by which vitamin D might reduce fall risk is not clear.

Data from 4 systematic reviews/meta-analyses and 12 clinical trials[3, 87-89 90-101] were examined. The studies variously comprised community dwellers, residents of aged care facilities, or a mixture of both, and falls were not always the primary outcome in clinical trials assessing the efficacy of vitamin D therapy.

There are conflicting results from clinical trials on the efficacy of vitamin D in reducing fall risk. Some trials have demonstrated a benefit, others not. At least 3 meta-analyses have failed to demonstrate a benefit of vitamin D in reducing risk of falls.

Although the dose and form of vitamin D likely to produce most benefit in specific housing situations, or with specific baseline vitamin D levels, cannot be unequivocally determined, there is limited evidence that a minimum dose of 700-800 IU daily of vitamin D3 may be needed for a beneficial effect.[102] The role of calcium in falls outcomes and the amount needed in combination with vitamin D cannot be definitively determined.

These issues make it difficult to make firm recommendations on vitamin D doses and form for clinical practice. However, vitamin D deficiency in the elderly is common, and an identified vitamin D deficiency should be corrected with appropriate supplementation. Similarly, vitamin D and calcium supplementation should be considered in osteoporosis.

Putting it all together – an algorithm for falls assessment and management

Screening: In patients > 70 years, ask:

1. History of falls? OR
2. Gait, balance or mobility difficulties or a fear of falling, as reported by them or a third party? OR
3. Any balance, gait or mobility difficulties with 'Get Up & Go' test?**

No →

1. Educate on falls prevention including:
   - multifactorial nature of most falls
   - patient-specific risk factors
   - recommended interventions
   - what to do if unable to get up from a fall
   - use of a personal emergency-response system or a telephone that is accessible from the floor.
2. Recommend an exercise program which includes progressive balance-training and strengthening (consider referral to physical therapist)

Yes →

Multifactorial Assessment (consider referral to a specialist)

- Detailed history of current and past falls; Collateral history from family/carer if possible
- Medical history (acute and chronic)
- Fear of falling
- Pain
- Medication review (especially psychotropics, anticholinergics, anti-Parkinsonian drugs, antihypertensives, narcotics)
- Alcohol
- Mobility, gait & balance
- Ability to stand from sitting
- Ability to get up after a fall
- Musculoskeletal examination
- Neurological examination
- Vision (acuity, depth perception, glaucoma, cataracts)
- Cardiovascular status (including postural blood pressure)
- Gross cognitive assessment (MMSE)
- Continence
- Bloods (FBE, ECU, TFT, LFT)

Refer →

Multifactorial Intervention (multidisciplinary team)

- Medication modification/withdrawal (consider pharmacist home medicine review)
- Pain management
- Education on falls prevention
- Strength and balance training (consider referral to physical therapist, consider tai chi)
- Exercise and gait program (consider referral to physical therapist; consider gait aid such as a cane or walker)
- Home hazard assessment and modification
- Vision management
- Cardiovascular management
- Continence management
- Feet and footwear management
- Cognitive management
- Alcohol management program
- Vitamin D supplementation
- Hip protector
- Nutrition management

← **Review**

** The Get-Up-and-Go test involves looking for balance, gait or mobility deficits as a patient gets up from a chair without using his or her arms, walks a few meters, turns, returns and sits down again.

Appendix 1. Berg Balance Test

The Berg Balance Test assesses balance in the elderly.[103] Participants perform 14 balance-related tasks in a standard order and an examiner scores performance by quality or time taken against each task. The components of the Berg Test reflect activities of daily living such as standing, sitting, and stepping.

The 14 components of the Berg Balance Test are:

1. change of position: sitting to standing
2. standing unsupported
3. sitting unsupported
4. change of position: standing to sitting
5. transfers
6. standing with eyes closed
7. standing with feet together
8. reaching forward with an outstretched arm while standing
9. retrieving objects from floor
10. turning trunk (feet fixed)
11. turning 360 degrees
12. placing foot on stool
13. tandem standing (standing with one foot in front of the other)
14. standing on one foot

Scores for each component range from 0 (cannot perform) to 4 (normal performance). Balance scores predict the occurrence of multiple falls among elderly residents. A total score less than 45 indicates an increased risk for falls.

Appendix 2. Tinetti Balance Tool

The Tinetti balance assessment tool assesses balance and gait using a scoring system, which is then correlated with the risk of falls as low, moderate, or high.[104]

TINETTI BALANCE ASSESSMENT TOOL

Tinetti ME, Williams TF, Mayewski R, Fall Risk Index for elderly patients based on number of chronic disabilities. Am J Med 1986:80:429-434

PATIENTS NAME ______________________ D.o.b. ___________ Ward ______

BALANCE SECTION

Patient is seated in hard, armless chair;

		Date		
Sitting Balance	Leans or slides in chair Steady, safe	= 0 = 1		
Rises from chair	Unable to without help Able, uses arms to help Able without use of arms	= 0 = 1 = 2		
Attempts to rise	Unable to without help Able, requires > 1 attempt Able to rise, 1 attempt	= 0 = 1 = 2		
Immediate standing Balance (first 5 seconds)	Unsteady (staggers, moves feet, trunk sway) Steady but uses walker or other support Steady without walker or other support	= 0 = 1 = 2		
Standing balance	Unsteady Steady but wide stance and uses support Narrow stance without support	= 0 = 1 = 2		
Nudged	Begins to fall Staggers, grabs, catches self Steady	= 0 = 1 = 2		
Eyes closed	Unsteady Steady	= 0 = 1		
Turning 360 degrees	Discontinuous steps Continuous	= 0 = 1		
	Unsteady (grabs, staggers) Steady	= 0 = 1		
Sitting down	Unsafe (misjudged distance, falls into chair) Uses arms or not a smooth motion Safe, smooth motion	= 0 = 1 = 2		
		Balance score	/16	/16

P.T.O.

TINETTI BALANCE ASSESSMENT TOOL

GAIT SECTION

Patient stands with therapist, walks across room (+/- aids), first at usual pace, then at rapid pace.

	Date		
Indication of gait (Immediately after told to 'go'.)	Any hesitancy or multiple attempts = 0 No hesitancy = 1		
Step length and height	Step to = 0 Step through R = 1 Step through L = 1		
Foot clearance	Foot drop = 0 L foot clears floor = 1 R foot clears floor = 1		
Step symmetry	Right and left step length not equal = 0 Right and left step length appear equal = 1		
Step continuity	Stopping or discontinuity between steps = 0 Steps appear continuous = 1		
Path	Marked deviation = 0 Mild/moderate deviation or uses w. aid = 1 Straight without w. aid = 2		
Trunk	Marked sway or uses w. aid = 0 No sway but flex. knees or back or uses arms for stability = 1 No sway, flex., use of arms or w. aid = 2		
Walking time	Heels apart = 0 Heels almost touching while walking = 1		
	Gait score	/12	/12
	Balance score carried forward	/16	/16
	Total Score = Balance + Gait score	/28	/28

Risk Indicators:

Tinetti Tool Score	Risk of Falls
≤18	High
19-23	Moderate
≥24	Low

Appendix 3. The Folstein Mini-Mental Status Examination (MMSE)

The MMSE is a tool for screening cognitive decline associated with dementia.[105]
Adapted from and available at: *http://rgp.toronto.on.ca/dmcourse/toolkit/Folstein.htm*

Questions 1 through 10 screen orientation in time and place.
Questions 11 to 13 screen learning and immediate recall.
Questions 14 to 18 screen mental control and concentration.
Questions 19 to 21 screen short-term recall.
Questions 22 and 23 screen naming ability.
Question 24 is an item to screen language expression.
Question's 25 to 27 screen verbal comprehension.
Question 28 is an item to screen writing comprehension.
Questions 29 & 30 screen writing ability and visuo-spatial coordination.

	Question	Correct answer	Incorrect answer
1.	What year is it?	☐	☐
2.	What season are we in?	☐	☐
3.	What month are we in?	☐	☐
4.	What is today's date?	☐	☐
5.	What day of the week is it?	☐	☐
6.	What country are we in?	☐	☐
7.	What province are we in?	☐	☐
8.	What city are we in?	☐	☐
9.	What street are we on (What building? - if in hospital or clinic)	☐	☐
10.	What is the street number? (What floor? - if in hospital or clinic)	☐	☐
	Name three objects ("Ball", "Car", "Man"). Take a second to pronounce each word. Then ask the patient to repeat all 3 words. Take into account only correct answers given on the first try. Repeat these steps until the subject learns all the words.		
11.	Ball?	☐	☐
12.	Car?	☐	☐
13.	Man?	☐	☐

Either "please spell the word WORLD and now spell it backwards" or "Please count from 100 by subtracting 7 every time".

14. "D" or 93
15. "L" or 86
16. "R" or 79
17. "O" or 72
18. "W" or 65

What were the 3 words I asked you to remember earlier?

19. Ball?
20. Car?
21. Man?

Show the subject a pen and ask:

22. Could you please name this object?

Show the subject your watch and ask:

23. Could you please name this object?

Listen and repeat after me:

24. "No ifs, ands or buts."

Put a sheet of paper on the desk and show it while saying: "Listen carefully and do as I say."

25. Take the sheet with your left/right (opposite to dominant)hand.
26. Fold it in half.
27. Put it on the floor.

Show the patient a written instruction directing him/her to "CLOSE YOUR EYES" and say:

28. "Do what is written on this page"

	Give the subject a blank sheet and a pen and ask:		
29.	Write a sentence, whatever you want, but a complete sentence.	☐	☐
	Give the patient a sheet of paper with a drawing of intersecting pentagons and ask:		
30.	Could you please copy this drawing?	☐	☐

A score of over 25 may be normal while a score below 20 is indicative of dementia.

If the patient scores in the normal range, but his/her family report declining behavioral integrity and cognitive problems, consider more detailed assessment by a geriatric psychologist or behavioral neurologist.

Test scores should always be interpreted cautiously, especially in the context of socio-cultural diversity or developmental disability.

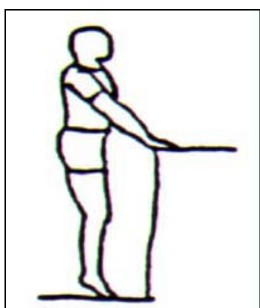
Appendix 4. Leg strengthening exercises

Preventing Falls and Broken Bones—What Can You Do?

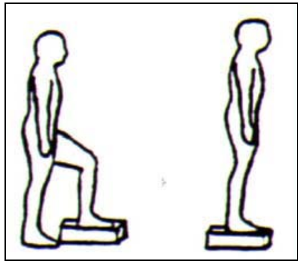
Make Your Legs Stronger to Prevent Falls

Research has shown that exercises like the ones shown below can help reduce the risk of falling. They can also help to improve the strength of bones. Try these four leg strengthening exercises:

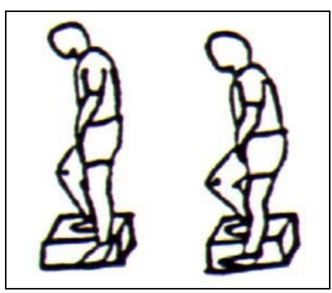
1. Sit on a firm surface with your legs hanging down and not touching the floor. Raise your right leg up slowly, hold for a count of 5, then lower. Repeat with the left leg. Repeat 10 times on each side.



2. Stand in front of a counter or table that is waist high. Slowly rise up on the tips of your toes, holding for a count of 5, then lower, using your arms for balance. Repeat 10 times on each side.



3. Find a step or sturdy box 6" tall. Step up onto the step, without using your hands, then down again. Alternate leading with first your right leg, then your left. Repeat 10 times on each side.



4. Stand sideways on a step or stair. Support your weight on your uphill (right) leg, and slowly lower yourself down on to the lower step, using your arms for balance if needed. Repeat facing the other direction. Repeat 10 times on each side.

Adapted from:
http://www.brighamandwomens.org/pharmacoepid/Osteoporosis%20Action/patient%20fall%20prevention%20sheet.pdf

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