

REFERENCE AND RESOURCE GUIDE

FALL RISK ASSESSMENT, PREVENTION, AND INJURY PREVENTION

The following list of references was compiled for NCPS staff, VISN patient safety managers, and other VHA employees seeking information about fall risk assessment and prevention, and fall injury prevention. The references were obtained from the VHA Patient Personal Freedoms and Security Fall Prevention and Management cognitive aid, PubMed and EBSCO databases, and bibliographies compiled by VHA clinical staff. Only current references with statistical validity were included in the bibliography. Each reference citation appears with a summary and some full text articles are available online or at the National Center for Patient Safety. Within topic categories, references are organized in descending order by most to least current. If a star is left of the numerical citation, then the reference comes recommended by NCPS staff.

These are the sections as follows:

I. General Falls Information

II. Specific Fall Prevention Interventions

III. Fall Risk Assessment Tools

IV. Falls Prevention Programs

V. Comorbid Conditions

VI. Economic Factors

VII. Cognitive Aids, Newsletters, Videos

VIII. Suggested Web Pages

I. GENERAL FALLS INFORMATION:



1. Chang, JT. Morton SC. Rubenstein LZ. Mojica WA. Maglione M. Suttorp MJ. Roth EA. Shekelle PG. "Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomized clinical trials." *British Medical Journal*. 20 March 2004. Vol 328: 1-7.

In a meta-analysis to assess the relative effectiveness of interventions to prevent falls in older adults, Chang et al systematically analyzed 40 randomized clinical trials. Their findings showed that patients in the falls intervention groups had a significant reduction in the risk of falling and the monthly rate of falling.

Quick Facts:

Multifactorial falls risk assessments and management programs (which include vision and blood pressure tests, balance and gait assessments, drug review, instrumental activities of daily living, and cognitive evaluations) are the most effective in reducing fall rates.

Exercise programs are also effective.

There is no clear evidence for the independent effectiveness of environmental modification or educational programs in reducing fall rates.



2. NCIPC. A Tool Kit to Prevent Senior Falls. Centers for Disease Control (CDC) Web site. Available at: <http://www.cdc.gov/ncipc/pub-res/Tool Kit.htm>. Accessed August 2003.

Available in full volume on the Internet, the CDC's Tool Kit offers an abundance and variety of statistics – some of which are highlighted below – cost information, research summaries, graphs, and useful pictures related to falls and fall prevention.

Quick Facts:

Number of people over age 65 is expected to increase from 31.0 million in 1990 to 68.1 million by 2040

Number of people age 65 or older living in nursing homes is expected to increase from 1.5 million in 1997 to 3 million in 2030

87% of all fractures among older adults are due to falls

Most common fractures are of the vertebrae, hip, forearm, leg, ankle, pelvis, upper arm, and hand

About 250,000 hip fractures occur each year among people over the age of 65

Hip fractures resulted in approximately 338,000 US hospital admissions in 1999

In 1996, more than 8,500 people over age 65 died because of falls

In 1999, about 10,000 people over age 65 died because of falls

Average health care cost of a fall injury of people aged 72 and older was \$19,440 (including hospital, nursing home, emergency room, and home health care, but not physician services)

In 1994, total cost of fall injuries in people age 65 and older was \$20.2 billion

By 2020, the cost of fall injuries is expected to be \$34.4 billion (before adjusting for inflation)

3. Tinetti ME. Preventing falls in elderly persons [clinical practice]. *N Eng J Med* 2003; 348(1): 42-9.

A case vignette highlighting a patient fall. Evidence supporting various strategies is presented, followed by a review of formal guidelines. The article ends with the author's clinical recommendations.

Quick Facts:

Greater than 1/3 of persons 65 years or older fall each year

Half of these falls are recurrent

1 in 10 falls results in a serious injury to the patient, such as hip fracture or subdural hematoma

“Patients 75 years or older (or 70 years or older if they have known risk factors) should be asked whether they have a history of falls and should be carefully questioned about the circumstances of the falls and examined for potential risk factors.” (Tinetti, 47)



4. Mills PD. Waldron J. Quigley PA. Stalhandske E. Weeks WB. “Reducing falls and fall related injuries in the VA system.” *Journal of Healthcare Safety*. 2003, 1:25-33.

A multi-facility quality improvement effort involving 31 teams tracked fall and injury rates, and reported on the interventions implemented for eight months. Major injury rate from falls dropped 62% from 2.14 major injuries per 100 falls to .82 major injuries per 100 falls after project completion.

Quick Facts:

Average reduction of 40.9 major injuries per month

Direct cost savings between \$667,569 and \$765,934 per month

Toileting interventions reduced major injury rates during the project by 2.7 falls per 100, which was well above the average reduction rate

Team performance was positively correlated with signage, post-fall assessment, environmental safety, and toileting programs

5. Weigand JV. Gerson LW. “Prevention care in the emergency department: should emergency departments institute a falls prevention program for elder patients?” *Academic Emergency Medicine*. August 2001. 8(8): 823-6.

A review of the emergency medicine literature to assess the appropriateness of an intervention to identify, counsel, and refer emergency department (ED) patients >64 years old who are at high risk for falls. The review used a structured template, a companion explanatory piece, and a grading and methodological scoring system based on published criteria for critical appraisal. A reference librarian did searches using the following: ED visits, patients >64 years old, falls, high risk, and effectiveness of intervention. *Emergency Medical Abstracts*, *Science Citation Index*, and the *Cochrane Collaboration* database were searched. Two team

members reviewed the abstracts and selected pertinent articles. References were screened for additional pertinent articles. Twenty-six articles were reviewed. None were ED-based primary or secondary falls prevention in older patients.

Quick Facts:

Randomized controlled trial showed structured interdisciplinary approach significantly reduced the number of falls in elderly patients

2 emergency room studies showed that it was possible to identify ER patients at risk for falls

1 randomized controlled trial showed significant reduction in the risk of further falls; authors recommend that EDs conduct research to evaluate the effectiveness of clinical interventions to identify, counsel, and refer ED patients >64 years old who are at high risk for an unintentional fall.



6. Agostini, Joseph V., Dorothy I Baker, and Sidney T. Bogardus. "Prevention of Falls in Hospitalized and Institutionalized Older People" Chapter 26 in Making Health Care Safer: A Critical Analysis of Patient Safety Practices by The Agency for Healthcare Research and Quality. July 2001.

<http://www.ahrq.gov/clinic/ptsafety/chap26a.htm>

Falls are among the most common incidents reported in hospital settings. Risk factors include age, gait or balance impairment, sensory or cognitive impairment, environmental hazards, and previously fallen. Despite the common occurrence of falls, there are few hospital or other institution-based randomized controlled trails of falls interventions. In Chapter 26, Agostini et al briefly evaluate five prominent falls prevention programs among community-dwelling and hospitalized elders. These programs include (1) identification bracelets for high-risk patients, (2) interventions that decrease the use of physical restraints, (3) bed alarms, (4) special hospital flooring materials to reduce injuries from patient falls, and (5) hip protectors to prevent hip fractures. They are evaluated based on the opportunities for impact, evidence for effectiveness, potential for harm, and implementation costs.

Quick Facts:

50% of 1.7 million nursing home residents fall at least once a year, resulting in serious injury in about 10% of residents

In 1994, the total cost of falls injuries for adults aged 65 and older was estimated at \$20.2 billion

20% of people sustaining hip fractures become non-ambulatory and only 14-21% recover their ability to carry out ADLs

Difference in cost of caring for an individual up to a year after a hip fracture is between \$16,300 and \$18,700

In 1991, Medicare expenditures for hip fractures were \$2.9 billion

- ☆ 7. "Guidelines for the prevention of falls in older persons." Journal of the American Geriatrics Society, 2001. 49:665-672

The American Geriatrics Society, British Geriatrics Society and American Academy of Orthopedic Surgeons Panel on Falls Prevention developed a set of guidelines to assist in the assessment and management older patients who are at risk for falling. The recommendations are divided into categories and graded based on the methodology of the research and the strength of the recommendations. The categories cover fall risk assessment, multifactorial interventions and specific single recommendations and comments about potential interventions that have not been as thoroughly studied. In addition, the panel outlines recommendations for future research relating to falls.

8. Przbelske RJ. Shea TA. "Falls in the geriatric patient." Wisconsin Medical Journal. 2001, 100(2): 53-6.

Falls are common in the geriatric and older adult population, often causing significant morbidity or mortality. The geometry of the human body in motion requires a highly functional individual to remain balanced and upright under a variety of conditions and perturbations. Balance in this population is adversely affected by intrinsic and extrinsic factors. Medications' therapeutic and side effects frequently contribute to falls. An aggressive approach to falls reduction, including eliminating balance-altering medication, obtaining sub-specialty and balance evaluations when warranted, and requesting home safety assessments is advocated in this review of the current concepts and literature.

9. Wu G. "Distinguishing fall activities from normal activities by velocity characteristics." Journal of Biomechanics. Nov 2000, 33(11): 1497-500.
- The purpose of this study was to identify unique features of the velocity profile during normal and abnormal (i.e., fall) activities to make the automatic detection of falls during the descending phase of a fall possible. Normal activities included walking, rising from a chair and sitting down, descending stairs, picking up an object from the floor, transferring in and out of a tub, and lying down on a bed. The fall activities included tripping, forward and backward falls from standing. The horizontal and vertical velocities ($V(h)$ and $V(v)$) at various locations of the trunk was measured. It was found that the $V(h)$ and $V(v)$ of the trunk during normal activities were within a well-controlled range, and that when the velocity in one direction increased, the velocity in the other direction usually did not. In contrast, the $V(h)$ and $V(v)$ demonstrated two different characteristics for the fall movement. Firstly, the magnitude of both $V(h)$ and $V(v)$ of the trunk increased
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dramatically during the falling phase, reaching up to 2-3 times that of normal velocities. Secondly, the increase of $V(h)$ and $V(v)$ magnitude usually occurred simultaneously, and usually about 300-400 ms before the end of the fall. These two velocity characteristics, that is, the magnitude change and the timing of the magnitude change of both $V(h)$ and $V(v)$, could be used to distinguish fall movements from normal activities during the descending phase of the fall. It is hoped that the application of these two velocity characteristics could lead to potentially preventing or degrading fall-related injuries in the elderly population when connected with other devices.

10. Feder G, Cryer C, Donovan S, et al. Guidelines for the prevention of falls in people over 65. *British Medical Journal (BMJ)*. Oct 2000, 321: 1007-1011. Feder et al. developed a set of guidelines for several different groups within the community. The guidelines stressed the importance of a multifaceted intervention program which included exercise aimed at improving balance, lower extremity strength, and range of motion. The most relevant recommendations centered on residential settings, such as nursing homes. For nursing home patients, the guidelines suggest implementing a program of risk assessment and offering hip protectors to all patients. The facilities participating in the hip protector program will be implementing a risk assessment using the guidelines in the Fall Prevention and Management handbook produced by the VHA National Center for Patient Safety, and will be providing each of the residents in the study with hip protectors. The hip protector study will be studying the durability and usability of various models of protectors in a setting with a hip protector program, which is developed by the facility.

Quick Facts:

Definition of Fall: a sudden, unintentional change in position causing an individual to land at a lower level, on an object, the floor, or the ground, other than as a consequence of sudden onset of paralysis, epileptic seizure, or overwhelming external force

Research is still needed in the following areas: further hip protector trials, validation of risk assessment as a guide to intervention, economic evaluations of interventions, and trials

11. Fuller GF. "Falls in the Elderly." *American Family Physician*, 2001. 61:2159-68, 2173-4. <http://www.aafp.org/afp/20000401/2159>. Accessed on: March 10, 2004.

This article provides a review of the issues surrounding falls. It provides information on the epidemiology of falls, evaluation of elderly patients who fall and preventing falls. The evaluation of elderly patients who fall is the most comprehensive section. It covers the importance of screening, obtaining a patient

history using a mnemonic device, risk factor assessment, physical examination and a recommendation to perform the "Up & Go" test or the "Get-Up and Go" test. Also included with the article is a patient information handout developed by the author.

Quick Facts:

- Emergency department visits related to falls are more common in children less than 5 years old and adults at least 65 years old
- Elderly patients who fall are 10 times more likely to be hospitalized and 8 times more likely to die as a result of a fall when compared with children
- 70% of accidental deaths in people 75 years and older are related to falls

12. Hanson JP. Redfern MS. Mazumdar M. "Predicting slips and falls considering required and available friction." *Ergonomics*. Dec 1999, 42(12): 1619-33.

This study investigated the relationship among measurements of friction, the biomechanics of gait, and actual slip and fall events. The goal was to develop a method for estimating the probability of slips and falls based on measurements of available friction and required friction. Five subjects wearing safety harnesses walked down a ramp at various angles on dry, wet or soapy conditions. Ramp angles of 0 degree, 10 degrees and 20 degrees were used. The dynamic coefficient of friction (DCOF) of shoe, floor surface and contaminant interfaces was measured. Required friction was assessed by examining the foot forces during walking trials when no slips occurred. Slips with recoveries and slips resulting in falls were recorded and categorized using a high-speed video camera. These data were then incorporated into a logistic regression to model the probability of a slip or fall event occurring based on the difference between the COF required by the foot forces generated and the measured DCOF.

Quick Facts:

Results showed number of slip and fall events increased as difference between the required COF and the measured DCOF increased

DCOF = .40 is the cut-off for a safe environment according to British Standards Institute

Subjects involved in the study were found to be highly capable of evaluating the slipperiness of a shoe, floor, or contaminant interface

Relationship between frictional requirements of walking and measured friction of the shoe, floor or contaminant interface can be used to predict slips and falls

13. Hilliard DJ. Frederick L. Tierney-Gumaer R. Simpson MJ. "Exploring the relationship between cultural values, beliefs, and practices and patient falls: a Middle Eastern study." *Journal for Healthcare Quality: Promoting Excellence in Healthcare*. Jan-Feb 1999, 21(1): 42-8.

Patient falls have been a concern in North American healthcare for many years. Studies have examined environmental, clinical, and patient variables for purposes

of risk identification and fall reduction, primarily in the context of Western societies. An investigation at King Faisal Specialist Hospital and Research Center in Riyadh, Saudi Arabia, began in 1993 to determine whether commonly reported risk factors apply to the Saudi patient population and whether cultural values, beliefs, and practices such as the performance of ablution before prayer, fasting during the holy month of Ramadan, and the need for socialization influence the rate of patient falls. The study included all inpatients (N = 379) who fell during a 3-year period.

14. Rubenstein L. Josephson ZKR, et al. "Falls in the nursing home." *Annals of Internal Medicine*. 1994, 121(6): 442-51.

Large scale published studies documenting incidence, causes, risk factors, and other information pertaining to patient falls were aggregated and reviewed. The mean incidence of falls in nursing homes is 1.5 falls per patient bed per year.

Quick Facts:

About 4% of falls result in fractures and 11% of falls result other serious injuries such as head traumas, soft-tissue injuries, and lacerations

About 1800 fatal falls occur in nursing homes per year

Weakness and gait problems were the most common causes of falls in nursing home patients, accounting for 24%

Environmental hazards including wet floors, poor lighting, lack of bed rails, clutter, incorrect bed height, and improperly maintained or fitted wheelchairs account for between 16% and 27% of nursing home falls

15. Tinetti, Mary E. Baker, Dorothy I. McAvary, Gail. Claus, Elizabeth B. Garrett, Patricia. Gottschalk, Margaret. Koch, Marie L. Trainor, Kathryn. Horwitz, Ralph I. "A multi-factorial intervention to reduce the risk of falling among elderly people living in the community." *The New England Journal of Medicine*. Sept 1994, 331(13): 821-827.

The authors investigated whether the risk of falling in the elderly could be reduced by modifying known risk factors. A sample of 301 men and women, at least 70 years old, living in the community, who had at least one of several risk factors for falling, were given either a combination of adjustment in their medications, behavioral instructions, or exercise programs aimed at modifying their risk factors. During one year of follow-up, 35 percent of the intervention group fell, as compared to 47 percent of the control group. The authors conclude that multiple-risk-factor intervention strategies resulted in significant reduction of falling among elderly persons in the community.



16. Morse JM. *Preventing Patient Falls*. 1997, Thousand Oaks: Sage Publications.

This book contains information on how to start a falls program, how to assess patients using the Morse scale, benchmarking information on falls and suggestions for measuring fall and injury rates.

II. SPECIFIC FALL PREVENTION INTERVENTIONS:

A. HIP PROTECTORS:

- ☆ 17. van Schoor NM. Smit JH. Twisk JWR. Bouter LM. Lips P. "Prevention of Hip Fractures by External Hip Protectors." JAMA. April 16, 2003, vol. 289(15): 1957-1962.

The authors examine the effectiveness of hip protectors in reducing the incidence of hip fractures in a randomized controlled trial of elderly persons aged 70 years or older, who have low bone density, and are at high risk for falls. Participants were enrolled in the study between March 1999 and March 2001. The intervention was an external hip protector. The main outcome measured was time to first hip fracture. Survival analysis was used to include all participants for the time they participated. In the intervention group, 18 hip fractures occurred vs. 20 in the control group. Four hip fractures in the intervention group occurred while an individual was wearing a hip protector. At least 4 hip fractures in the intervention group occurred late at night or early in the morning. Both in univariate analysis (log-rank $P = .86$) and in multivariate analysis (hazard ratio [HR], 1.05; 95% confidence interval [CI], 0.55-2.03), no statistically significant difference between the intervention group and control group was found with regard to time to first hip fracture. In addition, the protocol analysis in compliant participants did not show a statistically significant difference between the groups (HR, 0.77; 95% CI, 0.25-2.38). In conclusion, the hip protector studied was not effective in preventing hip fractures.

Quick Facts:

Patient compliance with hard-shelled hip protectors was: 61% after one month of wearing hip pads, 45% after six months, and 37% after twelve months

16% of patients wore hip protectors at night

The findings of this study appear to refute the effectiveness of hip protectors in preventing fractures during patient falls. NCPS and other researchers disagree with the findings of this study.

Adherence was measured by three random site visits at one, six, and twelve months

Compliance with hip protectors was low to begin with and decreased over time
Of the 18 fractures in the intervention group, 78% occurred while patients were not wearing hip protectors



18. Parker MJ. Gillespie LD. Gillespie WJ. “Hip protectors for preventing hip fractures in the elderly” (Cochrane Review). In: The Cochrane Library. Issue 1, 2003. Oxford. <http://www.update-software.com/abstracts/ab001255.htm>
Parker et al., in their review of seven studies on the effectiveness of hip protectors, confirmed that hip protectors are effective in preventing hip fractures. Compliance was a problem in all of the studies reviewed. While it ranged from 24 to 68 percent, the majority were less than 50 percent compliant and two were below 30 percent. Most of the hip fractures that occurred in the protector groups occurred while the patient was not wearing the hip protector when he or she fell. One occurred because the hip protector was not fitted correctly to the person. The most salient reasons for non-compliance were skin irritation and discomfort; however, other important reasons were mentioned, such as, difficulty in putting on or taking off the undergarment for patients who were bedridden, confused or infirm, difficulty in fitting the undergarment, forgetfulness and perceived lack of personal risk. This review exemplifies the effectiveness of hip protectors in preventing hip fractures and the role non-compliance may play in the reduction of hip fractures. Given that compliance is a major issue, the hip protector study will focus on compliance and the relationship between compliance and different models of hip protectors.

Quick Facts:

In patient groups wearing hip protectors, 2.2% of falls resulted in a hip fracture

In patient groups not wearing hip protectors, 6.2% of falls resulted in a hip fracture

Individually, 5 studies involving 4,316 participants reported a reduced incidence of hip fractures in hospital units allocated to receive hip protectors.

19. Burl J. Centola J. Bonner A. Burke C. “Hip protector compliance: a 13-month study on factors and cost in a long-term care facility.” J Am Med Dir Assoc. 2003 4:245-250.

Purpose of the study was to determine if a high compliance rate for wearing hip protectors could be achieved in a long-term care setting. It was a 13-month prospective analysis in a 100-bed long-term care facility. There were 38 participants all of whom were ambulatory and had at least one of the four risk factors: osteoporosis, recent fall, positive fall risk assessment, and previous fracture. The intervention involved: patient, family, and staff education and usage of hip protectors. The study found that hip protector compliance is feasible and sustainable in a long-term care setting. Compliance, however, requires the

enthusiasm of one department, acting as a leader and champion. It was believed that the cost of hip protectors could be a barrier to widespread use.

Quick Facts:

The education-based intervention achieved greater than 90% compliance in hip protector use

Average number of falls in intervention group was 3.9 per patient

Average number of falls in control group was 1.3 per patient

Zero hip fractures occurred during the 13-month study, whereas 2 occurred the year prior

Total cost of the intervention (staff hours and hip protectors) was \$6300



20. Kannus P. Parkkari J. Niemi S. Pasanen M. Palvannen M. Jarvinen M. Vuori I. "Prevention of Hip fracture in Elderly People with the use of a Hip Protector." The New England Journal of Medicine. Nov 23, 2000, 343(21), 1506-13.

The authors investigated the effect of an anatomically designed external hip protector on the risk of these age-related fractures. 1801 ambulatory but frail elderly adults (1409 women and 392 men; mean age, 82 years) were randomly assigned to a group that wore hip protectors or a control group. Fractures of the hip and all other fractures were recorded until the end of the first full month after 62 hip fractures had occurred in the control group. The risk of fracture in the two groups was compared, and in the hip-protector group the risk of fracture was also analyzed according to whether the protector had been in use at time of fall. It was found that the risk of hip fracture can be reduced in frail elderly adults by the use of an anatomically designed external hip protector.

Quick Facts:

13 patients in hip protector group had a fracture during the study, with a fracture rate of 21.3 per 1000 person-years

67 patients in control group had a fracture during the study, with a fracture rate of 46.0 per 1000 person-years

Risk of pelvic fracture was slightly but not significantly lower in the hip-protector group than in the control group (2 subjects and 12 subjects, respectively, had pelvic fracture)

4 patients in hip protector group had a hip fracture (among 1034 falls) while wearing the protector

9 patients had a hip fracture (among 370 falls) while not wearing the protector

21. Rubenstein, LZ. "Hip Protectors – A Breakthrough in Fracture Prevention." NEJM. Editorial. Nov 2000, 343(21): 1562-3.

Quick Facts:

Each year in US, more than 300,000 people over 65 are hospitalized because of hip fractures

A quarter of these people survive for less than one year

The cost of a hip protector is small compared to the cost associated with a hip fracture

Number needed to treat: one example, only 41 persons need be offered a hip protector to prevent 1 fracture during the course of 1 year

22. Cameron ID. Stafford B. Cumming RG. Birks C. Kurrle SE. Lockwood K. Quine S. Finnegan T. Salkeld G. "Hip protectors improve falls self-efficacy." *Age & Ageing*. Jan 2000, 29(1): 57-62.

Does the use of hip protectors affect an individual's fear of falling and falls self-efficacy (belief in their own ability to avoid falling)? A randomized controlled trial in aged-care health services in Sydney, Australia tests this question. 131 women aged 75 years or older who had two or more falls or one fall requiring hospital admission in the previous year and who live at home were included. Sixty-one subjects were in the intervention group and 70 in the control group. An adherence nurse encouraged use of external hip protectors. At the time of enrollment into a wider study examining the effect of hip protectors on hip fractures, participants recruited at home completed an assessment of fear of falling and falls efficacy as measured by the Falls Efficacy Scale and the Modified Falls Efficacy Scale. At 4-month follow-up, these scales were re-administered by a blinded observer (who was not aware of the allocation of the participant to intervention or control groups). Hip protectors improve falls self-efficacy. As users of hip protectors feel more confident that they can complete tasks safely, they may become more physically active and require less assistance with activities of daily living.

Quick Facts:

43% of subjects using hip protectors at the end of the study had a fear in falling

57% of the control group at the end of the study had a fear in falling

Hip protector users had greater improvement in falls self-efficacy at follow-up

23. Lauritzen JB. Peterse MM. Lund B. "Effect of external hip protectors on hip fractures." *The Lancet*. 1993, 341(8836), 11-13.

The authors investigated the effect of hip protectors on the prevention of hip fractures in nursing home residents. The controlled trial included 497 women and 204 men over 69 years in one nursing home in Copenhagen. Ten of the 28 nursing home wards were selected to receive hip protectors (intervention group).

According to the authors, the use of external hip protectors in the randomized study reduced the risk of hip fracture by 53% and nine hip fractures were avoided entirely.

Quick Facts:

24% of patients wore the hip protectors regularly.

Treatment group did not have a higher risk of non-hip fractures

B. SIDE RAILS:

24. Talerico KA. Capezuti E. "Myths and facts about side rails." *American Journal of Nursing*. 2001, 101(7): 43-8.

25. Capezuti E. et al. "Individualized interventions to prevent bed-related falls and reduce siderail use." *Journal of Gerontological Nursing*. 1999, 25(11) 26: 52-3.
Five situations that often impair siderail use: memory disorder, impaired mobility, injury risk, nocturia/incontinence, and sleep disturbance. As nursing homes work toward meeting the Health Care Financing Administration's mandate to examine siderail use, administrators and staff need to implement interventions that support safety and individualize care for residents. While no one intervention represents a singular solution to siderail use, there is a range of interventions tailored to individual needs. This article describes the process of selecting individualized interventions to reduce bed-related falls.

C. EXERCISE PROGRAMS:

26. Carter ND. Kannus P. Khan KM. "Exercise in the prevention of falls in older people: a systematic literature review examining the rationale and the evidence." *Sports Medicine*. 2001, 31(6): 427-438.

Falls cause 90% of hip fractures. The current cost of hip fractures in the US is estimated to be about 10 billion dollars. Age-related changes in physiologic systems (somatosensory, vestibular and visual), which contribute to the maintenance of balance, are well documented in older adults. These changes coupled with age-related changes in muscle and bone, are likely to contribute to an increased risk of falls. The integrated rehabilitation-based model of fall risk factors reveals multiple sites for interventions that may reverse fall risk factors. Regular exercise may be one way of preventing falls and fall-related fractures. On the basis of 9 randomized controlled studies conducted since 1996, exercise appears to enhance fall prevention in older adults, significantly reducing the incidence of falls compared with control groups. Current limitations such as inconsistencies in the measurement of key dependent and independent variables do not, at present, permit a meta-analysis of intervention trials. Further investigation, using trials designed with the current limitations in mind, is necessary to establish the optimum exercise program to maximize fall prevention in older adults.

27. Edelberg HK. "Falls and Function. How to prevent falls and injuries in patients with impaired mobility." *Geriatrics*. 2001, 56(3): 41-5 (quiz 49).

Patient falls typically result from a number of different risk factors including age, neurologic and musculoskeletal conditions, decreased physical strength, foot disorders, and use of medications or alcohol. This article presents the “DDROPP” mnemonic, a useful device for evaluating the risk of recurrent falls:

D-Is there a presence of disease?

D-What drugs is the patient taking?

R-Was the patient able to recover (i.e., get up off the floor) after the fall?

O-What was the onset? Did the patient fall suddenly? Was it a drop attack, or was it a gradual slumping to the ground?

P-What were the warning signs or symptoms (prodrome)?

P-What were the acute precipitants?

Additionally, this article presents a mobility and balance assessment tool called the “up and go” screen.

28. Christmas C. Andersen RA. “Exercise and older patients: guidelines for the physician.” *Journal of the American Geriatrics Society*. Mar 2000, 48(3): 318-24. Sedentary persons who improve their physical fitness are less likely to die of all causes and of cardiovascular disease than are those who remain sedentary. There now exists a wealth of data demonstrating that physical activity and exercise may ameliorate disease and delay decline in function in the geriatric population. We review evidence that exercise can improve body composition, diminish falls, increase strength, reduce depression, reduce arthritis pain, reduce risks for diabetes and coronary artery disease, and improve longevity. However, many healthcare professionals do not feel adequately prepared to design and prescribe exercise programs for their patients. This review provides a basic overview of the benefits of exercise in the geriatric population and guidelines indicating how to prescribe and facilitate adherence to an exercise program. Healthcare providers are strongly encouraged to promote a less sedentary lifestyle for older patients, which may augment quality of life in these older individuals.

29. Gregg EW. Pereira MA. Caspersen CJ. “Physical activity, falls, and fractures among older adults: a review of the epidemiologic evidence.” *Journal of the American Geriatric Society*. Aug 2000, 48(8): 883-93.

Assess the relationship between physical activity and risk for falls and osteoporotic fractures among older adults. Review and synthesis of published literature.

Literature was searched using MEDLINE, Current Contents, and the bibliographies of articles identified. Randomized controlled trials (RCT) of the effects of physical activity on the incidence of falls and case-control and prospective cohort studies of

the association of physical activity with osteoporotic fracture risk were included. Epidemiologic studies suggest that higher levels of leisure time physical activity prevent hip fractures and RCTs suggest certain exercise programs may reduce risk of falls. Future research needs to evaluate the types and quantity of physical activity needed for optimal protection from falls and identify which populations will benefit most from exercise.

Quick Facts:

Consistent evidence from prospective and case-control studies that physical activity is associated with a 20-40% reduced risk of hip fracture relative to sedentary individuals.

III. FALL RISK ASSESSMENT TOOLS:

30. Gowdy M. Godfrey S. "Using tools to assess and prevent inpatient falls." Joint Commission Journal on Quality & Safety. 2003, 29(7): 363-8.

A fall prevention program that includes a comprehensive fall risk assessment, root cause analysis of falls, and Failure Mode and Effect Analysis (FMEA) of falls. The fall risk assessment tool uses 11 patient indexes such as gait disturbance, confusion, previous falls in past 12 months, generalized weakness, and incontinence.

Quick Facts:

Fall rate for 450-bed community hospital is 6.1 falls per 1,000 patient days
Internal benchmark is 4.1 falls per 1,000 patient days
Geriatric psychiatry unit had 58% of all falls: 67 falls per 1,000 patient days
Surgical patients more likely to fall during middle or later part of hospitalization
Medical diagnosis patients fall soon after day of admission
After intervention, overall fall rate decreased 43% from 6.1 to 2.6 falls per 1,000 patient days

31. Perell KL. Nelson A., et al. "Fall risk assessment measures: an analytic review." Journals of Gerontology Series A-Biological Sciences & Medical Sciences. 2001, 56(12): M761-6.

In a summary of existing fall risk assessment scales, the authors analyze 21 published articles from 1984 through 2000. The scales are divided into two categories: comprehensive assessments mainly used by physicians and nursing assessments. The nursing instruments studied include: Morse Fall Scale, STRATIFY, RAI, Hendrich Fall Risk Model, High Risk for Falls Assessment Form, and Royal Melbourne Hospital Risk Assessment Tool. It was found that the majority of scales discussed in these articles were developed for elderly populations. The patient characteristics evaluated in each assessment were quite similar, but the time to complete the assessments varied from less than one minute to 80 minutes.

Quick Facts:

Inter-rater reliability ranged from 79% to 100% across the nursing assessment tools

Inter-rater reliability ranged from 58% to 98% across the functional assessment tools

32. Doughty K. Lewis R. McIntosh A. "The design of a practical and reliable fall detector for community and institutional telecare." *Journal of Telemedicine & Telecare*. 2000, 6 Suppl. 1: S150-4.

Falls are one of the greatest obstacles to independent living for frail and elderly people. Their early detection is an important step in providing people with the reassurance and confidence necessary to maintain an active lifestyle. The authors investigated a worn fall detector linked to a community alarm system. A worn device is the only one that is satisfactory, provided it generates few false alarms. The fall detector developed is the size of a small radio pager. It uses a two-stage detection process, which senses shock and the orientation of the wearer. A fall is detected within 20 seconds and triggers a radio signal to a community alarm system. Tests were devised using a jointed mannequin to simulate five modes of falling to understand the effects of impact at different parts of the body. This allowed the selection of appropriate trigger thresholds and wearing positions for the sensor. Prototypes were evaluated with 20 people to observe false alarms. The final design allowed reliable detection in 180 different falling scenarios.

33. Eagle DJ. Salama S. Whitman D. Evans LA. Ho E. Olde J. "Comparison of three instruments in predicting accidental falls in selected inpatients in a general teaching hospital." *Journal of Gerontological Nursing*. Jul 1999, 25(7): 40-5.

Accidental patient falls are a cause of concern for hospitalized inpatients. It is known that patients who fall once during their hospital stay are more likely to fall again and that fall rates tend to be higher in hospitalized elderly individuals. Many accidental patient falls can be predicted and, thus, prevented. The best tool to predict falls has not been determined yet. The purpose of this study was to compare the Morse Fall Scale (MFS), the Functional Reach (FR) test, and the nurses' clinical judgment in predicting those inpatients on a rehabilitation unit and a geriatric medical ward who were most likely to fall. A total of 98 patients were screened in a 3-month period, with each patient undergoing all three instruments the same day. The results showed that the two objective standardized tests (i.e., MFS, FR) were time consuming and often inconvenient and were no better at prediction than the clinical judgments made by the primary nurses.

IV. FALLS PREVENTION PROGRAMS:

34. Oliver D. Hopper A. Seed P. “Do hospital fall prevention programs work? A systematic review.” *Journal of the American Geriatrics Society*. Dec 2000, 48(12): 1679-89.

To analyze published hospital fall prevention programs to determine whether there is any effect on fall rates. Keyword searches of Medline, CINAHL, monographs, and secondary references. All papers were included that described fall rates before and during intervention. Risk ratios and 95% Confidence Intervals (95% CI) were estimated and random effects meta-analysis employed. Begg’s test was applied to detect possible publication bias. Separate meta-analysis regressions were performed to determine whether individual components of multifaceted interventions were effective. The pooled effect of about 25% reduction in the fall rate may be a result of intervention but may also be biased by studies that used historical controls not allowing for historical trends in the fall rate before and during the intervention. The randomized controlled trials apparent lack of effect might be due to a change in practice when patients and controls were in the same unit at the same time during a study. Studies did not analyze compliance with the intervention or opportunity costs resulting from the intervention. Research and clinical programs in hospital fall prevention should pay more attention to study design and the nature of interventions.

Quick Facts:

21 papers met the criteria; 18 from North America

10 contained sufficient data to calculate confidence intervals

Interventions reduce fall rate by <1

35. Deery HA. Day LM. Fildes BN. “An impact evaluation of a falls prevention program among older people.” *Accident Analysis & Prevention*. May 2000, 32(3): 427-33.

The goal of the evaluation study was to assess the impact of peer-presented education sessions on falls-related attitude, knowledge and behavior of older people. The non-randomized pre-test post-test evaluation was undertaken on the Bellarine Peninsula in Victoria, Australia. Baseline, three and twelve months follow-up data were collected for 107 individuals who attended the education sessions and 116 controls, matched by age range and sex. The groups were not equivalent at baseline, with the intervention group having a greater knowledge about falls and falls prevention. Analyses that controlled for baseline differences showed that those who attended the education sessions maintained a greater knowledge of factors that prevent falls at 12 months follow-up. The intervention group also made more changes in and around their home to prevent falls by 3 and 12-month follow-ups. Younger participants who reported a previous history of falls and having taken action to prevent falls were most likely to take additional action.

The results elucidate the major benefit in providing education programs, with voluntary attendance, in reducing falls and increasing fall awareness and prevention among the elderly.

V. COMORBID CONDITIONS:

36. van Doorn C. Gruber-Baldini AL. Zimmerman S. “Dementia as a Risk Factor for Falls and Fall Injuries Among Nursing Home Residents.” *Journal of the American Geriatrics Society*. September 2003, 51(8): 1213-1218.

To compare fall rates between nursing home residents with and without dementia and to examine dementia as an independent risk factor for falls and fall injuries. Prospective cohort study with 2 years of follow-up. Fifty-nine randomly selected nursing homes stratified by geographic region and facility size. Two thousand fifteen newly admitted residents aged 65 and older. During 2 years after nursing home admission, fall data were collected from nursing home charts and hospital discharge summaries. Dementia is an independent risk factor for falling. Although most falls do not result in injury, the fact that residents with dementia fall more often than their counterparts without dementia leaves them with a higher overall risk of sustaining injurious falls over time. Nursing home residents with dementia should be considered important candidates for fall-prevention and fall-injury-prevention strategies.

Quick Facts:

1700 residents fell 5,438 times during the 2-year follow-up period of this study

Fall rate for nursing home residents with dementia was 4.05 falls per year

Fall rate for nursing home residents without dementia was 2.33 falls per year

Unimpaired residents were less likely to fall than impaired residents (RR = .67, CI = .49-.92)

☆ 37. Gray P. Hildebrand K. “Fall risk factors in Parkinson’s disease.” *Journal of Neuroscience Nursing*. Aug 2000, 32(4): 222-8.

Parkinson’s disease (PD) is a neurodegenerative disorder characterized by tremor, rigidity, bradykinesia, gait disturbance, and postural instability. Patients with PD suffer frequent falls, yet little research has been done to identify risks specific to PD patients. The objective of this study was to identify the risk factors associated with falls for PD patients through the collection of demographic, environmental, and medical information as well as fall diaries completed during a 3-month period. Patients with a diagnosis of idiopathic PD, with and without falls, were included in the study provided they could stand and walk and had no other condition that could predispose them to falls.

Quick Facts:

59% of 118 participants reported one or more falls

Total of 237 falls were reported

40% of falls resulted in injury, but serious injury was rare
Duration and severity of PD symptoms, particularly freezing, involuntary movements, and walking and postural difficulties, were significantly associated with an increased risk of falls
Other factors associated with falls: postural hypotension and daily intake of alcohol

38. Brown JS. Vittinghoff E. Wyman JF. Stone KL. Nevitt MC. Ensrud KE. Grady D. "Urinary incontinence: does it increase risk for falls and fractures? Study of Osteoporotic Fractures Research Group." *Journal of the American Geriatric Society*. Jul 2000, 48(7): 721-5.

Is urinary incontinence associated with risk of falls and fractures (non-spinal) in older women. To answer this question, type and frequency of incontinent episodes were assessed in 6,049 community-dwelling women using a self-administered questionnaire. Follow-up postcards were mailed every 4 months inquiring about falls and fractures. Incident fractures were confirmed by radiographic report. Logistic and proportional hazard models were used to assess the independent association between urge urinary incontinence and risk of falling or fracture. Weekly or more frequent urge incontinence was associated independently with an increased risk of falls and (non-spine and non-traumatic) fractures in older women. Urinary frequency, nocturia, and rushing to the bathroom to avoid urge incontinent episodes most likely increase the risk of falling, which then results in fractures. Early diagnosis and appropriate treatment of urge incontinence may decrease the risk of fracture.

Quick Facts:

During an average follow-up of 3 years, 55% of women reported falling, and 8.5% reported fractures

One-quarter of the women (1,493) reported weekly or more frequent urge incontinence, 19% (1,137) reported weekly or more frequent stress incontinence, and 708 (12%) reported both types of incontinence.

Weekly or more frequent urge incontinence was associated independently with risk of falling (odds ratio = 1.26; 95% confidence interval (CI), 1.14-1.40) and with non-traumatic (non-spine) fracture (relative hazard 1.34; 95% CI, 1.06-1.69; P = .02).

Stress incontinence was not associated independently with falls or fracture.

39. Ooi WL. Hossain M. Lipsitz LA. "The association between orthostatic hypotension and recurrent falls in nursing home residents." *American Journal of Medicine*. Feb 2000, 108(2): 106-11.

Is orthostatic hypotension, including its timing and frequency, associated with falls in elderly nursing home residents? A prospective study of 844 elderly (60 years of age and older), long-stay residents at 40 facilities that were part of a multistate

nursing home chain was conducted. All subjects were able to maintain weight bearing for at least 1 minute. Orthostatic hypotension was defined as a 20 mm Hg or greater decrease in systolic blood pressure from supine to standing, as measured after 1 or 3 minutes of standing on four occasions (before or after breakfast, or before or after lunch). The outcome was any subsequent fall during a mean of 1.2 years of follow-up. Orthostatic hypotension is an independent risk factor for recurrent falls among elderly nursing home residents. Although the benefit of treating orthostatic hypotension will require further study, it may be prudent to identify high-risk residents and institute precautionary measures.

Quick Facts:

Orthostatic hypotension present in 50% of the subjects but not associated with subsequent falls

Among subjects with a history of previous falls in the past 6 months, those with orthostatic hypotension had increased risk of recurrent falls [adjusted relative risk (RR) = 2.1]

Risk of subsequent falls was greatest in previous fallers with orthostatic hypotension at two or more measurements (RR = 2.6)

Independent association between orthostatic hypotension and recurrent falls

Timing of orthostatic hypotension (before or after meals) did not affect the risk of falls

40. Liu BA. Topper AK. Reeves RA. Gryfe C. Maki BE. "Falls among older people: Relationship to medication use and hypotension." *Journal of American Geriatric Society*. 1995, 43: 1141-1145.

To assess the risk of falls attributable to medication use and orthostatic hypotension. Prospective cohort study. Two self-care, apartment-style residential facilities in the Toronto area. A total of 100 consecutive older volunteers (mean age = 83, range 62-96) who were independent in activities of daily living and able to stand unaided. Prescription medications used by each subject were documented at baseline. Blood pressure measurements were performed supine, immediately after standing, and after 5 minutes. Subjects reported falls weekly, by postcard, for a period of 1 year; nonreporters were contacted by telephone.

Patients using antidepressants should be followed closely because the risk of falls is increased. Previously reported relationships between benzodiazepines and diuretics and falls are not supported by the present findings. Clinical detection of orthostatic hypotension is unlikely to be useful in predicting future risk of falling.

Quick Facts:

59% of subjects fell at least once during the 1-year follow-up

Antidepressants were associated with increase risk of experiencing one or more falls (RR = 1.6, P = .02)

Other drugs examined, including diuretics and sedative-hypnotics, were not associated with an increased risk of falling

Orthostatic hypotension was not predictive of falls
Increase in the diastolic blood pressure of fallers after 5 minutes

VI. ECONOMIC FACTORS:

41. Robertson MC. Devlin N. Scuffham P. Gardner MM. Buchner DM. Campbell AJ. "Economic evaluation of a community-based exercise program to prevent falls." *Journal of Epidemiology & Community Health*. Aug 2001, 55(8): 600-6. To assess the incremental costs and cost effectiveness of implementing a home-based muscle strengthening and balance retraining program that reduced falls and injuries in older women. An economic evaluation carried out within a randomized controlled trial with two years of follow up. Participants were individually prescribed an exercise program (exercise group, n=116) or received usual care and social visits (control group, n=117). Seventeen general practices in Dunedin, New Zealand. Women aged 80 years and older living in the community and invited by their general practitioner to take part. Number of falls and injuries related to falls, costs of implementing the intervention, healthcare service costs resulting from falls and total healthcare service costs during the trial. Cost effectiveness was measured as the incremental cost of implementing the exercise program per fall event prevented. The costs resulting from falls make up a substantial proportion of the hospital costs for older people. Despite a reduction in falls as a result of this home exercise program there was no significant reduction in healthcare costs. However, the results reported will provide information on the cost effectiveness of the program for those making decisions on falls prevention strategies.

Quick Facts:

27% of total hospital costs during the trial were related to falls

Implementing the exercise program for one-year cost \$314 (1995 New Zealand dollars) per fall prevented and \$457 per fall resulting in moderate/serious injury prevented

Implementing exercise program for two years \$265 per fall prevented and \$426 per fall resulting in a moderate or serious injury prevented

- ☆ 42. US Department of Health and Human Services / Public Health Service. Centers for Disease Control and Prevention. "Incidence and Costs to Medicare of Fractures Among Medicare Beneficiaries Aged > 65 Years - United States, July 1991 - June 1992." *Morbidity and Mortality Weekly Report (MMWR)*. Oct 18, 1996, 45(41): 877-83.

Claims data were analyzed (n=1,288,618) to determine the incidence of fractures in persons 65 years or older and to estimate the excess costs to Medicare of these fractures during the 1-year period following.

Quick Facts:

- In 1991-1992, 26,785 fractures were identified among 1,288,618 Medicare beneficiaries
- Daily costs for person with a hip fracture were the highest at \$191.50 / day
- Daily costs for person with a fracture of the lower femur at \$153.98 / day
- Total excess cost to Medicare for patient w/ hip fracture after a year was \$15,294
- Total excess cost to Medicare for 10 fractures was \$4.2 billion
- Total excess cost to Medicare for hip fractures was \$2.9 billion (69%)

VII. COGNITIVE AIDS, NEWSLETTERS, VIDEOS:

43. VA National Center for Patient Safety. "Tips on Reducing Falls." TIPS, Topics in Patient Safety, Newsletter. 2002, 2(3):

<http://vaww.ncps.med.va.gov/TIPSarchive02.html>

44. VHA National Center for Patient Safety. Patient Personal Freedoms and Security. Fall Prevention and Management." October 2001:

<http://www.patientsafety.gov/FallPrev/howtostart.html>

45. Video: Fear of Falling. FFH 5783. Films for the Humanities & Sciences, Box 2053 Princeton, NJ 08543-2053: 800-257-5126

46. Tennstedt S. Peterson E. Howland J. Lachman M. A Matter of Balance: Managing Concerns about Falls. 1998. Boston University Roybal Center Consortium, Trustees of Boston University.

A group program developed by the Boston University Roybal Center Consortium uses cognitive restructuring techniques and skills training to change perceptions and behaviors in older adults whose activity levels have been limited by their fears about falling. The program has been implemented successfully by senior centers, senior housing sites, hospitals, and home health agencies. The program is a nine-session process.

VIII. SUGGESTED WEB PAGES

1. The Administration on Aging, <http://www.aoa.dhhs.gov/>
2. The American Association for Retired Persons, <http://www.aarp.org/>
3. CDC National Center for Injury Prevention, <http://www.cdc.gov/ncipc/falls/default.htm>
4. CDC - National Center for Injury Prevention: A Toolkit to Prevent Senior Falls, <http://www.cdc.gov/ncipc/pub-res/toolkit/toolkit.htm>
5. The Center for Aging Research and Clinical Care, <http://www.cornellaging.org/>
[go to http://www.cornellaging.org/medical/unit_gero.html to see a program showing the effect of disorders in the elderly on home design (Flash 6 required)]
6. The Gerontological Society of America, <http://www.geron.org/>
7. The Merck Institute of Aging & Health: Falls Toolkit, <http://www.miahonline.org/tools/falls/>
8. National Institute on Aging, <http://www.nia.nih.gov/>
9. Safe USA: Preventing Falls Among Older Adults, <http://www.safeusa.org/olderfalls.htm>
10. San Francisco Department of Public Health, <http://www.dph.sf.ca.us/PHP/CHIPPS.htm>

Additional Resources Online

1. Technology Assessment Guide, http://vaww.ncps.med.va.gov/fallstoolkit/resources/other/Technology_Assessment_Guide.pdf
 2. Education Resource Guide, http://vaww.ncps.med.va.gov/fallstoolkit/resources/other/Education_Resource_Guide.pdf
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