

## Home Safety and Fall Prevention

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### FALLS

#### Epidemiology

Accidents are the fifth leading cause of death in older adults, with falls constituting two thirds of all accidental deaths. Approximately three fourths of deaths from falls in the United States occur in 12% of the population aged 65 and older. The incidence of falls and the severity of complications rise steadily after middle age. Fall-related fatalities in 1987 rose from 8.5 per 100,000 persons aged 65 to 74 to 56.7 per 100,000 persons aged 75 years and older.<sup>11</sup> Elderly women have a higher rate of falls than do men and are more likely to sustain fall-related fractures,<sup>7,28,31</sup> but older men have a higher death rate from falls than do women.<sup>4,12,28</sup> Death rates from falls are also more than twice as high for whites as for blacks.<sup>1</sup>

Many population-based studies describe the epidemiology of falls in different settings. It has been estimated that one third of community living elderly persons fall each year.<sup>5,22,38</sup> In community surveys of elderly persons living at home, the annual rate of falls has been reported as 0.2 to 0.8 falls per person (Table 1). These incidence rates are based on self-reported data that may underestimate the true incidence of falls. Most falls produce no serious injury, but about 5% result in a fracture and about 2% in hospitalization. Of these elderly persons admitted to a hospital after a fall, only approximately 50% are alive 1 year later. Annual incidence rates of falls in institutional settings, by contrast, range from 0.6 to 3.6 per bed (mean 1.7 falls/bed), with 10%

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Table 1. Incidence of Falls at Home: Review of Population-Based Studies

REFERENCE	POPULATION/SITE	SIZE OF POPULATION	AGE	ANNUAL INCIDENCE (PER 1,000 PERSONS AT RISK)	FALLS RESULTING IN FRACTURE (PERCENTAGE)
Perry, 1982 <sup>21</sup>	Apartment complex	64	89% $\geq$ 70	625	5.0
Gabell, 1985 <sup>8</sup>	2 general practices	100	$\geq$ 65	224	n/a
Tinetti, 1988 <sup>38</sup>	Community survey	336	$\geq$ 75	809	6.3
Robbins, 1989 <sup>24</sup>	VA outpatients	761	$\geq$ 65	279	n/a
Campbell, 1990 <sup>4</sup>	Community survey	761	$\geq$ 70	666	3.6
Teno, 1990 <sup>35</sup>	Survey of Medicare beneficiaries living at home	586	$\geq$ 65	217	n/a
	Simple mean of all surveys			470	

n/a = not applicable

Data from references 4, 8, 21, 24, 35, 38.

to 25% of falls resulting in a serious complication such as a fracture or laceration.

No published data report the epidemiology of falls specifically among the home health care population. It can be expected, however, that the fall and injury rates among this population are as high or higher than the rates reported for institutionalized populations. This assertion is based on the observation that home care patients are generally as medically and functionally impaired as nursing home residents but live in environments that are often more hazardous than tightly regulated institutional settings.

Falls pose a threat to elderly persons not simply for their high incidence, because young children and athletes certainly have a higher incidence of falls than all but the frailest older adults. Rather, it is the combination of high incidence with high susceptibility to injury. The propensity for injury because of a high prevalence of clinical diseases (e.g., osteoporosis) and age-related physiologic changes (e.g., slowed protective reflexes) makes even a relatively mild fall particularly dangerous.

Hip fracture, one of the most serious injuries associated with falls, assumes epidemic proportions in old people, with 172,000 occurring in 1985. The cumulative lifetime incidence of hip fracture in the United States for those reaching age 90 is 32% for women and 17% for men. In 1984, the annual cost of hip fractures in the United States was estimated at 7 billion dollars.<sup>17</sup>

In addition to physical injury, falls can have other serious consequences for the older person. Repeated falls are a common reason for the admission of previously independent elderly persons to long-term care institutions.<sup>33</sup> In one study, 50% of fall injuries that required hospital admission resulted in the elderly person's being discharged to a nursing home.<sup>28</sup> "Fear of falling" and the "postfall syndrome" have been reported to result in self-imposed functional limitations among home living<sup>39</sup> and institutionalized elderly.<sup>20</sup> Loss of confidence in the ability to ambulate safely can thus result in further functional decline, depression, feelings of helplessness, and social isolation for many older persons.

### Causes

Table 2 lists the major causes of falls and their relative frequencies based on the major published literature. Of the nine studies reviewed, three<sup>15,26,29</sup> were conducted among institutionalized populations and six among community living populations.<sup>2,6,7,18,27,30</sup> The relative frequency of causes differs according to the population being studied. Frail, high-risk populations have higher rates of medically related falls and a higher incidence of falls of all types than healthier populations. Environmentally related falls are more common in community living populations than in those residing in institutions.

"Accidents" are the most common categoric cause of falls, accounting for 30% to 50% of all falls. Many falls attributed to accidents, however, stem from interactions between environmental hazards or

Table 2. Causes of Falls in Elderly Adults

MOST LIKELY CAUSE	MEAN (%)	RANGE (%)
Accident/environment-related	38	12-53
Gait problems or muscle weakness	13	3-39
Drop attack	11	1-25
Dizziness/vertigo	8	3-19
Postural hypotension	5	2-24
Syncope	1	0-13
Other specified causes*	17	6-37
Unknown	7	5-21

\*CNS disturbances, acute illness, confusion, poor eyesight, drugs, alcohol, and falling out of bed.

Data from Rubenstein LZ, Robbins AS, Josephson KR, et al: The value of assessing falls in an elderly population: A randomized clinical trial. *Ann Intern Med* 113:308, 1990; and Rubenstein LZ, Robbins AS, Schulman BL, et al: Falls and instability in the elderly. *J Am Geriatr Soc* 36:266, 1988.

hazardous activities and increased individual susceptibility to hazards from the accumulated effects of age and disease. For impaired patients, even normal activities of daily living (ADL) may be considered hazardous if performed without assistance or modification. Older persons have stiffer, less coordinated, and more dangerous gaits than younger persons. Posture control, body-orienting reflexes, muscle strength and tone, and height of step all decrease with age and impair the individual's ability to avoid a fall after an unexpected trip or when reaching or bending. Age-associated impairment of vision, hearing, and memory also tend to increase the number of trips and stumbles.

Although the environment outside the home contains many hazards, impaired older adults are much more likely to fall inside their homes—perhaps because they spend more time inside and may be more careless there.<sup>19,31,38</sup> These falls most often occur on a level surface<sup>1,31,38</sup> during normal everyday activities that require only low-to-moderate displacement of the individual's center of gravity (i.e., standing, walking, transferring, bending, or reaching).<sup>38</sup>

The broad category of gait problems and muscle weakness is the second most common cause for falls. Gait problems and muscle weakness can arise from many processes in addition to the age-related changes mentioned. Gait problems can stem from specific dysfunctions of the nervous, muscular, skeletal, circulatory, and respiratory systems as well as from simple deconditioning following inactivity. Muscle weakness is an extremely common finding among the aged population. Studies have reported the prevalence of lower extremity weakness to range from 48% among community living older persons,<sup>3</sup> to 57% among residents of an intermediate-care facility,<sup>39</sup> to over 80% among nursing home residents.<sup>24</sup> Although there is a consensus that reduction in muscle strength accompanies the aging process, much of this stems from disease and inactivity rather than aging per se. Common causes of muscle weakness and gait problems include stroke, parkinsonism, frac-

RANGE (%)
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tures, skeletal abnormalities, arthritis, myopathies, and polyneuropathies. Weakness and gait disorders are particularly common among home care patients because most have experienced recent hospitalization or prolonged periods of bed rest.

*Drop attacks* are defined as falls associated with sudden leg weakness without a loss of consciousness or dizziness. A sudden change in head position is often a precipitating event to this condition. This syndrome has been attributed to transient vertebrobasilar insufficiency, although more diverse pathophysiologic mechanisms may be to blame. The leg weakness is usually transient but can persist for hours. Tone and strength sometimes can be restored more rapidly if patients push their feet against a solid object. Although drop attacks are considered an important cause of falls, recent more precisely documented studies indicate that they cause substantially fewer falls than the 11% mean figure indicated in Table 2.

The sensation of dizziness is an extremely common complaint of elderly patients who fall. An evaluation of this sensation is necessary because dizziness means different things to different people and arises from very diverse causes. True vertigo, a sensation of rotational movement, may indicate a disorder of the vestibular apparatus, e.g., benign positional vertigo, acute labyrinthitis, or Meniere's disease. Symptoms described as "imbalance on walking" often reflect a gait disorder. Many patients describe a vague lightheadedness that may reflect cardiovascular problems, hyperventilation, orthostasis, a drug side effect, anxiety, or depression.

Orthostatic hypotension, defined as a drop of more than 20 mm of systolic blood pressure after standing, has a 5% to 25% prevalence among normal elderly persons living at home.<sup>23</sup> It is more common among persons with certain predisposing risk factors, including autonomic dysfunction (frequently related to age, diabetes, or central nervous system [CNS] damage), hypovolemia, low cardiac output, parkinsonism, metabolic and endocrine disorders, and medications—particularly sedatives, antihypertensives, and antidepressants.<sup>16</sup> The orthostatic drop may be more pronounced on rising in the morning because the baroreceptor response is diminished after prolonged recumbency. Orthostatic hypotension may also be exacerbated by certain activities and after meals.<sup>14</sup>

Syncope is a serious but less common cause of falls. Syncope, often defined as a sudden loss of consciousness with spontaneous recovery, results from decreased cerebral blood flow or, occasionally, from metabolic causes such as hypoglycemia or hypoxia. The most common causes in elderly persons are cardiac arrhythmias, orthostatic hypotension, vasovagal reactions, and syncope of unknown cause. A history of syncope may be difficult to obtain because many patients do not remember exactly what occurred during the fall, and drop attacks or dizziness may be confused by the patient with syncope.

Other specified causes of falls include disorders of the CNS, cognitive deficits, poor vision, drug side effects, alcohol intake, and acute illness. Diseases of the CNS (e.g., cerebrovascular disease, dementia,

normal pressure hydrocephalus, parkinsonism), often result in falls by causing dizziness, orthostatic hypotension, and gait disorders. Patients with cognitive deficits often are not able to recognize and avoid hazards. Drugs frequently have side effects that result in impaired mentation, stability, and gait. Especially significant are agents with sedative, antidepressant, and antihypertensive effects, particularly diuretics, vasodilators, and beta blockers.<sup>10,34</sup> The overuse of alcohol is an underreported but common problem in the elderly. Patients should be specifically questioned about their alcohol consumption because alcohol is an occult cause of instability, falls, and serious injury. Other less common causes of falls include anemia, hypothyroidism, unstable joints, foot problems, and severe osteoporosis with spontaneous fracture.

### Risk Factors

The exact cause of a fall is frequently difficult to determine, particularly among home care patients who usually have multiple identifiable age-related changes or medical conditions that can precipitate a fall. Therefore, rather than trying to pinpoint a specific (and often inaccurate) cause for a fall, the physician may focus on identifying and treating relevant risk factors so that subsequent falls can be avoided. Several case control studies have compared fallers and nonfallers and have identified many specific risk factors associated with falls among community living and institutionalized populations. Table 3 lists the major fall risk factors identified from several studies that examined and compared fallers and nonfallers.

In two nursing home studies,<sup>24,39</sup> lower extremity weakness, gait and balance impairments, postural hypotension, neurosensory deficits, and impaired vision were significantly more prevalent among patients who fell. Similar differences were reported in studies that compared community living fallers and nonfallers.<sup>4,19,24,38</sup> Leg strength was found to be weaker among healthy older persons with a history of falling than among nonfallers.<sup>9</sup> In a study examining only knee and ankle strength, weakness at both joints was found to be significantly more common among institutionalized fallers than nonfallers.<sup>40</sup> Lower extremity weakness was also shown to be a significant risk factor for fall-related injury among nursing home patients.<sup>37</sup>

Functional variables identified as risk factors in both community living and institutionalized populations include the use of an assistive device for ambulation, self-reported limitations in mobility, and difficulty in performing basic self-care ADLs. Cognitive impairment was another identified risk factor for community living fallers.

Polypharmacy has also been identified as an independent predictor of falls; fallers took significantly more prescription medications than nonfallers. Specifically, psychotropic<sup>10,34</sup> and cardiac drugs<sup>10</sup> have been implicated in falling. Fallers also tend to have more medical diagnoses than nonfallers. Specific diagnoses associated with falls in both home and nursing home populations include arthritis, depression, and incontinence. Perhaps as important as specific diagnoses is the interaction among an increasing prevalence of multiple diagnoses.

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Table 3. Risk Factors for Falling Identified in Case Control Studies

REFERENCE NUMBER OF SUBJECTS TYPE OF POPULATION	TINETTI, 1986 <sup>34</sup>	ROBBINS, 1989 <sup>24</sup>	TINETTI, 1988 <sup>38</sup>	CAMPBELL, 1989 <sup>3</sup>	NEVITT, 1989 <sup>19</sup>	ROBBINS, 1989 <sup>24</sup>
	79 NH	149 NH	272 HOME	507 HOME	325 HOME	68 HOME
	Female Male					
Physical examination data						
Muscle weakness	+	±*	+	+	+	±*
Gait impairment	+	±*	+	+	+	±*
Balance impairment	+	±	+	+	+	±
Postural hypotension	+	±	0	0	n/a	0
Neurosensory	0	±	+	+	+	0
Visual impairment	+	±	+	+	+	0
Functional level						
Impaired ADL	+	±	+	n/a	+	+
Use assistive device	+	±	+	+	+	+
Mobility limitation	+	0	+	+	+	+
Cognitive impairment	±	±	+	+	0	±
Drugs	+	±*	+	+	+	0
Medical history factors						
Arthritis	0	0	0	+	+	±
Incontinence	+	+	+	n/a	+	0
Depression	0	0	+	n/a	+	0

+ = Significant risk factor ( $P < 0.05$ ); ± = Risk factor of borderline significance ( $0.1 > P > 0.05$ ); \* = Risk factor confirmed in multivariate analysis; n/a/ = Not tested in study; NH = Nursing home  
Data from references 3, 19, 24, 38, 39.

One study found through multivariate analysis that it was possible to estimate fairly accurately the likelihood of a patient fall by assessing only 3 risk factors: hip strength, balance, and the number of prescribed medications taken.<sup>24</sup> Using this model, the predicted 1-year risk of falling ranged from 12% for persons with none of the 3 risk factors to 100% for persons with all 3 risk factors. Another study developed a fall risk index based on 9 identified risk factors and found that the likelihood of falling increased with the number of risk factors present.<sup>39</sup> Both of these studies confirm that, among frail older people, falling is often the result of interacting conditions and that muscle weakness and gait and balance disorders significantly increase the risk of falling.

### Diagnostic Approach

The home health care practitioner may be the first person to recognize the problem of recurrent falls or the existence of a high risk for falling. Once a faller is identified, the home health care practitioner should conduct a systematic search for the underlying cause of the fall and associated risk factors, with the intent of preventing further falls. The basic components of this diagnostic approach are listed in the following outline:

- Assess and treat injury
- Determine probable cause of fall
  - History
  - Physical examination
  - Laboratory and other tests (e.g., complete blood count, serum electrolytes, electrocardiogram, Holter monitor)
- Prevent recurring falls
  - Treat underlying illness
  - Reduce accompanying risk factors (e.g., visual problems, orthostasis, weakness)
  - Reduce environmental hazards
  - Teach adaptive behavior (e.g., slow rising, gait training, cane or walker use)

The importance of this systematic assessment was recently demonstrated in a randomized trial that revealed that a postfall assessment uncovered many important treatable problems among elderly fallers and that following treatment for these conditions, the rate of subsequent hospitalizations was significantly reduced.<sup>26</sup>

A complete patient fall history is the most helpful part of the diagnostic process. Obtaining a full report of the circumstances and symptoms surrounding the fall is crucial. Because the patient may have a poor recollection of these events, however, reports from witnesses are important. Historic factors that can indicate a specific cause or limit the differential diagnosis include a sudden rise from a lying or sitting position (orthostatic hypotension); a trip or slip (gait, balance, or vision disturbance, or an environmental hazard); an unexplained drop attack without a loss of consciousness (vertebrobasilar insufficiency); looking up or sideways (arterial or carotid sinus compression); and loss of

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that it was possible to prevent fall by assessing number of prescribed medications, 1-year risk of fall, and that the likelihood of falling increased if 3 risk factors were present. Both weakness and gait abnormalities are listed in the

the first person to be notified of a high risk fall. The care practitioner should determine the cause of the fall and prevent further falls. The interventions are listed in the

blood count, serum chemistry (monitor)

visual problems, ortho-

, gait training, cane

as recently demonstrated in a postfall assessment among elderly fallers, the rate of subsequent falls was

helpful part of the history, circumstances and the patient may have reported from witnesses a specific cause or limitation from a lying or sitting position, balance, or vision (unexplained drop attack, insufficiency); looking down (lassitude); and loss of

consciousness (syncope or seizure). Symptoms experienced near the time of falling may also suggest a potential cause: dizziness or giddiness (orthostatic hypotension, vestibular problem, hypoglycemia, arrhythmia, drug side effect); palpitations (arrhythmia); incontinence or tongue biting (seizure); asymmetric weakness (cerebrovascular disease); chest pain (myocardial infarction or coronary insufficiency); or a loss of consciousness (any cause of syncope). Medications and the existence of concomitant medical problems may be important contributory factors to falls. Other points to elicit during the history that might be helpful in directing further work-up and care planning include: How long was the patient on the ground? What effect did the fall have on patient confidence, fear of further falls, and activity? Are there any effects on caregiver expectations, fears, and plans for future activities?

Pertinent items on the postfall physical examination should include orthostatic changes in pulse and blood pressure, the presence of arrhythmias, carotid bruits, nystagmus, focal neurologic signs, muscle weakness, other musculoskeletal abnormalities, visual loss, and gait disturbances. Careful mental and functional status assessment is also crucial. Even if risk factors that did not cause the fall in question are discovered, their identification and treatment can possibly reduce the likelihood of subsequent falls.

It may be helpful during the examination for the examiner, taking appropriate precautions, to attempt to reproduce the circumstances that might have precipitated the fall, e.g., positional changes, head turning, urination. Gait and stability should be assessed by close observation of how the patient rises from a chair, stands with eyes open and closed, walks, turns, and sits down. Often, a specific treatable gait abnormality can be detected. The physician should take particular note of gait velocity and rhythm, stride length, double support time (the time spent with both feet on the floor), the height of step, the use of assistive devices, and the degree of sway. Imbalance observed during head turning or flexion is an important finding associated with vestibular or vertebrobasilar pathology.

The laboratory evaluation need not be extensive but should include several key tests when the cause is not obvious: a complete blood count for anemia or infection; serum chemistries, especially for the levels of sodium, potassium, calcium, glucose, and creatinine; an electrocardiogram; and thyroid function tests. Even after these steps have been taken, the clinical evaluation and initial laboratory tests may not detect an intermittent problem that may have caused the fall (e.g., orthostatic changes, arrhythmias, and electrolyte disturbances).

The use of an ambulatory cardiac (Holter) monitor is advisable for patients in whom a transient arrhythmia is suspected by case history, in cases of an otherwise unexplained syncope or in cases in which the patient with unexplained falls has a history of cardiac disease and is taking cardiac medication. The likelihood of finding suggestive abnormalities with Holter monitoring in elderly patients who fall is particularly high. In one study, 82% of both fallers and nonfaller controls had transient ventricular arrhythmias documented on Holter monitoring,

and 100% had supraventricular arrhythmias,<sup>25</sup> yet none of these patients was symptomatic during the Holter monitoring. Because asymptomatic arrhythmias are so prevalent among elderly persons, it is often unclear whether a monitored abnormality is related to the fall. The study concluded that without symptoms or a history suggesting a cardiac disorder as a possible cause of the fall, Holter monitoring should not be part of the routine fall evaluation.

### Therapy

The purpose of the diagnostic approach is to uncover direct or contributing causes of falls that are amenable to medical therapy or other corrective intervention. Because home health care patients are likely to have many of the risk factors associated with falling, however, a thorough examination of patients without a history of falls may be helpful in identifying potentially correctable problems in an effort to prevent future falls.

Among the more obvious examples of treatable causes of falls requiring urgent specific treatment are cardiac dysrhythmias, hypovolemia, syncope, and drug side effects. For patients with gait and balance disturbances, specific assistive devices are often helpful (e.g., walkers, crutches, canes, shoe modifications). These must be tailored to the patient, and consultation with a rehabilitation specialist is frequently helpful. Many such patients, for example those with stroke, hip fracture, arthritis, or parkinsonism, can also benefit from a home program of gait training and exercise under the supervision of a physical therapist.

Several techniques may benefit patients with persistent orthostatic hypotension due to autonomic dysfunction: sleeping in a bed with the head raised to minimize a sudden drop in blood pressure upon rising; wearing full-leg elastic stockings to minimize venous pooling in the legs; rising slowly or sitting on the side of the bed for several minutes before standing up; and avoiding heavy meals and activity in hot weather. If conservative mechanical measures are ineffective, circulating blood volume can be increased by liberalizing dietary salt, provided that associated medical conditions do not preclude this.

Persons subject to drop attacks from vertebrobasilar insufficiency associated with head motion may be helped by a cervical collar. The collar should be prescribed in consultation with a neurologist or physiatrist for proper fit, because an ill-fitting collar theoretically could cause carotid compression.

It is more difficult for the physician to manage and prevent recurrent falls in patients for whom a specific cause cannot be identified or who have multiple or irreversible causes. A careful search for and correction of other risk factors that predispose an individual to falling, such as visual and hearing deficits, is essential. For disabilities that do not properly resolve with treatment of the underlying medical disorder (e.g., hemiparesis, ataxia, persistent weakness, or joint deformities), a trial of short-term rehabilitation in consultation with a physiatrist, physical or occupational therapist may improve safety and diminish

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long-term disability. When irreversible problems exist, residual limita-  
tions should be explained and coping methods developed. Among this  
group of patients, it is unlikely that falls can be prevented without  
markedly curtailing mobility. The use of restraints may be an appropri-  
ate short-term intervention for acutely ill patients or a necessity for  
severely demented patients; however, for the majority of fallers the  
risks of immobility and the impact on quality of life from restraints may  
be more detrimental than a fall. Issues of personal autonomy and pref-  
erence must be balanced against risk reduction. In addition, there is  
some evidence to suggest that physical restraints (bedrails, poseys) as  
well as chemical restraints (sedatives, tranquilizers) actually contribute  
to falls in some instances. Alarm systems that alert caregivers when  
patients try to get out of bed or ambulate unassisted are available and  
are one alternative to restraints. Use of an electric bed that can lie very  
close to the ground, or the placement of a mattress directly on the  
floor, are other alternatives. Additional injury-prevention alternatives  
are currently being tested but are not yet generally available (e.g.,  
ceiling-mounted inertia-reel safety harnesses, hip protective pads).

## BURNS

### Epidemiology

Burns are another major cause of accidental injury and death  
among older persons. The annual incidence of new burns requiring  
hospitalization in the general population is reported as 27 per 100,000  
persons. This incidence rate increases to 41 per 100,000 for persons  
aged 85 years and older.<sup>12</sup> Older men have a higher incidence of burn  
injuries than do older women, and their fatality rate from burns is about  
twice as high. Among older blacks, the death rate from house fires is  
twice as high as for older whites. Poverty is also associated with in-  
creased death rates among older persons, as is residing in rural areas.<sup>1</sup>

Fatality rates from burns are the highest among the very young and  
the very old. In a survey of elderly burn victims admitted to a burn  
ward, mortality was 63%.<sup>32</sup> In another study of burn victims over the  
age of 70 years, nearly 40% died.<sup>13</sup> A comparison of expected survival  
rates for different age groups with similar large burns estimated that  
the survival rates for persons 35 to 49 years would be 80%, the rate for  
those 60 to 74 years would be 30%, and for those 75 years and older,  
6%.<sup>12</sup>

The increased vulnerability of older persons to injury and death  
from burns is a result of both physiologic and functional changes.  
Impairments in mobility, mental status, vision, and smell may hinder an  
older person's ability to detect a fire or hazardous situation and to  
respond appropriately. Elderly burn victims suffer more complications  
and have longer hospital stays. Changes in the immune system, skin  
thickness, and nutritional status due to normal aging and disease can  
impair the older person's ability to heal.

### Causes

Injuries and fatalities from burns among older people are most frequently caused by residential fires, clothing ignition, and contact with hot surfaces or liquids. In one survey of burn victims, fatal burns were most often the result of house fires and smoking-related accidents, whereas nonfatal burns were most frequently caused by cooking accidents.<sup>32</sup> Cigarettes are reported to be the leading cause of house fires, with more than 50% of smoking-related fires the result of a smoldering cigarette's igniting upholstered furniture or mattresses. Consequently, patients with upper extremity disabilities or mental confusion are especially at risk of sustaining smoking-related burns.

Clothing ignition is relatively infrequent, accounting for only 5% of all burn fatalities.<sup>1</sup> Three fourths of these fatalities, however, occur among the elderly population, with burns from clothing ignition the second leading cause of burns requiring hospital admission.<sup>1</sup> The most common sources of clothing ignition are stoves, on which loose, long sleeves on robes can brush against a gas flame, and matches used to light cigarettes.

Scalding from hot liquids is the leading cause of burn-related hospital admissions among older adults.<sup>1</sup> Many of these scalds are the result of hot water in bathtubs and showers, and others are the result of spilling hot liquids during cooking.

### Risk Factors

No case control studies that identify risk factors for burn morbidity and mortality among older adults have been published. Based on the epidemiology of burn injuries and deaths, certain crude demographic risk factors have been identified, such as race, income, and geographic area. Medical risk factors likely to increase the risk of burns from fire include sensory impairment, dementia, upper extremity impairment, muscle weakness, impaired mobility and balance, alcoholism, and smoking. Persons with peripheral neuropathies are at risk of hot water scalds or burns from electric heaters or heating pads. Older people at highest risk for sustaining burns are those who are functionally or cognitively impaired, live alone in substandard housing, and continue to smoke and cook for themselves.

## HOME SAFETY ASSESSMENT

Assessing the home environment is a major component of any injury prevention strategy. Identification of environmental hazards and subsequent modification of the home environment can potentially reduce the risk of accidental injuries. In addition, by modifying the environment to improve safety, the secondary goal of improving the patient's ability to safely perform ADLs is often achieved. Home safety modifications can give the patient a greater sense of control, security, and independence and reduce the chance of further disability from home accidents.

Before performing a structured assessment, the practitioner can

ascertain much about the safety of the home environment from some basic observations. On the first visit to the home the practitioner should keep the following questions in mind: Are odors of urine, gas, or garbage present? Do floor surfaces, stairs, or clutter hinder mobility? Is vision limited by inadequate or uneven lighting? These initial impressions can alert the practitioner to the need for immediate intervention. At a later date, the practitioner can then use a home safety checklist, such as the following one to look for specific hazards in each room of the house:

#### Fall Prevention:

##### *Throughout the home*

- Remove throw rugs
- Secure any loose carpeting
- Use nonskid wax on floors
- Consider the removal of thresholds from floors
- Adjust lighting to reduce glare
- Light pathways to bedroom and bathroom
- List emergency numbers on phone
- Keep phone in reach
- Consider telephone emergency alert system

##### *Kitchen*

- Assure easy access to commonly used dishes
- Avoid shelves above easy reach
- Use footstool with handrail or not at all

##### *Bathroom*

- Use rubber bathmat
- Install showerhead extender
- Use shower chair with back and nonskid tips
- Install grab bars in shower and tub and alongside toilet
- Obtain raised seat and arms for toilet

##### *Bedroom*

- Check bed height and firmness of mattress
- Consider use of bedrails
- Consider need for bedside commode or urinal
- Assure safe pathway to bathroom

##### *Stairs and Hallways*

- Assure handrails are graspable and easily visible
- Place markers on top and bottom of handrail
- Install light switches at top and bottom of stairs
- Assure nonskid surfaces on stairs
- Consider marking stair edges

##### *Outdoors*

- Remove clutter from walkways
- Keep paths snow and ice free
- Install lights and handrails
- Check pathways for soft gravel or uneven surfaces

##### *Assistive Devices/Footwear*

- Educate patient on the use of any assistive device
- Check tips of canes and walkers

Check wheelchair brakes and footrests  
Check for proper footwear, avoiding loose shoes or slippery soles

#### Fire/Burn Prevention

Check or install smoke detectors on all floors  
Assure an escape route is identified  
Assess safe cooking ability  
Avoid clothing with loose sleeves when cooking  
Unplug small appliances when not in use  
Check for frayed electrical cords or overloaded outlets  
Use screens for space heaters  
Assess smoking habits  
Assure water heater  $\leq 110^{\circ}\text{F}$

#### Throughout the Home

Throw rugs are one of the more common hazards leading to trips and slips. Although the removal of throw rugs is the best recommendation, several techniques are frequently used to make them less slippery for patients unwilling to remove them. A nonskid vinyl-mesh pad that can be cut to fit under a rug is readily available at carpet and department stores (Fig. 1). Applying double-stick tape to the underside of the rug and tacking the rug to the floor are also frequently suggested. Most tape, however, is unlikely to remain sticky for a long period of time, and the edges of both the taped and tacked down rugs are likely to



Figure 1. If patients decline to remove area rugs, a vinyl product can be placed under the rug to reduce chances of slipping, although this will not prevent tripping on the edge of the rug.

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bunch up. Consequently, patients with a shuffling gait or a toe drop may still trip on the edge of any rug. Area rugs and loose-fitting slick-soled slippers can be a hazardous combination (Fig. 2).

Even wall-to-wall carpets pose a fall hazard when they are torn or become unattached at the threshold between entryways. Care should be taken to resecure loose edges. Raised thresholds between rooms can be a source of trips, especially for patients using walkers for ambulation. Removing the threshold between rooms is suggested to reduce the risk of tripping.

Hardwood and linoleum floors can be waxed with nonskid wax and should be kept free of dirt and liquid spills. Telephone and extension cords stretched across walkways can be removed and tacked down against the walls. Because falls may occur when the patient rushes to the phone, the practitioner may suggest that the patient install convenient extension phones or cordless phones, if economically feasible. Phones can be placed on tables that are low enough to reach from the floor in the event of a fall, and emergency numbers can be written in bold print on the phone.

Assessment of lighting is a very important component of the home survey. Lighting should be sufficient to perform basic ADLs. A general guideline for determining sufficient lighting is 100 W of light for every 6 to 8 ft. Light-colored walls are preferable to dark-colored paint and paper. Glare can be reduced by using shades on light fixtures and by installing frosted bulbs.

Smoke detectors can prevent many fire injuries and fatalities provided they are properly installed. Detectors should be located on all



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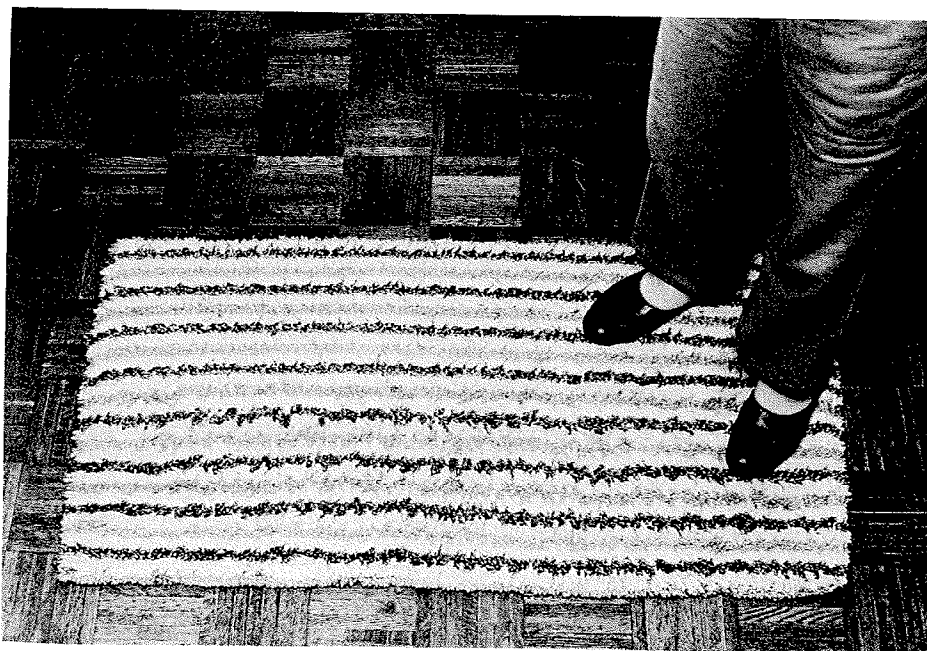


Figure 2. Loose fitting slippers and area rugs are a dangerous combination.

floor levels, including the basement. The practitioner should check to see that the batteries are operational. Proper installation dictates placement in or near bedrooms and away from air vents. If detectors are not actually placed on the ceiling, they should be no lower than 12 in from the ceiling. Other guidelines for practical installation can be obtained from local fire departments.

Space heaters are a common heating source in rural areas. In many cities, they are often used in lieu of central heating to reduce high energy bills. Older space heaters should have screens to protect from burns. The practitioner should note the location of the heater and advise patients to move it out of walkways and away from curtains and drapes. Old newspapers and other flammable materials should not be stored by heaters, furnaces, stoves, or water heaters. Fireplaces are another potential source of house fires. Fireplace screens should be present if the fireplace is used frequently, and chimneys should be cleaned by a professional chimney sweep regularly to prevent chimney fires. Throughout the house, the practitioner should check for frayed electrical cords and overloaded outlets.

### The Kitchen

A key component in reducing injuries in the kitchen area is the incorporation of energy conservation measures and work simplification techniques. Frequently used dishes and food items can be stored on low shelves or counters so that the patient is less likely to lose balance when reaching overhead. In addition, a hand reacher in the kitchen can be used to retrieve items from overhead or low storage areas. In general, the use of a footstool should be discouraged, but if they must be used, they should be sturdy and have a handrail (Fig. 3).

The kitchen can be a source of burns from both clothing ignition and hot liquids. Because loose sleeves can catch fire during meal preparation, the practitioner should inspect bathrobe sleeves and advise the patient against wearing hazardous garments. The use of a microwave oven is advisable to decrease the chance of burns. Another consideration is the provision of one hot meal a day from community services such as "Meals on Wheels." Patients with memory impairment can also be deterred from cooking by removing the knobs from the stove. Handles on cooking pots should be heat resistant, and patients should be advised to use carts on wheels to transport hot liquids to another room or table, rather than carrying them themselves.

### The Bathroom

The most important injury prevention strategies for the bathroom center around reducing falls during bathing and transferring. Rubber bathmats or abrasive strips in the bathtub reduce the risk of slipping. Mats and rugs used on the bathroom floor should have nonskid backing. Stability and safety for transfer activities, sitting, and standing are threatened by poorly selected and arranged devices. Grab bars by the toilet and in the tub or shower should be correctly installed for appropriate use. Precise placement of the grab bars depends on whether the



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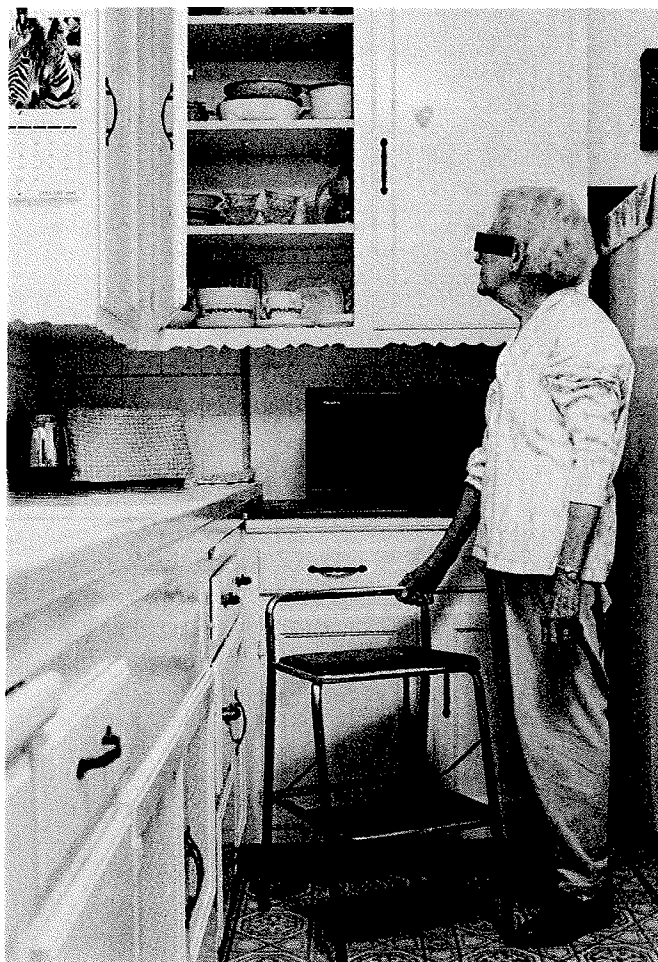


Figure 3. If a footstool is used, it should be sturdy and have a back. Move frequently used dishes and pans to low shelves or counters.

patient stands or sits during bathing. Note that the grab bar in Figure 4 is erroneously positioned for the individual using a shower chair. Usually, grab bars are installed at a 30° angle. A shower or bathtub chair, handheld hoses and raised toilet seats are other low-technology devices that can help reduce falls in the bathroom. Shower chairs should have a back and nonskid tips on the legs. The practitioner should encourage very frail patients to take a sponge bath rather than use the shower or bathtub. All patients should be advised to have a nightlight in the bathroom.

Burns that occur in the bathroom are generally due to hot scalding water. The practitioner should test the temperature of the water. If the water temperature is above 110°F, the patient or caregiver should be advised to turn the water heater down.

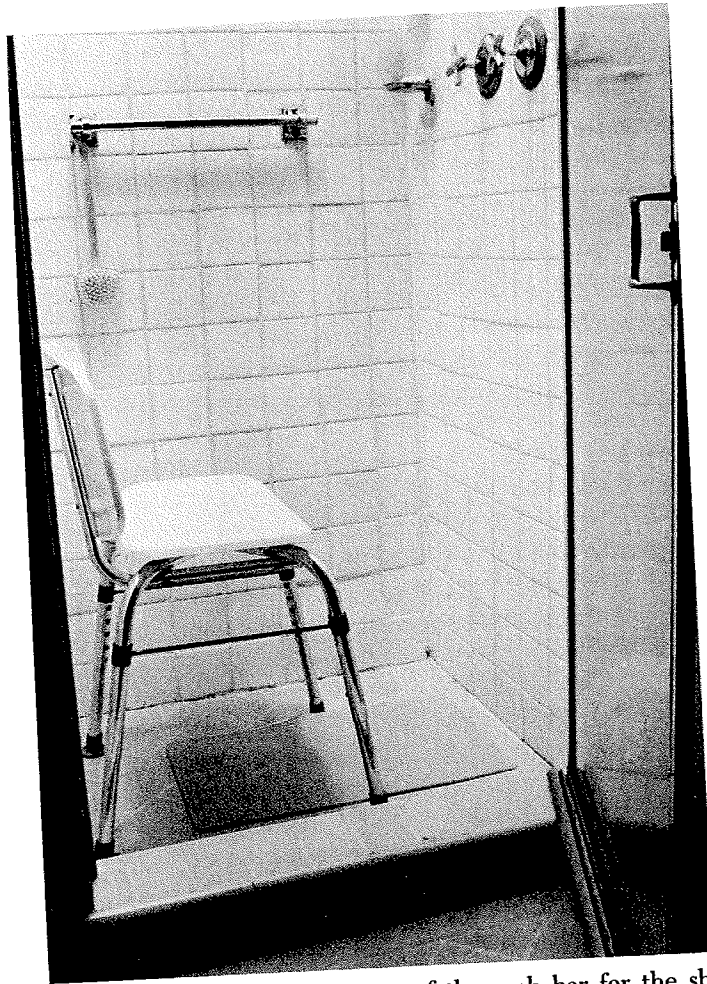


Figure 4. Note the incorrect placement of the grab bar for the shower chair; it should be lower and at an angle.

### Bedroom

Frail older adults usually spend more than 12 hours each day in the bedroom, and for them, the bedroom is most used room in the house. It is especially important that the patient can safely transfer from the bed to a chair or wheelchair. The bed should be positioned at least 4 ft from the wall to allow for safe transfer. A firm mattress assists the patient in both bed mobility and transferring. Bed height must also be considered, especially if the patient is using an orthopedic bed. Often, the bed is in a raised position for the convenience of the caregiver. In general, optimal bed height allows the patient to sit on the edge of the bed with their feet touching the floor and their knees bent at a 90° angle. The practitioner should also check that the wheel locks are functioning properly on orthopedic beds.

Bedrails are generally not required. If there is concern that a patient may roll out of the bed, however, side rails can be purchased or

constructed from plywood; usual dimensions are 4 ft × 4 ft).<sup>36</sup> A small sturdy table that can hold both a phone and lamp should be located next to the bed. The bedside light can be rewired with a cord switch that is taped to the table.

Visits to the bathroom at night can be potentially dangerous, especially if the patient is hurrying or is unsteady from the use of sedatives. The path between the bedroom and the bathroom should be free of clutter. Nightlights or remote control hall lights should be used to illuminate the pathway. The practitioner may advise the use of a portable toilet, a bedside urinal, or bedpan for patients who need to make frequent trips to the bathroom or are particularly unsteady.

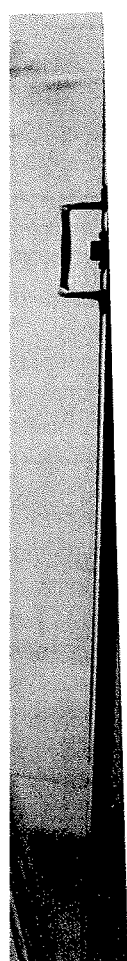
To avoid fires in the bedroom, the practitioner should strongly discourage patients from smoking in bed. If a room heater is used, the bedroom should have adequate ventilation.

### Stairs and Hallways

Because stairs are a common site of falls, the practitioner should look closely for potential hazards on and near any stairs in the house. Handrails are imperative for all staircases and should extend the full length of the stairs and a little beyond the last step—the one most often missed in falls. If possible, the handrail should be a contrasting color to the wall, with a knob or other indicator at the top and bottom for tactile awareness of the stairway boundaries. Lighting for the stairwell should be adequate, with glare minimized. Light switches should be located at both the top and bottom of the stairs. To further aid the patient's vision, the edges of the top and bottom steps should be painted with a contrasting color or marked with fluorescent tape. This is especially important when the stairs are covered with patterned or floral designs, because such designs can disguise step edges for patients with limited depth perception. Carpet on the stairs should be repaired or removed if it is frayed or torn (Fig. 5). Persons who are insecure about navigating the staircase can be encouraged to sidestep up and down stairs, keeping both hands on the railing. Patients prone to disorientation because of dementia or medication they are taking can be protected from falling down stairs by installing a gate, such as those used for children or pets, at the top of the stairs.

### Outdoors

Although many home care patients are house-bound, the practitioner should still survey outdoor areas (porch, steps, sidewalk) that the patient may have to maneuver to perform everyday activities, such as collecting the mail or paper, taking out the trash, or getting to the car. The practitioner should look for hazards, such as broken concrete and uneven steps and surfaces (Fig. 6). Steps and sidewalks may need extensive repair or modification to make them safe, and the cost can be prohibitive for many patients. Installation of handrails and increased lighting near steps and doors to eliminate shadowy areas should be advised as a minimum modification. Obstacles, such as gardening tools, hoses, and toys, should be removed from walkways (Fig. 7). During the



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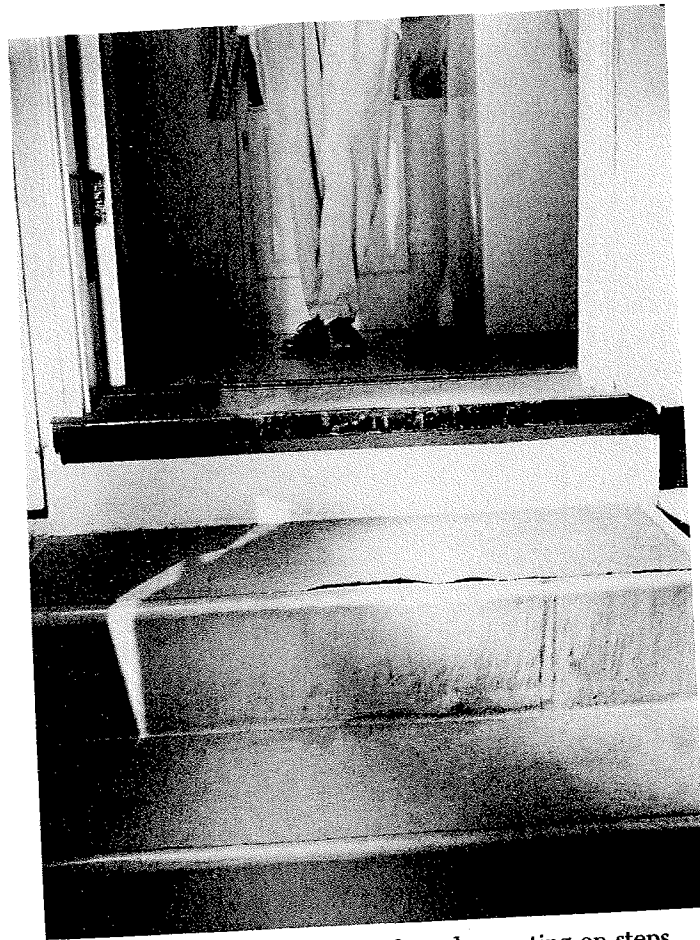


Figure 5. Remove or repair frayed carpeting on steps.

winter, removal of snow and ice is important. The porch can be completely covered with a nonslippery indoor-outdoor carpet. Patients with gait and balance impairments should be encouraged to use their assistive devices when venturing outdoors and to avoid uneven or gravel surfaces if possible.

#### Assistive Devices

Wheelchairs, canes, and walkers are products intended to reduce injury and promote independence. Unfortunately, a large number of injuries among the elderly population are associated with these aids. Although it is incorrect to surmise that the products themselves caused the injuries, the sheer number of accidents warrants complete education of the family and patient on the proper use and maintenance of the products. Consultation from a rehabilitation therapist may be advisable if observation of the patient suggests any hazard in the use of an assistive device.

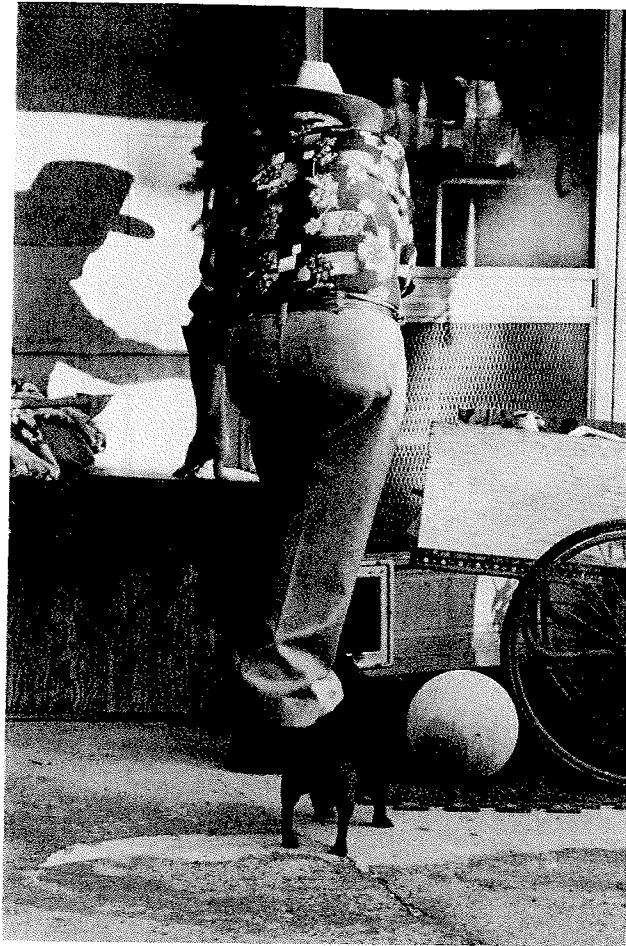


Figure 6. Remove clutter from walkways.

**Footwear**

Although not usually considered as part of the home environment, footwear can also be hazardous. Ill-fitting shoes, shoes with worn soles and heels, heels that are too high or too narrow, and shoes that are too tight or are left untied or unbuckled are unsafe. Slippers without soles or backs are also hazardous. Footwear should fit properly, be low heeled, and have a nonslippery sole. If a callous, bunion, or hammer toe is a problem, a shoe with a soft pliable upper that conforms to the shape of the foot should be recommended. The practitioner may also refer the patient to a podiatrist or orthopedist for treatment.

**Community Services**

Many communities offer a variety of programs to assist older persons in modifying their homes to enhance safety and security. A social worker or case manager at a local senior multipurpose center is usually

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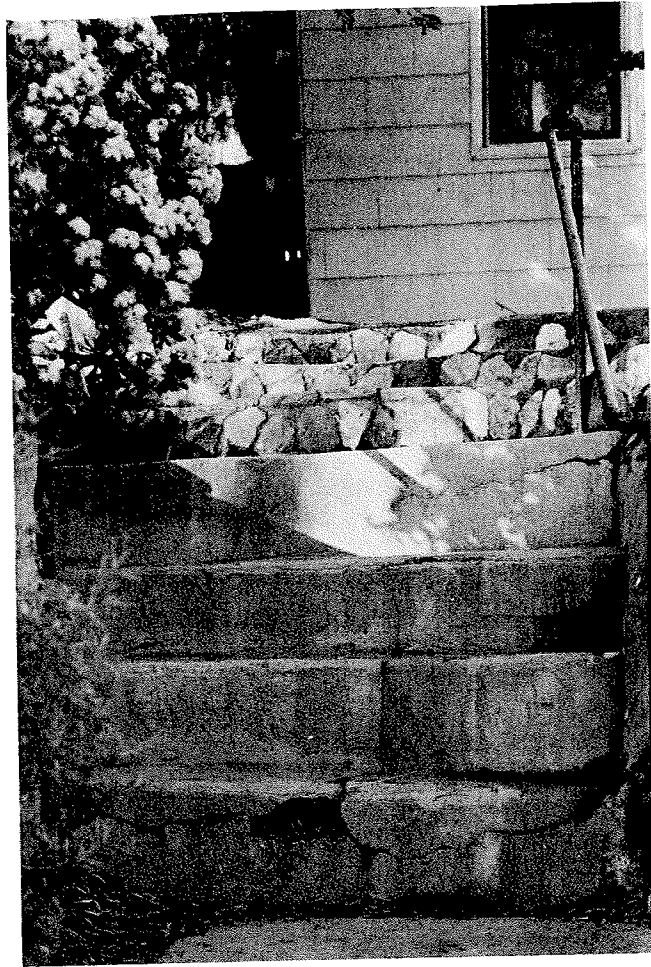


Figure 7. Broken and uneven steps and flimsy handrails can be hazardous. Community services may provide low-cost repairs.

a good resource for obtaining information about these services. Many metropolitan cities subsidize nonprofit handyworker and home safety programs. Services generally are provided on a sliding scale fee basis and include the installation of handrails, grab bars, and smoke alarms and the construction or repair of wheelchair ramps. The US Department of Veterans Affairs also provides assistive devices for eligible veterans. In rural areas, the federally funded Cooperative Extension Service and the local health department may be of assistance. The fire department often makes home visits to assess fire safety, and the gas company inspects appliances for gas leaks.

In some communities commercial emergency response programs are available. When the older person pushes a panic button worn around the neck or pinned to clothing, a signal is transmitted to the telephone, and an emergency response operator is automatically dialed. If voice contact is not made with the older person through a

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speaker phone, the operator sends assistance to the home. Enrollment in such a program is especially appropriate for the home care patient living alone. In addition, senior centers frequently have a telephone reassurance program that calls homebound persons daily to check on their well-being.

### Compliance

The home assessment should not be made without observational knowledge of the patient's functional abilities in the home. Sole reliance on scores from ADL instruments may be misleading because patients often overstate their functional ability. The practitioner's observations of the patient at home provide valuable information about the patient's personal preferences and habits that can assist in making recommendations for home safety modifications. The practitioner aware of a client's personal goals is more effective in introducing environmental and behavioral changes. These recommendations should be discussed with the patient and the caregiver, if appropriate. Because finances are often a barrier to compliance, the practitioner should be familiar with community programs that offer free or low-cost home safety programs. Patients may not consider the importance of a recommendation. The practitioner must include the patient in the decision-making process and solicit support from the caregiver, because the implementation of safety modifications may actually depend more on the caregiver's acceptance and understanding than the patient's. Home modifications and the use of assistive devices are often shunned by patients who feel that change and the use of these devices negatively accentuates his or her disabilities. The practitioner should be sensitive to these feelings, recommending only essential modifications. In addition, the practitioner can educate patients about the wide range of available products. Fortunately, the demand for more attractive low-technology devices has led to a better selection of products than in the recent past. If recommendations are not implemented in a given time period, the practitioner should ascertain the reason for noncompliance and then attempt to make an acceptable compromise with the patient.

### SUMMARY

In conclusion, the majority, or at least a large proportion, of accidental injuries in the elderly are preventable with careful medical and environmental evaluation and intervention. A vigorous diagnostic, therapeutic, and preventive approach is appropriate in all older patients who fall in addition to those at a high risk of falling. Any intervention that can make inroads on this major cause of death and disability in the elderly population will clearly have major impact.

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