Published in final edited form as:
Jt Comm J Qual Patient Saf. 2012 September ; 38(9): 408–413.

Is It Possible to Identify Risks for Injurious Falls in Hospitalized Patients?

Lorraine C. Mion, PhD, RN, FAAN [Independence Foundation Professor],
Vanderbilt University School of Nursing, Nashville, Tennessee

A. Michelle Chandler [Research Coordinator],
Medical Education and Research, Methodist Healthcare, Memphis

Teresa M. Waters, PhD [Professor],
Department of Preventive Medicine, University of Tennessee Health Science Center, Memphis

Mary S. Dietrich, PhD [Research Associate Professor and Statistician],
Schools of Medicine and Nursing, Vanderbilt University

Lori A. Kessler, PharmD [Administrative Director],
Medical Education and Research, Methodist Healthcare

Stephen T. Miller, MD [Professor of Medicine], and
University of Tennessee Center for Health Sciences; and Medical Director for Medical Education and Research, Methodist Le Bonheur Healthcare, Memphis

Ronald I. Shorr, MD, MS [Formerly Associate Professor]
Department of Preventive Medicine, University of Tennessee, Memphis, is Professor, College of Medicine, University of Florida; and Director, Geriatric Research Education and Clinical Center, North Florida/South Georgia Veterans Health System, Gainesville

Abstract

Background—Patient falls are among the most commonly reported adverse hospital events with more than one million occurring annually in the United States; approximately 10% result in serious injury. A retrospective study was conducted to determine predictors and outcomes of fall injuries among a cohort of adult hospitalized patients.

Methods—Data were obtained regarding patients who sustained an initial fall in hospital during a 26-month period from 16 adult general medical and surgical units in an urban university-affiliated community hospital. Data on intrinsic (individual) factors, extrinsic (environmental) factors, and situational activities were collected via nurse and patient interviews, patient examinations, and audits of incident reports and electronic health records. Fall injuries were classified as none/any for analyses. Unadjusted odds ratios [ORs] and 95% confidence intervals [CIs] for each of the variables of interest with fall injury were generated using logistic regressions.

Results—The 784 patients had a median age of 63.5 years (range, 20 to > 90 years), 390 (50%) were women, and 526 (67%) were black. Some 228 (29%) fallers sustained injury; patients who were white (OR: 2.23; 95% CI: 1.62, 3.08), or were administered a selective serotonin reuptake inhibitor (OR: 1.04; 95% CI: 1.04, 2.67), two antipsychotic agents (OR: 3.26; 95% CI: 1.20, 8.90), an opiate (OR: 1.59; 95%; CI: 1.14, 2.20), or a diuretic non-antihypertensive agent (OR: 1.53; 95% CI: 1.03, 2.26) were more likely to sustain an injury. Home-based wheelchair use was

Please address correspondence to Lorraine Mion, Lorraine.c.mion@vanderbilt.edu.

protective of fall injury (OR: 0.20; 95% CI: 0.05, 0.84). Seventy-nine percent of the patients had been designated as “high” fall risk within 24 hours before the fall.

Conclusions—Few variables were able to distinguish patients who sustained injury after a hospital fall, further challenging clinicians’ efforts to minimize hospital-related fall injury.

Patient falls are among the most commonly reported adverse hospital events, with more than one million occurring annually in the United States; approximately 10% result in serious injury.[1] Among older adults, falls are particularly dangerous because of their increased causation of morbidity and mortality.[1,2] This is particularly worrisome because older adults (> 65 years of age) comprise more than one third of hospital admissions.[3] Significant hospital costs (for care, increased length of stay, and liability) are associated with falls.[4,5] Moreover, in 2008 the Centers for Medicare & Medicaid Services eliminated payment to hospitals for cost of treating these injuries.[6] Thus, the potential for cost savings if hospital fall injuries can be reduced is great.

The causes of falls are heterogeneous and represent an interaction among intrinsic factors (that is, individual), extrinsic factors (environmental) and situational activities (for example, bending, reaching).[7] Organizational factors influencing fall rates are an additional domain to consider in health care settings.[8–12] Most hospital fall prevention programs, however, rely primarily on clinicians’ judgment of patient factors and accomplishing numerous cognitive tasks to (1) assess each patient for multiple risk factors, (2) identify patients at high risk of falls, and (3) institute a variety of prevention strategies. Major meta-analyses have found that fall prevention in community-dwelling older adults is cost-effective but that hospital fall prevention strategies are only modestly effective despite more than 20 years of intense effort.[1,2,13]

Given the fact that hospital falls cannot be entirely prevented, another avenue for staff efforts is the prevention of fall *injuries.* Although there are numerous hospital fall risk assessment tools,[2] factors that place hospital patients at high risk for fall injury are based on expert opinion and focus primarily on advanced age (that is, 85 years of age or older), presence of osteoporosis, and use of anticoagulation.[14,15] In the past decade, investigators have examined predictors of fall injuries among hospitalized adults; most of these studies have been retrospective designs dependent primarily on incident reporting systems and have yielded varying results.[4,16–21] In a retrospective study, using multiple sources of data, we attempted to identify the individual, environmental, and situational activities that were predictors of fall injuries among a cohort of adult hospitalized patients who fell in hospital during a 26-month period and to determine hospital outcomes associated with hospital fall injury.

Methods

Setting

This study was part of a larger, cluster randomized trial that we conducted to test the effectiveness of bed alarms at Methodist University Hospital, a 661-bed urban, academically affiliated, community hospital in Memphis.[22] The study’s 16 units, totalling 349 beds, ranged in size from 18 to 36 beds (median, 24 beds) and included medical, general surgery, neurology, orthopedic surgery, surgical oncology, solid organ transplant, and cardiovascular step-down clinical services. The research protocol was reviewed and approved by the Methodist Healthcare Institutional Review Board.

Participants

All adults admitted to the study units between September 9, 2005, and October 30, 2007, were followed from time of admission to time of discharge. Patients who fell were included in this secondary study. Only first-time fall events were examined.

Variables

Fall Event—A fall event was defined as a sudden, unintentional change in position, coming to rest on the ground or other lower level.[7] Ascertainment of fall events was accomplished via several mechanisms: An online incident report system, regular rounding and inquiry by fall study personnel, and clinical personnel's reporting of all fall events to a centralized hospital fall evaluation service.[23]

Fall Injury—The primary outcome, fall injury, was categorized as one of the following[24]:

1. None
2. Minor—resulted in application of a dressing, ice, cleaning of a wound, limb elevation, or topical medication
3. Moderate—resulted in suturing, application of butterfly stitches/skin glue, or splinting
4. Major—resulted in surgery, casting, traction, or required consultation for neurologic or internal injury
5. Death—the patient died as a result of injuries sustained from the hospital fall (not from the physiologic events causing the fall).

Predictor Variables—Data on predictor variables representing intrinsic factors were gathered from the electronic health record and included patient demographics, admission source, specific disease conditions associated with high fall prevalence (congestive heart failure, diabetes, hypertension, dementia, Parkinson's, stroke, delirium), medication classes associated with fall prevalence or fall injury that were administered 24 hours before the fall event (anticoagulant, antidepressant, CNS [central nervous system], Alzheimer's, sedative, psychotropic, antihypertensive, antiemetic, opiate),[25] surgery/anesthesia within seven days before the fall, and laboratory values before the fall event (hematocrit, white blood cell count, blood urea nitrogen, creatinine, potassium, albumin). All patients had a fall risk assessment (a modified Morse Scale[26]) documented each day. The fall risk status (low/high) closest to the fall event was abstracted. After the fall event, patients were examined by trained nurse evaluators for cognitive impairment, delirium, and orthostatic hypotension.

Predictor variables representing environmental/extrinsic factors and situational factors were ascertained by trained nurses evaluators from patient interviews, nurse interviews, and chart audits. Variables included time of fall, location of fall, assistive devices (canes, walkers, wheelchairs), medical devices (intravenous line, bladder catheter, gastrostomy/feeding tube, pneumatic compression stockings, other), bed-related fall (transferring in or out of bed, rolled out of bed), side-rail use, physical restraint in place at the time of the fall, noted environmental cause (tripping, unlocked bed/chair wheels, tangled in linen or tubing, slipping off air mattress), the patient's activity at the time of the fall, whether a bed alarm was in use, and whether the call light was in reach.

Hospital Outcomes—Hospital outcomes were broadly categorized as resource utilization, practice patterns, and discharge disposition. Resource utilization included use of

radiology tests within 24 hours after the fall, surgical procedure for a fall injury, and hospital length of stay.

Practice patterns were new orders for physical restraint, change in medication as a result of a fall, and physical or occupational order as a result of a fall. Discharge disposition was recorded as home, assisted living, postacute facility, long term care, hospice, or death.

Data Collection

Trained fall evaluators—primarily registered nurses—used standardized data collection instruments to gather information within 24 hours of the fall event. Data were collected via patient interviews, patient examinations, nurse interviews, and chart audits. Medical record audits for pre- and postfall data were conducted by research personnel [A.M.C., L.A.K].

Data Analyses

Data analyses were conducted using SPSS v. 17.0 (SPSS Inc., Chicago). Descriptive statistics included frequencies and percentages for categorical variables and means, standard deviations, medians, and ranges for continuous variables. Any fall injury (minor to death) was compared with no fall injury. Between group comparisons were conducted using chi-square tests for categorical variables and Mann-Whitney U tests for skewed continuous variables. Certain continuous variables that are not linearly associated with falls were dichotomized to indicate abnormal level/normal level: Abnormal albumin (< 2.5 g/dL), abnormal potassium level (< 3, > 5.2 mEq), abnormal creatinine (< 0.5, > 1.2 mg/dL), abnormal blood urea nitrogen (BUN; < 10, > 20 mg/dL), abnormal white blood cell count (< 4,000, > 12,000/cu mm), abnormal hematocrit (< 36%, > 53%), abnormal heart rate (< 58, > 89), abnormal diastolic blood pressure (< 60, > 89), abnormal systolic blood pressure (< 90, > 140). Logistic regressions were used to generate unadjusted odds ratios (ORs) with 95% confidence intervals (CIs) for each of the study variables with the likelihood of fall injury. We used an alpha of .05 throughout. The statistical tests were not adjusted for multiple comparisons. The impact of fall injury on discharge disposition, hospital resource utilization, and practice patterns was also investigated via descriptive statistics, and logistic regressions and unadjusted ORs were calculated.

Results

Participant Profile

Some 969 patients and 1,097 fall events were identified. Interview and electronic health record data were available for 784 (81%) of the patients with first-time fall events. Half the sample was female, 31% were white, and 67% were black. Patient ages ranged from 20 to > 90 years (median age, 63.5 years; mean, 63.3 years [±15.8]). Forty-seven percent were age 65 years or older, and patients age 75 years and older comprised 28% of the fallers. There was an equivalent distribution of race among age group and sex by fall injury (none versus any). Seventy-nine percent of the patients had been designated as “high” fall risk within the 24 hours before the fall.

Fall-Injury Description

Of the 784 patients, 228 (29%) sustained some level of injury. Of these, 187 (82%) were minor, 16 (7%) moderate, 21 (9%) major, and 4 (2%) fall injuries resulted in death during hospitalization (1 subdural hematoma, 3 hip fractures). Sites of injury were lower extremity other than hip (27%), head nonfacial (25%), upper extremity (24%), hip (14%), face (12%), back (7%), other (8%). More than one body site could be affected. Table 1 (page 411) displays the descriptors of the fall events. There were slightly more falls during the first four hours of the day as compared with other four-hour intervals. The majority occurred in the

patient's room, almost half were bed related, 18% were attributable to an environmental cause, approximately two thirds of the patients had at least one medical device, and one third of the falls were related to elimination needs.

Predictors of Fall Injury

Patient Intrinsic Factors—Appendixes 1 and 2 (available in online article) display the unadjusted ORs with 95% CIs for all patient intrinsic factors. The only statistically significant associations of patient intrinsic factors with fall injury were observed for race and some classes of medications. One hundred sixteen (47%) of the 247 white patients versus 129 (24%) of the 537 nonwhite patients (526 blacks, 3 Hispanics, 5 Asian Americans, and 3 "other") sustained some level of injury (OR: 2.23; 95% CI: 1.62, 3.08, $p < .001$).

Higher proportions of injured fallers versus noninjured fallers were administered a selective serotonin reuptake inhibitor (SSRI) antidepressant (15% versus 10%, OR: 1.04; 95% CI: 1.04, 2.67); two antipsychotic agents (4% versus 1%, OR: 3.26; 95% CI: 1.20, 8.90), an opiate (41% versus 30%, OR: 1.59; 95% CI: 1.14, 2.20), and a diuretic non-antihypertensive agent (23% versus 16%, OR: 1.53; 95% CI: 1.03, 2.26). None of the other patient intrinsic factors demonstrated statistically significant associations with the likelihood of sustaining an injury from a fall (Appendixes 1 and 2).

Extrinsic and Situational Factors—Appendix 3 (available in online article) displays the unadjusted ORs with 95% CIs for extrinsic and situational factors. Of those factors, only home use of wheelchair identified on admission demonstrated a statistically significant inverse relationship with fall injury (OR: 0.20; 95% CI: 0.05, 0.84).

Hospital Resource Utilization, Discharge Disposition, and Practice Patterns Postfall—Of the 206 (26%) patients given a radiology exam following a fall, 129 (63%) were for those who sustained injury (OR: 8.00; 95% CI: 5.61, 11.43). Nine (4%) of the injured patients underwent surgical procedures because of their fall injuries. New orders for physical restraints were initiated for 16% of the injured fallers and 15% of the noninjured fallers. There was a trend of medication changes among injured fallers as a direct result of the fall (13% versus 8%, OR: 1.62; 95% CI: 0.99, 2.65). Physical or occupational therapy was ordered for 8% of the injured fallers and 6% of the noninjured fallers. Discharge disposition patterns were also similar between injured fallers and noninjured fallers: Home discharge 49% (versus 44%), postacute care 17% (15%), long term care 6% (9%), and hospital death 8% (7%), respectively. Hospital length of stay did not differ significantly, with a median of 11 days for each group.

Discussion

Hospital falls are an important patient safety issue, and much attention in the interest of developing fall prevention strategies has been devoted to predicting which patients are most likely to fall.[2,27,28] Despite several decades of clinical research, hospital falls have remained relatively stable in the United States. Some have expressed the opinion that prevention strategies should focus on fall injury rather than on falls per se, and several risk factors on the basis of expert opinion have been proposed.[14,15] This retrospective study of adult medical/surgical patients provides little evidence to help distinguish those likely to sustain an injury in the event of a hospital fall.

Within this cohort of 784 fallers, 29% sustained some type of injury, and 5% sustained injury classified as moderate to severe, with four of these related to an inpatient death. In previous hospital studies in the United States, the proportion of fallers having any type of

injury range from 23% to 42%, and the proportion of those sustaining moderate to severe injuries range from 1.5% to 8%.[4,16–20] The wide variation in results is likely due to study design differences, including settings, classification of injury severity, ascertainment of falls, ascertainment of fall injury, variable selection, data collection procedures, and comparison group (for example, nonfallers versus noninjured fallers).

We examined a number of intrinsic, situational, and extrinsic factors that may distinguish those likely to sustain a fall injury, few of which were significant. Several medication classes were associated with an increased risk for fall injury: SSRIs, concomitant use of two classifications of antipsychotic medications, opiates, and diuretics for other than hypertension management. Of four hospital-based studies that examined the association of medication classes with fall injury, no medications were found to be statistically significant.[4,17,19,20] However, our findings of an increased risk of fall-injury reflect those found in community- and nursing home–based studies for those on SSRIs,[29–33] benzodiazepines,[29,31,34] conventional antipsychotics,[35] and opiates.[36] For a number of years, the Beers Criteria for potentially inappropriate medications (PIMs) has designated benzodiazepines, conventional antipsychotics, and opiates as PIMs because of increased risk of falls, fall injury, and delirium for older adults.[37] During this time, geriatricians had recommended SSRIs as first line therapy for depression.[38] Because of the growing body of evidence indicating the increased risk for falls and fall injuries with SSRIs, independent of depression, the updated 2012 American Geriatric Society Beers Criteria designates SSRIs as a medication to avoid unless safer alternatives are not available.[39]

The finding of white race as a predictor of fall injury is puzzling because neither advanced age nor sex was associated with racial distribution. Nor did we find advanced age or being female to be associated with fall injury; indeed the influence of age, sex, or race is inconsistent among previous hospital studies.[4,16–20]

The finding of wheelchair use as protective may likely be a result of falling from a lower height. Others have postulated that falling from greater heights has greater fall impact that could contribute to injury,[40,41] although one clinical trial of very low beds failed to reduce hospital fall injuries.[42] One other hospital-based study found that height of fall may have an association with fall injury; Bradley and colleagues reported that patients who had an activity order for ambulation were at increased risk for fall injury.[17]

Discharge disposition, practice patterns, and hospital resource utilization other than use of imaging procedures did not differ among fallers with no injury and those with injury.

A major strength of the study was the use of multiple methods for data collection: Chart abstraction, hospital administrative databases, nurse interviews, patient interviews, and targeted examinations. However, despite the standardized approach using multiple data sources, there were still a number of patients for whom data were not available, a limitation that has plagued many hospital-based fall studies. A second limitation is that there are likely unmeasured confounders, including work environment issues such as staffing. Finally, the study was limited to one large urban hospital, limiting the generalizability of the findings. Nevertheless, our approach is, to our knowledge, the most comprehensive to date.

Implications

The major result of this study is what we did *not* find, despite using a liberal definition of "fall injury" and not adjusting for the multiple comparisons. Identifying salient risk factors that are generalizable across varying acute patient populations is difficult. Several meta-analyses have demonstrated that fall risk scales have moderate predictive accuracy at best and often do not perform significantly better than clinical nursing judgment.[2,27,28] Given the

multifactorial etiology of falls (intrinsic, extrinsic, situational, and organizational factors), this is not surprising. We found that 79% of the patients who sustained a fall injury had been classified as high fall risk, which means that one fifth of fall-injured patients had been classified as low risk. We believe that predicting fall injury among hospitalized patients will face the same issues as trying to predict those likely to fall, bringing into question the utility of further efforts and resources devoted to development and validation of fall-injury risk scales.[2,28,29]

Single-intervention hospital strategies aimed at preventing falls are ineffective; rather a multicomponent strategy and/or targeted approach shows promise.[2,13,43,44] Recent studies designed to implement multiunit, multicomponent, patient-specific strategies in acute care hospitals have had mixed results.[45–47] There is a need to examine both patient- and organization-specific interventions. The approach to hospital fall prevention should center on commonly known risk factors for falls, such as postural instability and select medications, and apply intervention(s) to reverse or at least modify the associated risk.[2] Further, it may be that successful organizational strategies are those at the unit rather than hospital level, accounting for unit variation in physical design, patient population, nursing workload, and care delivery models.[8,12,48–50] In November 2011 The Joint Commission Center for Transforming Healthcare launched a multisite project using Robust Process Improvement™ (RPI) methods and tools to develop solutions to prevent falls that occur in health care facilities and result in injury to patients.[51]

As evidence accumulates of successful approaches to prevent hospital fall injuries, clinical and administrative leadership will be better able to determine sustainable and cost-effective strategies to implement within their settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The work represented in this article was supported by a grant from the National Institute on Aging/NIH R01AG025285.

References

1. Currie, L. Fall and injury prevention. In: Hughes, RG., editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville, MD: Agency for Healthcare Research and Quality; 2008. http://www.ncbi.nlm.nih.gov/books/NBK2651/
2. Oliver D, Healey F, Haines T. Preventing falls and fall-related injuries in hospitals. Clin Geriatr Med. 2010; 26(4):645–692. [PubMed: 20934615]
3. Agency for Healthcare Research and Quality. [Accessed Aug 1, 2012] Healthcare Cost and Utilization Project (HCUP), Nationwide Inpatient Sample (NIS). National Statistics for All Stays (2010 and age group). http://hcupnet.ahrq.gov
4. Bates DW, et al. Serious falls in hospitalized patients: Correlates and resource utilization. Am J Med. 1995; 99(2):137–143. [PubMed: 7625418]
5. Wong C, et al. The cost of serious fall-related injuries at three Midwestern hospitals. Jt Comm J Qual Patient Saf. 2011; 37(2):81–87. [PubMed: 21939135]
6. US Centers for Medicare & Medicaid Services. Medicare program; proposed changes to the hospital inpatient prospective payment systems and fiscal year 2008 rates; correction. Fed Regist. 2007 Jun 7; 72(109):31507–31540.
7. Tinetti ME, Speechley M. Prevention of falls among the elderly. N Engl J Med. 1989 Apr 20; 320(16):1055–1059. [PubMed: 2648154]

8. Cummings GG, et al. Influence of organizational characteristics and the context on research utilization. Nurs Res. 2007; 56(4 Suppl):S24–39. [PubMed: 17625471]

9. Tzeng HM, Hu HM, Yin CY. The relationship of the hospital-acquired injurious fall rates with the quality profile of a hospital's care delivery and nursing staff patterns. Nurs Econ. 2011; 29(6):299–306. [PubMed: 22360104]

10. Tzeng HM, Yin CY. The extrinsic risk factors for inpatient falls in hospital patient rooms. J Nurs Care Qual. 2008; 23(3):233–241. [PubMed: 18562866]

11. Lake ET, et al. Patient falls: Association with hospital Magnet status and nursing unit staffing. Res Nurs Health. 2010; 33(5):413–425. [PubMed: 20824686]

12. Mion LC, et al. Outcomes following physical restraint reduction programs in two acute care hospitals. Jt Comm J Qual Improv. 2001; 27(11):605–618. [PubMed: 11708040]

13. Cameron ID, et al. Interventions for preventing falls in older people in nursing care facilities and hospitals. Cochrane Database Syst Rev. 2010 Jan 20.(1):CD005465. [PubMed: 20091578]

14. Quigley PA, et al. Reducing serious injury from falls in two veterans' hospital medical-surgical units. J Nurs Care Qual. 2009; 24(1):33–41. [PubMed: 19092477]

15. Robert Wood Johnson Foundation. [Accessed Jul 30, 2012] Prevention of Hospital Falls: An RWJF National Program. May 27. 2010 http://www.rwjf.org/files/research/HFS.final.pdf

16. Fischer ID, et al. Patterns and predictors of inpatient falls and fall-related injuries in a large academic hospital. Infect Control Hosp Epidemiol. 2005; 26(10):822–827. [PubMed: 16276957]

17. Bradley SM, et al. Predictors of serious injury among hospitalized patients evaluated for falls. J Hosp Med. 2010; 5(2):63–68. [PubMed: 20104622]

18. Krauss MJ, et al. Circumstances of patient falls and injuries in 9 hospitals in a Midwestern healthcare system. Infect Control Hosp Epidemiol. 2007; 28(5):544–550. [PubMed: 17464913]

19. Chelly JE, et al. Risk factors and injury associated with falls in elderly hospitalized patients in a community hospital. J Patient Saf. 2008; 4(3):178–183.

20. Hitcho EB, et al. Characteristics and circumstances of falls in a hospital setting: A prospective analysis. J Gen Intern Med. 2004; 19(7):732–739. [PubMed: 15209586]

21. Brand CA, Sundararajan V. A 10-year cohort study of the burden and risk of in-hospital falls and fractures using routinely collected hospital data. Qual Saf Health Care. 2010; 19(6):e51. [PubMed: 20558479]

22. Shorr RI, et al. Trial of proximity alarms to prevent patient falls in hospitals. J Am Geriatr Soc. 2010; 58(Suppl 1):S103–104.

23. Shorr RI, et al. Improving the capture of fall events in hospitals: Combining a service for evaluating inpatient falls with an incident report system. J Am Geriatr Soc. 2008; 56(4):701–704. [PubMed: 18205761]

24. Montalvo I. The National Database of Nursing Quality Indicators® (NDNQI). Online J Issues Nurs. 2007 Sep 30.12(3) http://nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume122007/No3Sept07/NursingQualityIndicators.html.

25. Walker PC, et al. Medication use as a risk factor for falls among hospitalized elderly patients. Am J Health Syst Pharm. 2005 Dec 1; 62(23):2495–2499. [PubMed: 16303905]

26. McFarlane-Kolb H. Fall risk assessment, multitargeted interventions and the impact on hospital falls. Int J Nurs Pract. 2004; 10(5):199–206. [PubMed: 15461689]

27. Oliver D, et al. Risk factors and risk assessment tools for falls in hospital in-patients: A systematic review. Age Ageing. 2004; 33(2):122–130. [PubMed: 14960426]

28. Haines TP, et al. Design-related bias in hospital fall risk screening tool predictive accuracy evaluations: Systematic review and meta-analysis. J Gerontol A Biol Sci Med Sci. 2007; 62(6):664–672. [PubMed: 17595425]

29. Woolcott JC, et al. Meta-analysis of the impact of 9 medication classes on falls in elderly persons. Arch Intern Med. 2010 Nov 23; 169(21):1952–1960. [PubMed: 19933955]

30. Vestergaard P, Rejnmark L, Mosekilde L. Selective serotonin reuptake inhibitors and other antidepressants and risk of fracture. Calcif Tissue Int. 2008; 82(2):92–101. [PubMed: 18219438]

31. Vestergaard P, Rejnmark L, Mosekilde L. Anxiolytics, sedatives, antidepressants, neuroleptics and the risk of fracture. Osteoporos Int. 2006; 17(6):807–816. [PubMed: 16520889]
32. Hegeman J, et al. Unraveling the association between SSRI use and falls: An experimental study of risk factors for accidental falls in long-term paroxetine users. Clin Neuropharmacol. 2011; 34(6): 210–215. [PubMed: 21996643]
33. Kerse N, et al. Falls, depression and antidepressants in later life: A large primary care appraisal. PLoS One. 2008 Jun 18.3(6):e2423. [PubMed: 18560599]
34. Nurminen J, et al. Psychotropic drugs and the risk of fractures in old age: A prospective population-based study. BMC Public Health. 2010 Jul 6.10:396. [PubMed: 20602803]
35. Pouwels S, et al. Antipsychotic use and the risk of hip/femur fracture: A population-based case-control study. Osteoporos Int. 2009; 20(9):1499–1506. [PubMed: 19156348]
36. Buckeridge D, et al. Risk of injury associated with opiod use in older adults. J Am Geriatr Soc. 2010; 58(9):1664–1670. [PubMed: 20863326]
37. Fick DM, et al. Updating the Beers Criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. Arch Int Med. 2003 Dec 8–22; 163(22):2716–2724. [PubMed: 14662625]
38. Reuben, DB., et al. Geriatrics at Your Fingertips 2010. 12. New York City: American Geriatrics Society; 2010.
39. American Geriatrics Society 2012 Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2012; 60(4):616–631. [PubMed: 22376048]
40. Capezuti E, et al. Bed and toilet height as potential environmental risk factors. Clin Nurs Res. 2008; 17(1):50–66. [PubMed: 18184978]
41. Bowers B, et al. Biomechanical evaluation of injury severity associated with patient falls from bed. Rehabil Nurs. 2008; 33(6):253–259. [PubMed: 19024240]
42. Haines TP, Bell RA, Varghese PN. Pragmatic, cluster randomized trial of a policy to introduce low-low beds to hospital wards for the prevention of falls and fall injuries. J Am Geriatr Soc. 2010; 58(3):435–441. [PubMed: 20398112]
43. Coussement J, et al. Interventions for preventing falls in acute- and chroniccare hospitals: A systematic review and meta-analysis. J Am Geriatr Soc. 2008; 56(1):29–36. [PubMed: 18031484]
44. Clyburn TA, Heydemann JA. Fall prevention in the elderly: Analysis and comprehensive review of methods used in the hospital and in the home. J Am Acad Orthop Surg. 2011; 19(7):402–409. [PubMed: 21724919]
45. Dykes PC, et al. Fall prevention in acute care hospitals: A randomized trial. JAMA. 2010 Nov 3; 304(17):1912–1918. [PubMed: 21045097]
46. Cumming RG, et al. Cluster randomized trial of a targeted multifactorial intervention to prevent falls among older people in hospital. BMJ. 2008 Apr 5; 336(7647):758–760. [PubMed: 18332052]
47. Ang E, Mordiffi SZ, Wong HB. Evaluating the use of a targeted multiple intervention strategy in reducing patient falls in an acute care hospital: A randomized controlled trial. J Adv Nurs. 2011; 67(9):1984–1992. [PubMed: 21507049]
48. Minnick AF, et al. Resource clusters and variation in physical restraint use. J Nurs Scholarsh. 2007; 39(4):363–370. [PubMed: 18021138]
49. Catrambone C, et al. The design of adult acute care units in U.S. hospitals. J Nurs Scholarsh. 2009; 41(1):79–86. [PubMed: 19335681]
50. Oliver D. Prevention of falls in hospital inpatients: Agendas for research and practice. Age Ageing. 2004; 33(4):328–330. [PubMed: 15226103]
51. The Joint Commission Center for Transforming Healthcare. [Accessed Jul 30, 2012] Project Detail: Preventing Falls with Injury. http://www.centerfor-transforminghealthcare.org/projects/detail.aspx?Project=7

Table 1

Fall Events Among 784 Hospitalized Adults

Variable	Percentage
Time of Day	
Midnight–3:59 A.M.	22
4 A.M.–7:59 A.M.	16
8 A.M.–11:59 A.M.	12
Noon–3:59 P.M.	14
4 P.M.–7:59 P.M.	16
8 P.M.–11:59 P.M.	17
Fall Location	
Bathroom	10
Patient's room	85
Hall	2
Other hospital area	1
Outside hospital	< 1
Bed Related	47
Environmental Cause *	18
Physical Restraint	5
Medical Devices	
Intravenous line †	57
Bladder catheter	17
Feeding tube	4
Compression stockings	4
Other devices	5
Any device	64
Patient Activity at Time of Fall	
Unknown	9
Getting in/out of bed	45
Rolled out of bed	3
Getting on/off chair/toilet	10
Standing (for example, at sink)	13
Bending/reaching	8
Walking	5
Intrinsic event ‡	< 1
Elimination Needs Related	33

* Identified environmental causes: Tripped, bed/chair not locked, tangled in linen, slipped off mattress.

† Central or peripheral.

‡Stroke, pulmonary embolism.