

## CLINICAL PRACTICE

## Preventing Falls in Elderly Persons

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*This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author's clinical recommendations.*

**A 79-year-old woman with a history of congestive heart failure, arthritis, depression, and difficulty sleeping presents for a follow-up visit. She takes several prescription medications, including an antidepressant, a diuretic, an angiotensin-converting-enzyme inhibitor, and a beta-blocker, as well as over-the-counter sleep and allergy medications. Her chronic conditions appear to be stable. Her daughter reports that the patient has fallen twice during the past six months. What can be done to prevent future falls?**

## THE CLINICAL PROBLEM

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More than one third of persons 65 years of age or older fall each year, and in half of such cases the falls are recurrent.<sup>1,2</sup> Approximately 1 in 10 falls results in a serious injury, such as hip fracture, other fracture, subdural hematoma, other serious soft-tissue injury, or head injury.<sup>3-5</sup> Falls account for approximately 10 percent of visits to the emergency department and 6 percent of urgent hospitalizations among elderly persons.<sup>4,6</sup> Independently of other health conditions, falls are associated with restricted mobility; a decline in the ability to carry out activities such as dressing, bathing, shopping, or housekeeping; and an increased risk of placement in a nursing home.<sup>7-9</sup>

Although a few falls have a single cause, the majority result from interactions between long-term or short-term predisposing factors and short-term precipitating factors in a person's environment.<sup>1-5</sup> Each of the following conditions has been shown to increase the subsequent risk of falling in two or more observational studies: arthritis; depressive symptoms; orthostasis; impairment in cognition, vision, balance, gait, or muscle strength; and the use of four or more prescription medications. Furthermore, the risk of falling consistently increases as the number of these risk factors increases.<sup>1,2</sup> The risk of falling increased in a cohort of elderly persons living in the community, for example, from 8 percent among those with no risk factors to 78 percent among those with four or more risk factors.<sup>1</sup>

Although there is a clear relation between falling and the use of a higher number of medications, the risks associated with individual classes of drugs have been more variable.<sup>10,11</sup> To date, serotonin-reuptake inhibitors, tricyclic antidepressants, neuroleptic agents, benzodiazepines, anticonvulsants, and class IA antiarrhythmic medications have been shown to have the strongest link to an increased risk of falling.<sup>10-12</sup>

During the month after hospital discharge, the risk of falling is high, particularly among elderly persons frail enough to require home health care.<sup>13</sup> Other periods of high risk include those in which there are episodes of acute illness or exacerbations of chronic illness.

As discussed in the next section of this article, several single and multifactorial, health care-based strategies have proved effective in reducing the rate of falling in clin-

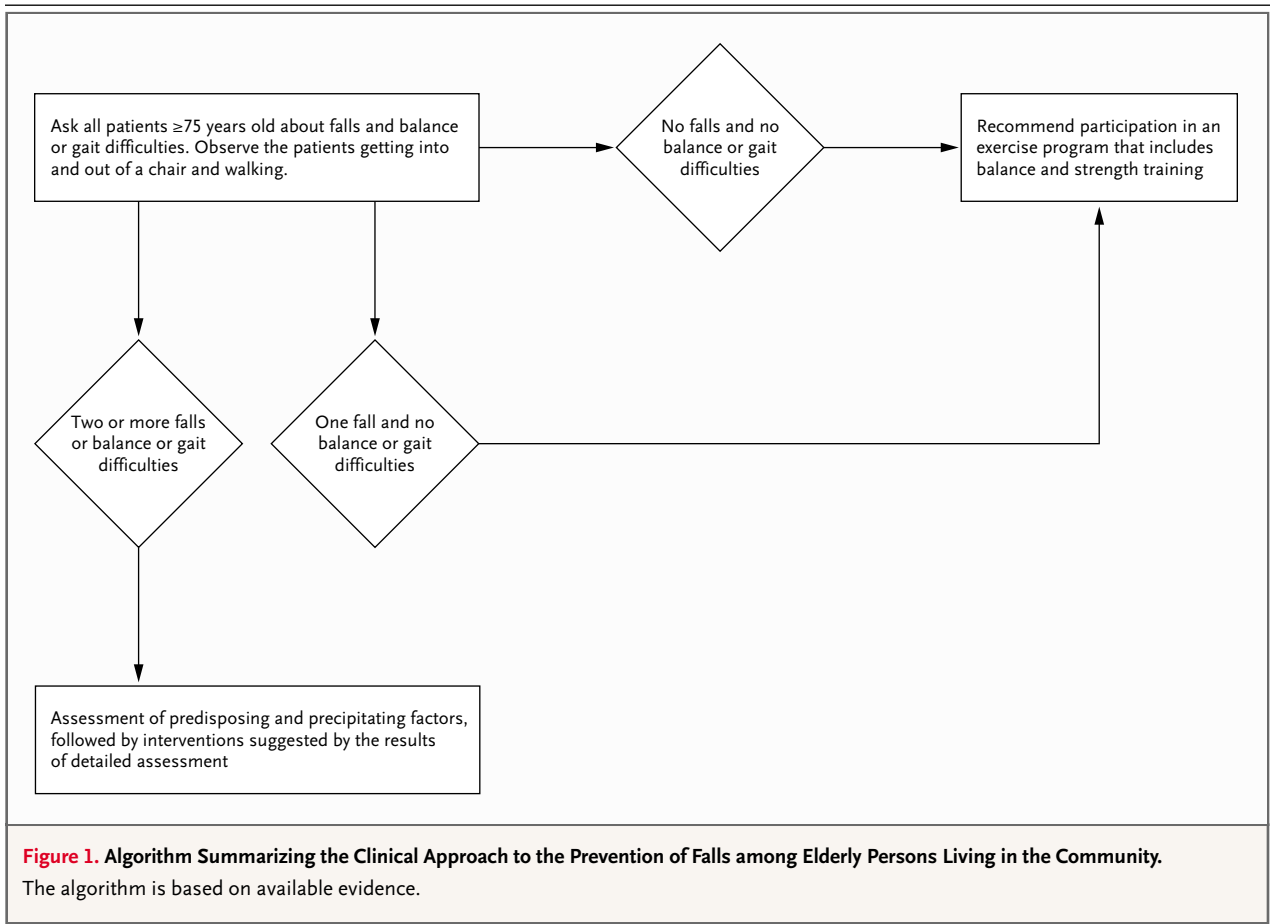
STRATEGIES AND EVIDENCE

ical trials.<sup>14-21</sup> However, implementation of these approaches for the prevention of falling may be complicated, for at least two reasons. First, clinicians are more experienced at managing discrete diseases than at managing multifactorial conditions, such as falling. Second, although many components of an effective fall-prevention strategy are relatively straightforward, others require tradeoffs and the weighing of risks and benefits. Perhaps the most complicated component of a strategy to prevent falls involves reduction in the use of medications. Medications may be appropriately recommended for the treatment of a disease, but they also have adverse effects; falling is one of the most common adverse events related to drugs.<sup>22-24</sup> Many elderly patients have several chronic conditions for which multiple medications are prescribed, further increasing the associated risks, including falling.

**ASSESSMENT AND INTERVENTION**

Because falls result from various combinations of factors, an effective and efficient clinical strategy for risk assessment and management must address many predisposing and precipitating factors. However, a clinically sensible strategy can be extrapolated from the available clinical-trial data, augmented by observational data from well-designed studies.<sup>1-5,10-21</sup>

A rational approach to the prevention of falls is presented in Figure 1. Because elderly persons may not volunteer the information, physicians should, on at least a yearly basis, ask their elderly patients about any falls and ask about and look for any difficulties with balance or gait. Brief screens such as the “Get-Up and Go” test, which involves looking for unsteadiness as the patient gets up from a chair



without using his or her arms, walks a few meters, and returns, is easily incorporated into short clinical encounters.<sup>25,26</sup> Other assessments provide more specific information about balance and gait abnormalities.<sup>27</sup> Although there is no consensus about the optimal time to initiate screening, the rate of falling and the prevalence of risk factors for falling increase steeply after the age of 70 years.<sup>1-4</sup>

Single-intervention strategies that have proved effective among elderly persons deemed at risk for falling, either because of the presence of a known risk factor or because of a history of falls, include professionally supervised balance and gait training and muscle-strengthening exercise; gradual discontinuation of psychotropic medications; and modification of hazards in the home after hospital discharge (Table 1).<sup>14-21</sup> In one study, tapering and discontinuation of psychotropic medications, including benzodiazepines, other sleep medications, neuroleptic agents, and antidepressants, over a 14-

week period were associated with a 39 percent reduction in the rate of falling.<sup>17</sup> Although nonspecific advice about modification of home hazards directed at untargeted groups of elderly persons has not proved effective, standardized assessment of home hazards by an occupational therapist, along with specific recommendations and follow-up after hospital discharge, was associated with a 20 percent reduction in the risk of falling.<sup>14,18</sup> The most commonly recommended modifications in that study were the removal of rugs, a change to safer footwear, the use of nonslip bathmats, the use of lighting at night, and the addition of stair rails. Adherence to the recommended interventions ranged from 19 percent for the installation of stair rails to 75 percent for the use of bathmats.<sup>18</sup>

Whereas multifactorial assessments not linked to targeted interventions have been ineffective in preventing falls,<sup>14,28-30</sup> the most consistently successful approach to prevention has been multifactorial assessment, followed by interventions targeting the identified risk factors.<sup>19-21</sup> Such targeted assessment and management strategies have been shown to reduce the occurrence of falling by 25 to 39 percent (Table 1). Successful components of these interventions include review and possible reduction of medications; balance and gait training, muscle-strengthening exercise; evaluation of postural blood pressure, followed by strategies to reduce any decreases in postural blood pressure; home-hazard modifications; and targeted medical and cardiovascular assessments and treatments. Ascertainment of the circumstances surrounding previous falls may reveal precipitating factors, such as environmental hazards, risks associated with the activity at the time of the fall, and acute host factors, such as acute illness or immediate effects of medication, that may be amenable to intervention.

Specific recommendations for assessment and intervention are summarized in Table 2. The assessments can be performed either by the patient's usual physician or by a geriatric specialist. All medications, including over-the-counter medications, should be thoroughly reviewed and considered for possible elimination or dose reduction; the goal should be to maximize the overall health and functional benefits of the medications while minimizing their adverse effects, such as falls. Psychotropic medications warrant particular attention, since there is very strong evidence that use of these medications is linked to the occurrence of falls.<sup>10,11,17</sup> Reducing the total number of medications to four or

**Table 1. Strategies Shown in Randomized Clinical Trials to Be Effective in Reducing the Occurrence of Falls among Elderly Persons Living in the Community.\***

Strategy	Estimated Risk Reduction	No. of Trials with Positive Results†
	%	
Health care–based strategy‡		
Balance and gait training and strengthening exercise	14–27	2 of 3
Reduction in home hazards after hospitalization	19	1 of 1
Discontinuation of psychotropic medication	39	1 of 1
Multifactorial risk assessment with targeted management§	25–39	3 of 3
Community-based strategy¶		
Specific balance or strength exercise programs	29–49	2 of 2

\* The trials are those reported in the Cochrane review<sup>14</sup> that included at least six months of follow-up and involved persons living in the community. Among the strategies that have not been shown to be effective are multifactorial risk assessment without targeted management (none of three trials with positive results<sup>28-30</sup>), low-intensity general exercise programs (none of seven trials with positive results<sup>31-37</sup>), and cognitive–behavioral, educational, and self-management programs (one of six trials with positive results<sup>38-43</sup>).

† Positive results were defined as relative risks with 95 percent confidence intervals that did not include 1.<sup>15,16,19-21</sup>

‡ Participants were recruited from clinical settings, and interventions were carried out by health care professionals. Participants had reported previous falls or balance or gait difficulties or had one or more risk factors for falling.

§ The specific assessments and interventions varied among the trials. The trial personnel directed or carried out specific interventions on the basis of the results of the assessments.

¶ Participants were recruited from community sites, and interventions were not carried out by health care professionals. Participants were not recruited on the basis of previous falls, balance or gait difficulties, or risk factors.<sup>44,45</sup>

**Table 2. Recommended Components of Clinical Assessment and Management for Older Persons Living in the Community Who Are at Risk for Falling.**

Assessment and Risk Factor	Management
Circumstances of previous falls*	Changes in environment and activity to reduce the likelihood of recurrent falls
Medication use High-risk medications (e.g., benzodiazepines, other sleeping medications, neuroleptics, antidepressants, anti-convulsants, or class IA antiarrhythmics)*†‡ Four or more medications‡	Review and reduction of medications
Vision* Acuity <20/60 Decreased depth perception Decreased contrast sensitivity Cataracts	Ample lighting without glare; avoidance of multifocal glasses while walking; referral to an ophthalmologist
Postural blood pressure (after ≥5 min in a supine position, immediately after standing, and 2 min after standing)‡ ≥20 mm Hg (or ≥20%) drop in systolic pressure, with or without symptoms, either immediately or after 2 min of standing	Diagnosis and treatment of underlying cause, if possible; review and reduction of medications; modification of salt restriction; adequate hydration <sup>46</sup> ; compensatory strategies (e.g., elevation of head of bed, rising slowly, or dorsiflexion exercises); pressure stockings; pharmacologic therapy if the above strategies fail
Balance and gait†‡ Patient's report or observation of unsteadiness Impairment on brief assessment (e.g., the Get-Up and Go test <sup>25,26</sup> or performance-oriented assessment of mobility <sup>27</sup> )	Diagnosis and treatment of underlying cause, if possible; reduction of medications that impair balance; environmental interventions; referral to physical therapist for assistive devices and for gait and progressive balance training
Targeted neurologic examination Impaired proprioception* Impaired cognition* Decreased muscle strength†‡	Diagnosis and treatment of underlying cause, if possible; increase in proprioceptive input (with an assistive device or appropriate footwear that encases the foot and has a low heel and thin sole); reduction of medications that impede cognition; awareness on the part of caregivers of cognitive deficits; reduction of environmental risk factors; referral to physical therapist for gait, balance, and strength training
Targeted musculoskeletal examination: examination of legs (joints and range of motion) and examination of feet*	Diagnosis and treatment of the underlying cause, if possible; referral to physical therapist for strength, range-of-motion, and gait and balance training and for assistive devices; use of appropriate footwear; referral to podiatrist
Targeted cardiovascular examination† Syncope Arrhythmia (if there is known cardiac disease, an abnormal electrocardiogram, and syncope)	Referral to cardiologist; carotid-sinus massage (in the case of syncope)
Home-hazard evaluation after hospital discharge†‡	Removal of loose rugs and use of nightlights, nonslip bathmats, and stair rails; other interventions as necessary

\* Recommendation of this assessment is based on observational data that the finding is associated with an increased risk of falling.

† Recommendation of this assessment is based on one or more randomized controlled trials of a single intervention.

‡ Recommendation of this assessment is based on one or more randomized controlled trials of a multifactorial intervention strategy that included this component.

fewer, if feasible, has also been demonstrated to reduce the risk of falling.<sup>47</sup>

When assessed appropriately, clinically significant postural hypotension is detected in up to 30 percent of elderly persons.<sup>46,48</sup> Moreover, some elderly persons with postural hypotension do not report symptoms, such as dizziness or lighthead-

edness.<sup>46</sup> Evidence from trials of single and multifactorial interventions suggests that all elderly persons who have any abnormalities on balance and gait testing should be referred to physical therapy for a comprehensive evaluation as well as rehabilitation.<sup>15,16,19-21</sup>

In addition to direct observation of the elderly

person while he or she stands from a sitting position and walks, a targeted neurologic examination may reveal potentially treatable causes of balance or gait impairment. Proprioceptive impairment due to a neuropathy, for example, is a common cause of balance impairment in elderly persons. A decreased sensation of vibration, a frequent but abnormal finding in this population, is a more sensitive marker of neuropathy than a decrease in the sensation of position. A gait that worsens when the eyes are closed and improves when minor support is given by the examiner is a further clue to proprioceptive problems.

Persons who have fallen should be asked about loss of consciousness. Given recent evidence that some elderly persons are unaware of episodes of loss of consciousness, syncope should also be considered in those who report "just going down."<sup>49</sup>

#### LABORATORY TESTS AND IMAGING

The role of laboratory and ancillary testing in the prevention of falls has not been well studied. Laboratory tests that might reasonably be performed in all persons at risk for falling include a complete blood count; measurement of serum electrolytes, blood urea nitrogen, creatinine, glucose, and vitamin B<sub>12</sub>; and assessment of thyroid function. These tests are relatively inexpensive, and abnormal results, which are likely to be prevalent, suggest the presence of a treatable entity. Other tests should be reserved for persons in whom the presence of an abnormality is suggested by the history and results of physical examination. Neuroimaging is indicated only if there is a head injury or new, focal neurologic findings on the physical examination or if a central nervous system process is suspected on the basis of the history or examination results. Electroencephalography is rarely helpful and is indicated only if there is a high degree of clinical suspicion of seizure. Similarly, ambulatory cardiac monitoring is helpful only rarely; in elderly persons, this technique is associated with frequent false positives and false negatives.<sup>50</sup> An evaluation for arrhythmia is warranted only if there is clinical evidence of this diagnosis, such as a known history of cardiac events or an abnormal electrocardiogram.

#### EDUCATION AND OTHER MEASURES

Though repeatedly shown to be ineffective as a sole intervention,<sup>38-43</sup> education is an important component of strategies to manage the risk of falling.

The person at risk and his or her family members should be educated about the multifactorial nature of most falls, about the specific risk factors for falling that are present, and about recommended interventions. Persons at risk for falling who live alone or who spend large amounts of time alone should be taught what to do if they fall and cannot get up, and they should have a personal emergency-response system or a telephone that is accessible from the floor.

For healthy elderly persons who have not fallen and who do not report or show balance or gait difficulties, the available evidence suggests that community-based exercise programs not supervised by health care professionals that include progressive balance-training and strengthening components may reduce the likelihood of a fall (Table 1).<sup>14,44,45</sup> Nonspecific, general exercise programs,<sup>31-37</sup> self-management and cognitive-behavioral approaches,<sup>38-43</sup> and home-hazard modifications for older persons without a history of falling or recent hospitalization have not proved effective.<sup>14,38,51</sup>

Low bone density increases the risk of hip and other fractures and should be identified and treated. The guidelines of the National Osteoporosis Foundation recommend that all women 65 years of age or older and women less than 65 years of age who are postmenopausal and who have additional risk factors for osteoporotic fractures (such as a lean habitus, a history of fractures, or a history of cigarette smoking) should undergo bone mineral density measurement to assess the risk of fractures and to ascertain whether pharmacologic or nonpharmacologic treatment would be appropriate.<sup>52</sup> A discussion of the prevention and treatment of osteoporosis is beyond the scope of this article, but information is available from the National Osteoporosis Foundation (<http://www.nof.org/physguide>).<sup>52</sup> In addition to other therapies, hip protectors appear to reduce the risk of hip fracture among persons at high risk.<sup>53</sup>

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#### AREAS OF UNCERTAINTY

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It remains to be determined whether the strategies that have proved effective in reducing the occurrence of falls are equally effective in reducing the most serious injuries that occur as a result of falling, such as fractures and head injuries. Observational data suggest that the risk factors for falls and for serious injuries due to falls are similar<sup>3-5</sup>; trials of fall-prevention strategies to date, however, have

not had sufficient power to detect whether they have an effect on the incidence of serious injury.<sup>14</sup>

The exercise programs found to be effective have been short term, usually lasting one year or less. Since most of the benefits of exercise are maintained only as long as the exercise regimen is maintained, methods for enhancing long-term adherence are needed. The optimal intensity, frequency, and type of exercise needed to minimize the risk of falling and of incurring injury while maximizing mobility remain to be determined.

Studies suggest that the number of medications prescribed can be reduced safely and effectively.<sup>14,47,54</sup> However, practical methods are needed to balance the benefits of medications for the treatment of specific diseases with the risk of adverse events, including falls, in elderly persons.

There may be an overlap between falling and the presence of syncope: preliminary data suggest that patients who have had recurrent, unexplained falls and who have bradycardia in response to carotid-sinus stimulation have fewer falls with cardiac pacing.<sup>49</sup> Until these findings are confirmed in clinical trials, however, pacemaker therapy for the prevention of unexplained falls cannot be recommended.

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#### GUIDELINES

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The U.S. Preventive Services Task Force recommends that all persons 75 years of age or older, as well as those 70 to 74 years of age who have a known risk factor, be counseled about specific measures to prevent falls.<sup>55</sup> It also recommends that elderly persons at high risk for falling receive individualized, multifactorial interventions in settings where adequate resources to deliver such services are available.

The American Geriatrics Society, the British Geriatrics Society, and the American Academy of Orthopaedic Surgeons have released joint, evidence-based guidelines for the prevention of falls.<sup>56</sup> They recommend that all elderly patients be asked about any falls that have occurred during the previous year and that they undergo a quick test of gait and balance. The age at which screening should begin is not stipulated in the guidelines. A more comprehensive assessment, followed by a multifactorial intervention strategy, is recommended for patients who report recurrent falls, who present after a fall, or who have difficulties with balance or gait.

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#### CONCLUSIONS AND RECOMMENDATIONS

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All patients 75 years of age or older (or 70 years of age or older, if they are known to be at increased risk for falling) should be asked whether they have a history of falls and, if they do, should be carefully questioned about the circumstances of the falls and examined for potential risk factors. Strategies involving multifactorial assessment and intervention effectively reduce the rate of falling.

In the case of the patient described in the vignette, a review of the circumstances of her previous falls may identify high-risk activities that should be discontinued, such as carrying laundry up and down stairs. Her depressive symptoms should be reviewed to assess the tradeoff between the amelioration of depression and the risk of falling associated with her use of antidepressant medication. Efforts should be made to encourage the patient to eliminate over-the-counter sleep and allergy medications, both of which have anticholinergic effects and thus probably contribute to her risk of falling. Because her congestive heart failure is stable, it may be possible to reduce the dose of her diuretic or her cardiac medications. Any evidence of postural hypotension would further support an attempt to reduce the dose of her cardiac medications. Adequate hydration should be ensured, while avoiding fluid overload or serious hyponatremia.<sup>57</sup> If, as is likely, she has any balance or gait problems, she should be referred to a physical therapist who will train her in the use of an appropriate assistive device, such as a cane or walker, and who will prescribe a progressive program of balance and gait training and muscle strengthening. If her bone mineral density is low, I would advise her to wear hip protectors and to take calcium and vitamin D supplements, along with a bisphosphonate. These interventions will reduce by one third her risk of falling and of sustaining a hip fracture.

Additional information on the prevention of falls, including educational material for patients, can be obtained from the National Institute on Aging (<http://www.nia.nih.gov>), the Centers for Disease Control and Prevention (<http://www.cdc.gov>), and the American Geriatrics Society (<http://www.americangeriatrics.org/education/forum>).

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