Balance, Postural Control, and Falls in Older Adults

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Contact hours: 5.0

Course price: $39

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Course Summary

Discussion of the scope, morbidity, and mortality related to falls and fall risk in older adults. Strategies for assessing and preventing falls in older adults, with discussion of age-related risk factors including polypharmacy. Description of common screening and assessment tools used to identify fall risk in older adults and suggested interventions are designed to improve balance and reduce the risk of falls.

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Criteria for Successful Completions

80% or higher on the post test, a completed evaluation form, and payment where required. No partial credit will be awarded.

Course Objectives

When you finish this course you will be able to:

- Provide definitions for balance, postural control, and falls.
- Describe the incidence and cost of falls in the United States and their medical consequences.
- Relate how nurses, rehabilitation therapists, physicians, and older adults themselves differ in their approach to fall risk and fall prevention.
- Summarize the factors that increase fall risk in older adults.
- Describe tools used for screening and assessing fall risk in older adults.
- Describe the components of a comprehensive balance assessment.
- Outline interdisciplinary interventions used to improve balance and reduce the risk of falls in older adults.

The Problem of Falls

In the next 17 seconds, an older adult will be treated in a hospital emergency department for injuries related to a fall. In the next 30 minutes, an older adult will die from injuries sustained in a fall. Falls are the leading cause of injury among adults aged 65 years and older in the United States, and can result in severe injuries such as hip fractures and head traumas. Many older adults, even if they have not suffered a fall, become afraid of falling and restrict their activity, which drastically decreases their quality of life.

As the U.S. population ages, both the number of falls and the costs to treat fall injuries are likely to increase. The total cost of fall injuries for older Americans was estimated to be $28.2 billion (in 2010 dollars). By 2020 the annual direct and indirect cost of fall injuries is expected to reach $54.9 billion (NCOA, n.d.). Having information on the economic burden of older adult falls can help make the case to fund prevention programs and reduce overall healthcare costs.

Falls and fall-related injuries in older adults are widespread, expensive, and largely avoidable. They are responsible for significant disability, reduced physical function, and loss of independence. More than one-third of people aged 65 and older fall each year, and those who fall once are 2 to 3 times more likely to fall again, making falls an urgent public health issue.

Preventing falls in older adults is a stated priority of the Affordable Healthcare Act, which promotes and strengthens policies and programs to prevent falls, especially among older adults. The act's goal is to enhance cooperation and collaboration between clinical and community-based prevention efforts and increase the availability and use of falls-prevention programs. It stresses the importance of exercise programs to increase strength and balance, medication review and modification to eliminate all but essential drug treatments, home modifications, and vision screening (National Prevention Council, 2012).

The National Council on Aging (NCOA) published a National Action Plan in 2005 with 36 evidence-based strategies designed to reduce the growing number of falls. The strategies focus on physical mobility, medications management, and home and environmental safety. NCOA provides extensive resources through its Falls Free Initiative, which aids communities, states, federal agencies, nonprofits, businesses, and older adults and their families in their fight against falls.

The leadership and direction provided by these and other organizations is bringing much-needed evidence-based falls prevention information to healthcare providers and the public. But identifying whether a person is at risk for falls can be surprisingly complicated, and treating the underlying balance deficit can be even more so. Ideally, the process involves an interdisciplinary team of healthcare providers knowledgeable about when to screen, intervene, refer, and treat. In reality, there are a host of reasons why we often fall short of that goal, which points to the need for education and training across the spectrum of healthcare providers.

Video: News on Falls (3 min, 35 sec)

http://www.youtube.com/watch?v=RaCLbCnktfE

Balance, Postural Control, and Falls

As a medical professional, you may take balance for granted in your own life and even in the lives of people you see in the workplace. You may find yourself thinking about balance when a patient falls—then perhaps only in terms of administering help, filling out paperwork, contacting family members, or considering whether to order a restraint or medication.

But what is balance and postural control? And what, exactly, is a fall? Let's begin by defining these terms.

Balance

For the vast majority of young and middle-aged adults, our feet, legs, torso, and head stay aligned without effort and we rarely think about the danger of falling. In some older adults and in those with balance impairments due to illness or injury, balance can be more difficult. In extreme cases, the body becomes an unwieldy tower of uncontrolled levers that seems suddenly incapable of sustaining itself in the upright position.

Technically, **balance,** or **postural stability,** is the ability to automatically and accurately maintain your center of mass (i.e., center of gravity) over your base of support. Balance is successful because multiple systems interact flawlessly and automatically—coordinating, weighing, and modulating information from both the environment and the central nervous system. This involves both motor input and sensory feedback and is affected by disorders within those systems (muscle weakness, decreased range of motion, pain, neuropathies, and visual and vestibular disorders, among others).

A woman demonstrating superb balance by standing tip-toed on a champagne bottle. Source: Wikipedia and the Library of Congress.

Postural Control

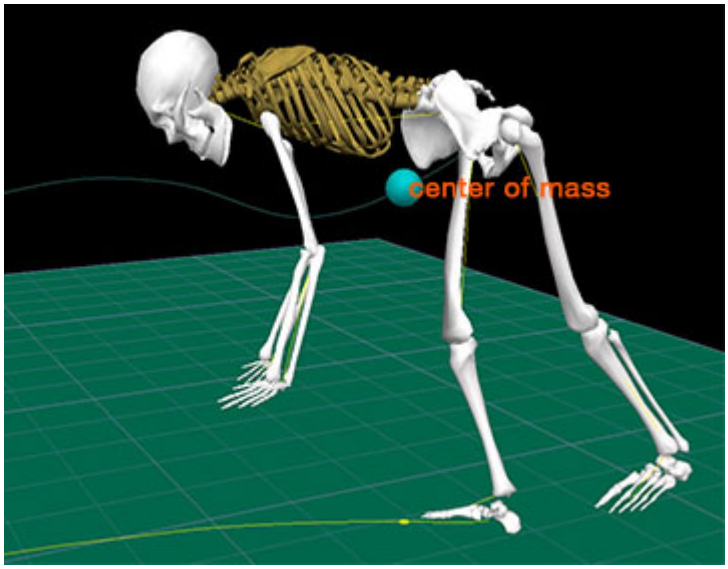
Postural control involves postural stability (balance) and postural orientation. Postural stability or balance is the ability to maintain your center of mass over your base of support. Postural orientation is the ability to control the segments of your body in relation to one another and to gravity, taking into account the environment and whatever task is being performed.

Postural control requires the interaction of musculoskeletal and neural components. Musculoskeletal components include range of motion, flexibility, muscle function, and the biomechanical relationship between body segments. Neural components include: motor processes, which organize the muscles into neuromuscular synergies; sensory and perceptual processes, which integrate input from the somatosensory, visual, and vestibular systems; and higher level processes that contribute to anticipatory and adaptive aspects of postural control (Shumway-Cook and Woollacott, 2012).

Falls

Finding a simple description or definition for "fall" is a bit more difficult than defining balance and postural control. When we lose our balance, if it is severe enough we fall—to the ground, to a chair, onto a couch, or on top of a friend. If the loss of balance is mild, we generally don't think of this as a fall—we simply say we lost our balance for a moment but quickly regained it.

Technically, a fall occurs when we are unable to maintain our center of mass over our base of support. In the picture below the center of mass is represented by a blue ball. In standing, the center of mass would be within the gymnast's body. As she is completing a cartwheel however, her center of mass has moved well forward and outside her body. Whether she falls or not depends on several internal and external factors: her speed, the support surface, her strength, and her sensory awareness.



The center of mass/gravity (blue ball) is outside the body of this gymnast after completing a cartwheel. As the center of mass moves further outside the body the more likely that a fall will occur. Source: D. Gordon E. Robertson. Wikimedia Commons.

Researchers, clinicians, and caregivers often describe falls differently than people who have fallen do. For example, a 92-year old retired nurse recently fell in her garage. Her daughter, a physical therapist, found her sitting next to the washing machine, struggling to rise from the cement floor. When asked what happened, her mother said "I sat down on the ground." When her daughter said "You lost your balance and fell" her mother angrily replied "I didn't fall, I sat down."

Disagreement about how to define a fall is not restricted to retired nurses and their daughters. A nursing assistant in a skilled nursing facility likely knows what a fall is but may be reluctant to report it out of fear of reprimand. A charge nurse may not want to do the extra paperwork required to document a fall. The facility operators or owners may not want to spend the money to repair unsafe equipment and, not surprisingly, an older adult may be reluctant to admit to a fall—perhaps considering it unimportant or fearing the consequences.

To learn more we turn to professional organizations, researchers, government agencies, and consensus groups. Many of these organizations have useful definitions for falls, assisted falls, and accidental falls.

The National Database of Nursing Quality Indicators (NDNQI) is a patient-safety and quality improvement program that provides data to participating hospitals and conducts research on the relationship of nursing care and patient outcomes. NDNQI defines a patient fall is "an unplanned descent to the floor (or extension of the floor, such as a trash can or other equipment with or without injury to the patient, and occurs on an eligible reporting nursing unit." The NDNQI recommends that all types of falls be included, whether they result from physiologic reasons (fainting) or environmental reasons (slippery floor) (AHRQ, 2010a).

NDNQI also addresses a well-known gray area—the "assisted fall," which they describe as: "a fall in which any staff member was with the patient and attempted to minimize the impact of the fall by easing the patient's descent to the floor or in some manner attempting to break the patient's fall. A fall that is reported to have been assisted by a family member or visitor does not count as an assisted fall" (AHRQ, 2010b).

The Hartford Institute for Geriatric Nursing (HIGN), the geriatric arm of the NYU College of Nursing, is a leading advocate of interdisciplinary solutions to falls in older adults. HIGN defines a fall is "an unexpected event in which the participant comes to rest on the ground, floor, or lower level." They consider falls to be a geriatric syndrome, the result of pre-existing and precipitating factors (HIGN, 2012).

Clinicians Ann Shumway-Cook and Marjorie Woollocott offer a practical clinical definition in their book *Motor Control: Theory and Practical Application*. A fall is "an unplanned and unexpected contact with a supporting surface" (Shumway-Cook and Woollacott, 2012). In this definition a supporting surface can be the floor, a wall, a chair, a bed, or another surface that is used unexpectedly to aid recovery of balance.

In the research setting, because of the need to protect research subjects from injury, a fall is commonly defined as "a movement of the center of gravity outside the base of support." But this definition is by no means universal. In a review of 90 studies dealing with fall prevention interventions, researchers noted that 44 of the studies had no definition of what constitutes a fall and the remaining 40 studies had no definition that stood out as a gold standard. The studies that included a definition used a combination of mechanical, behavioral, and medical descriptions. Most of the studies agreed that a fall occurs when a person comes to rest at a lower level, but the description of that level varied. In most cases, falls associated with an acute medical event or external force (such as a collision) were excluded or characterized as an accident (Hauer et al., 2006).

Agreement on what defines a fall is urgently needed and the Prevention of Falls Network Europe and Outcomes Consensus Group, among others, have worked to find a comprehensive definition. As a start the group recommends that a fall be defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level." They stress that any definition should be simple, be understood reliably by laypeople who document their own falls, and include time, location, and activity when documented by staff (Hauer et al., 2006).

Incidence and Cost of Falls

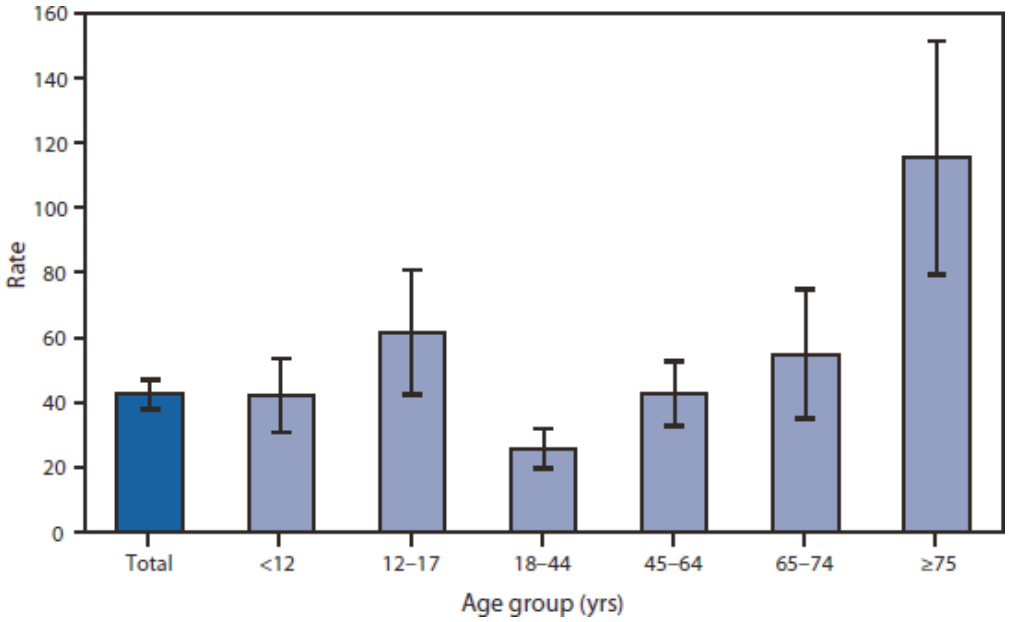
In 2004, according to NDNQI data, nursing units reported 113,067 patient falls. The observed fall rate across all nursing units was 3.32 per 1,000 patient days. Falls were most common in rehabilitation units and least common in intensive care units. Most patients (72%) had no injury from their falls; most of the others (23%) suffered a minor injury from the fall. Five percent had a moderate or major fall-related injury (Lake et al., 2010).

Similar results were found in a 2012 study of adults 85 years and older in northeast England—the Newcastle 85+ Study. Researchers found that 38% of the study participants had at least one fall in the previous 12 months, and 11% of those who fell sustained a fracture in the 12-month period, which equates to 4% of 85-year-olds overall. Previous studies in this age group report prevalence rates for falls over a 12-month period of 43% to 44%, and fracture rates of 7% to 9% per fall (Collerton, 2012).

Despite the relatively small number of serious fall-related injuries, falls have major social and medical consequences for older adults. In the United States in 2008 nearly 20,000 older adults died as a result of injuries from unintentional falls. Globally, the World Health Organization (WHO) estimates that just under 500,000 people die each year as a result of a fall, and nearly 40 million people experience falls that are severe enough to require medical attention (Zhang, 2012).

In 2010 the rate of nonfatal fall injury episodes for which a healthcare professional was contacted was highest in persons aged 75 years and older (CDC, 2012b). Among older adults, lacerations, hip fractures, or head traumas occur in about a quarter of people who fall, and falls are the most common cause of hospital admissions for trauma.

Nonfatal Fall Injuries in the United States, 2010



Rate of nonfatal, medically consulted fall injury episodes per 1000 population in the U.S. in 2010 by age group. Source: CDC, 2012b.

Hip Fractures

In adults over the age of 65, falls are the cause of more than 95% of hip fractures. Injuries such as these can cause severe health problems and lead to reduced quality of life and even premature death. Within a year after sustaining a hip fracture, an elderly nursing home resident has a 40% risk of death and a 6% to 12% risk of another hip fracture (Sawka, 2010).


Medial hip fracture in a 92-year-old woman. Source: Wikimedia Commons.

On average, older adults with hip fractures are hospitalized for about one week. About one-quarter of adults who lived independently before their hip fracture will stay in a nursing home for at least a year after their injury (CDC, 2010).

In both men and women, hip fracture rates increase exponentially with age. People 85 and older are 10 to 15 times more likely to sustain hip fractures than are those age 60 to 65. Osteoporosis increases a person's risk of sustaining a hip fracture. The National Osteoporosis Foundation estimates that more than 10 million people over age 50 in the United States have osteoporosis and another 34 million are at risk for the disease (CDC, 2010).

Falls in Nursing Homes

In 2010 about 1.6 million people 65 and older lived in nursing homes, representing about 5% of adults 65 and older. Despite this relatively small number, residents of nursing homes account for about 20% of deaths from falls in this age group (CDC, 2012c).

Each year a typical nursing home with 100 beds reports 100 to 200 falls, although the number is probably much higher because many falls go unreported. As many as 3 out of 4 people in nursing homes fall each year, which is twice the rate of falls for older adults living in the community. Nursing home residents often fall more than once—an average of 2.6 falls per person per year. About a third of fall injuries occur among residents who cannot walk (CDC, 2012c).

Effects of Stroke on Fall Rate

Balance difficulties and falls are two of the serious medical complications that are associated with a stroke. Most people who have had a stroke (75%) fall during the first 6 months post stroke compared with the 30% annual fall rate in the general older adult population (Schmid et al., 2010).

Studies that focus on post stroke safety and complications have identified an increased fall risk during acute hospitalization. Falls and other medical complications are associated with triple the length of the acute hospital stay (Schmid et al., 2010). The highest **rates** of falls occur upon discharge from the hospital (Simpson, 2011).

Falls are an important issue during the acute stay, and fall prevention should be addressed immediately upon admission. Stroke severity, specifically a National Institutes of Health Stroke Scale (NIHSS) score ≥8, can be used to identify stroke patients who are at greatest risk of falling. Those determined to be at risk for falls should have a fall prevention program initiated while they are still in the acute inpatient hospitalization period (Schmid et al., 2010).

In a recent Canadian study, a lower score on the Berg Balance Scale (see later section on Assessing Functional Mobility and Gait) was associated with greater falls for both stroke and control groups. Researchers found that people recently discharged from rehabilitation to home were at greater risk for falls in their home. This may be because, following a stroke, people spend more time at home or are more cautious when outside their home. This finding reinforces the importance of a home assessment, home safety education, and environmental modifications as part of discharge planning (Simpson, 2011).

Psychosocial Consequences of Falls

Psychosocial factors are those factors related to social and psychological behavior. Social factors include marital status, living situation, and engagement in social activities, among others. Psychological factors include anxiety, worry, fear of falling, psychological trauma, and depression. Psychosocial factors can become barriers to improved outcomes, particularly if a provider makes inaccurate assumptions about the patient's ability to follow up on recommendations and willingness to adhere to a complicated regimen.

In a structured interview of 816 men and women in northeast England (the Newcastle 85+ Study), researchers found that falls had significant psychosocial consequences. Those who sustained a fall "worried about falling" (42.0%), expressed "loss of confidence" (40.0%), and reported "going out less often" (25.9%). "Fear of falling" was reported by 42% of the study participants. Psychosocial consequences of falls were significantly more common in women, which suggests the need for gender-specific interventions in older adults (Collerton, 2012).

Fear of Falling

Experiencing a fall often increases an older adult's fear of falling, which of itself is correlated with future falls. Fear of falling leads older adults with and without a history of falling to limit activities, which eventually increases fall risk through functional decline, deterioration in perceived health status, and increased risk for admission to institutional care (Michael, 2010).

A review of 33 studies that looked at fear of falling in community-dwelling older adults found that fear is widespread among those who have a history of falls as well as those who had not yet experienced a fall. The main risk factor for developing a fear of falling was a previous fall. Fear of falling increases with age and is more prevalent in women than men (Scheffer et al., 2008).

Risk factors associated with a fear of falling included:

- Dizziness

- Self-rated health status
- Depression
- Gait and balance disorders (Scheffer et al., 2008)

Fear of falling may also contribute to changes in gait. Older adults who fear falling tend to walk at a slower pace and have higher levels of anxiety and depression compared with adults who do not fear falling (Shumway-Cook and Woollacott, 2012).

The Long-Lie Condition

The "long-lie" condition, in which a faller is unable to get up and remains on the ground for several hours, is a consequence of falling that has social and psychological overtones. Even if no injury has occurred, many people who fall are unable to get up off the floor without assistance. Long-lies are associated with social isolation, fear of falling, muscle damage, pneumonia, pressure sores, dehydration, and hypothermia (Bagala et al., 2012).

Half of the older adults who experience a long-lie die within 6 months, even if no direct injury from the fall has occurred. More than 20% of older adults admitted to hospital as a result of a fall experienced a long-lie as a result of the fall (Bagala et al., 2012).

Protective Factors

Certain psychosocial factors, if present, have been shown to have a protective effect against fall risk. In a study of hip-fracture risk involving 387 Australians over the age of 65, the following factors were protective of hip fracture:

- Being currently married
- Living in present residence for 5 or more years
- Having private health insurance
- Using proactive coping strategies
- Having a higher level of life satisfaction
- Engagement in social activities (Peel, 2007)

Healthcare Providers: Differing Approaches to Falls

How healthcare providers approach the problem of falls and fall risk in older adults can be profoundly profession-centric, largely because training, education, and research focus differs from profession to profession. Compounding this problem—and despite the existence of ample evidence that falls can be reduced or even prevented—assessing fall risk in high-risk patients is often ignored by clinicians of all stripes.

Several studies by Mary Tinetti and her colleagues at the Connecticut Collaboration for Fall Prevention (CCFP) have attempted to discern why medical professionals are reluctant to incorporate fall prevention into their practices. Among the reasons given:

- Ignorance of falling as a preventable condition
- Competing time demands
- Perceived lack of expertise
- Insufficient reimbursement
- Inadequate referral patterns among clinicians (Tinetti et al., 2008)

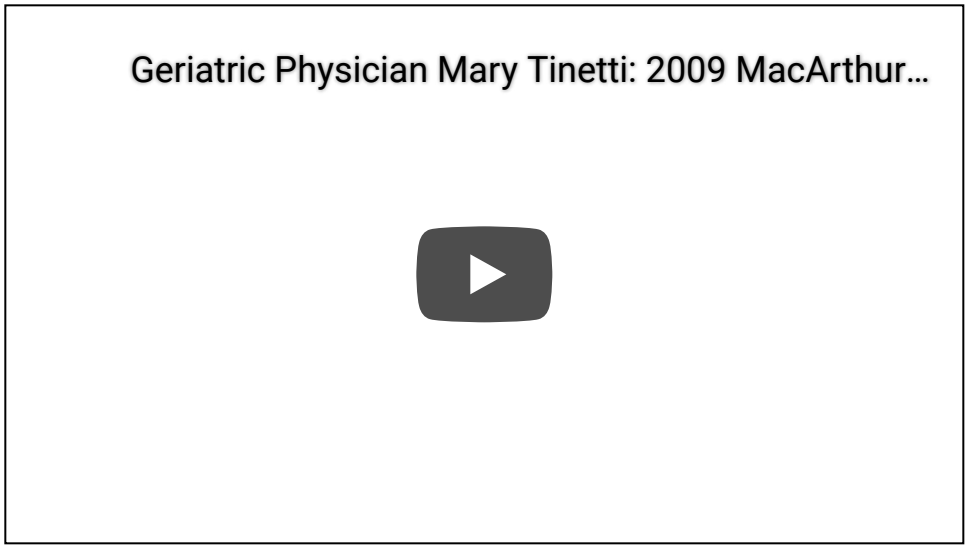
A 2008 study by the CCFP attempted to address this issue by encouraging clinicians involved in home care, outpatient rehabilitation, and senior centers to adopt fall risk assessments and develop strategies to reduce falls among their clients. Participating clinicians and facilities were asked to incorporate evidence from the Yale-based study, "Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT)," and other trials into their practices (Tinetti et al., 2008).

The study assessed the rates of (1) fall-related injuries, and (2) fall-related medical services among older adults in an intervention group and a usual-care group. Participating clinicians (physical and occupational therapists, emergency department physicians and nurse managers, and primary and home care providers) were given fall-related training and offered educational materials to share with their patients.

Recommended fall prevention strategies included: a reduction in medications; management of postural hypotension; management of visual and foot problems; hazard reduction; and balance, gait, and strength training. Clinicians were encouraged to incorporate assessments, treatments, and referrals into their practice as appropriate to their discipline and setting. Following these interventions, a 9% decrease in fall-related injuries and an 11% decrease in fall-related use of medical services were noted in the intervention group (Tinetti et al., 2008).

A significant number of study participants said they have adopted fall prevention practices. Among primary care clinicians, 50% reported referring patients for balance disturbances, and 88% reported performing medication reviews. Among home care clinicians, more than 80% reported addressing postural hypotension, balance disturbances, multiple medications, and home hazards for at least some patients. Similar rates for adopting balance and gait treatments were reported by outpatient rehabilitation (Tinetti et al., 2008).

Mary Tinetti Video (2 min, 29 sec)



Video: Geriatric Physician Mary Tinetti: 2009 MacArthur Fellow (2 min, 29 sec).
http://www.youtube.com/watch?v=13LCLKpSKqY

A Washington State Department of Health telephone survey assessed current knowledge of, attitude toward, and provision of best practices for preventing falls among older adults. Fifty healthcare workers, including physicians, nurses, therapists, and nursing assistants, were asked how much they know about fall prevention practices. They were also asked about the importance of providing fall prevention services (or referring a patient to another clinic that provides fall preventions services) and whether they have an understanding of the barriers or the main reasons for not providing fall prevention services (Laing, 2011).

Not surprisingly, a majority of respondents identified falls to be an urgent or very urgent issue facing older adults. When asked about the perceived importance of and regular use of the following six fall-prevention services, two-thirds rated the prevention practices listed below as “very important”:

- Individual fall-risk assessments
- Strength and balance training programs
- Home safety assessments
- Medication review and management

- Assistive device training
- Fall prevention education

When asked about their own level of knowledge, a little more than one-third (38%) felt "very knowledgeable" about recommended fall prevention practices, and 58% perceived themselves to be "somewhat knowledgeable." More than one-third (38%) of respondents said strength and balance training and fall prevention education were the services used most often regularly. When asked about available resources, survey participants felt that insufficient resources and funds were the main barriers to regular provision of fall prevention services (Laing, 2011).

Although nearly 60% of respondents rated themselves as somewhat or very knowledgeable about fall prevention practices they identified a lack of trained personnel as a barrier to the regular provision of a fall prevention services. They also identified low organizational priority and low awareness of the importance of fall prevention (Laing, 2011).

Attitudes and Provision of Fall Prevention Services Among Community-Based, Senior-Serving Organizations, n=50				
Fall prevention practice	Practice perceived as very important (%)	Provision of service on a regular basis (%)	Provision of service sometimes (%)	Referral to outside organization to provide service (%)
Individual risk assessment	74	16	36	26
Strength, balance training	94	38	28	24
Home safety assessment	76	14	34	40
Medication review and management	84	10	22	44
Assistive device training	68	8	25	42
Fall prevention education	74	38	30	20

Source: Laing, 2011.

Fall Prevention: Nurses

Among all healthcare professionals, nurses are perhaps most responsible for the overall safety of the patient. Nurses provide advice, education, screening, and coordinated medical referrals to the primary care physician, geriatrician, optometrist, physical therapist, occupational therapist, and other professionals. Nurses' ability to identify fall risk and either address the problem or make a referral to another healthcare professional is critical to the success of a falls prevention program.

As part of their regular duties, nurses are responsible for assessing the environment for extrinsic risk factors, screening patients for fall risk, providing staff with instructions regarding what to do if a patient falls, identifying patients who need additional safety precautions or referral to a specialist, and developing a interdisciplinary plan of care to prevent falls (HIGN, 2012).

A recent Norwegian study looked at the nursing staff's opinions of caring for older persons with dementia with the focus on causes of falls, fall-prevention interventions, and routines of documentation and reports. The study also looked at the nursing staff's experiences and reactions when falls occur, and compared opinions of registered nurses and enrolled nurses (similar to licensed practical nurses) and staff with less than 5 and more than 5 years of employment in care units (Struksnes et al., 2011).

Causes of falls are, according to the study participants, most often related to the individual's condition. Four causes were cited as the most important factors associated with falls:

- Forgetfulness related to physical impairment
- Impaired mobility
- Anxiety
- Inability to call for help (Struksnes et al., 2011)

The participants felt that impaired short-term memory and dementia often causes residents to forget their physical impairments, and falls can occur when they are getting up from the bed or a chair. Those who can get up from a chair, but cannot stand upright or sit down unaided, are particularly exposed to fall-risk (Struksnes et al., 2011).

Anxiety was reported "often" to cause falls by the respondents. These results are in line with other studies showing that anxiety and confusion are symptoms that can precede falls. The respondents felt that the disturbing behavior of another resident "sometimes" precipitated falls among residents with dementia. Although many studies have found that residents who wander are at high risk of falling, the nursing staff in this study did not report wanderers as a risk group for falling (Struksnes et al., 2011).

Environmental factors were not reported as a frequent cause of falls by the respondents. By comparison, some studies have suggested that external physical factors cause about 8% of falls in residential care facilities, while others have found that 14.5% of falls are associated with environmental factors. The respondents in the Norwegian study did not emphasize this issue, perhaps because the facilities in the nursing homes studied are well designed for persons with dementia (Struksnes et al., 2011).

Staffing and the number of experienced nurses on duty were also associated with a decrease in falls in U.S. healthcare facilities. A review of data by researchers at the National Database of Nursing Quality Indicators (NDNQI) looked at the effect of nursing experience and staffing on fall rates at more than 1400 healthcare organizations in the United States. The data indicate that for every increase of one year in average RN experience, the fall rate was lowered by 1%. A higher percentage of experienced RNs was also associated with lower fall rates (Hill, 2010).

Fall Prevention: Rehabilitation Therapists

Rehabilitation therapists—physical and occupational therapists—are trained to identify and assess fall risk, design programs to reduce the risk of future falls, recommend assistive devices, design exercise programs, and complete home evaluations to reduce hazards in the home. Physical therapists (PTs) in particular are educated to complete comprehensive balance assessments and establish fall prevention strategies in older adults who are at risk for falls.

A discrepancy exists, however, between what PTs view as their professional responsibility and how they practice. While they believe it is their professional responsibility to routinely review medications, screen for vision deficits, and complete home safety evaluations, PTs may not be routinely doing this in practice (Monson, 2011).

A survey of 362 physical therapists practicing in Kansas looked at attitudes and beliefs about fall prevention strategies in older adults and whether the respondents regularly include certain strategies in their practice. The study found that more than 90% of respondents feel that falls are a significant public health problem and that screening for fall risk should be a routine part of a physical therapy evaluation in older adults (Monson, 2011).

The vast majority (>90%) also indicated they feel it is their professional responsibility to ask older adult patients about medications, vision deficits, exercise habits, strength and balance, and home safety. When asked about current practice habits however, although about 90% said they routinely ask about history of falls, exercise habits, and strength and balance exercises, only 35% frequently reviewed medications for fall prevention, only 22% routinely asked about vision screenings, and only about half routinely recommended a home safety evaluation (Monson, 2011).

In a Connecticut Collaboration for Fall Prevention survey of 94 physical therapists that had been exposed to a fall prevention program, researchers asked participants if exposure to the program had changed practice behavior with respect to fall prevention practices. The participants were asked to name as many preventable risk factors for falls in older adults as they could think of and as many interventions or treatments that might help prevent falls in their older patients. Environmental hazards, gait and balance impairment, and multiple medications were the most commonly cited fall risk factors. Only 11% were able to name an intervention for sensory-perceptual deficits even though many studies have shown them to be key contributors to falls.

Knowledge of Risk Factors and Interventions for Falls		
Risk factor	Named a risk factor	Named an intervention to address the risk factor
Environmental hazards	86%	71%
Gait or balance impairments	78%	96%
Multiple medications	77%	48%
Sensory and perceptual deficits	57%	11%
Foot and footwear problems	47%	37%
Postural hypotension	30%	15%

Source: Brown et al., 2005.

A one-year followup survey by CCFP found that more than two-thirds of the physical therapy providers reported using fall reduction strategies increasingly in their older patients. More than half of the study participants had adopted strategies for reduction of fall risk factors that they had not used in the past. These strategies included an increase in the use of referrals to other healthcare providers, increased use of exercise, and increased education of patients about their fall risk factors (Brown et al., 2005).

Fall Prevention: Physicians

Physicians are responsible for managing a patient's care, identifying patients who are at increased risk of falling, and referring the patient to a physical or occupational therapist or other balance specialist for treatment. They are generally not involved in designing or implementing exercise programs or completing home assessments.

Primary Care

In a study using a structured interview of 18 primary care physicians (PCP) by the Connecticut Collaboration for Fall Prevention (CCFP), a CCFP physician visited the PCPs and discussed risk factors for falls in older adults. The CCFP physician suggested treatment strategies to reduce the risk of falls and provided the PCPs with checklists to focus their evaluation of fall risk, educational materials to use with patients, brochures, and information about billing for fall risk evaluation and treatment (Chou et al., 2006).

The goal of the study was to encourage the physicians to incorporate fall risk assessment and treatment into their office practices. During the visit, emphasis was placed on:

- Identification of patients at risk for falls
- Treatment of balance and gait problems
- Assessment of postural hypotension
- Medication review and reduction

The participating physicians reported several factors that influence their ability to incorporate routine fall risk assessment into their evaluations of their older adult clients. They described, among other factors, competing risks and priorities, the need to use clinical time to address more pressing health issues, concern about referring a patient with complex medical problems to another healthcare provider, and awareness that their training emphasizes a disease approach rather than a multifactorial approach needed to address fall risk (Chou et al., 2006).

The PCPs also cited patient factors that influence their approach to fall risk assessment, particularly patient underreporting of falls and conflicting attitudes among some patients about discontinuing medications that the patient feels is needed but the physician has identified as associated with fall risk.

The PCPs said they were concerned about referring to another healthcare provider because many of their patients lack transportation to get to other appointments. They also cited lack of reimbursement for time-consuming fall risk assessments and pointed out the need for family involvement with fall risk reduction recommendations.

Assisted Living and Residential Care

Nearly 1 million people live in an estimated 38,000 residential care or assisted living facilities in the United States and are under the direct care of a PCP. These facilities are less regulated than nursing homes and are increasingly admitting older adults with serious cognitive and physical impairments. Residents have a mean age of 85 years and an average of 4.6 chronic health conditions; 55% are diagnosed with dementia or Alzheimer's disease and 67% take 10 or more mediations a day (Nyrop, 2010).

A survey of physicians in North Carolina (Nyrop, 2010) looked at physician attitudes about fall prevention in assisted living and residential care settings and asked physicians about four fall risk assessment and management practices:

- Assessing residents for fall risk
- Reviewing medications for potential side effects related to falls
- Talking to and working with staff to reduce fall risk
- Communication and collaboration between the physician and residential care staff regarding patients at high risk for falls

Thirty-six physicians completed the survey and estimated that, for their patients in the residential care or assisted living setting, in the past six months they had:

- Conducted fall risk assessments of 47% of their patients
- Reviewed medications for potential side effects related to falls for 73% of their patients
- Talked to or worked with facility staff to reduce the fall risks for 36% of their patients at high risk for falls (Nyrop, 2010)

Physicians expressed strong support for fall risk assessments and believed they have the expertise to conduct these assessments. However, they felt that facility staff bore greater responsibility for conducting fall risk assessments than the physicians themselves (Nyrop, 2010). By contrast, the physicians believed they were best qualified to review medications that might be related to fall risk.

Attitudes About Falls Among Older Adults

Older adults themselves have conflicting attitudes about fall risk, including underreporting of falls to their healthcare providers. In the Washington State Department of Health survey mentioned above, surveyors interviewed 101 at-risk older adults, 48% of whom had fallen in the last year. Within this group, one-third said that falling was their least important health concern and most had little knowledge of proven fall prevention practices. Those who felt that fall prevention was important were more likely to participate in activities that addressed risk assessment and medication management (Laing et al., 2011).

Study participants identified "not feeling at enough risk for falling" as the primary barrier to participating in most fall prevention practices. They reported being motivated to participate actively in fall prevention practices when "something happened to increase their perception of risk," or if they began "falling frequently;" these factors were the primary motivation for participation in three of the six fall prevention practices (medication review, home assessment, and individual risk assessment) (Laing et al., 2011).

When asked about specific fall prevention practices, awareness of best practices was generally low. A large number of participants named gait-related activities (moving slowly, wearing safe shoes, and using canes or walkers) and home safety improvement as important prevention practices. None mentioned medication management without being prompted. Those who perceived falls to be an important health concern were significantly more likely to engage in the practices about which they had awareness such as medication management and risk assessment (Laing et al., 2011).

When prompted, participants had good awareness of strength and balance training, home safety improvement, and medication management as fall prevention practices. They were least likely to have an awareness of assistive devices designed to improve balance. Fewer than 10% rated avoiding risk of fall injury to be of highest importance. Many did not consider themselves as having a high fall risk even though they understand that falls are preventable (Laing et al., 2011).

Risk Factors for Falls

A **risk factor** is something that increases a person's risk or susceptibility for falling. Determining fall risk and making a timely referral to a healthcare professional familiar with assessment and treatment is recommended by a number of professional organizations. The complex nature of the deficits related to fall risk requires close case management and coordination of services (Moyer, 2012).

The risk of falling increases dramatically with a number of risk factors, such as musculoskeletal problems, neurologic diseases, psychosocial characteristics, functional dependency, and drug use. Prevention is not easy because falls are complex events caused by a combination of intrinsic impairments and disabilities and, sometimes, environmental hazards (Baranzini et al., 2009).

In her seminal study of risk factors associated with falls in older adults, Mary Tinetti studied multiple-modifiable risk factors and the effects of multifactorial interventions on the risk of falling among community-dwelling older adults. Tinetti's research has shown that as the number of risk factors rise so does the risk of falling. The following risk factors were examined in the Tinetti study:

- Postural hypotension
- Use of sedatives
- Use of at least four prescription medications
- Impairment in arm or leg strength or range of motion
- Balance
- Ability to move safely from bed to chair or to the bathtub or toilet (transfer skills)
- Gait (Tinetti, 1994)

Researchers noted that a patient's ability to compensate for loss of function declines sharply as the number of risk factors increases (Tinetti, 1994).

Other studies have focused on these common risk factors associated with falls:

- Muscle weakness
- History of falls
- Gait deficit
- Balance deficit
- Use of assistive device
- Visual deficit
- Arthritis
- Impaired ADLs
- Depression
- Cognitive impairment
- Age >80 years (Shumway-Cook and Woollocott, 2012)

In the Veterans Affairs (VA) system, in addition to the factors listed above, these risk factors trigger a fall risk assessment:

- Agitation/delirium
- Medication timing and dosing
- Frequent toileting
- Impaired vision, inappropriate use of assistive devices or footwear
- Psychotropics, digoxin, type 1A anti-arrhythmics, diuretics (thiazides > loop diuretics)
- Antihistamines/benzodiazepines
- Antidepressants: tricyclics higher risk than SSRI but SSRIs have risk as well, high level of phenytoin; low-dose amitriptyline affects gait
- Drugs treating nocturia (USDVA, 2009)

A Taiwanese study involving 1377 community-dwelling adults 65 and older looked at co-morbidities, cognitive impairment, neuromuscular impairment, balance and gait disorder, depression, functional decline, higher use of medication, and environmental hazards. They noted that many older adults neither recognize risk factors for falls nor report falls to their physicians. Risk factors for falls only become evident after injuries and disability has occurred (Lin et al., 2011).

Studies of risk factor assessment have used a large and varied list of risk factors for falls, which makes it difficult to synthesize the literature. One systematic review of risk factor assessments used in falls intervention trials found that three risk factors provided independent prognostic value in most studies: history of falls, use of certain medications (for example, psychoactive medications), and gait and balance impairment (USPSTF, 2012). Several risk factors for falls in older adults will be considered in more detail.

Polypharmacy

Polypharmacy is the use of multiple medications at one time, including over-the-counter (OTC) medications, dietary supplements, and herbal remedies. Polypharmacy includes prescribing more medications than are clinically indicated, using inappropriate medications, and using the correct medication for an inappropriate length of time (NHTSA, 2006; Pugh et al., 2005). Polypharmacy is regarded as an important risk factor for falling, and several studies and meta-analyses have shown an increased fall risk in users of diuretics, type 1a anti-arrhythmics, digoxin, and psychotropic agents (Baranzini et al., 2009).

Due to concurrent prescription of several drugs, the risk of inappropriate drug combinations is increased in older adults. In addition, medication metabolism is affected by age-related changes, which increase both drug half-life and drug free fraction. Coexisting illnesses can also interact with medications. For all these reasons, older adults are at higher risk of experiencing adverse drug effects (Berdot et al., 2009).

An older man on multiple medications participating in a medication review. Medications that increase his risk of falling are of particular interest. Source: National Institutes of Health.

Polypharmacy, arbitrarily defined as the use of four or more medications, may **not** to be an independent risk factor for falls in all settings. Polypharmacy has been discussed extensively and at length in the scientific literature, but the concept still lacks an unequivocal and clearly accepted definition. Attempts to establish a cut-off value for the number of drugs used, which might make it easier to identify patients at risk, have not always been successful. Even though a relationship between the number of drugs taken and the occurrence of drug-related problems has been demonstrated, such a relationship may not be universally valid and must always be considered in the context of the specific clinical setting and the peculiarities of the population considered (Baranzini et al., 2009).

In a study that looked at polypharmacy and falls in nursing home residents in Varese, Italy, polypharmacy was **not** found to be a risk factor for fall-related injuries. Injuries were associated with the use of multiple drugs (7 or more), but only when a fall-risk-increasing drug (antiarrhythmic or anti-Parkinson drug) was part of the patient's therapeutic regimen. Multiple medications or particular medication classes were not clearly associated with injurious falls. In particular, digoxin, type 1a antiarrhythmics, and diuretic use were associated with falls in older adults (Baranzini et al., 2009).

Less well known is that fall risk increases significantly in the days following a medication change. In October 2004, researchers at Johns Hopkins University studied the effect of medication changes on the risk of falls among residents of three nursing homes who fell during 2002–2003. The study looked at medication changes that occurred 1 to 9 days before a fall, including the risk of falling after a start, stop, or dose change in medications. The results indicated that the short-term risk of single and recurring falls may triple within two days after a medication change (CDC, 2012a).

To address these issues, the National Council on Aging (NCOA) Falls-Free National Action Plan encourages healthcare professionals to support policies that increase awareness of polypharmacy and fall risk. The goal is to "increase the number of older adults who have annual medication reviews conducted by healthcare providers or pharmacists and ensure this review includes an adequate focus on falls and fall-related injury prevention, with the goal of reducing or eliminating medications that increase fall risk."

To accomplish this goal, NCOA recommends that clinicians regularly review each patient's medications for potential interactions and side effects that may increase fall risk and, where possible, reduce or eliminate medications or select alternatives. Reducing the number and types of medications, particularly tranquilizers, sleeping pills, and anti-anxiety drugs, can be an effective fall prevention strategy when used alone or as part of a multi-component intervention.

Depression, Antidepressants, and Falls

Depression is common and treatable in older adults and outcomes improve with effective antidepressant therapy, which could lead to a decrease in the morbidity associated with falls. Older people who fall are twice as likely to be depressed compared with those who do not fall (Kerse, 2008). However, antidepressant use can also increase the risk of falls, both for those in the community and in residential care (Kerse et al., 2008).

A cross-sectional survey of Australians aged 60 and over investigated the association between depressive symptoms, medication use, falls, and fall-related injury. Both depression and the treatment for depression were independently associated with an increased risk of falls. Selective serotonin reuptake inhibitor (SSRI) use was associated with the highest risk of falls and injurious falls of all psychotropic agents (Kerse et al., 2008).

Cognitive Decline

The understanding of the relationship between age-associated declines in cognitive function and reduced mobility is evolving. For a long time, these two common geriatric symptoms were viewed as distinct and separate. An increased fall risk in older adults was typically considered to be unrelated to age-associated changes in cognitive function. New research gives us reason to suspect that falls are affected by cognitive function even in the absence of dementia (Mirelman et al., 2012).

Several studies have examined the role of specific cognitive domains on fall risk. Lower scores on cognitive screening tests such as the Mini-Mental State Examination and the Montreal Cognitive Assessment were associated with an increased risk of falls (Buracchio et al., 2011). Lower scores on tests of attention, executive function, memory, and visual-spatial function have all been reported to be associated with an increased risk of falls in both cognitively intact and cognitively impaired individuals.

Difficulty with dual-task walking, a measure of divided attention and executive function in which individuals are given a secondary mental task while walking, has consistently been shown to be associated with an increased risk of falls (Buracchio et al., 2011). Impaired cognition may cause these problems because of a limited ability to perform either task or problems in allocating attention efficiently between the two tasks (Shumway-Cook and Woollocott, 2012).

An Israeli study looked at executive function, attention, and other cognitive domains in 256 community-living older adults with an average age of 76 years. Participants were free of dementia and had good mobility upon entrance into the study. Baseline cognitive function was established using computerized cognitive tests. Gait was assessed during single and dual task conditions. Falls data were collected prospectively using monthly calendars. The researchers found that among community-living older adults, the risk for future falls was predicted by executive function and attention tests conducted five years earlier, indicating that screening executive function will likely enhance fall risk assessment and that treatment of executive deficits may reduce fall risk (Mirelman et al., 2012).

Cardiovascular Disorders

Cardiovascular complications are a significant cause of recurrent falls in older adults. Cardiovascular causes can be from neurally mediated syndromes such as orthostatic hypotension, syncope, or carotid sinus hypersensitivity. The cause can also be structural and can include abnormalities such as cardiac arrhythmias, valvular stenosis, cardiomyopathies, and myocardial infarctions.

A study in The Netherlands involving 215 older patients (average age, 77 years) looked at echo (Doppler) cardiographic abnormalities to determine if certain findings were indicators of increased risk for falls. Risk of falls was increased if regurgitation of the mitral, tricuspid, or pulmonary valve was present. The level of risk increased according to the severity of the regurgitation. An increased fall risk was also found for high tricuspid-regurgitation velocity and high pulmonary systolic pressure, which was used as a proxy for pulmonary hypertension (van der Velde, 2007).

Current cardiovascular status may be related to risk of falling. In a retrospective case-control study of 13 acute hospital patients who had fallen in the last year, researchers found that the fallers displayed a larger change in blood pressure and heart rate readings over 12 hours than those in the matched control group. In the control, blood pressure and pulse changed an average of 10% over 12 hours, while those who had fallen had a variation in their heart rate and blood pressure of approximately 20% (Freilich and Barker, 2009).

Restraints and Fall Risk

Because unsafe behaviors such as wandering, aggressive behaviors, and falls are common among older adults in certain healthcare settings, it may seem like a good idea to restrain people to prevent falls. But physical and chemical restraints can actually increase the risk of falls and contribute to other negative outcomes such as bruises, musculoskeletal injuries, skin tears, physical deconditioning, pressure ulcers, anger, depression, and anxiety (Castle and Engberg, 2009).

The topic of restraint reduction has been under intense scrutiny since the late 1980s, when it began with a public outcry in developed countries arising out of concern about the standard of care in long-term care settings. In Britain, the use of physical restraints on older people was regarded as abuse (Lai, 2007).

In the United States, the Omnibus Budget Reconciliation Act of 1987 (OBRA 87) established a resident’s right to be free of the use of restraints in nursing homes when used for the purpose of discipline or convenience and when not required to treat the resident’s medical symptoms. Related regulations also specify that uncooperativeness, restlessness, wandering, or unsociability are not sufficient reasons to justify the use of antipsychotic medications (Agens, 2010).

Physical Restraints

A **physical restraint** is "any manual method or physical or mechanical device, material, or equipment attached or adjacent to the patient that the individual cannot remove easily and which restricts freedom of movement or normal access to one's body" (Canadian Patient Safety Institute, 2007).

Physical restraints have been used in nursing homes and hospitals both as safety devices and as falls prevention tools. Theoretically, a restrained patient cannot fall or, in the case of bedrails, cannot roll out of bed. Several studies have shown no statistically significant difference in falls compared with historical controls when bedrails are removed. In fact, restrained patients appear to have a modest increase in fall risk or fall injuries (CDC, 2012a).

Restraint use can have significant negative outcomes—they have been shown to increase the length of hospital stays and increase mortality, pressure sores, hospital-acquired infections, falls, and aggression (Strout, 2010). Several studies have reported extensive injuries among nursing staff while applying physical restraints, as well as distress, anxiety, and anger among nursing staff when the need to maintain safety and control conflicts with their professional values (Strout, 2010).

Despite evidence that restraints can increase the likelihood of a fall, a Hong Kong study (Lai, 2007) found nurses were resistant to the notion of removing patients' restraints and how (or whether) it relates to fall risk. The study involved focus-group interviews with nurses in rehabilitation facilities and explored the perspective of the nursing staff with regard to the use of physical restraints, and their perception of the means available to reduce it. The nurses' responses highlight the ambivalence many medical professionals feel when tasked with the responsibility of preventing falls among high-risk older adults:

> I am not worried about having to write an incident report (if a patient fell). Probably we would have to face the family. That is to say, they placed their relative under our care in the hospital, but then we allowed him or her to get hurt. They may put the responsibility on us. That is, they will blame us. It is not as simple as writing a statement. We will feel the burden. (Lai, 2007)

In regards to staffing:

> In fact, really . . . we feel that there is nothing much we can do . . . in many situations, one member of staff has to look after two-and-a-half to three cubicles; one cubicle has eight beds, and there is one nurse and one healthcare aide looking after five cubicles of patients. Well, each of us has our work to do. Both the healthcare organization and I have the responsibility to prevent falls.

> For the sake of patients' safety, well, we have to prevent them from falling, so we have to do everything . . . we can. (Lai, 2007)

In regards to pressure from the hospital organization to perform:

> In fact the management is very important. . . . For example, when the ward manager comes around the unit and asks us to take off the restraints, even if we feel inside that this one cannot do without a restraint, we still need to try. The work that you have to do after a patient falls is considerable. Even if it is only a minor fall, the work that follows takes at least an extra hour. . . . You have to get the patient up, reassure him, get him back into bed, do your observations, and ask them about what happened. Then, if the patient needs treatment, you call the doctor. Probably you will have to arrange for the patient to have an x-ray, and then you will have to report it—you will have to write up a statement, update the patient's record . . . and then you will have to inform the family, etc. (Lai, 2007)

Reducing falls in high-risk older adults takes a commitment on the part of the healthcare organization to provide training, staffing, and equipment. It also takes a commitment on the part of individual healthcare workers and family members to educate themselves about fall-risk reduction strategies. Despite these difficulties the use of physical restraints can be significantly and safely reduced by making certain environmental and equipment modifications:

- Keep hallways free of equipment and obstacles
- Install rails in hallways
- Install grab bars in bathrooms, bedrooms, and showers
- Install floor-to-ceiling transfer poles next to chairs and beds
- Install half-rails on beds
- Lower beds—place mattress on floor if necessary
- Remove wheels from beds and chairs
- Adapt wheelchairs to improve posture and support
- Provide "pressure-relief" wheelchair cushions to improve comfort
- Lower wheelchairs to allow self-propelling with feet
- Provide comfortable alternative seating
- Install carpeting to reduce injury from falls
- Use undergarments with pads over the hips to reduce injuries from falls

Chemical Restraints

A **chemical restraint** is the use of any medications to subdue, sedate, or restrain an individual. Chemical restraints are intended to restrict the freedom of movement of a patient—usually in acute, emergency, or psychiatric settings. Legally, a chemical restraint can be prescribed for dangerous, uncontrolled, aggressive, or violent behavior, but it must be used for the shortest time possible. As with physical restraints, chemical restraints have been shown to increase falls in older adults (Agens, 2010).

Although an off-label use, antipsychotic medications in particular are often used in older patients to control unwanted behaviors such as hitting, yelling, and cursing. They become, in effect, a chemical restraint and have been shown to increase falls and patient deaths (Agens, 2010).

An increased risk of mortality in older adults prompted the Food and Drug Administration to mandate a "black box" label on atypical antipsychotic medications stating that they are not approved to treat behavioral issues associated with dementia. Research suggests that conventional antipsychotics are just as likely to cause death, if not more so (Agens, 2010).

Given the risks, if antipsychotic medications are used at all, they should be prescribed as part of a documented informed-consent process. Education of patients, family members, and staff about the harms of restraints is a good first step in a plan to avoid or eliminate their use (Agens, 2010).

Assessing Fall Risk

In 2005 the Joint Commission added the goal of "reducing the risk of patient harm resulting from falls" to its 2005 JCAHO National Patient Safety Goals (NPSG), which were recently renewed. The goals state that Joint Commission-accredited healthcare organizations must:

- Assess all patients for fall risk
- Implement interventions to reduce the risk of falls based upon the resident's assessed risk
- Educate staff in the prevention of falls
- Evaluate the effectiveness of fall reduction activities (Joint Commission, 2012)

A number of professional organizations have also recommended that older adults be assessed for fall risk. The American Geriatrics Society (AGS) encourages healthcare providers to ask all older adult clients about falls at least once a year. If an older adult patient has fallen within the last year, a gait and balance assessment is recommended. Those who cannot perform or who perform poorly on a standardized gait and balance test should be given a multifactorial fall risk assessment. The multifactorial fall risk assessment should include a focused medical history, physical examination, functional assessments, and an environmental assessment (Moyer, 2012).

The Prevention of Falls in the Elderly Trial (PROFET) found that a structured interdisciplinary assessment for older adults presenting to a hospital emergency department in the United Kingdom after a fall reduced subsequent falls and hospitalizations. The intervention involved a detailed medical assessment by a geriatrician with appropriate referral, as well as home-based occupational therapy review assessing for environmental hazards with education and advice (Elley, 2007).

The National Institute for Clinical Excellence (NICE) also recommends that healthcare providers routinely assess their older adult clients for fall risk. Those reporting falls should be observed for balance and gait deficits and considered for interventions to improve strength and balance. Older adults appearing to be at high risk for falls should be offered an individualized, multifactorial intervention including strength and balance training, home hazard assessment and intervention, vision assessment and referral, and medication review and modification (Michael, 2010).

The Joint Commission has launched a Long Term Care Accreditation Program, expected to take effect by July 2013. When this voluntary program is fully implemented, accredited nursing homes will be required to comply with Joint Commission safety standards, including those related to prevention of falls.

Screening

Screening is a method for detecting dysfunction before an individual would normally seek medical care. Screening tests are usually administered to individuals without current symptoms but who may be at high risk for certain adverse outcomes. The purpose of screening is early diagnosis and treatment. Screening tools that address fall risk have been developed for use in various populations, including hospitalized older adults, adults in residential care, and community-dwelling older people.

Screening is an effective tool for quickly identifying patients at high risk for falling. But just as there is confusion about how to define a fall, finding an agreed-upon definition for "screening" is also fraught with problems. For example, some clinicians consider a check box on a form to be an adequate screen.

As an example of how the requirement to screen patients for specific behaviors or risks can create confusion, Medicare recently instituted a requirement that patients be screened for smoking. There are no parameters for how long, when, or what "smoking" means in this screen. The reason for the smoking screen is to provide education and, if warranted, to expand the examination based on the patient's answer to the question.

The same problem occurs when screening for fall risk—if a patient is asked "Have you fallen in the last year?" and the answer is no, the screen leads nowhere, even in the case of an older adult patient who has real risk factors for falls. So it is important to observe the patient and have a screening tool that is quick and easy but also provides guidance about fall risk.

In fall intervention studies, age and history of falls are the two risk factors most commonly used to define high risk. Also considered are gender, impaired balance and gait, visual impairment, and use of multiple medications. A number of studies have indicated that a history of falls, use of certain medications, and gait and balance impairment are important indicators of the likelihood of future falls in older adults (Moyer, 2012).

A practical approach for screening high-risk persons is to **ask** and **assess**: ask about history of falls, frequency and circumstances of falls, and mobility problems, then assess performance using a quick test such as a Timed Up and Go (TUG) test. The TUG test is performed by observing the time it takes a person to rise from an armchair, walk 10 feet, turn, walk back, and sit down again. The average healthy adult older than 60 years can perform this task in less than 10 seconds (Moyer, 2012).

Case

Recently a registered nurse received a comprehensive physical exam at a local clinic. Although she is 68 years old and is in the age category for fall risk, she was not asked about falls. There was a checkbox on the intake form asking "Have you fallen over the past year?" The patient answered no, even though she has fallen twice in the last year. Although she was examined by a doctor and a nurse practitioner, neither asked about falls. In this case, the checkbox on the intake form stopped the doctor from inquiring further even though the patient is in the age category for high risk and has two other risk factors: cataracts and stiff knees. When a clinician considers a checkbox on a form to be an adequate screen for fall risk a gap is created. In this case it failed to lead to some sort of action—patient education, a referral, or further assessment.

Brief Fall Risk Assessment

The Morse Fall Scale (MFS) is a brief fall risk assessment tool used widely in acute care settings. The MFS (Table 1) assesses a patient's fall risk upon admission, following a change in status, and at discharge or transfer to a new setting. Prevention interventions are based on the Morse Fall Scale score (Table 2) (USDVA, 2009).

Table 1. Morse Fall Scale		
1.	History of falling; immediate or within 3 months	No = 0 Yes = 25
1.	Secondary diagnosis	No = 0 Yes = 15
1.	Ambulatory aid	None, bed rest, wheel chair, nurse = 0 Crutches, cane, walker = 15 Furniture = 30
1.	IV/heparin lock	No = 0 Yes = 20
1.	Gait/transferring	Normal, bed rest, immobile = 0 Weak = 10 Impaired = 20
1.	Mental status	Oriented to own ability = 0 Forgets limitations = 15

Source: USDVA, 2009.

Table 2. Recommendations Based on Morse Fall Scale		
Risk factor	MFS score	Action
No risk	0–24	None
Low risk	25–50	Initiate **standard** fall prevention interventions
High risk	>51	Initiate **high risk** fall prevention interventions

Source: USDVA, 2009.

Multifactorial Assessment

The multifactorial assessment is an additional assessment tool that offers a more comprehensive look at fall risk. If, during a quick screening, an older adult has difficulty with balance or has unsteady gait, a multifactorial fall risk assessment should be completed. The multifactorial fall risk assessment should include a focused medical history, physical examination, functional assessments, and an environmental assessment. The AGS recommends the following interventions for falls prevention:

- Adaptation or modification of home environment
- Withdrawal or minimization of psychoactive or other medications
- Management of postural hypotension
- Management of foot problems and footwear
- Exercise (particularly balance), strength, and gait training
- Vitamin D supplementation of at least 800 IU per day for people who have vitamin D deficiency or are at increased risk for falls (USPSTF, 2012)

Mary Tinetti refers to the multifactorial assessment as an intervention that flows out of a fall risk screening. It is meant to put parameters around the issue of fall risk and is part of a continuum going back to the simple check box.

According to AGS/BGS guidelines, any older adult reporting a single fall within the last year should be referred to a specialist for a comprehensive gait and balance assessment. If, after reporting a single fall, an older adult performs well on the gait and balance assessment, a multifactorial fall risk assessment is not recommended (AGS/BGS, 2009).

Medicare OASIS-C Fall Risk Assessment

For over a decade, the Centers for Medicare and Medicaid Services (CMS) has required Medicare-certified home health agencies to collect and transmit Outcome and Assessment Information Set (OASIS) data for all adult home health patients 18 and older receiving skilled services, whose care is reimbursed by Medicare and Medicaid, with the exception of patients receiving pre- or postnatal services only (CMS, 2010).

The OASIS directs home health agencies to assess fall risk in all patients over the age of 65. The multifactorial assessment includes items such as falls history, use of multiple medications, mental impairment, toileting frequency, general mobility/transferring impairment, and environmental hazards (CMS, 2010).

During the multifactor fall risk assessment, the agency:

- Can use the single standardized, validated comprehensive multifactor falls risk assessment tool

- May incorporate several tools so long as one of them is standardized and validated

The purpose is to promote falls risk assessment across disciples and across healthcare settings.

Fall Risk Assessment in Nursing Homes

About 1,800 older adults living in nursing homes die each year from fall-related injuries and those who survive falls frequently sustain hip fractures and head injuries that result in permanent disability and reduced quality of life (CDC, 2012b).

In nursing homes, nurses assess residents for fall risk upon admission to the facility and on a regular basis after admission. To assess fall risk, nurses can choose from a variety of fall risk assessment tools, which are generally not standardized or regulated. Most assessment tools contain a scoring system that evaluates the cumulative effect of risk factors for the purpose of identifying those at greatest risk of falling or sustaining a fall-related injury (Wagner, 2011).

A Canadian study involving 137 nursing homes in the province of Ontario asked about what fall risk assessment tools were being used and tried to identify commonalities across the assessment tools (Wagner, 2011). The most commonly used fall risk assessment tools were the Morse Fall Scale and the Performance-Oriented Mobility Scale. Across all facilities the common domains assessed included:

- Intrinsic factors
- Treatment-related or extrinsic factors
- Mobility status
- Cognitive status
- Sensory status
- History of falls
- Behaviors and attitudes (Wagner, 2011)

In this study, the researchers noted the need for an evidence-based tool for the assessment of fall risk similar to the universally excepted Braden Scale for predicting pressure ulcer risk. They point out that poorly designed assessment tools hinder the development of a fall-risk reduction program and fail to address the needs of individual patients (Wagner, 2011).

A particular barrier for quality improvement programs is that many do not fully address the ways in which staff duties overlap when attempting to address fall risk among their patients. Complex syndromes such as fall risk result from multiple risk factors and require multifactorial, interdisciplinary interventions to improve outcomes. Reducing multiple risk factors may be difficult because it requires many staff members to have strong connections that permit effective information flow and problem solving from varied perspectives; thus, an intervention is needed to help staff establish a working relationship and improved communication to support the new practices introduced by fall-reduction programs (Anderson et al., 2012).

Fall Classification Using a Mobile Phone

A novel way of documenting patient falls is through the use of mobile phones; most smart phones are equipped with accelerometers that can be used to detect when patients fall with exceptionally high accuracy. Falls are generally high-impact events, making detection simpler than identifying other daily activities. Automatically detecting falls can allow rapid response to potential emergencies; in addition, knowing the cause or manner of a fall can be beneficial for prevention studies or a more tailored emergency response.

A Rehabilitation Institute of Chicago study sought to demonstrate techniques that not only reliably detect a fall but also automatically classify the type. Fifteen subjects simulated four different types of falls—left and right lateral, forward trips, and backward slips—while wearing mobile phones and accelerometers. Nine subjects also wore the devices for ten days, to provide data for comparison with the simulated falls. Researchers were able to identify a fall with 98% accuracy and classify the type of fall with 99% accuracy (Albert, 2012).

Types of Falls Measured and Axes of Measurement

(A) Four different types of simulated falls, positioned according to direction of the fall. (B) The G1 android mobile phone that was used for recording, and the placement of the phone on the back of subjects. (C) The axes of the accelerometer. The phone was placed on the back of the subject so that the three axes pointed up, left, and to the back of the subject. Source: Albert, 2012. Used with permission

This work demonstrates how current machine-learning approaches can simplify data collection as well as improve rapid response to potential injuries due to falls (Albert, 2012).

Comprehensive Balance Assessment

A comprehensive balance assessment typically begins with a referral from a nurse practitioner or a physician who has completed a fall risk screen or some sort of risk assessment and is concerned about a person's fall risk. The assessment begins with the gathering of subjective data from the patient or the patient's caregiver, which includes a detailed medical history, review of medications, and any other factors that contribute to loss of function. A brief history of recent falls is particularly important and often provides information about the cause of the balance disorder.

Following the subjective assessment, musculoskeletal function, functional mobility and gait, movement strategies, and sensory systems involved with balance are evaluated. The ultimate goal is to find the cause of the balance impairment, design a program that reduces future falls, and make decisions related to home modification and assistive devices.

Assessing Musculoskeletal Function

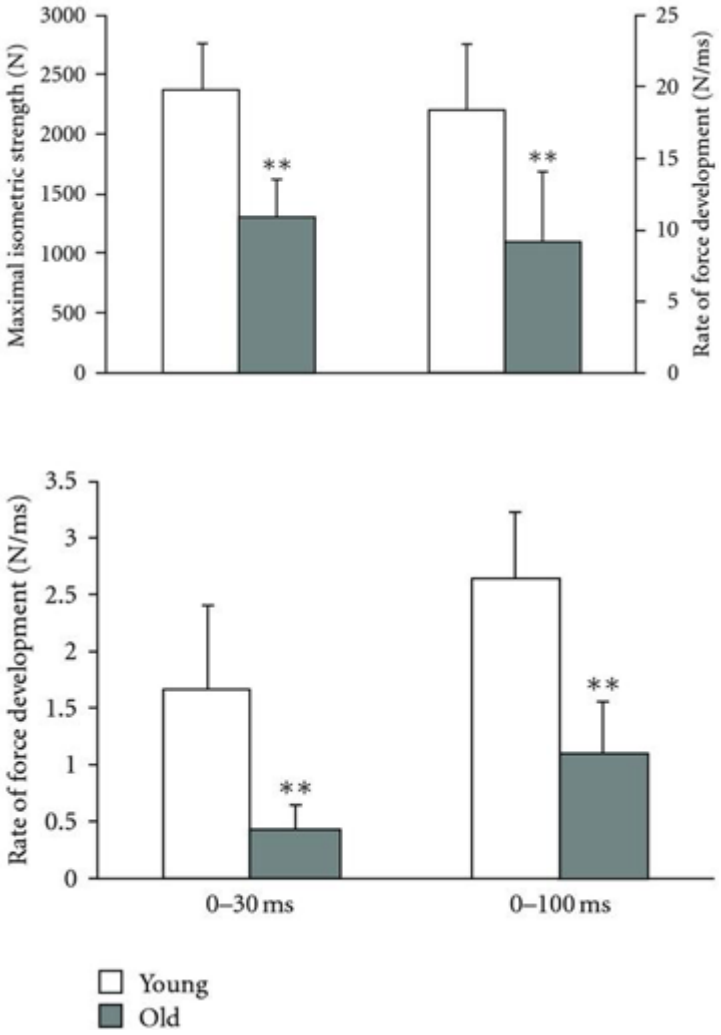
Musculoskeletal assessment involves a comprehensive look at strength, range of motion, posture, pain, and the presence of abnormal tone.

Strength

Strength is an important part of musculoskeletal function and must be thoroughly evaluated. If muscle tone is normal (no spasticity or abnormal tone), strength can be tested on a 1–5 scale (with 5 meaning full strength) using manual resistance by the evaluator. Manual muscle testing is a good measure of strength in a specific muscle but tests muscles in isolation. Tests of functional strength such as standing on one leg (to test the gluteus medius muscle of the stance leg), or performing a semi-squat, are better indicators than individual muscle tests for balance deficit.

From a fall prevention point of view, what is a relationship between strength and balance? In a review of the literature on strength and balance, Granacher looked at maximum isometric strength and the rate of force development in healthy older adults. Maximal and particularly explosive force production under isometric conditions is significantly lower in old and especially the oldest old adults (≥80 years) compared to young adults. Loss of muscle volume as well as decreased neural drive for activation of muscles is thought to account for the age-related reductions (Granacher, 2012).

Age Related Differences in Strength



(Top) Maximal isometric strength and rate of force development. (Bottom) Rate of force development over time intervals of 0–30 ms and 0–100 ms. Young different from old. Source: Adapted from Granacher et al.

Power training or high-velocity strength training has the potential to improve both strength and functional performance. High-velocity strength training with high loads specifically increases muscle power, whereas power training with low to moderate loads improves balance and functional performance (Granacher, 2012).

Although strength is certainly a contributing factor, balance may be more adversely affected by abnormalities in the sequence and timing of muscle contraction than by localized muscle weakness (Shumway-Cook and Woollacott, 2012).

Range of Motion

Decreased range of motion can have a profound impact on balance. Loss of flexibility in the spine—particularly spinal extension—affects postural alignment, shifting the center of body mass backwards towards the heel (Shumway-Cook and Woollacott, 2012).

Because ankle flexibility is critical for postural control, ankle joint range of motion has been the focus of considerable research. Ankle joint flexibility, particularly dorsiflexion, declines by as much as 50% in women and 35% in men between the ages of 55 and 85 (Shumway-Cook and Woollacott, 2012).

Pain

Pain affects balance by affecting postural alignment and available range of motion. Back pain is among the most important factors affecting health status and functional capacity in older adults, with a prevalence of 12% to 42% in those over 65 years of age. Low back pain was found to be related to two-fold increase in the risk of falling. Chronic low back pain in older adults may cause neurophysiologic changes that adversely affect postural control (Champagne, 2012).

In a study looking at pain and postural control in 605 adults aged 75 and over, the participants with moderate to severe pain had more than twice the risk for impaired balance compared with those without pain (Lihavainen et al., 2011).

Assessing Functional Mobility and Gait

Once the musculoskeletal evaluation has been completed, a patient's performance on functional tasks that depend on postural control is evaluated. Assessing balance and postural control from a functional perspective involves the use of tests and measures to determine a person's abilities in both the clinical and home environment.

When selecting an assessment tool for use in your clinic or hospital, choose a tool that is appropriate for client population, reliable, evidence based, repeatable, and—most of all—fast and easy to use. Patient safety is of paramount importance.

Timed Up and Go Test

The Get Up and Go Test, the predecessor of the Timed Up and Go Test (TUG), was developed by Mathias and Nayak as a tool to screen for balance problems, primarily in the frail elderly. The test measures how long it takes for a person to rise from a chair, walk 3 meters (about 10 feet) to a line on the floor, and return to the chair. The test correlates well with the Berg Balance Test, the Barthel Index of activities of daily living, and gait speed tests. The Timed Up and Go modified the earlier test by adding a timing component. An adult who is independent in balance and mobility can perform the TUG in less than 10 seconds (Shumway-Cook and Woollcott, 2007).

In a study with older adults with a range of neurologic pathologies, people taking 30 seconds or more to complete this task were more likely to need an assistive device, walk too slowly for community ambulation, and score lower on the Berg Balance test. In contrast, a person completing the test in less than 20 seconds was more likely to be independent in daily living activities, score higher on the Berg Balance test, and walk at a speed sufficient for community mobility (Podsiadlo and Richardson, 1991).

Shumway-Cook, Brauer, and Woollacott (2000) found that in addition to predicting functional mobility the TUG could be used to predict the risk of falls in older adults. Thirty community-dwelling frail elderly adults were tested using the TUG; researchers found that those taking longer than 14 seconds to complete the task were at high risk for falls.

In the same study, the TUG was modified by adding a cognitive task (counting backward by threes) and a manual task (carrying a full cup of water). The addition of a secondary task increased the time need to complete the TUG by 22% to 25% (Shumway-Cook, Brauer, and Woollacott, 2000).

In another study, researchers wanted to determine if the TUG can be used to predict falls following hip surgery during a 6-month followup period. Fifty-nine patients were tested using the TUG at discharge and then 6 months later. Of these, 19 (32%) had one or more falls in the 6 months following surgery. Kristensen found that 95% of the subjects who fell had a score of ≥24 seconds on the TUG test (Kristensen, Foss, and Kehlet, 2007).

Berg Balance Scale

The Berg Balance Scale (BBS) was developed in 1989 by Kathy Berg and is a reliable clinical tool for assessment of functional mobility and gait—especially in ambulatory older adults. The BBS consists of 14 static and dynamic tasks scored from 0 to 56, which assess a variety of functional activities. Each task is scored on a 0–4 scale; a score of 0 indicates an inability to perform the task while a score of 4 means the patient is independent with that task. The BBS scale has excellent internal consistency and good test-retest reliability and requires little specialized training (Shumway-Cook and Woollacott, 2012). It can be performed with minimal equipment, in a small space, and can be used in any clinical setting.

In a 2008 study of 655 physical therapists working with stroke patients, the BBS was identified as the most commonly used tool for assessment of functional mobility following stroke (Blum and Korner-Bitensky, 2008). This and other studies have shown the BBS to be a good predictor of length of stay, discharge destination, and disability levels after discharge.

The Berg Balance Scale includes the following activities:

- Sit to stand
- Stand unsupported
- Sit unsupported
- Stand to sit
- Transfers
- Stand with eyes closed
- Stand with feet together
- Reach with outstretched arm
- Retrieve object from floor
- Turn to look behind
- Turn 360 degrees
- Alternate stepping on stool
- Standing with one foot in front of the other
- Standing on 1 foot

Berg Balance Test (5 min, 13 sec)

http://www.youtube.com/watch?v=NX2LD5G3BFo

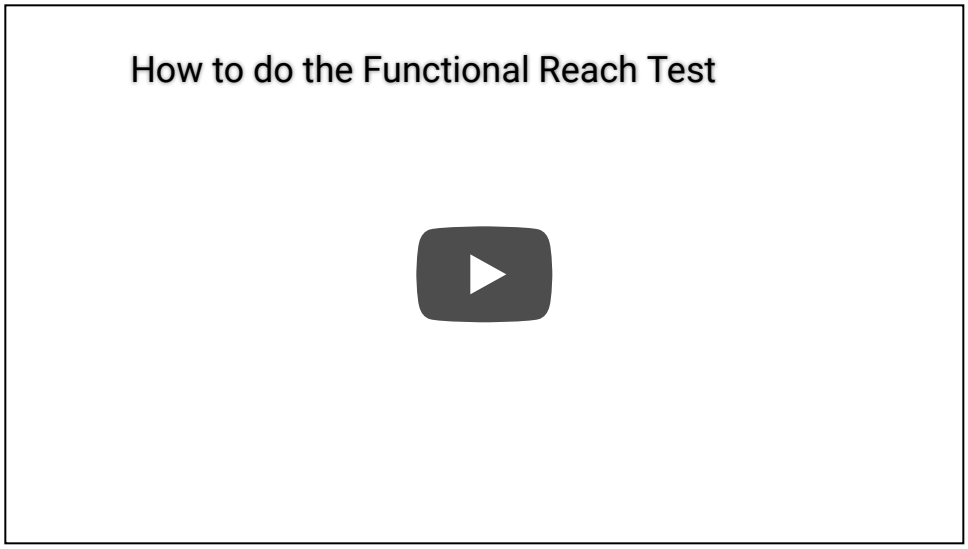
Can the BBS be used to predict the likelihood of a future fall? According to Ann Shumway-Cook and colleagues (1997), the BBS is the best single predictor of falls in community-dwelling older adults without neurologic disability. Shumway-Cook noted that declining score on the BBS is clearly associated with an increased risk of falls. From 56 to 54, a 1-point change in the Berg score was associated with a 3% to 4% increase in fall risk. Between 54 and 46, a 1-point drop in score was associated with a 6% to 8% increase while a score below 36 was associated with an almost 100% risk of falls (Shumway-Cook and Woollacott, 2012).

Functional Reach Test

Pamela Duncan and colleagues developed the Functional Reach test in 1990. In a busy clinic the Functional Reach test has the benefit of being fast and repeatable with good test-rest reliability. The test defines functional reach as "the maximal distance one can reach forward beyond arm's length, while maintaining a fixed base of support in the standing position" (Duncan et al., 1990). It is a dynamic rather than a static test and measures a person's "margin of stability" as well as the ability to maintain balance during a functional task. In older clients with a reach of 6 inches or less, the test has been shown by Duncan to be predictive of falls (Duncan et al., 1990).

Functional reach was originally testing using a force platform and an electronic measure of forward reach. In a clinical setting it is tested by placing a yardstick or tape measure on the wall, parallel to the floor, at the height of the acromion of the subject's dominant arm. The client stands with the feet a comfortable distance apart, makes a fist, and reaches the dominant arm to approximately 90 degrees. The client then reaches forward as far as possible without taking a step or touching the wall. The distance between the start and end point is measured using the head of the metacarpal of the third finger as the reference point (Duncan et al., 1990).

How to do the Functional Reach Test (1 min, 13 sec)



http://www.youtube.com/watch?v=_aJqJzt-U2s&feature=related

Performance Oriented Mobility Test (Tinetti Tests)

The Performance Oriented Mobility Assessment (POMA) was developed by Mary Tinetti, a physician and researcher at Yale University. It is divided into two parts: balance and gait. Along with the Berg Balance Test, it is one of the most widely used mobility and gait assessment tests. At least one study has shown POMA to have the best test-retest reliability when compared to the TUG, One-Leg Stand, and Functional Reach. It was also shown to have good predictive value for fall risk when compared to the other tests (Shumway-Cook and Woollacott, 2012).

The first part of the tool, the Tinetti Balance Test, is scored on a scale of 0 to 16 and assesses:

- Sitting balance
- Sit to stand
- Standing balance
- Standing balance when nudged
- Standing balance with eyes closed
- Balance while turning, and stand to sit

The second part to the tool, the Tinetti Gait Test, is scored on a scale of 0 to 12 and assesses:

- Initiation of gait
- Step length and height
- Step symmetry

- Step continuity
- Deviation from a straight path when walking
- Trunk sway and stance when walking

When taken together the maximum score on the Tinetti tests is 28; a client that scores between 19 and 24 is at risk for falls and a client that scores below 19 is at high risk for falls.

Gait is a functional task that is closely related to balance and postural control. Functional gait can be assessed with a number of reliable tools. In a task-oriented approach advocated by Shumway-Cook and Woollacott (2007) gait and mobility assessment are related to examination at the functional level. In one approach, gait can be assessed as a function of velocity, a measure that combines time and distance. This can be compared to normative values such as 80 m/min.

The Balance Evaluation Systems Test (BESTest)

Most existing clinical balance tests are directed at predicting fall risk or identifying whether a balance problem exists, rather than determining what type of balance problem exists (Horak, 2009). The Balance Evaluation Systems Test (BESTest) is a clinical assessment tool that looks at 36 items grouped under 6 categories:

- Biomechanical Constraints
- Stability Limits/Verticality
- Anticipatory Postural Adjustments
- Postural Responses
- Sensory Orientation
- Stability in Gait

The goal is to examine multiple balance and postural control systems so treatment can be fine-tuned to address a specific balance deficit. A shorter mini-BESTest is also available, which tests items 3, 4, 5, and 6. For more information, including video of anticipatory postural responses please visit http://www.bestest.us/samples.html.

Assessing Movement Strategies

Our nervous system simplifies motor control by creating patterns of movement called synergies or strategies. A **movement strategy** is a flexible, repeatable pattern of movement that can be quickly and automatically accessed by the central nervous system. This allows us to store and reuse patterns of movement that have been successful in the past. Strategies are efficient, automatic movement patterns that evolve over time. Each time a loss of balance threatens, the nervous system can draw on these pre-programmed movement strategies to ensure the maintenance of balance.

Ankle Strategy

The ankle strategy—also called ankle sway—is used in response to small perturbations or losses of balance. When a small loss of balance occurs—as when standing on a moving bus—the foot acts as a lever to maintain balance by making continuous automatic adjustments to the movement of the bus. When a small balance adjustment is needed muscles close to the floor activate first and flow upward in a distal to proximal pattern.

If your body sways forward the toes dig into the floor and the ankle, calf, and posterior leg muscles contract to prevent you from falling forward. If your body sways backwards the toes lift up and the anterior tibialis muscles at the front of the lower leg—as well as other muscles on the anterior surface of the body—contract, thus preventing you from falling backwards. The ankle strategy is automatically utilized a thousand times a day in response to small losses of balance. There's no need to think about the toes lifting or the calf muscles contracting—the central nervous system does the work automatically.

In older adults studies have shown that during quiet stance sway increases with age; when quiet stance is perturbed, older adults have slower contractions of the leg muscles and—in some cases—activate proximal muscles first followed by distal muscles (Shumway-Cook and Woollacott, 2012).

Older adults also tended to co-activate agonist and antagonist muscles, effectively stiffening the joint. Others bend at the waist (hip strategy) rather than using the ankle strategy possibly due to ankle weakness or sensory changes (Shumway-Cook and Woollacott, 2012).

Hip Strategy

The hip strategy is needed if a perturbation is too large to be successfully handled by the ankle strategy. In the bus example, when the movement of the bus is steady, the ankle strategy works just fine. But what happens when the bus driver slows or accelerates suddenly? If we only had the ankle strategy we would fall over the moment our center of gravity passed the limits of the ankle range of motion. Instead we use the hip strategy—bend a bit at the waist or arch our backs as much as is needed to keep our center of gravity over our base of support.

When the hip strategy is needed, movement is centered about the hip and the ankle muscles (anterior tibialis and gastrocnemius) are largely inactive. The muscles in the trunk activate first as activation flows downward to the legs in a proximal to distal pattern. So, if the bus stops suddenly and the body is thrust forward, the low back and hamstrings will contract in that order to return the body to upright.

When the hip strategy is used, the muscles of the lower leg are almost silent. Studies have shown that when a walker is used the body largely abandons the ankle strategy and relies heavily on the hip strategy for balance. This dependence on the hip strategy for balance paradoxically may lead to a decrease in ankle sway and contributes to further decline in balance arising from loss of ankle strength and flexibility. **For this reason the pros and cons of walker use must be carefully considered before a walker is recommended for fulltime use.**

Stepping Strategy

The stepping strategy is used when the ankle or hips strategies are insufficient to regain balance. When your center of gravity moves well past your base of support it is necessary to take a forward or backward step to regain balance.

Studies have shown age-related changes in stepping and reaching reactions in older adults. Compared to younger people, older adults initiate the stepping strategy in response to smaller losses of balance and tend to take several small steps rather than one larger step (Maki and McIlroy, 2006).

Older adults also reach for a support surface more readily than younger adults but the reach reaction is slower. Increased tendency to reach for support and a slowing of these reactions have been found to be predictive of falling in daily activities (Maki and McIlroy, 2006).

The Sensory System and Balance

A healthy sensory system is a critical and often overlooked part of what makes balance work. Maintaining postural equilibrium, sensing movement, and maintaining an awareness of the relative location of our body parts requires the precise integration of several of the body's sensory and response systems, including visual, vestibular, and somatosensory. Acting together, these systems gather and interpret sensory information from all over the body and allow us to act on that information in an appropriate and helpful way.

Somatosensory Input

The **somatosensory system**—touch, pressure, and proprioception—has perhaps the strongest influence on balance. Sensory receptors specialized for touch, temperature, pressure, joint and muscle stretch, vibration, and pain sensation, among others, continuously feed sensory information to the brain, where it is processed and routed back out to the muscles. The information is used by the body to make constant quick and automatic adjustments that allow us to maintain balance and avoid falls.

Balance and postural control are affected in a number of ways, depending upon which part of the somatosensory system is impaired. Large sensory fiber damage lessens our ability to feel vibration and touch, resulting in a general sense of numbness, especially in the hands and feet. This damage to sensory fibers may also contribute to the loss of reflexes. If sensory decline is significant, peripheral neuropathies can develop. Peripheral neuropathies affect posture and balance by significantly delaying muscle response following a loss of balance (Shumway-Cook and Woollacott, 2012).

Visual Input

The **visual system** is also a key component of balance. Vision helps us determine the movement of objects in our environment and tells us where we are in relation to parts of our own body and to other objects (Shumway-Cook and Woollacott, 2012). Visual changes occur as we age—loss of visual acuity, narrowing of visual fields, decreased light-dark adaptation, increased sensitivity to glare, and loss of peripheral vision and depth perception. Balance and postural control are affected by changes in vision.

The eye contains both central and peripheral vision. Central vision is processed mostly through the macula, which allows us to see clearly. Peripheral vision provides information about general spatial orientation and is more important for postural control and balance than central vision.

A recent study tracked hip fracture incidence among 400,000 Medicare patients who had cataract surgery between 2002 and 2009. Cataract surgery was associated with a 16% decrease in patients' adjusted odds of suffering a hip fracture within one year of the procedure (AAO, 2012).

Vestibular Input

Our vestibular system enables us to determine body orientation, senses the direction and speed at which we are moving, and helps us maintain balance. The vestibular system processes information about movement in relation to gravity—specifically, rotation, acceleration and deceleration, and head stabilization during gait.

The vestibular system works with the visual and somatosensory systems to check and maintain the position of our bodies at rest or in motion. It also helps us maintain a steady focus on objects when the position of our body changes. The vestibular system does this by detecting mechanical forces, including gravity, that act upon the vestibular organs when we move.

The vestibular system declines with age and there may be as much as a 40% loss of vestibular nerve and hair cells by age 70 (Shumway-Cook and Woollacott, 2012). Symptoms associated with vestibular system impairment are:

- Dizziness or vertigo (a spinning sensation)
- Falling, or feeling as if you are going to fall
- Lightheadedness, faintness, or a floating sensation
- Blurred vision
- Confusion or disorientation

Sensory conflicts can occur when the senses send inaccurate information to the brain. For example, we've all had the experience of being stopped at a stoplight when the car next to us starts to move—we think we are also moving and slam on the brake. As soon as our foot touches the brake we know instantly that we are not moving and even feel a little foolish. For a split second the brain has given preference to visual input, causing a sensory conflict. The sensory conflict is quickly resolved by the somatosensory and vestibular systems. The touch of the foot on the brake, pressure on the back and legs, and hair cells in the vestibular system tell us that there is no forward motion and we are in fact sitting still.

Sensory Disruption and Balance

Sensory disruption—blurred vision, intermittent numbness, pain, and pressure from swelling—can have a profound negative effect on balance and postural control. How (and how much) balance is affected depends on several factors, including the extent of the nervous system damage, the number and extent of sensory losses, and the ability of the other senses to compensate for the damage. If more than one sensory system is impaired —as occurs with diabetes and stroke—it may be difficult to compensate for sensory losses.

Sensory Loss

When sensory loss occurs, the nervous system compensates by giving more weight to input from another sensory system. For example, sensory loss in the feet affects the speed, accuracy, and amount of sensory information available for postural control. Unable to rely on this all-important somatosensory information, the nervous system will try to use vision to compensate for the somatosensory loss. Unfortunately, visual input is a little slower than somatosensory input, which can create instability. An assistive device may help because it widens the base of support and provides somatosensory input through the hands, which is often enough to compensate for loss of input through the feet.

When vision is impaired a similar process takes place. Because visual input is inaccurate or unavailable, the nervous system relies more on touch and vestibular feedback for balance. Impaired vision may cause someone to have difficulty in complex visual situations that demand rapid visual interpretation of multiple visual cues. For example, a person may be safe walking in a quiet environment but be unable to negotiate a busy, noisy street filled with people and cars.

Vestibular decline has a profound effect on balance and postural control because it is used as a reference system by the visual and somatosensory systems when those systems are in conflict. Vestibular impairment can lead to problems with gaze stabilization, blurred vision, and vertigo (Shumway-Cook and Woollacott, 2012).

Improper Sensory Selection

Sensory loss can lead to inflexible or improper sensory weighting. For example, a person with decreased sensation in the feet gradually grows to depend upon vision for balance, which is not as effective as somatosensory feedback for balance. A person may depend on one particular sense for postural control, even if that sense leads to further instability (Shumway-Cook and Woollacott, 2007). You may notice a person walking with head down, carefully watching every step. In this case, the person is relying on vision as the dominant sense being used for balance. Retraining would involve improving the use of somatosensory and vestibular input to reduce dependence on visual input.

Case

Carla is an 89-year-old woman living at home with her son and having home care during the day while her son is at work. Carla is independent in household ambulation, transfers, bed mobility, and self-care. A physical therapist was called in to assess Carla's balance because she had fallen several times in her living room when her son was at work. The PT completed a comprehensive balance assessment and suspected from her findings that Carla was having problems with sensory selection, perhaps relying too much on vision for balance. She based this on her observation that Carla was hesitating and swaying as she crossed from the living room into the kitchen where a large picture window streamed light into the room, effectively blinding Carla as she entered the kitchen. The bright light from the window may have caused a visual conflict, disrupting her balance. Carla was unable to adjust quickly enough to maintain her balance. The PTs strategy was three-fold: close the kitchen curtain during the day, work with Carla to strengthen her legs and ankles to improve somatosensory function, and encourage her to use a cane to widen her base of support and provide additional proprioceptive feedback during ambulation.

Interdisciplinary Interventions to Prevent Falls

A vast number and variety of strategies and interventions have been shown to reduce falls in older adults. These include strength training and balance training. Modifying the home or workplace decreases the chance of falling. The number of falls can also be decreased by optimizing medication or even having patients take nutritional supplements such as Vitamin D (Albert, 2012).

A number of studies have shown the benefits of interdisciplinary interventions to reduce the risk of falls in community-dwelling older adults, a practice that is becoming commonplace. A breakthrough 1994 study by Yale researcher Mary Tinetti used a combination of intervention strategies based on an assessment of each participant's fall risk factors. Tinetti assigned assessment responsibilities to a nurse practitioner and a physical therapist (see Table 3).

Table 3. Yale FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques)	
Risk Factor	Intervention
Assessed by a nurse practitioner:	
Postural hypotension	▪ Behavioral modifications such as elevating the head of the bed and using ankle pumps ▪ Changes in medications
Use of sedative-hypnotic medication	▪ Education ▪ Discontinued medications ▪ Non-pharmacological alternatives
Use of 4+ prescription medication	▪ Reviewed medications with primary physician ▪ Final decision on changes made by physician
Inability to transfer safely to bathtub or toilet	▪ Training in transfer skills ▪ Home modifications (installing grab bars, raising toilet seat)
Environmental hazards	▪ Home modifications (removing rugs, installing rails)
Assessed by a physical therapist:	
Gait impairments	▪ Gait training ▪ Use of assistive devices ▪ Balance training ▪ Strength exercise
Impairments in transfer skills or balance	▪ Training in transfer skills ▪ Home modifications ▪ Progressive balance exercises
Impairment in leg or arm strength, range of motion	▪ Progressive strength exercises ▪ Exercises performed 10–20 min per day

Source: Stevens, 2010.

Key elements of the study involved linking the screening and assessments to the interventions. At the end of three months, participants were about 30% less likely to fall compared with people who did not receive the interventions (Stevens, 2010).

Exercise-Based Interventions

The benefits of exercise have long been recognized. The USPSTF concludes with high certainty that exercise or physical therapy has moderate net benefit in preventing falls in older adults (USPSTF, 2012). Exercise programs of varying design have diverse positive effects in community-dwelling older people including improved muscle strength and gait speed, reduction in falls, improved balance, and increased bone mineral density (Hubbard, 2009).

A review of 18 studies of exercise or physical therapy in community-dwelling older adults found a statistically significant reduction in risk for falling (USPSTF, 2012). The benefit was greater in high-risk than in low-risk populations. The studies included approximately 3500 adults who were mostly older than 75 years and primarily non-Hispanic white women. Most studied populations were deemed high-risk on the basis of several factors, including history of falling, gait and balance impairments, chronic disease status, and use of psychotropic medications. Exercise or physical therapy trials included various components that can be summarized into 3 major categories: gait, balance, or functional training (including a study on tai chi); strength or resistance exercise; and general exercise. Treatment intensity ranged from 2 to 80 hours (USPSTF, 2012).

A 2010 CDC report reviewed 22 exercise-based, home modification, and multi-faceted interventions for the prevention of falls. We will review several programs in each of those categories. To be included in the CDC review, evidence-based fall prevention intervention studies had to meet the following criteria:

- Published in the peer-reviewed literature
- Included community-dwelling adults aged 65 and older
- Used a randomized controlled study design
- Measured falls as a primary outcome (did not include intervention studies using other outcomes, such as balance improvement or reduced fear of falling)
- Demonstrated statistically significant positive results in reducing older adult falls (Stevens, 2010)

Older adults participating in an exercise class consisting of stretching and aerobic repetitive movements. Source: CDC, Public Health Image Library.

Stay Active, Stay Fit

This Australian study used weekly structured group sessions of moderate-intensity exercise, held in community settings, with additional exercises performed at home. Participants were 163 individuals at risk for falling because of lower limb weakness, poor balance, or slow reaction time. All were aged 67 or older and lived in the community. About two-thirds of participants were female.

Participants were divided into two groups: a control group and an exercise intervention group. The exercise group participated in 23 exercise classes over a 1-year period and completed exercises at home. The exercises were designed by a physical therapist to address physical fall risk factors: balance and coordination, strength, reaction time, and aerobic capacity. Each class began with 5 to 10 minutes of warmup that included stretching of the major lower limb muscle groups and 10 minutes of cool-down that included gentle stretching, relaxation, and controlled-breathing practice. Each class featured music chosen by the participants. The classes included the following types of exercises:

- Balance and coordination exercises, including modified Tai Chi exercises
- Practice in stepping and in changing direction, dance steps, and catching and throwing a ball
- Strengthening exercises, including exercises that used the participant's weight (eg, sit-to-stand, wall press-ups) and resistance-band exercises that worked both upper and lower limbs
- Aerobic exercises, including fast-walking practice with changes in pace and direction (Stevens, 2010)

As the classes progressed, the complexity and speed of the exercises and the resistance of the bands were steadily increased. Participants also took part in a home exercise program using content from the exercise class and recorded their participation in a home exercise diary (Stevens, 2010).

Results

At retest, the exercise group performed significantly better than the controls in 3 of 6 balance measures: (1) postural sway in standing with eyes open, (2) postural sway in standing with eyes closed, and (3) coordinated stability. The groups did not differ at retest in measures of strength, reaction time, or walking speed. However, within the 12-month trial period, the rate of falls in the intervention group was 40% lower than that of the control group (Barnett et al., 2003).

The Otago Exercise Program

This intervention involved four randomized-controlled trials and one controlled multi-center trial. It used an individually tailored program of muscle-strengthening and balance-retraining exercises of increasing difficulty, combined with a walking program. This extensively tested fall prevention program is now used worldwide.

The program was conducted in participants' homes and was intended for people who did not want to attend, or could not reach, a group exercise program. The program was delivered by either a PT experienced in prescribing exercises for older adults or a nurse who was given special training and received ongoing supervision from a PT.

A physical therapist or nurse visited each participant four times at home over the first 2 months and visited again for a booster session at 6 months. Participants were telephoned once a month during the months when no visits were scheduled. The first home visit lasted an hour; all subsequent visits took about half an hour. During the visits, the PT or nurse prescribed a set of in-home exercises (selected at appropriate and increasing levels of difficulty) and a walking plan (Stevens, 2010).

The exercises included:

- Strengthening exercises for lower leg muscle groups using ankle cuff weights
- Balance and stability exercises such as standing with one foot in front of the other and walking on the toes
- Active range of motion exercises such as neck rotation and hip and knee extensions (Stevens, 2010)

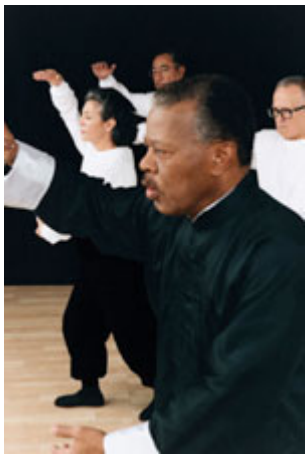
Exercise programs were individually tailored and each participant received instructions and an illustration of each exercise. Participants were encouraged to complete the exercises three times a week and to walk outside the home at least two times a week. The exercises took about 30 minutes to complete. In three trials, the exercise program was prescribed for 1 year and in one trial was extended to 2 years (Stevens, 2010).

Results

Overall, the fall rate was reduced by 35% among program participants compared with those who did not take part, and it was equally effective for men and women. Participants aged 80 years and older who had fallen in the previous year showed the greatest benefit (Stevens, 2010).

Tai Chi: Moving for Better Balance

This Portland, Oregon study compared the effectiveness of a 6-month program of Tai Chi classes with a program of stretching exercises. Participants were inactive seniors aged 70 years or older. Three-quarters were female. All participants lived in the community (Stevens, 2010).



Adults in a Tai Chi class. Source: CDC.

The program included 24 Tai Chi forms that emphasized weight shifting, postural alignment, and coordinated movements. Synchronized breathing aligned with Tai Chi movements was integrated into the movement routine. Each session included instructions in new movements as well as review of movements from previous sessions.

Each practice session incorporated musical accompaniment and each hour-long session included:

- A 5- to 10-minute warmup period
- Practice of Tai Chi movements
- A 5- to 10-minute cool-down period (Stevens, 2010)

Practicing at home was encouraged and monitored using a home-practice log. One-hour classes were held three times a week for 26 weeks, followed by a 6-month period in which there were no organized classes (Stevens, 2010).

Results

Participants in the Tai Chi classes had fewer falls and fewer fall injuries, and their risk of falling was decreased 55%.

Australian Group Exercise Program

This study evaluated a 12-month group exercise program for frail older adults. The program was tailored to each participant's abilities. Ages ranged from 62 to 95, although nearly all were 70 years or older. Most study participants were female. Participants lived in retirement villages and most were independent (Stevens, 2010).

The program consisted of four 3-month terms. The first term included understanding movement, how the body works, training principles, and basic exercise principles. This was followed by progressive strength training and increasingly challenging balance exercises, using equipment to maintain interest. In each term, the exercise sessions built on the skills acquired in the previous term (Stevens, 2010).

Each hour-long class had three segments:

- A 5- to 15-minute warmup period that included chair-based activities, stretching large muscle groups, and, later in the program, slow to moderate walking
- A 35- to 40-minute conditioning period that included aerobic exercises, strengthening exercises, and activities to improve balance, hand-eye and foot-eye coordination, and flexibility. As the program progressed, the number of repetitions of each exercise increased, beginning with 4 repetitions at week 2 and reaching 30 by week 10. Thirty repetitions were maintained for rest of the program.
- A 10-minute cool-down period that included muscle relaxation, controlled breathing, and guided imagery (Stevens, 2010)

One-hour classes were held twice a week for 12 months. The program consisted of four successive 3-month terms (Stevens, 2010).

Results

Overall, the fall rate was 22% lower among people who took part in the program, and 31% lower among participants who had fallen in the previous year, compared with those who were not in the program.

Veterans Affairs Group Exercise Program

This study evaluated a structured group exercise program for fall-prone older men. All participants were aged 70 or older and lived in the community. All were males who had at least one of these fall risk factors: leg weakness, impaired gait, mobility, or balance, and had fallen two or more times in the previous 6 months. The study calculated the fall rate as the number of falls per hour of physical activity (Stevens, 2010).

The program was conducted at a Veterans Affairs ambulatory care center. Strength training included hip flexion, extension, abduction, and adduction; knee flexion and extension; squats, dorsiflexion, and plantar flexion. Over the first 4 weeks, participants increased each exercise from one to three sets of 12 repetitions. Resistance levels also were increased progressively. The rate of progression was modified for subjects with physical limitations (Stevens, 2010).

Endurance training used bicycles, treadmills, and indoor walking sessions. Endurance training alternated between cycling (once a week), using a treadmill (twice a week), and indoor walking that included a walking loop as well as two flights of stairs (twice a week). Heart rates were monitored to ensure that participants did not exceed 70% of their heart rate reserve (Stevens, 2010).

Balance training used a rocking balance board, balance beam, obstacle course, and group activities such as balloon volleyball and horseshoes. Balance training sessions were held twice a week and increased in difficulty over the 12-week program (Stevens, 2010).

Results

During the 3-month program, participants were two-thirds less likely to fall compared with those who did not take part in the program (Stevens, 2010).

Simplified Tai Chi

This study compared a 15-week program of Tai Chi classes that used ten simplified movements with a balance training program. All participants were 70 years or older and lived in the community. Most study participants were female (Stevens, 2010).

Participants were taught a simplified version of Tai Chi. The 108 existing Tai Chi forms were synthesized into a series of 10 composite forms that could be completed during the 15-week period. The composite forms emphasized all elements of movement that generally become limited with age (Stevens, 2010).

Exercises systematically progressed in difficulty. The progression of movements led to gradually reducing the base of standing support until, in the most advanced form, a person was standing on one leg. This progression also included increasing the ability to rotate the body and trunk as well as performing reciprocal arm movements. These exercises were led during the group sessions; however, individuals were encouraged to practice these forms on their own, outside of the group setting (Stevens, 2010).

The 15-week program included:

- Twice weekly 25-minute group sessions

- Weekly 45-minute individual contact time with the instructor
- Twice daily 15-minute individual practice sessions at home without an instructor (Stevens, 2010)

Results

After 4 months, the risk of falling more than once among participants in the Tai Chi classes was almost half that of people in the comparison group. Participants reported that after the study they were better able to stop themselves from falling by using their environment and appropriate body maneuvers. After the study ended, almost half the participants chose to continue meeting informally to practice Tai Chi.

Video (6:06): Tai Chi for Older Adults

http://www.youtube.com/watch?v=g0ZEpT__ZQ8&feature=related

Home Modification Interventions

Modifying the home to improve safety and reduce the risk of falls is extremely effective. The first step is to remove hazards and clutter and educate the client about fall risks in the home. The next step is to recommend assistive devices and equipment and additions to the home such as grab bars or transfer poles that can be installed in high risk areas. Here are two examples of successful home modification programs.

Home Visits by an Occupational Therapist

This Australian study used an occupational therapist (OT) who visited participants 65 years and older in their homes, identified environmental hazards and unsafe behaviors, and recommended home modifications and behavior changes.

The OT visited each participant's home and conducted an assessment using the standardized Westmead Home Safety Assessment form. The OT identified environmental hazards such as slippery floors, poor lighting, and rugs with curled edges, and discussed with the participant how to correct these hazards. The OT also assessed each participant's abilities and behaviors, and how each functioned in his or her home environment. Specific unsafe behaviors were identified such as wearing loose shoes, leaving clutter in high-traffic areas, and using furniture to reach high places. The OT discussed with the participants ways to avoid these unsafe behaviors (Stevens, 2010).

Two weeks after the initial home visit the OT telephoned each participant to ask whether they had made the modifications and to encourage them to adopt the recommended behavioral changes (Stevens, 2010).

Results

Fall rates were reduced by one-third but only among men and women who had experienced one or more falls in the year before the study (Stevens, 2010).

Falls-HIT (Home Intervention Team) Program

This German intervention provided home visits to identify environmental hazards that can increase the risk of falling, provided advice about possible changes, offered assistance with home modifications, and provided training in using safety devices and mobility aids.

Participants were frail community-dwelling older adults who had been hospitalized for conditions unrelated to a fall and then discharged to home. Participants showed functional decline, especially in mobility. All were 65 years or older and lived in the community and three-quarters were female (Stevens, 2010).

The intervention team consisted of a physical therapist, occupational therapist, three nurses, a social worker, and a secretary. The first home visit was conducted while the participant was still hospitalized. Two team members, an occupational therapist with either a nurse or a physical therapist, depending on patient's anticipated needs, conducted a home assessment. They identified home hazards using a standardized home safety checklist and determined what safety equipment a participant needed (Stevens, 2010).

During two to three subsequent home visits, an occupational therapist or nurse met with the participant to:

- Discuss home hazards
- Recommend home modifications
- Facilitate necessary modifications
- Teach participants how to use safety devices and mobility aids when necessary (Stevens, 2010)

Results

The fall rate for participants was reduced 31%. The intervention was most effective among those who had experienced two or more falls in the previous year; the fall rate for these participants was reduced 37% (Stevens, 2010).

Multifaceted Interventions

AGS/BGS guidelines stress the importance of interventions that target risk factors identified during the initial risk assessment. In a review of programs that target multiple risk factors, most of the interventions can be described under the broad headings of exercise and physical activity, medical assessment and management, medication adjustment, environmental modification, and education. These components represent distinct areas of expertise and clinical practice and are often administered by several clinicians from various disciplines, presenting challenges of coordination (AGS/BGS, 2009).

The components most commonly included in multifaceted interventions are:

- Adaptation or modification of home environment
- Withdrawal or minimization of psychoactive medications
- Withdrawal or minimization of other medications
- Management of postural hypotension
- Management of foot problems and footwear
- Exercise, particularly balance, strength, and gait training (AGS/BGS, 2009)

Multifaceted intervention should also include an education component complementing and addressing issues specific to the intervention being provided, tailored to individual cognitive function and language. It should also include an exercise program incorporating balance, gait, and strength training. Flexibility and endurance training should also be offered, but not as sole components of the program. The health professional or team conducting the fall risk assessment should directly implement the interventions or should ensure that the interventions are carried out by other qualified healthcare professionals (AGS/BGS, 2009). We will review several programs that stress multifaceted interventions in the following section.

Stepping On

This Australian study used a series of small group sessions to teach fall prevention strategies to community-dwelling older adults. Participants were individuals who had fallen in the previous year or who were concerned about falling. All were 70 years or older and lived in the community. Most study participants were female (Stevens, 2010).

The program addressed multiple fall risk factors: improving lower limb balance and strength, improving environmental and behavioral safety in both the home and community, and encouraging visual and medical screenings to check for low vision and possible medication problems. Each session covered a different aspect to reducing fall risk:

- Session 1: Risk appraisal and introducing balance and strength exercises

- Session 2: Review and practice exercises and how to move safely in the home
- Session 3: Hazards in and around the home and how to remove or reduce them
- Session 4: How to move safely in the community and safe footwear and clothing
- Session 5: Poor vision and fall risk and the benefits of vitamin D, calcium, and hip protectors
- Session 6: Medication management, review of exercises, and more strategies for moving safely in the community
- Session 7: Review of topics covered in program (Stevens, 2010)

The program included seven weekly 2-hour program sessions, a 1- to 1.5-hour home visit by an occupational therapist, and—6 weeks after the final session—a 1-hour booster session. The follow-up home visit included review of fall prevention strategies, assistance with home adaptations, and modifications, if needed. A 3-month booster session included review of achievements and how to maintain motivation (Stevens, 2010).

A team of content experts, trained by the OT and guided by the Stepping On manual, participated in the study. Duties were divided as follows:

- Physical therapist: introduced exercises and led a segment on moving about safely.
- Occupational therapist: led segments on home safety, community safety, behavioral methods for better sleep, and hip protectors.
- Older adult volunteer from the Roads and Traffic Authority: spoke on pedestrian safety.
- Retired volunteer nurse from the Medicine Information Project: discussed how to manage medications.
- Mobility officer from the Guide Dogs: spoke on coping with low vision. (Stevens, 2010)

Results

The fall rate among participants was reduced about 30% compared with those who did not receive the intervention. The intervention was especially effective for men. The fall rate among male participants was reduced almost two-thirds.

PROFET (Prevention of Falls in the Elderly Trial)

This British intervention provided assessments for fall risk with referrals to relevant services and an occupational therapy home hazard assessment with recommendations for home modifications. Participants were older adults who had been treated for a fall in a hospital emergency department. All were aged 65 years and older and lived in the community. Two-thirds of participants were female (Stevens, 2010).

An outpatient medical assessment was conducted soon after the fall that was treated in the emergency room. It included assessments of visual acuity, postural hypotension, balance, cognition, depression, and medication problems. The results were used to identify and address problems that could contribute to fall risk. Participants received referrals to relevant services, based on identified risk factors (Stevens, 2010).

The home assessment was conducted during a single visit. The occupational therapist (OT) identified environmental hazards in the home, such as uneven outdoor surfaces, loose rugs, and unsuitable footwear. Based on findings, the OT provided advice and education regarding safety within the home, made safety modifications to the home with the participant's consent, and provided minor safety equipment. The OT made social service referrals for participants who required hand rails, other technical aids, adaptive devices such as grab bars and raised toilet seats, and additional support services. The average length of the medical assessment was 45 minutes. The average length of the home assessment was 60 minutes (Stevens, 2010).

Results

After 12 months, those in the intervention group were 60% less likely to fall once and 67% less likely to fall repeatedly (at least three times), compared with those who did not receive the intervention.

The NoFalls Intervention

This Australian study looked at the effectiveness of group-based exercise in preventing falls when used alone or in combination with vision improvement and home hazard reduction. The interventions focused on increasing strength and balance, improving poor vision, and reducing home hazards. All participants were aged 70 and older and lived in the community. Sixty percent were female (Stevens, 2010).

The exercise program was delivered in community settings such as exercise rooms in fitness centers and community health centers. The vision intervention was delivered via usual services available in the community. Participants went to their optometrist or ophthalmologist if they had one. If any further action was required, it was facilitated using normal services such as hospitals for cataract surgery, optometrists for new glasses, and general practitioners or ophthalmologists for medication if required. The home hazard intervention was conducted in participants' homes (Stevens, 2010).

The exercise intervention consisted of weekly 1-hour classes plus daily home exercises. Classes were designed by a physical therapist to improve flexibility, leg strength, and balance. About one-third of the exercises were devoted to balance improvement. Exercises were adjusted for participants with limitations. Music was played during the sessions. Leaders provided a social time with coffee and tea after each session to talk informally about exercise improvements and opportunities (Stevens, 2010).

The vision intervention included referral to an appropriate eye care provider if a participant's vision fell below predetermined criteria during the baseline assessments for visual acuity, contrast sensitivity, depth perception, and field of view. Criteria for referral included more than four lines difference between the line of smallest letters read correctly on the high and low contrast sections of the vision chart or any loss of field of view (Stevens, 2010).

A referral was recommended if:

- A potential visual deficit was identified and the participant was not already receiving treatment, or
- If a deficit had been identified previously but the participant had not received treatment during the previous 12 months. The intervention consisted of the participant receiving the recommended treatment by an appropriate specialist

The home hazard assessment consisted of a walk-through with a checklist for those rooms used in a normal week. The checklist included a comprehensive section defining the various areas of the house and specific hazards. The checklist was divided into rooms or areas of the house—access points (main entry door, back door), hallways, stairwells, dining room, living room, den, bedrooms, and wet areas (kitchen, bathroom, laundry rooms). Within each of these areas, the focus was on steps and stairs, floor surfaces, lighting, and some key furniture items or fixtures such as a favorite chair or bathroom fixtures (Stevens, 2010).

After the assessment, the results were discussed with the participant and potential interventions noted on the checklist were suggested. If the participant agreed to the intervention, it was determined who would carry it out. Hazards could be removed or modified by the participants, their families, the City of Whitehorse home maintenance program, or some other person. Study staff visited the participants' homes and provided quotes for the materials needed for the suggested modifications; labor was provided free of charge (Stevens, 2010).

The duration of the study was as follows:

- Exercise: Weekly 1-hour group classes for 15 weeks and 25 minutes of daily home exercises.
- Vision improvement: Duration depended on the specific intervention (such as cataract surgery or new glasses).
- Home hazard reduction: Duration depended on the length of time the home modifications were left in place by the participant.

Results

The group-based exercise program was the most potent single intervention. When used alone, it reduced the fall rate by 20%. Falls were reduced further when vision improvement or home hazard reduction was combined with exercise. The most effective combination was the group-based exercise with both vision improvement and home hazard reduction. Participants who received all three components were one-third less likely to fall (Stevens, 2010).

The SAFE Health Behavior and Exercise Intervention

The Study of Accidental Falls in the Elderly (SAFE) health behavior intervention, conducted in Washington and Oregon, was a program of four group classes on how to prevent falls. The classes addressed environmental, behavioral, and physical risk factors and included exercise with instructions and supervised practice. The home safety portion included a home inspection by a BA-level home assessor with guidance and assistance in reducing fall hazards. All were participants were 65 years or older and lived in the community. About 60% of participants were female (Stevens, 2010).

The SAFE health behavior intervention consisted of four 1.5- hour group classes that used a comprehensive approach to reducing fall risks. Classes addressed environmental, behavioral, and physical risk factors. Classes included:

- A slide presentation on common household risks.

- Discussions of behavioral risks such as walking on ice or using a chair to reach high places.
- A self-appraisal of home hazards using a specially designed form.
- Small group sessions during which participants worked together to develop action plans.

Each class session also had an exercise component that included a brief demonstration of fall prevention exercises and about 20 minutes of supervised practice. Participants received a manual describing the exercises and were encouraged to begin walking at least three times a week. The exercises were chosen to:

- Actively involve all parts of the body
- Maintain full range of motion of all joints
- Strengthen muscles
- Improve posture
- Improve balance

During the home safety inspection, the assessor inspected the participant's home and identified fall hazards using a standard protocol. The assessor encouraged the participant to remove or repair the hazards identified during this initial visit. The participant was also given fact sheets on how to obtain technical and financial assistance for making repairs and modifications to the home (Stevens, 2010).

After the four classes were completed, the assessor returned to the participant's home to check on the progress of repairs and to offer financial and technical assistance, if needed, as well as discounts on safety equipment. The full duration of the study included two home visits, each lasting about 15 minutes, and four weekly 1.5-hour classes (including 20 minutes of supervised exercise) over a 1-month period (Stevens, 2010).

Results

Overall, participants were 15% less likely to fall compared with those who did not receive the intervention. Male participants showed the greatest benefit.

Yale FICSIT

This Yale FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques) study used a tailored combination of intervention strategies based on an assessment of each participant's fall risk factors. Participants were members of a health maintenance organization. All were 70 years or older and lived in the community. Most participants were female (Stevens, 2010).

Individualized interventions were delivered to each of the participants in their homes. The content varied based on the fall risk factors identified. Possible intervention components included medication adjustment, recommendations for behavioral change, education and training, home-based physical therapy, and a home-based progressive balance and strengthening exercise program. The selection of interventions was guided by decision rules and priorities. No participant received more than three balance and strength training programs (Stevens, 2010).

The assessments were directly linked to the interventions. The minimum risk factor interventions included:

- Postural blood pressure and behavioral recommendations
- Medication review and reduction (especially psychoactive medications
- Balance, strength, and gait assessments and interventions
- Environmental assessment and modification

The progressive balance and strength exercise program included both supervised and at-home (unsupervised) components (Stevens, 2010).

Results

Participants were about 30% less likely to fall compared with people who did not receive the intervention.

A Multifactorial Program

This Seattle study tested a moderate-intensity intervention that used tailored strategies based on assessment of each participant's risk factors. All participants were 65 years and older and lived in the community, and about 60% of participants were female (Stevens, 2010).

Participants received the assessments and interventions from a nurse at a local health maintenance organization (HMO) center. Participants conducted a home assessment or had it done by a family member or volunteer. The assessments consisted of simple screening tests for six risk factors. The intervention content varied based on the individual's risk factors (see Table 4).

Table 4: Risk Factors and Interventions	
Risk Factor	Intervention
Inadequate exercise	▪ Participated in a 2-hr exercise orientation class testing fitness. ▪ Given exercise instruction. ▪ Encouraged to begin a program of brisk walking.
Excessive alcohol use	▪ Referred to an alcohol treatment program if alcoholism suspected. ▪ Given instructional booklet with strategies for limiting use.
Home hazards	▪ Assessed home safety using a home safety checklist.
Use of psychoactive drugs	▪ Reviewed medications using a pharmacist and sent written recommendations to primary care provider.
Impaired hearing	▪ Evaluated for hearing aid. ▪ Provided with behavioral intervention classes for participants with uncorrectable deficits
Impaired vision	▪ Corrected when possible. ▪ Received information about available community resources if vision impairments were uncorrectable.

Source: Stevens, 2010.

Results

After 1 year, participants were 10% less likely to fall and 5% less likely to have an injurious fall, compared with people who received usual medical care.

Conclusion

Falls are a leading cause of morbidity and mortality among older adults in the United States and throughout the world. In recent years, research is leading us to clinical interventions that have been shown to reduce the risk of falls and lessen the number and severity of injuries caused by falls.

Healthcare provider attitudes about falls in older adults are slowly changing as researchers find ways to bring evidence-based findings into the clinical setting. Programs such as the Connecticut Collaboration for Fall Prevention are working directly with a range of healthcare providers, encouraging the adoption of screening and assessment tools and educating clinicians about the importance of identifying and treating balance disorders in older adults.

An understanding of the factors associated with poor balance, such as impaired strength, decreased flexibility, and sensory dysfunction, can help clinicians understand and treat the source of balance disorders in older adults. Assessment tools such as the Berg Balance test and the Timed Up and Go test are helping clinicians accurately assess and treat balance problems in their older adult clients.

With an increased emphasis on interdisciplinary interventions, healthcare providers are working together to design fall-risk reduction programs using exercise, home modification programs, and multifaceted interventions to reduce the falls and injuries among their older adult clients.

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Post Test

Use the answer sheet following the test to record your answers.

1. Balance is:

    a. The ability to maintain your center of mass over your base of support.

    b. The ability to maintain the segments of our body in relation to one another and to maintain stability and orientation in space.

    c. An unplanned and unexpected contact with a supporting surface.

    d. A skill that is not affected by age-related changes or cognitive changes.

2. Compare "postural control" to balance:

    a. They describe the same thing.

    b. Balance refers to postural orientation.

    c. Balance is an entirely different concept from postural control.

    d. Postural control comprises both postural stability and postural orientation.

3. In defining a fall, one thing virtually everyone can agree on is:

    a. The distance the individual travels before coming to rest.

    b. That only professionals can document a true fall accurately.

    c. That an acute medical event or a collision is an accident, not a fall.

    d. The definition of a fall.

4. The main risk factor for developing a fear of falling is:

    a. A previous fall.

    b. Above average height.

    c. Incapacity as a personal belief.

    d. General lack of confidence.

5. Psychosocial factors found to be protective of hip fracture include:

    a. Being unmarried.

    b. Engagement in social activities.

    c. Dancing for at least a few minutes each day.

    d. Moving one's residence every 5 to 10 years.

6. Higher level nursing staffing and experience:

a. Was found to be unrelated to the incidence of falls.

b. Increased the rate of falls by 5% because higher level duties distracted nurses from fall prevention.

c. Lowered the rate of falls by 1% for every one-year increase in average RN experience.

d. Was focused on falls prevention through lower level healthcare workers.

7. Physical therapists were found to be:

a. Surprisingly uninformed about fall prevention.

b. Unlikely to be aware of the need for routine screening for fall risk.

c. Especially aware of sensory-perceptual deficits.

d. Well-versed in fall prevention but not emphasizing it in practice.

8. Primary care physicians reported some factors that influence their ability to incorporate routine fall risk assessment in the evaluation of elders. These included:

a. Belief that fall risk reduction can have little priority in the complexity of care.

b. Patient resistance to discontinuing medications that may contribute to fall risk.

c. Unwillingness to refer fall risk reduction to other healthcare professionals.

d. Concern that neither the patient nor the family will be responsive.

9. Physicians of patients in assisted living:

a. Believe that the facility staff has greater responsibility for fall risk assessments.

b. Prefer to conduct their own risk assessment when time allows.

c. Defer to facility staff in reviewing medications related to falls.

d. Believe fall risk assessments are a positive but not a necessity.

10. Some of the most common risk factors for falls include:

a. Age over 40 years.

b. Cough or other respiratory symptoms.

c. Hearing deficits.

d. Muscle weakness, gait or balance deficits.

11. Polypharmacy is a well-established risk factor for falls. Medications associated with increased fall risk include:

a. Penicillin.
b. Aspirin.
c. Diuretics.
d. Antihypertensives.

12. Psychotropic drugs are commonly prescribed for older adults, but they sometimes contribute to fall risk. The group most highly associated with risk of falls and injuries is:

a. SSRIs.
b. Tricyclics.
c. MAO inhibitors.
d. Benzodiazepines.

13. Use of restraints in older, hospitalized adults:

a. May substantially decrease adverse outcomes.
b. Can be used for the purpose of discipline or convenience if correctly documented.
c. Appear to cause a modest increase in fall risk or injury.
d. Are approved as safety device and as falls prevention tools.

14. Screening for fall risk:

a. Is best accomplished by asking "Have you fallen in the past year?"
b. Should be done before the patient would normally seek medical care.
c. Can be part of a patient questionnaire filled out before a healthcare visit.
d. Includes assessment if the patient has had a previous fall.

15. For a quick assessment of fall risk when admitting a patient to a nursing home, choose:

a. The Performance-Oriented Mobility Scale.
b. OASIS-C.
c. The Morse Fall Scale.
d. The Focused Fall Risk Scale.

16. The Timed Up and Go Test:

a. Screens for balance problems by measuring the time it takes to rise from a chair, walk 3 meters, and return to the chair.

b. Is used primarily in the healthy elderly to predict future falls.

c. Is also referred to as the Tinetti test.

d. Does not correlate well with the Berg Balance test.

17. A flexible, repeatable pattern of movement that can be quickly accessed by the central nervous system is called:

a. Posture.

b. Range of motion.

c. Abnormal tone.

d. A movement strategy.

18. Movement strategies used to maintain balance:

a. Includes the hip strategy, which is used when there is a small loss of balance.

b. Are largely ineffective for complex balance tasks.

c. Include the ankle strategy, which is used for small perturbation or losses of balance.

d. Are strengthened when a walker is used.

19. The system that consists of touch and proprioception is called:

a. The visual system.

b. The somatosensory system.

c. The vestibular system.

d. Ankle sway.

20. Problems with gaze stabilization, blurred vision, and vertigo:

a. Can be caused by vestibular impairment.

b. Are often due to macular degeneration.

c. Occur with age-related changes in the visual system.

d. May cause increased sensitivity to glare.

21. Interventions to address poor balance:

a. Are numerous but untested.

b. Have resulted in significantly reduced risk for falls.

c. Must be done in a clinical setting to produce positive results.

d. Have produced disappointing results because of patient nonadherance.

Answer Sheet

Balance, Postural Control, and Falls in Older Adults

Name (Please print your name): _____

Date: _____

Passing score is 80%

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____

Course Evaluation

Please use this scale for your course evaluation. Items with asterisks * are required.

- 5 = Strongly agree
- 4 = Agree
- 3 = Neutral
- 2 = Disagree
- 1 = Strongly disagree

* Upon completion of the course, I was able to:

a. Provide definitions for balance, postural control, and falls.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

b. Describe the incidence and cost of falls in the United States and their medical consequences.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

c. Relate how nurses, rehabilitation therapists, physicians, and older adults themselves differ in their approach to fall risk and fall prevention.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

d. Summarize the factors that increase fall risk in older adults.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

e. Describe tools used for screening and assessing fall risk in older adults.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

f. Describe the components of a comprehensive balance assessment.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

g. Outline interdisciplinary interventions used to improve balance and reduce the risk of falls in older adults.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* The author(s) are knowledgeable about the subject matter.

5 4 3 2 1

* The author(s) cited evidence that supported the material presented.

5 4 3 2 1

* This course contained no discriminatory or prejudicial language.

Yes No

* The course was free of commercial bias and product promotion.

Yes No

* As a result of what you have learned, do you intend to make any changes in your practice?

Yes No

If you answered Yes above, what changes do you intend to make? If you answered No, please explain why.

* Do you intend to return to ATrain for your ongoing CE needs?

- Yes, within the next 30 days.
- Yes, during my next renewal cycle.
- Maybe, not sure.
- No, I only needed this one course.

* Would you recommend ATrain Education to a friend, co-worker, or colleague?

- Yes, definitely.
- Possibly.
- No, not at this time.

* What is your overall satsfaction with this learning activity?

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* Navigating the ATrain Education website was:

- ○ Easy.
- ○ Somewhat easy.
- ○ Not at all easy.

* How long did it take you to complete this course, posttest, and course evaluation?

- ○ 60 minutes (or more) per contact hour
- ○ 50-59 minutes per contact hour
- ○ 40-49 minutes per contact hour
- ○ 30-39 minutes per contact hour
- ○ Less than 30 minutes per contact hour

I heard about ATrain Education from:

- ○ Government or Department of Health website.
- ○ State board or professional association.
- ○ Searching the Internet.
- ○ A friend.
- ○ An advertisement.
- ○ I am a returning customer.
- ○ My employer.
- ○ Other
- ○ Social Media (FB, Twitter, LinkedIn, etc)

Please let us know your age group to help us meet your professional needs.

- ○ 18 to 30
- ○ 31 to 45
- ○ 46+

I completed this course on:

- ○ My own or a friend's computer.
- ○ A computer at work.
- ○ A library computer.
- ○ A tablet.
- ○ A cellphone.
- ○ A paper copy of the course.

Please enter your comments or suggestions here: _____

_____

_____

_____

Registration Form

Please print and answer all of the following questions (* required).

* Name: _____

* Email: _____

* Address: _____

* City: _____ * State: _____ * Zip: _____

* Country: _____

* Phone: _____

* Professional Credentials/Designations:

_____

Your name and credentials/designations will appear on your certificate.

* License Number and State: _____

* Please email my certificate:

○ Yes ○ No

(If you request an email certificate we will not send a copy of the certificate by US Mail.)

Payment Options

You may pay by credit card or by check.
Fill out this section only if you are **paying by credit card.**
5 contact hours: $39

Credit card information

* Name: _____

Address (if different from above): _____

* City: _____ * State: _____ * Zip: _____

* Card type:

○ Visa ○ Master Card ○ American Express ○ Discover

* Card number: _____

* CVS#: _____

* Expiration date: _____