Review Article

Fall Prevention in the Elderly: Analysis and Comprehensive Review of Methods Used in the Hospital and in the Home

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Abstract

Falls in the elderly are a significant problem both in and out of the hospital. The Deficit Reduction Act of 2005 and the Fiscal Year 2009 Inpatient Prospective Payment System Final Rule, as outlined by the Centers for Medicare & Medicaid Services, placed on hospitals the financial burden of fall prevention for falls (ie, hospital-acquired conditions) that could have been prevented by following evidence-based guidelines. Multifaceted and individualized programs have been created to prevent falls in the elderly. Many of these interventions are based on expert opinion and statistical trends. Our review of the literature revealed that the risk of fall is only slightly greater in the hospital environment than in the home and that there is no medical evidence that evidence-based guidelines are effective in fall prevention.

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The Deficit Reduction Act of 2005 and the Fiscal Year 2009 Inpatient Prospective Payment System Final Rule outlined by the Centers for Medicare & Medicaid Services (CMS) placed the financial burden of inpatient fall prevention on hospitals.[1] CMS will no longer reimburse hospitals for injuries secondary to falls that occur inside the hospital (ie, hospital-acquired conditions) that could have been prevented by following evidence-based guidelines.[1] The Centers for Disease Control and Prevention (CDC) defines a fall as an "injury received when a person descends abruptly due to the force of gravity and strikes a surface at the same or lower level."[2,3] We performed a literature review to determine what medical evidence exists regarding the effectiveness of protocols and individual modalities in preventing falls.

Falls in the elderly are a significant problem in and out of the hospital. Approximately one third of persons aged ≥65 years and 50% of persons aged ≥80 years fall at least once per year.[4] In the hospital setting, approximately 3% to 20% of inpatients fall at least once during their stay, which translates to 4 to 12 falls per 1,000 bed days.[3,4] In the year 2000, the total direct medical cost of all fall injuries for persons aged >65 years was >$19 billion ($0.2 billion for fatal falls, $19 billion for nonfatal falls).[5] The CDC estimates that the annual direct and indirect cost of all fall-related injuries, including hospitalization, payments for physician and other professional services, medical equipment, prescription drugs, changes to the home, and lost time from work and household duties, will reach $54.9 billion by 2020.

The CDC report found fractures to

Table 1

Fall Prevention Modalities

Medical interventions
Delirium prevention
Nutrition
Medications
Vision/eye care
Physical interventions
Bed rails
Electronic bed sensors/alarms
Bed height
Toilet seat height
Footwear
Flooring
Identification bracelets
Bed trapeze
Grab rails
Room and floor illumination
Scheduled toileting
Access to call light
Bedside commode
Unobstructed environment
Exercise and balance training

be the most common injury and the most costly.[5] More than one third of nonfatal injuries were fractures, and they accounted for 61% of costs ($12 billion). Hip fractures were most common, with average hospital costs of $18,000. These numbers are gathered from reports prior to the year 2000; costs are likely significantly higher today. In addition to physical injury, falls can result in fear, anxiety, and depression. Fear of falling can cause a patient to ambulate less frequently, which may lead to weakness and reduced balance, resulting in increased risk of falling.

Studies specific to orthopaedic patients are limited. In one retrospective review of 6,912 orthopaedic patients following primary or revision arthroplasty performed in the years 2003 through 2005, Ackerman et al[6] reported that 1% of patients fell (2.5 per 1,000 musculoskeletal inpatient days). Sixty-four percent of falls were bathroom-related, 77% were unassisted, and 66% occurred during the night shift. Of these falls, 19% resulted in injury. Orthopaedic surgeons should be involved in preventing falls as well as managing fall-related sequelae.

Fall Risk

Naqvi et al[7] stratified fall risk into two major categories: intrinsic and extrinsic. Intrinsic risk factors are endogenous to the patient (eg, comorbidities, functional status). These include age, sex, history of fall, cognitive impairment, socioeconomic status, psychological condition, fear of falling, and restricted activities of daily living. Many intrinsic factors are nonmodifiable (eg, age).[7] Men are most likely to experience a fatal fall, whereas women are most likely to suffer a fracture.[8] Comorbidities include diabetes, Parkinson disease, osteoporosis, history of stroke, arthritis, peripheral sensory deficit, malnutrition, arrhythmia, and orthostatic hypotension. Functional disabilities include immobility or reduced muscle strength, dizziness and vertigo, visual impairment, inappropriate footwear, incontinence, the use of high-risk medications (eg, psychotropic agents, benzodiazepines, sedatives, antihypertensive drugs, analgesics/opiates, anticoagulants[7,9]), and use of assistive devices. Medications may be modified to reduce the risk of a fall.

Extrinsic risk factors are those found in the hospital environment. They include hospitalization itself, condition of the floor, cluttered environment (eg, tables, chairs), rugs, grab rails or the lack thereof, poor lighting, non-collapsing bed rails, intravenous (IV) pole and tubing, restraints, and Foley catheter or chest tube. A multidisciplinary team can address these factors in the hospital. In one 12-month period, >65% of geriatric patients studied sustained a fall when three or more risk factors were identified.[3] Iinattiniemi et al[9] prospectively analyzed 512 falls in 273 participants to identify fall risk factors and calculated univariate and multivariate incidence rate ratios (IRRs) for each factor. The strongest predictive variables for a fall were fall history (mean IRR, 1.91); poor vision (mean IRR, 1.46); anxiety, nervousness, or fear of falling (mean IRR, 1.56); and use of an antipsychotic drug (mean IRR, 1.66).

Fall Prevention

Table 1 lists individual fall prevention modalities that are considered to be modifiable and, therefore, effective in fall prevention. However, published medical evidence to support this assumption is lacking. Multifaceted approaches combine a variety of individual modalities.

Multifaceted Prevention Programs

The incidence of falls is positively correlated to the duration of hospital stay. Lengthened hospitalization was found to contribute to fall occurrences.[3] With the current trend toward shorter hospitalization, acute fall prevention methods must be effective within these abbreviated periods. Two meta-analyses indicate that the effect of multifaceted hospital fall prevention programs to reduce the number of falls is largely inconclusive.[10,11]

Cumming et al[12] conducted a randomized trial involving 3,999 hospitalized patients in elderly care wards. One group spent 25 hours per week with a nurse who conducted fall risk assessments; provided education for patients and families; and arranged for appropriate walking aids, eye-

wear, environmental modifications, and increased supervision. This nurse also consulted with specialists regarding adjustments in medication and managing confusion and foot-related problems. A physiotherapist saw the same patients and supervised exercises that were designed to enhance balance and the ability to perform functional tasks. The physiotherapist also worked with patients to practice safe mobility within the ward. The control group did not receive specialized care from a nurse or physiotherapist. No differences were found in the frequency of falls, injurious falls, or fractures. The authors attributed this finding to the short median patient stay (7 days). A similar study has shown that multifaceted fall prevention programs are successful in long-term care settings (ie, 20 to 30 days).[12]

Medical Considerations

Delirium

A prospective observational study of 1,025 patients identified 201 falls, of which 38% occurred within the first week of hospitalization.[13] These "early fallers" were more likely than patients who fell later to have a history of falls ($P = 0.0009$), have an unsafe gait ($P = 0.001$), demonstrate confusion ($P < 0.0001$), and to have been admitted to a medical ward ($P = 0.03$). Patients admitted to an orthopaedic ward with an admitting diagnosis of lower extremity fracture had a significantly lower risk of fall-related fracture ($P = 0.027$). Stenvall et al[14] prospectively examined 97 hospitalized patients following surgical management of femoral neck fracture to identify inpatient falls, fall-related injuries, and risk factors for falls postoperatively. Of the falls that occurred in the hospital, 45% happened while the patient was delirious. Kallin et al[15] examined 140 women and 59 men in a prospective cohort study of residential care facilities and found that 10% of falls were precipitated by delirium. Gustafson et al[16] prospectively studied 103 patients with femoral neck fracture who were on an acute confusional state prevention program and compared them retrospectively with a match group of 111 patients. The intervention consisted of pre- and postoperative geriatric assessments, oxygen therapy, early surgery, prevention and management of perioperative blood pressure reduction, and management of postoperative complications. The incidence of acute confusion state was 47.6% in the interventional group and 61.3% in the control group ($P < 0.05$). Length of stay was reduced with intervention (17.4 to 11.6 days) ($P < 0.001$). No falls occurred in the intervention group, but six occurred in the control group; this difference was not statistically significant. This suggests that reducing the incidence and duration of delirium results in fewer serious injurious falls. It is unknown whether these data can be applied to the acute hospital setting.

The protocols of the Hospital Elder Life Program (HELP) that are used to address delirium focus on orientation, therapeutic activities, early mobilization, vision and hearing, oral volume repletion, and sleep enhancement.[17] HELP is designed to improve hospital care for older patients with the goals of maintaining physical and cognitive functioning, maximizing independence at discharge, assisting with the transition from hospital to home, and preventing unplanned readmission. HELP interventions have significantly reduced the development of delirium. Inouye et al[4] suggested that HELP may be useful in fall prevention, as well, and reported that 95% of medical staff working in 29 hospitals using the HELP program report a decrease in falls after implementation.

There is a strong correlation between falling and delirium that supports the need for the early identification and management of delirium in the hospital. Although studies have shown that the HELP program may reduce fall risk, the authors believe that the literature is not adequate to support its consideration as a medical evidence-based guideline.

Nutrition

Some studies have shown that nutritional supplements with vitamin D and calcium reduce falls in specifically targeted patients with vitamin D deficiency and poor musculoskeletal function as well as in persons who fell following hip fracture. In a double-blind randomized controlled trial of 122 women aged 63 to 99 years, patients received supplements of either calcium or calcium plus vitamin D for 12 weeks.[18] In patients who took calcium plus vitamin D, a 49% reduction in the number of falls was noted, along with improved musculoskeletal function. Because of the small sample size, this can be considered only a statistical trend.

Medication

In the ambulatory medical setting, educational programs for primary care physicians on the use of medication and the implementation of patient self-assessment questionnaires have been shown to reduce the risk of falls.[19,20] Gradual withdrawal of psychotropic medications was found to reduce the rate of falling, but it did not affect risk.[19,20] In one study, 20 general practitioners received pharmacologic education, a medication risk assessment to be completed by each patient, and a medication review checklist to be completed by the physician and patient together.[20] The control group consisted of general practitioners who received no educational materials but whose patients completed a review checklist. At 12-

month follow-up, the intervention group had lower adjusted odds ratios of falling, fall-related injury, and experiencing a fall requiring medical attention.

Vision and Eye Care

In theory, addressing vision deficits may reduce falls. In a randomized controlled trial of 616 patients in outpatient aged care services, persons in the intervention group were assessed with vision tests and eye examinations; when necessary, they received new glasses and ophthalmologic treatment.[21] Persons in the control group maintained their usual care. At 12-month follow-up, falls in the intervention group were shown to have increased, with 31 fractures, compared with 18 in the control group (relative risk from proportional hazards model 1.74; 95% confidence interval [CI], 0.97 to 3.11; $P = 0.06$). This greater risk of fall with vision correction was attributed to the time required by elderly persons to adjust to new eyeglasses.

Harwood et al[22] randomized 306 women aged >70 years to receive either expedited cataract surgery (within 1 month) or routine cataract surgery (within 13 months). Patients recorded falls themselves and were assessed at 3, 6, 9, and 12 months. Early first eye cataract surgery was associated with improved visual function and reduced visual disability as well as improvement in activity, anxiety and depression, confidence, handicap, and quality of life. Rate of falling was reduced by 34% in the operated group (rate ratio, 0.66; 95% CI, 0.45 to 0.96; $P = 0.03$). Four persons in the operated group had fractures, compared with 12 in the control group (3% and 8%, respectively; $P = 0.04$).

Multimodal fall prevention programs and methods to improve vision have been shown to be effective in the outpatient setting. However, there is no evidence-based support for multimodal programs or individual modalities in the acute hospital setting.

Physical Considerations

Bed Rails and Bed Alarms

Healey et al[23] reviewed 24 articles on the use of bed rails. No controlled trials were included. They concluded that the use of bed rails in the hospital is generally helpful, although insignificant results have been reported. The authors suggested that bed rails might be unnecessary for patients who are independently mobile without them and for severely confused patients who are mobile enough to climb over them. Rails may be helpful for patients who are incapable of leaving their beds without assistance. There is no conclusive evidence that bed rails are either effective or dangerous.

In a case-control study, 70 patients were randomized to the use of a bed alarm or no alarm.[24] Falls were reduced in the study group, but only a statistical trend was found.

Bed and Toilet Seat Height

Tzeng and Yin[25] reviewed bed height in relation to fall prevention. They recommended that bed height be adjusted to the knee-to-heel distance, which is approximately 21 inches for men and 19 inches for women. In a retrospective study of 263 nursing home residents, Capezuti et al[26] used lower leg length to quantify adequate bed height and toilet seat height to facilitate easier sit-to-stand maneuvers and thereby, theoretically, reduce falls. No statistical or clinical significance was found to indicate that higher bed height reduced the ability to transfer from sitting to standing. Patients were able to transfer with higher toilet seats, as well. Eight of the reported serious injuries occurred in patients whose bed height was >120% of lower leg length. No evidence was found to indicate that adjustable bed height reduced falls. However, the study did show that when falls occur, they may be more severe when the bed is elevated.

Footwear

Footwear is considered to be a modifiable extrinsic factor for altering balance in the wearer and thereby adjusting fall risk. Some hospitals mandate that patients wear rubber-soled socks when ambulating. There are no current studies on footwear in the hospital setting.

Menant et al[27] conducted a systematic review on adequate footwear in the elderly for reduction of fall risk. Adequate footwear was defined as appropriately fitted shoes. Publications were examined for information on balance, heel height, sole cushioning, and sole properties (eg, grip). Walking barefoot or in socks indoors was found to be associated with increased falls because of decreased walking stability and decreased grip on the walking surface. The authors of the study recommended the use of thin shoes with low heels and with hard soles and treads. They also noted the need for further research to identify the effects of shoe modifications on reducing falls on various floor surfaces and when persons are engaged in dynamic motor tasks.

Flooring

Flooring type has been discussed as a controlled modality. Vinyl has been proposed to be best because the foot or shoe is less likely to catch on that surface than on carpet. Others theorize that carpet reduces the amount of trauma when a fall occurs.

One study evaluated the incidence of falls on vinyl flooring compared with carpeting in a rehabilitation ward. Fifty-four patients were randomized to a bay with a vinyl or a

carpeted floor, and they were further randomized to receive either conventional physiotherapy alone or conventional physiotherapy with additional exercise.[28] Conventional exercise involved function-based training, with an emphasis on transfers, walking exercises, and dynamic balance. The additional exercise consisted primarily of strengthening techniques. Eight patients fell 11 times, with more falls recorded in patients treated with conventional physiotherapy. Seven of the eight patients fell in a carpeted room on 10 occasions, whereas only one patient fell on vinyl 1 time. Because of the small sample size, these results are not statistically significant.

Identification Bracelets

Use of identification (ID) bracelets to identify persons at high risk of falling during inpatient rehabilitation has not been shown to reduce falls. Mayo et al[29] conducted a study in which 134 patients with one or more primary risk factors for falls were randomized to receive a blue ID bracelet or no bracelet. In the course of 1 year, 65 high-risk patients were randomized to receive a blue ID bracelet; 69 high-risk subjects served as controls. Two risk strata were specified. The high-risk stratum consisted of patients with stroke or ataxia, urinary incontinence, or a history of falls, and the low-risk stratum consisted of patients aged >80 years and those on one or more medications that had been identified as contributing to the risk of falling. The 65 persons who wore ID bracelets were instructed to think of the bracelet as a reminder to use caution while ambulating. The effect of the bracelet is reported only for those persons in the high-risk stratum. In the intervention group, 27 persons fell at least once, whereas in the control group, 21 persons fell at least once (41% and 30%, respectively; hazard ratio, 1.3; 95% CI, 0.8 to 2.4). At the culmination of the trial, the intervention group had a higher but not statistically significant risk of falling. Thus, the study provided no evidence that the use of an ID bracelet will result in fewer falls.

There are no studies that show statistical reduction in falls of hospitalized patients using overhead trapeze, grab rails, room and floor illumination, scheduled toileting, easy access to a call light, and use of a bedside commode.

Unobstructed Environment

Patient education on adequate room lighting, maintaining unobstructed pathways in the hospital room, and ensuring orientation to place, especially at dusk, have been assumed to be helpful in reducing the risk of falls. Other factors believed to reduce the risk of fall include eliminating IV lines and Foley catheters as well as addressing environmental factors. However, no isolated research has been done to evaluate the risk of falling in relation to attachment to catheters, electrocardiogram leads, IV lines, and room lighting.[30] Current recommendations for fall prevention are guided mostly by expert opinion and ethical considerations.[31]

Exercise and Balance Training

Orthopaedic surgeons are aware of the risk of falls at home following patient discharge from the hospital. Home assessments are often conducted when ordering home health services. Hauer et al[32] examined 57 patients aged 75 to 90 years who were undergoing rehabilitation at a geriatric hospital secondary to a fall or who had a recent history of injurious falls, among other criteria. The randomized controlled trial consisted of three weekly sessions of training to improve ambulatory strength, functional performance, and balance in a 3-month period. The control group attended placebo training of flexibility exercises, calisthenics, ball games, and memory tasks for the same duration. Both groups received additional identical physiotherapeutic treatment twice weekly because of their acute orthopaedic problems. Strength and balance training were excluded from this treatment. Because of the small sample size, a significant reduction in subsequent falls could not be shown. However, persons in the intervention group demonstrated improved strength, balance, and functional performance; improvement in subjective awareness of stability while walking; and fewer fall-related emotional and behavioral restrictions.

A meta-analysis of elderly persons in the general community and in residential care facilities revealed that higher total dose of exercise and balance exercises reduced fall rates by 17%.[33] The large number of participants in the study provides confidence that this finding may be generalizable throughout the elderly population. The latest Cochrane review analysis indicates that multiple-component exercise interventions, whether in the home or in a group, as well as tai chi practice, are effective in reducing the rate and risk of falling.[19] All of these studies offer insight regarding the beneficial effects of exercise programs focused on strength, functional performance, and balance training, as well as long-term commitment to exercise.[19,32,33] However, these methods have been shown to be effective only at long-term follow-up and outside acute care facilities.

Home Health Services

Home health service personnel often provide a thorough investigation of extrinsic risk factors by analyzing each room in the home and address-

Table 2

Published Levels of Evidence on Fall Prevention Modalities and Programs

Level of Evidence	Modality or Program
High	None
Strong	Community or long-term care prevention (delirium prevention, exercise and balance, vision and eye care)
	Acute care prevention (no evidence of risk reduction in "strong" level of evidence studies)
Intermediate	Medication oversight
	Nutritional support
	Flooring
	Footwear
	Bed alarms
	Multifaceted programs (community and long-term)
Low	Multifaceted programs (acute care)
	Bed rails
	Bed and toilet seat height
	Identification bracelets
	Home health services
None	Floor illumination
	Scheduled toileting
	Access to call light
	Bedside commodes
	Grab rails

ing areas of risk, such as rugs that may skid, arrangement of furniture, and floor and room lighting. They also assess whether the patient uses a proper step stool to get to items that are out of reach and has and uses grab bars in the bathtub or shower. Physical assessment tools are used to evaluate patient intrinsic risk factors and indicate strength and balance exercises that can be performed at home. The physical assessment also focuses on cognitive impairment, medication side effects, and the use of adaptive equipment.[34] According to the Cochrane review, home safety interventions did not result in a statistically significant difference in the rate of falls (rate ratio, 0.90; 95% CI, 0.79 to 1.03).[19] These results were based on 2,367 participants in three trials. However, subgroup analysis by fall risk (ie, high versus low) demonstrated that the rate and risk of falling were significantly lower in the high-risk group ($P = 0.004$).

Discussion

Falls are associated with increased morbidity, mortality, and cost of health care. CMS regulations have placed falls in the category of preventable events, with the result that hospitals now have a financial burden to prevent such accidents. The Joint Commission "Speak Up" campaign of 2010 appears to recognize the significance of the problem, but it reinforces the belief that falls in the hospital are preventable. Mark R. Chassin, MD, MPP, MPH, president of The Joint Commission, stated,

> Falls can cause serious to life-threatening injuries; however, there are steps people can take at home or in a health care facility to reduce their risk of falling. We want people to be aware of these simple yet important precautions and avoid preventable injuries.[35]

By 2050, the US population is projected to be 403,932,000, of which approximately 21.6% (87 million) will be age 65 years or older.[36] Thus, the problem of falls and fall-related injury will increase with time.

Our review of the literature reveals no conclusive medical evidence that multifactorial prevention programs in the acute hospital setting are effective (Table 2). We found no studies demonstrating statistically significant evidence that any of the individual measures used in the hospital that are often considered to be effective in reducing fall risk are effective, with the exception of addressing delirium. Most current recommendations are based on expert opinion and statistical trends. Many of the methods used to reduce falls are either not harmful or do not increase risk, and thus may be safely continued. Larger studies are needed to evaluate these measures for statistical significance. However, it is our opinion that it is not appropriate to make the hospital financially responsible for the cost of a fall in the facility because the risk of falls in and out of the hospital are similar, and one would expect the risk to be greater in the acute care setting. Outside the hospital, multimodal fall prevention programs that include exercise programs, nutrition, and vision care, along with home health evaluations for high-risk patients, have been proven to be effective.

Recently, Inouye et al[4] noted that rule changes made in the Deficit Reduction Act of 2005 and the Fiscal Year 2009 Inpatient Prospective Payment System Final Rule could lead to increased use of restraints as well as

the use of chairs that are more difficult to get out of, bed alarms, and other methods of reducing free patient movement in order to combat a complex problem. Although restraints may reduce the risk of falls, they may create new complications, such as delirium; agitation; pressure sores, which are not reimbursable; pneumonia; and other side effects that inhibit a patient's ability to recover and leave the hospital.

Health care practitioners should be educated as to the extent of inpatient falls and must actively participate in large controlled trials to evaluate preventative measures. We must also be aware of the potential risks of enacting measures to prevent falls that may be counterproductive to patient recovery.

Summary

Falls in the elderly are a significant problem. CMS has deemed falls to be hospital-acquired conditions that can be prevented with the use of evidence-based practices. Multifaceted and individualized fall prevention programs have been instituted to combat falls both inside and outside the hospital setting. Thorough review of these existing fall prevention techniques indicates that many of these interventions were designed using expert opinion or statistical trends and that there is no conclusive medical evidence that any of them qualifies as an evidence-based guideline or is even effective, with the exception of addressing delirium. Further investigation is required, especially in the area of randomized controlled trials, to design the best fall prevention protocols for patients.

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References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 6, 9-15, 18, 21, 22, 28, 29, 32, and 33 are level II studies. References 3, 16, 19, 20, 24, 26, and 27 are level III studies. Reference 30 is a level IV study. References 1, 2, 4, 5, 7, 8, 17, 23, 25, 31, and 34-36 are level V expert opinion.

References printed in **bold type** are those published within the past 5 years.

1. Centers for Medicare and Medicaid Services: *Hospital-Acquired Conditions*. Available at: http://www.cms.hhs.gov/HospitalAcqCond/06_Hospital-Acquired_Conditions.asp#TopOfPage. Accessed April 12, 2011.
2. Centers for Disease Control and Prevention: *Definitions for WISQARS Nonfatal*. Available at: http://www.cdc.gov/ncipc/wisqars/nonfatal/definitions.htm#fall. Accessed April 12, 2011.
3. **Cozart HC, Cesario SK: Falls aren't us: State of the science. *Crit Care Nurs Q* 2009;32(2):116-127.**
4. **Inouye SK, Brown CJ, Tinetti ME: Medicare nonpayment, hospital falls, and unintended consequences. *N Engl J Med* 2009;360(23):2390-2393.**
5. Centers for Disease Control and Prevention: *Costs of Falls Among Older Adults*. Available at: http://www.cdc.gov/HomeandRecreationalSafety/Falls/fallcost.html. Accessed April 12, 2011.
6. **Ackerman DB, Trousdale RT, Bieber P, Henely J, Pagnano MW, Berry DJ: Postoperative patient falls on an orthopedic inpatient unit. *J Arthroplasty* 2010;25(1):10-14.**
7. **Naqvi F, Lee S, Fields SD: Appraising a guideline for preventing acute care falls. *Geriatrics* 2009;64(3):10-13, 26.**
8. National Council on Aging: *Falls Free: Promoting a National Falls Prevention Action Plan. National Action Plan.* Available at: http://www.healthyagingprograms.org/content.asp?sectionid=69&ElementID=220. Accessed April 12, 2011.
9. **Iinattiniemi S, Jokelainen J, Luukinen H: Falls risk among a very old home-dwelling population. *Scand J Prim Health Care* 2009;27(1):25-30.**
10. Oliver D, Connelly JB, Victor CR, et al: Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: Systematic review and meta-analyses. *BMJ* 2007;334(7584):82-87.
11. Coussement J, De Paepe L, Schwendimann R, Denhaerynck K, Dejaeger E, Milisen K: Interventions for preventing falls in acute- and chronic-care hospitals: A systematic review and meta-analysis. *J Am Geriatr Soc* 2008;56(1):29-36.
12. Cumming RG, Sherrington C, Lord SR, et al: Cluster randomised trial of a targeted multifactorial intervention to prevent falls among older people in hospital. *BMJ* 2008;336(7647):758-760.
13. Vassallo M, Sharma JC, Briggs RS, Allen SC: Characteristics of early fallers on elderly patient rehabilitation wards. *Age Ageing* 2003;32(3):338-342.
14. **Stenvall M, Olofsson B, Lundström M, Svensson O, Nyberg L, Gustafson Y: Inpatient falls and injuries in older patients treated for femoral neck fracture. *Arch Gerontol Geriatr* 2006;43(3):389-399.**
15. Kallin K, Jensen J, Olsson LL, Nyberg L, Gustafson Y: Why the elderly fall in residential care facilities, and suggested remedies. *J Fam Pract* 2004;53(1):41-52.
16. Gustafson Y, Brännström B, Berggren D, et al: A geriatric-anesthesiologic program to reduce acute confusional states in elderly patients treated for femoral neck fractures. *J Am Geriatr Soc* 1991;39(7):655-662.
17. Inouye S: *The Hospital Elder Life Program (HELP)*. Available at: http://hospitalelderlifeprogram.org/public/public-main.php. Accessed April 12, 2011.
18. Bischoff HA, Stähelin HB, Dick W, et al: Effects of vitamin D and calcium supplementation on falls: A randomized controlled trial. *J Bone Miner Res* 2003;18(2):343-351.
19. Gillespie LD, Robertson MC, Gillespie WJ, et al: Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2009;2:CD007146.
20. Pit SW, Byles JE, Henry DA, Holt L, Hansen V, Bowman DA: A Quality Use of Medicines program for general practitioners and older people: A cluster randomised controlled trial. *Med J Aust* 2007;187(1):23-30.
21. Cumming RG, Ivers R, Clemson L, et al: Improving vision to prevent falls in frail older people: A randomized trial. *J Am Geriatr Soc* 2007;55(2):175-181.

22. Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T: Falls and health status in elderly women following first eye cataract surgery: A randomised controlled trial. *Br J Ophthalmol* 2005;89(1):53-59.

23. **Healey F, Oliver D, Milne A, Connelly JB: The effect of bedrails on falls and injury: A systematic review of clinical studies. *Age Ageing* 2008;37(4):368-378.**

24. Tideiksaar R, Feiner CF, Maby J: Falls prevention: The efficacy of a bed alarm system in an acute-care setting. *Mt Sinai J Med* 1993;60(6):522-527.

25. **Tzeng HM, Yin CY: Height of hospital beds and inpatient falls: A threat to patient safety. *J Nurs Adm* 2007;37(12):537-538.**

26. **Capezuti E, Wagner L, Brush BL, Boltz M, Renz S, Secic M: Bed and toilet height as potential environmental risk factors. *Clin Nurs Res* 2008;17(1):50-66.**

27. **Menant JC, Steele JR, Menz HB, Munro BJ, Lord SR: Optimizing footwear for older people at risk of falls. *J Rehabil Res Dev* 2008;45(8):1167-1181.**

28. Donald IP, Pitt K, Armstrong E, Shuttleworth H: Preventing falls on an elderly care rehabilitation ward. *Clin Rehabil* 2000;14(2):178-185.

29. Mayo NE, Gloutney L, Levy AR: A randomized trial of identification bracelets to prevent falls among patients in a rehabilitation hospital. *Arch Phys Med Rehabil* 1994;75(12):1302-1308.

30. **Hignett S, Masud T: A review of environmental hazards associated with in-patient falls. *Ergonomics* 2006;49(5-6):605-616.**

31. Vassallo M, Wilkinson C, Stockdale R, Malik N, Baker R, Allen S: Attitudes to restraint for the prevention of falls in hospital. *Gerontology* 2005;51(1):66-70.

32. Hauer K, Rost B, Rütschle K, et al: Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls. *J Am Geriatr Soc* 2001;49(1):10-20.

33. **Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JC: Effective exercise for the prevention of falls: A systematic review and meta-analysis. *J Am Geriatr Soc* 2008;56(12):2234-2243.**

34. Encompass Home Health: *Fall Prevention and Balance Program*. Dallas, TX, Encompass Home Health, 2009.

35. Zhani EE: *Joint Commission Urges Americans to 'Speak Up' to Prevent Falls*. Available at: http://www.jointcommission.org/joint_commission_urges_americans_to_'speak_up'_to_prevent_falls/. Accessed April 28, 2011.

36. United Nations Department of Economic and Social Affairs (DESA) Population Division: Population Estimates and Projections Section: *World Population Prospects: The 2008 Revision*. Available at: http://esa.un.org/unpp/. Accessed April 29, 2011.