Falls and mobility problems are two of the most common and serious concerns facing older adults. In addition to reducing function and causing considerable morbidity and mortality, falls and instability precipitate premature nursing home admissions. Impaired gait and balance, which rank among the most significant underlying causes of falls, are also common consequences of falls. Because older adults often do not report these problems to physicians, they may go undetected until after preventable injury and disabilities have occurred.

Falls and mobility problems generally result from multiple, diverse, and interacting causes. After detecting a problem, clinicians must use careful and thorough diagnostic approaches to identify the most likely causes, contributing factors, and associated comorbid conditions, many of which will respond to intervention.

Epidemiologic Considerations

Both the incidence of falls and the severity of fall-related complications increase steadily after 60 years of age. Accidents are the fifth leading cause of death in older adults, and falls account for two thirds of these accidental deaths. Approximately 75% of deaths due to falls in the United States occur in the 14% of the population who are 65 years of age and older (1).

Fall incidence varies among settings and populations. In persons 65 years of age and older, the lowest fall rates are reported among community-living, generally healthy elderly persons, between 30% and 60% of whom fall each year, for an overall annual rate of about 0.7 falls per person (1, 2). After 75 years of age, the rates increase markedly. Although most falls result in no serious injury, approximately 5% of elderly community dwellers who fall in a given year experience a fracture or require hospitalization, a proportion much higher than among younger persons who fall (1). Incidence rates for falls in nursing homes and hospitals (about 1.6 falls per bed annually) are two to three times greater than in the community, and complication rates are also considerably higher. Ten percent to 25% of institutional falls result in fracture, laceration, or need for hospital care (1). Thus, a key issue of concern is not simply the high incidence of falls in elderly persons, since children and athletes also have a very high incidence of falls, but rather the combination of a high incidence and a high susceptibility to injury.

The injury susceptibility in older adults stems from a high prevalence of comorbid diseases (for example, osteoporosis, sarcopenia) and age-related decline (for example, slowed reflexes), which make even a relatively mild fall dangerous. Fear of falling and the post-fall anxiety syndrome result in loss of self-confidence and self-imposed functional limitations in both home-living and institutionalized elderly persons who have fallen (3). National data indicate that falls are the largest single cause of restricted-activity days among older adults (4), are a leading precipitating cause of nursing home admissions (1), and account for 6% of all medical expenditures for persons 65 years of age and older.

The related problems of gait and balance disorders are also extremely prevalent among elderly persons and can have a similarly profound effect on physical health, quality of life, and capacity for independent living. Detectable gait abnormalities affect 20% to 40% of persons 65 years of age and older, approximately half of whom have a grossly abnormal gait (5). Gait problems are even more common in older subgroups; 40% to 50% of those older than 85 years of age are affected (5). In a large study of community-living persons 75 years of age and older, 10% needed assistance to walk across a room, 20% were unable to climb a flight of stairs without help, and 40% were unable to walk a half-mile (6).

The important interaction between mobility disorders and falls is further highlighted by epidemiologic case-control studies conducted to identify risk factors that increase the likelihood of falling. Taken together, these studies indicate that lower extremity weakness, gait and balance disorders, previous falls, functional impair-
ment, visual deficits, cognitive impairment, depression, and polypharmacy (defined as taking ≥5 prescription medications) are the most important risk factors for falls. For example, data summarized from 17 studies suggest that persons with readily identifiable leg weakness have a four- to fivefold increase in risk for falls, and persons with impaired gait or balance have approximately a threefold increase (1). Seven additional studies have identified specific risk factors for injurious falls (1, 7). In general, these risk factors are the same as those for noninjurious falls, with the addition of factors associated with osteoporosis (for example, being female, having decreased bone density, and being underweight) and the use of physical restraints. Perhaps as important as identifying individual risk factors is appreciating the interaction and probable synergism among several risk factors. Several studies have shown that the risk for falling increases dramatically as the number of risk factors increases. For example, three separate studies have reported that 65% to 100% of elderly persons with three or more risk factors fell in a 12-month observation period, compared with 8% to 12% of persons with no risk factors (1, 7–9).

**Clinical Approaches**

Numerous clinical approaches have been advocated for ameliorating the complex and serious concerns of falls and mobility problems in older persons. Many of these approaches have demonstrated efficacy and have become part of evidence-based guidelines, while others are still in the testing phase. The indicators described in this paper, which reflect the literature in this area, can be grouped roughly into three categories: 1) detection of the problem or problems; 2) diagnosis or evaluation of the problem or problems; and 3) treatment, with an aim toward preventing recurrence.

The Figure illustrates a model linking detection, evaluation, and intervention and shows the relationship of each of the indicators to the overall picture of diagnosis and management.

**Methods**

The methods for developing these quality indicators, including literature review and expert panel consideration, are detailed in a preceding paper (10). For falls and mobility problems, the structured literature review identified 4913 titles, from which relevant abstracts and articles were identified. On the basis of the literature and the authors’ expertise, 10 potential quality indicators were proposed. The search terms and the results of the literature review can be accessed at www.acponline.org/sci-policy/.

**Results**

Of the 10 potential quality indicators, 6 were judged valid by the expert panel process (see the quality indicators on pp 653-667) and 4 were not accepted (www.acponline.org/sci-policy/). The literature review that supports each of the indicators judged to be valid is summarized below.

**Quality Indicator 1**

*Inquiring about Falls*

ALL vulnerable elders should have documentation that they were asked at least annually about the occurrence of recent falls because falls are common, often preventable, frequently unreported, and often the cause of injury and unnecessary restriction of activity, which results in a reduction in overall health and quality of life. In addition, a recent history of falls is a strong predictor of future falls.

Supporting Evidence. While no controlled trials or observational studies directly demonstrated the benefit of inquiring about the occurrence of recent falls, a convincing chain of indirect evidence supports this practice: 1) Falls are frequently undetected; 2) people who fall are at increased risk for recurrent falls; and 3) falls are potentially preventable. Therefore, detecting falls is likely to reduce the likelihood of future falls.

Several studies indicate that many problems (including falls) in the elderly population go undetected (11–13). In addition to causing injury, falls can be strong indicators of accelerating frailty and the presence of underlying, treatable risk factors (6, 14). Moreover, if no injury has occurred, patients and providers alike often ignore falls, thus missing important opportunities for potentially life-saving evaluation and treatment. A cornerstone of most fall-prevention programs is identification of risk factors, one of the strongest of which is previous falling. Inquiring regularly about recent falls can help detect this risk factor and lead to appropriate intervention. One study has shown that fewer falls go
undetected (that is, fewer persons who fall are mislabeled as persons who do not fall) when the patient is asked about falls that occurred in the previous 1-year period than when he or she is asked about a shorter period, such as 6 months (11).

The ultimate effectiveness of this screening strategy for improving outcomes has yet to be tested with controlled trials. Such trials are unlikely to take place, since most screening and case-finding studies in older adults are multifactorial and involve simultaneous screening for many different conditions, including falls. While most of these studies have shown positive benefits, disentangling the specific role of the fall-detection component is probably impossible (15).

Quality Indicator 2
Detecting Balance and Gait Disturbances

ALL vulnerable elders should have documentation that they were asked about or examined for the presence of balance or gait disturbances at least once because normal balance and mobility are important to health and quality of life, and underlying, treatable problems often go undetected.

Supporting Evidence. No controlled trials or observational studies could be found that directly demonstrated the benefit of routinely inquiring about or examining for the presence of balance or gait disturbances. Nevertheless, a convincing chain of evidence supports this practice: 1) Balance and gait disturbances are fre-
quent undetected; 2) people with these problems are at increased risk for falls and further reduced mobility; and 3) balance and gait disturbances are treatable and potentially correctable, and controlled trials of therapy show clear benefit. Therefore, detecting balance and gait disturbances is likely to lead to improved gait and balance and reduce the likelihood of future falls.

Several studies indicate that many problems, including balance and gait disturbances, are under-detected in older persons (6, 7, 13). Balance and gait disturbances are major risk factors for falls and, in themselves, are major causes of decreased function and deterioration (5, 6). Although these conditions have many underlying causes that require specialized diagnosis, many of the causes are readily amenable to treatment (6). Numerous studies have established that mobility disorders respond favorably to treatment (see quality indicators 5 and 6) (16–29). Similarly, many studies have shown that case finding and assessment programs in older populations can successfully detect mobility problems (15).

**Quality Indicator 3**

**Basic Fall Evaluation**

IF a vulnerable elder reported two or more falls in the past year, or a single fall with injury requiring treatment, THEN there should be documentation that a basic fall evaluation was performed that resulted in specific diagnostic and therapeutic recommendations BECAUSE many causes of falls can be detected and treated, and detection and treatment will reduce the likelihood of future falls and associated complications.

**Supporting Evidence.** Three randomized, controlled trials and several observational studies demonstrated that post-fall evaluation can identify treatable causes of falls (30–32) and reduce the risk for subsequent falls (31, 32). The first trial evaluated the effect of post-fall assessment on identifying treatable causes of falls and reducing the risk for falls among 160 nursing home residents who fell (30). On average, four treatable conditions and risk factors possibly related to the fall were identified in each patient who had the post-fall assessment. However, subsequent falls were not reduced in the intervention group compared with the control group, possibly because patients in the intervention group received extensive physical therapy and increased their level of mobility. Nevertheless, hospital admissions and hospital days for patients in the intervention group were reduced significantly during the 2-year follow-up period (30).

The second randomized, controlled trial of a post-fall assessment studied 397 elderly fall victims in an emergency department and found a significant reduction in fall recurrence (odds ratio, 0.39 [95% CI, 0.23 to 0.66]) as well as a reduced likelihood of hospital admission and a lower likelihood of functional decline during the 1-year follow-up period (31). Both of these studies confirmed that a fall was also often a marker of an acute or subacute medical problem that could benefit from a systematic post-fall assessment. Such problems discovered on the post-fall assessment included postural hypotension, drug side effects, metabolic disorders, infections, dehydration, and cardiac arrhythmia.

The third trial evaluated the effect of a comprehensive individualized falls assessment among 221 patients living in seven nursing homes compared with 261 patients living in seven control nursing homes; the 14 nursing homes were matched in pairs, then randomly assigned to the intervention or control group. All patients had fallen at least once in the preceding year and had other risk factors for falls. Patients in the intervention group had a significant 19% lower fall rate over the year of follow-up and a trend toward fewer injurious falls (32).

The basic fall evaluation was defined as an examination that included the following components: 1) a history of fall circumstances, medications, acute or chronic medical problems, and mobility levels; 2) an examination of postural pulse and blood pressure, vision, gait and balance, and lower extremity joint function; 3) an assessment of basic neurologic function, including strength, mental status, lower extremity peripheral nerves, proprioception, reflexes, and tests of cortical, extrapyramidal, and cerebellar function; 4) an environmental assessment; and 5) a formulation summarizing diagnostic impressions and therapeutic recommendations.

While all of these elements are important to a falls assessment, some might be considered implicit; therefore, a chart audit might require only evidence of a subset of elements to decide whether a basic fall evaluation has been performed. The recommendations should address all potential fall risk factors identified, especially such mutable causes as medications, environmental hazards, and weakness due to inactivity. For example, with regard to medications associated with fall likelihood, the
record should reflect consideration of the ongoing need for the drug with the goal of finding the lowest effective dose.

**Quality Indicator 4**

*Gait–Mobility and Balance Evaluation*

IF a vulnerable elder reports or is found to have new or worsening difficulty with ambulation, balance, or mobility, THEN there should be documentation that a basic gait, mobility, and balance evaluation was performed within 6 months that resulted in specific diagnostic and therapeutic recommendations BECAUSE many causes of gait and mobility disturbances can be detected and treated, often by prescribing specific assistive devices and exercises that will reduce the likelihood of future falls and their associated complications.

*Supporting Evidence.* While no controlled trials were found that documented the ability of a gait, mobility, and balance evaluation alone to improve outcomes, a logical chain of indirect evidence supports this practice: 1) Persons with balance, mobility, and gait disturbances are at increased risk for falls and further reduced mobility; and 2) balance and gait disturbances are usually treatable, and often correctable, following careful assessment of the problem and appropriate intervention. Therefore, evaluating and treating balance, mobility, and gait disturbances are likely to lead to improved gait and balance and reduced likelihood of falls.

A basic gait and mobility evaluation should include the following components: 1) history of the problem, contributory causes, and medications; 2) examination of vision, gait and balance, and lower extremity joint function; 3) assessment of basic neurologic function that includes strength, mental status, lower extremity peripheral nerves and proprioception, vestibular function, reflexes, and tests of cortical, extrapyramidal, and cerebellar function; and 4) environmental assessment.

Several studies have shown that it is important to evaluate mobility problems (5, 6, 33). A careful examination can detect many contributors to abnormal mobility (for example, muscle weakness, joint abnormalities, neurologic dysfunction, pain, postural hypotension), most of which respond favorably to treatment. For example, gait problems related to muscle weakness improve with strengthening exercises, and balance problems improve with specific balance training (34–36) (see Quality Indicators 5 and 6). While no trial was identified that addressed the specific value of gait, mobility, and balance evaluation alone, such an evaluation is a major component of most comprehensive assessment and management programs for older adults. These programs have been shown to produce many important outcome benefits, such as improved survival and function, reduced health care utilization and costs, and greater patient satisfaction (15).

**Quality Indicator 5**

*Exercise and Assistive-Device Prescription for Balance Problems*

IF a vulnerable elder demonstrates decreased balance or proprioception, or increased postural sway, THEN an appropriate exercise program should be offered and an evaluation for an assistive device performed BECAUSE impaired balance or proprioception and increased postural sway can contribute to instability, and appropriate treatment will reduce the likelihood of falls and their complications.

*Supporting Evidence.* Ample support exists for the premise that exercise can improve indices of balance in older persons and reduce the risk for falls. The literature search identified 16 studies of the effects of various forms of exercise on objective measures of balance. Of the 16 studies, 3 specifically examined the effects of balance training exercises, and 2 of these were randomized, controlled trials. The findings of the 2 randomized, controlled trials demonstrated improvements of 20% to 50% in various force-plate balance variables in persons older than 65 years of age (16, 17). An additional study reported a 32% improvement in balance variables (postural-sway velocities) among young adults participating in tai chi (18).

Four studies measured the effects of aerobic and endurance exercise. One study found that increased aerobic and anaerobic capacity was associated with decreased postural sway in patients 50 to 55 years of age (19). Three randomized, controlled trials evaluated effects of aerobic activity on balance among adults older than 70 years of age and found aerobic conditioning to be associated with an approximately 20% improvement in balance (20, 21). Strengthening exercises alone were not found to improve balance variables in one randomized, controlled trial (26).
The effects of multidimensional exercise programs on balance were evaluated in nine randomized, controlled trials among adults older than 65 years of age. Five of these studies demonstrated an average improvement in balance variables of approximately 20% (22–24, 27, 28). Two studies found an inconsistent effect of exercise on balance measures (37, 38), and one found no improvement (39).

Apart from demonstrating an influence of exercise on specific measures of balance, several studies have reported reductions in falls after participation in exercise programs. In a preplanned meta-analysis of the seven Frailty and Injuries: Cooperative Studies on Intervention Techniques (FISCIT) trials, treatments that included exercise resulted in significant reduction in falls (incidence ratio, 0.90 [CI, 0.81 to 0.99]) (29). It is important to note that the exercise components in these studies varied in type, duration, frequency, and intensity.

Two randomized, controlled trials reported that multidimensional home-based exercises (strengthening, balance, and gait) reduced falls by 9% and 35% in patients older than 70 years of age (40–42). A randomized trial of a 2-hour, three-sessions-per-week multidimensional group exercise program for fall-prone older men found a significant postintervention reduction in falls after adjustment for activity levels (38). In contrast, two other randomized, controlled studies showed no significant reduction in falls after a multidimensional exercise program (23, 43).

Assistive devices are often prescribed in patients with balance problems. Studies have shown that ambulation assistive devices, when prescribed with adequate training, can improve mobility and independent performance of mobility-related tasks (44, 45). Use of a cane has been shown to improve balance in patients with peripheral neuropathy or vestibular balance disorders (46, 47). It is accepted practice to encourage use of a cane, walker, or other ambulation aid for patients at high risk for falls; however, the need for adequate instruction must be stressed (48).

Collectively, these studies support the use of exercise to improve balance and reduce the incidence of falls. Multidimensional exercise programs that incorporate balance, mobility, and strengthening can particularly improve postural stability and reduce the risk for falling among older adults. Including an education and follow-up component in the program seems to increase these benefits. Assistive devices can also be helpful in improving mobility and increasing safe independent function.

**Quality Indicator 6**

*Exercise Prescription for Gait Problems and Weakness*

If a vulnerable elder is found to have problems with gait, strength (for example, ≤4 out of 5 on manual muscle testing, or the need to use his or her arms to rise from a chair), or endurance (for example, dyspnea on mild exertion), THEN an exercise program should be offered BECAUSE these problems can contribute to falls and mobility dysfunction, and exercise intervention can improve or ameliorate them and reduce the likelihood of falls and their complications.

**Supporting Evidence.** Decreased muscle strength is strongly associated with functional gait variables in various populations, including older adults (23, 49–52). The literature review identified seven randomized, controlled trials that evaluated the effects of exercise on gait variables in older adults. The effects of strength training on gait variables in older adults were specifically evaluated in four of these studies. Two studies (26, 53) found that after strength training, gait velocity or other objective measures of ambulation did not improve in adults older than 60 years of age. In contrast, two other studies found that strengthening the lower extremities was related to improved gait speed, endurance, and stability (34, 38). Two separate studies demonstrated that lower extremity muscle strength was related to the ability to rise from a chair (54, 55). A multidimensional program (strengthening and aerobic exercise) significantly improved mobility scores and walking speed in elderly male nursing home residents in two separate trials (35, 36). Finally, three randomized, controlled studies (21, 38, 56) showed that a walking–endurance program in older adults (average age, 70 years) increased ambulatory function by 5% to 15% after 8- to 12-week interventions (21, 38, 56).

**DISCUSSION**

Falls and mobility problems are generally the result of multiple, diverse, and interacting causes. Falls and gait disorders represent an underlying pathologic condition that may be amenable to treatment but may herald clinical demise if left unrecognized. Improvements in
processes of care for falls in this high-risk population may lead to substantial improvements in patient outcomes. Six indicators of these care processes were judged sufficiently valid for use as measures of the quality of fall and mobility disorder management for vulnerable elders. These indicators can potentially serve as a basis with which to compare the care provided by different health care delivery systems and the change in care over time.

From the Geriatric Research and Education and Clinical Center, Veterans Affairs Greater Los Angeles Healthcare System, Sepulveda, California; University of Southern California, Los Angeles, California; RAND Health, Santa Monica, California; and University of California, Los Angeles, Los Angeles, California.

Acknowledgments: The authors thank Jane Mahoney, MD, for review of an earlier version of the monograph containing the full set of proposed quality indicators and Patricia Smith for technical assistance.

Grant Support: By a contract from Pfizer Inc. to RAND.

Requests for Single Reprints: Laurence Z. Rubenstein, MD, MPH, Geriatric Research Education and Clinical Center, Sepulveda Veterans Affairs Medical Center, 16 111 Plummer Street, 11E, Sepulveda, CA 91343.

Current Author Addresses: Dr. Rubenstein: Geriatric Research Education and Clinical Center, Sepulveda Veterans Affairs Medical Center, 16 111 Plummer Street, 11E, Sepulveda, CA 91343. Dr. Powers: Department of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, 1540 East Alcazar Street, CHP-155, Los Angeles, CA 90033. Dr. MacLean: RAND, 1700 Main Street, M-23C, Santa Monica, CA 90407-2138.

References
2. Rubenstein LZ, Josephson KR. Epidemiology of falls and syncpe. Ger Med Clin. [In press].


