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Inpatient Falls: Defining the Problem and Identifying Possible Solutions. Part I: An Evidence-Based Review

Jennifer R. Simpson, MD[1], Laura D. Rosenthal, DNP, ACNP[2], Ethan U. Cumbler, MD[3], and David J. Likosky, MD[4]

Abstract

In this 2 part series, analysis of the risk stratification tools that are available, definition for the scope of the problem, and potential solutions through a review of the literature are presented. A systematic review was used to identify articles for risk stratification and interventions. Three risk stratification systems are discussed, St Thomas's Risk Assessment Tool in Falling Elderly Inpatients, Morse Fall Scale, and the Hendrich Fall Risk Model. Of these scoring systems, the Hendrich Fall Risk Model is the easiest to use and score. Predominantly, multifactorial interventions are used to prevent patient falls. Education and rehabilitation are common themes in studies with statistically significant results. The second article presents a guide to implementing a quality improvement project around hospital falls. A 10-step approach to Plan-Do-Study-Act (PDSA) cycles is described. Specific examples of problems and analysis are easily applicable to any institution. Furthermore, the sustainability of interventions and targeting new areas for improvement is discussed. Although specific to falls in the hospitalized patient, the goal is to present a stepwise approach which is broadly applicable to other areas requiring quality improvement.

Keywords

accidental falls, inpatients, review

Introduction

An increased focus is being placed on inpatient falls. The reasons for this are multiple including associated morbidity and mortality, increased cost of care, and lack of reimbursement from the payors. The World Health Organization defines a fall as ''inadvertently coming to rest on the ground, floor, or other lower level, excluding intentional change in position.''[1] Significantly, while having been reported in between 2% and 12% of admissions,[2] these events are found to cause harm in up to 40% of the patients.[3,4] In addition to the real personal cost, the financial impact associated with these falls are of consequence, associated with an increase in hospital charges and longer length of stay.[5] Given the preventable nature of many of these events, scrutiny by payors has followed. The Centers for Medicare and Medicaid Services have listed falls as a ''never'' event and therefore do not reimburse hospitals for expenses associated with the care for an inpatient fall.[6]

The nature of falls and their prevalence in patients with neurologic admissions will inevitably affect the neurohospitalist, presenting an excellent opportunity for involvement in risk reduction. Patients with neurological weakness with or without a clouded sensorium are clearly at risk of falls. In addition, assessing patients with potentially significant head injuries after a fall may well involve the neurohospitalist by nature of their presence and specialty interest. Beyond the clinical care of the individual patient, however, falls may be addressed systematically. The result is the potential to improve the care of the entire hospital population and to develop or fortify the infrastructure necessary to do so for other clinical conditions or events.

[1] Departments of Neurology and Internal Medicine, University of Colorado, Denver, CO, USA
[2] School of Nursing and School of Medicine, University of Colorado, Denver, CO, USA
[3] Department of Internal Medicine, University of Colorado, Denver, CO, USA
[4] Departments of Neurology and Hospitalist Internal Medicine, Evergreen Health, University of Washington, WA, USA

Corresponding Author:
Jennifer R. Simpson, Departments of Neurology and Internal Medicine, University of Colorado, Denver, Mail Stop B185, 12631 E. 17th Avenue, Aurora, CO 80045, USA.
Email: jennifer.simpson@ucdenver.edu

In this 2-part series, we will first assess the risk stratification tools that are available, and then define the scope of the problem and potential solutions through a review of the literature. The second article will present a guide to implementing a quality improvement project around hospital falls. Although specific to falls in the hospitalized patient, the goal is to present a stepwise approach which is broadly applicable.

Methods

A literature search using PubMed database was performed for articles published prior to January 21, 2012 concerning inhospital fall prevention programs. No time limit was set. Combinations of the words accidental falls (MESH), patient falls, inhospital falls, hospitals, hospitalization (MESH), acute care, prevention, intervention, economics, risk management, and adult were used. The Cochrane library was searched using the phrase "hospital fall interventions." References from included articles and reviews were used to complete the search. The search was used to identify articles about predicting falls and interventions to reduce falls. A review of all abstracts eliminated articles regarding falls in outpatient settings, children, and letters. For studies regarding interventions, studies that were not randomized were excluded.

Risk Stratification

Risk stratification of falling patients is difficult, as the etiology of inpatient falls is multifactorial. In the literature, there are over 35 common factors thought to be directly related to inpatient falls. Over 15 scales attempt to identify patients at risk of falling.[7-21] The majority of these tools have not been validated, include only 1 population, or lack adequate sensitivity or specificity for clinical use. Three of these fall risk tools have been validated in multiple studies across the populations. These are the St Thomas's Risk Assessment Tool in Falling Elderly Inpatients (STRATIFY), the Morse Fall Scale (MFS), and the Hendrich Fall Risk Model (HFRM).

The original phases of STRATIFY were completed within various hospitals in London, England. The population (n = 548) was limited to inpatients ≥65 years of age. When predicting falls within a week of admission at a local hospital, a STRATIFY score of ≥2 points had a sensitivity of 93% and a specificity of 88%. A score of ≥3 points had a sensitivity of 69% and a specificity of 96%.[20]

Since the initial evaluation of the STRATIFY risk tool (Figure 1) in 1997, multiple studies have examined the validity of the tool.[7,22-24] A meta-analysis of 12 articles on STRATIFY completed by Harrington et al revealed that STRATIFY may be clinically useful in the specific settings where studied, but may not have accurate clinical use outside these areas.[22] When compared to other fall risk stratification tools, the STRATIFY had lower sensitivity and higher specificity.

The MFS (Figure 2) was prospectively trialed in 2 facilities and 3 types of clinical areas (n = 2689).[18] Sensitivity of the original scale was 78% and specificity was 83%. This scale placed patients into categories of high risk (≥45), medium risk (25-44), and low risk (≤20). The meta-analysis by Harrington et al stated that the MFS had significantly higher sensitivity, but lower specificity than that of STRATIFY.[22]

1. Did the patient present to hospital with a fall or has he or she fallen on the ward since admission? (Yes=1, No=0)

Do you think the patient is (questions 2-5)

2. Agitated? (Yes=1, No=0)
3. Visually impaired to the extent that everyday function is affected? (Yes=1, No=0)
4. In need of especially frequent toileting? (Yes=1, No=0)
5. Transfer and mobility score of 3 or 4? (Yes=1, No=0)

Total score

Figure 1. St Thomas's Risk Assessment Tool in Falling Elderly Inpatients (STRATIFY) risk assessment tool.

The HFRM (Figure 3) divides patients into normal/low risk (0-2), high risk (3-6), and extremely high risk (>6) for inpatient falls.[13] The original scale had a sensitivity of 77% and specificity of 72%. This study was a retrospective case–control chart review (n = 338) completed at a large Midwest teaching institution. Hendrich modified this scale into the Hendrich II Fall Risk Model (HFRM II) and validated the modified scale (Figure 4) with an additional case–control study (n = 338) in 2003 at a 750-bed acute care hospital. In this population, sensitivity and specificity of the HFRM II was similar to the HFRM in the first study (75% and 74%).[14] The HFRM II has since been validated in an Italian acute geriatric unit (n = 179).[25] The HFRM has been compared to the STRATIFY and the MFS. With a cutoff score of ≥5, the sensitivity of HFRM is 70% and specificity is 61%. Scoring ≥25 on the MFS has a higher specificity, 88%, but a lower specificity, 48.3%, makes the HFRM a more suitable tool. Of all the 3 tools, the HFRM was more user friendly and easier to score.[23]

Common themes that indicate increased risk of patient falls between these 3 tools, and others, include assessment for previous falls or admission secondary to falling, presence of mental confusion or agitation, necessity for frequent toileting, and altered gait or mobility.[9,13,14,19,21,25-41] One of the most common populations studied and cited as high risk of falls is the older adult (≥65).[8,16,17,27-30,42-48] Medications including benzodiazepines, anticonvulsants, antihypertensives, antidepressants, and sleep aids have also been targeted as high-risk medications.[8,26-28,31-35,42,49-56] Two additional risk factors that are often mentioned are male sex and poor functioning or inability to independently perform activities of daily living.[13,15,19,24,27,35,56,57]

History of Falling	
No	0
Yes	25
Secondary Diagnosis	
No	0
Yes	15
Ambulatory Aid	
None/bed rest/nurse assist	0
Crutches/cane/walker	15
Furniture	30
IV or IV access	
No	0
Yes	20
Gait	
Normal/bed rest/wheelchair	0
Weak	10
Impaired	20
Mental status	
Knows own limits	0
Overestimates or forgets limits	15
Total	_____

Figure 2. Morse Falls Scale.

Confusion/Disorientation	3
Depression	4
Altered Elimination	3
Recent History of Falls	7
Non-Adaptive Mobility/generalized weakness	2
Dizziness/Vertigo	3
Primary Cancer Diagnosis	3
Final Risk Score	___

Figure 3. Hendrich High Risk Fall Model.

Although a multitude of studies have been performed on tools for fall risk stratification, the majority of these studies used tools specific to the institution or population of study, which makes it difficult, if not impossible, to generalize the use of these tools in practice. When selecting a tool, the operators must take into account the setting and the population of use. Many of these tools have been studied only in the older adult population. This is a glaring limitation when attempting to extrapolate their predictions to risk in patients younger than 65 years.

One must assess the performance of each tool in the context of tradeoff of sensitivity and specificity at the chosen risk cutoff score. The danger of decreasing sensitivity includes missed identification of patients at high risk of falling. Poor specificity can divert resources from the patients most at risk due to over targeting interventions toward patients at lower risk.

The most effective tools are those that are easy for the operator to use, allowing rescoring as patient status changes and providing adequate sensitivity and specificity for the specific population. The overall accuracy of each tool is greatly affected by setting and population. When looking for the highest sensitivity and specificity in general, the MFS has the highest sensitivity and STRATIFY tool has the highest specificity. If sheer ease of use is desired, the Hendrich Fall Model would be the tool of choice. It must be reiterated that if applying a new tool in a setting or population where previous study has not been completed, great caution and evaluation must be taken before permanent adoption of the new tool.

Confusion/Disorientation	4
Depression	2
Altered Elimination	1
Dizziness/Vertigo	1
Male Gender	1
Any prescribed antiepileptics	2
Any prescribed benzodiazepines	1
Get-up-and-go Test Item #2	
"Rising from Chair"	
Able to rise in single movement	0
Pushes up, successful in one attempt	1
Multiple attempts but successful	3
Unable to rise without assistance	4

Figure 4. Hendrich II High Risk Fall Model.

Interventions

Multiple interventions to prevent falls have been studied. Most studies are nonrandomized single-center reports with prospectively collected data. Our search criteria identified 15 randomized studies with a myriad of interventions. Table 1 briefly summarizes the studies, participants, interventions, and results. In the articles summarized in the table, there was no consensus regarding the method to screen patients. When screening tools were used, various screens were implemented, including the HFRM II, MFS, Downtown Fall Risk Score, and clinical judgment. Interventions were also variable including single interventions, multiple elements used on all patients, or elements targeted based on risk level or individual risk factors. Themes in the studies included staff and patient education, discreetly displaying high risk of falls, exercise, safety while ambulating (assistive devices, footwear, etc), medication use, and toileting.

Prior Systematic Reviews and Meta-Analyses

A Cochrane review analyzed 41 studies performed in the hospital setting. The rate of falls was reduced when multifactorial interventions were performed, as demonstrated in the 3 studies (risk ratio [RR] 0.73, 95% confidence interval [CI] 0.56-0.96). Three studies had exercise as the primary intervention, which reduced falls (RR 0.44, 95% CI 0.20-0.97).[73] Other meta-analyses have variable results. One analysis suggested that fall prevention interventions did not reduce the number of falls,

Table 1. Randomized Studies.

Study	Size	Participants	Intervention	Control	Outcome
Ang, 2011[58]	1822. Intervention: 910. Control: 912.	Single center. Patients older than 21 years Score greater than 5 on the Hendrich II falls risk model. No in-hospital falls before risk assessment was performed.	Educational session (<30 minutes) to increase awareness of fall risk factors. Targeted interventions based upon risk factors.	Usual care, including a falls risk assessment, call button and bed locker placement, raised bed rails, and bed at the lowest position.	RR estimate of number of falls was 0.29 (95% CI 0.10-0.87 in favor of intervention group). HR 0.29% (95% CI 0.11-0.73, $P = .019$ log rank). Longer time to first fall (HR 0.29)
Barreca[59]	48. Intervention: 25. Control: 23.	Single center, rehabilitation unit. Block randomization. Stroke patients age 18 to 90 years, medically stable, postural control stage 3 or greater on Chedoke-McMaster Stroke Assessment (CMSA), and failed the third item of CMSA stage 4 postural control.	Staff education. Sit-to-stand exercise protocol for intervention group 3 times weekly for 45 minutes. Feedback between participants was encouraged.	Control group had 45 minutes of therapy 3 times weekly while seated in wheelchairs. Pet therapy, information sessions, word and picture games were included.	No difference in number of patients with falls ($P = .70$). Greater number of patients able to stand without using hands on 2 consecutive days ($P = .02$)
Burleigh[60]	205. Intervention: 101. Control: 104. Each group had 2 patients who stopped the drug and 1 with incomplete data.	Single center. General assessment and rehabilitation wards in an acute geriatric unit. Age older than 65. Exclusion: hypercalcemia, urolithiasis, dialysis, bed bound, previous calcium, and vitamin D supplementation.	Daily dose of 800 IU cholecalciferol plus 1200 mg calcium carbonate supplementation.	1200 mg calcium carbonate supplementation daily.	No difference in falls ($P = .263$) or falls per person ($P = .453$). Trend toward fewer patients with falls, but not statistically significant (RR 0.82, 95% CI 0.59-1.16).
Cumming[61]	3999. Intervention: 2047, but only1907 received the intervention. Control: 1952.	Acute and rehabilitation elderly care wards in Sydney, Australia. 12 institutions with a total of 24 elderly care hospital wards. Cluster randomized trial, matched pairs of wards.	Risk assessment. Patient and family education. Walking aids, eyewear. Modifications to environment. Increased supervision. Discussion about medication, confusion, and foot issues with staff. Individual or group exercises. Sock alarm.	Usual care, which included fall prevention awareness.	No difference in falls between acute and rehabilitation wards per 1000 patient days. No difference in falls between intervention and control wards per 1000 patient days.
Donald[62]	54. Carpet: 28. Vinyl: 26. Additional physical therapy: 30. Routine therapy: 24.	Rehabilitation unit, elderly care patients. 2 × 2 controlled trial.	Risk assessment. Carpet flooring. Additional physical therapy.	Vinyl flooring. No additional therapy.	No significant difference in number of falls, but trend toward less falls on vinyl floor ($P = .05$, 95% CI 0.95-73).

(continued)

Table 1. (continued)

Study	Size	Participants	Intervention	Control	Outcome
Dykes[63]	10 264. Intervention: 5160. Control: 5104.	4 hospitals. Cluster randomized design. Matched units randomized at each hospital, 8 total units.	Fall prevention tool kit in health information technology using Morse Falls Scale. Individualized poster placed above bed. Patient and family education individualized to patients needs. Fall plan automatically generated.	Usual care, which included Morse Falls scale, signs above beds for patients scoring >45 on scale, patient/family education, documentation in record.	Intervention group had fewer falls in per 1000 patient days ($P = .04$) and fewer patients with falls ($P = .02$). Not effective in the young, but lower fall rate per 1000 patient days ($P = .004$) in patients older than 65.
Haines[64]	1206. Complete program: 401. Materials only: 424. Control: 384	2 hospitals. Acute admission if >60 y old and expected to stay >3 days and all patients on subacute wards. More acute than subacute patients recruited.	3-Group randomization, control, complete program, and materials only. Complete program: written and multimedia presentation (health-belief model) plus physiotherapist follow-up sessions over 1 week, and usual care. Materials only: written and video materials.	Usual care, which was variable between hospitals. Falls risk screening, arm bands, nursing checklist, and higher nurse to patient ratio for those who are agitated or confused. Physical and occupational therapy could be provided.	Fewer falls per 1000 patient days in cognitively intact patients' intervention group when comparing the complete group vs materials only (aHR 0.51, 95% CI 0.28-0.93) and complete group vs control (aHR 0.43, 95% CI 0.24-0.78). No difference in fall rate per 1000 patient days in all the patients.
Haines[65]	626. Intervention: 310. Control: 316.	Single rehabilitation center. All patients accepted by geriatrician	Clinical judgment identified patients. Alert card with risk card with information brochure, exercise program, education program, and hip protectors.	Usual care, which included risk assessment tool and recommendations for interventions, but the interventions were not provided to the patients.	30% fewer falls ($P = .045$) in intervention group. Trend toward reduction in number of fallers (RR 0.78, 95% CI 0.56-1.06, $P = .02$).
Healey[66]	Intervention group before intervention implementation: 776. Intervention group after intervention implementation: 749. Control group before intervention implementation: 956. Control group after intervention implementation: 905.	8 care of elderly wards or units of a hospital. 4 wards had acute patients or short-term rehabilitation. 2 wards had specialty wards (stroke and geriatric psychiatry) and 2 wards were long-term rehabilitation, respite, and terminal care. Intervention and control group participants were identified 6 months before and 6 months after intervention implementation.	Matched pairs of study wards. Risk factor screening. Care plans with targeted interventions including sensory aids, physiotherapy referrals, medication review, alterations to beds, evaluation for UTI, orthostasis, and footwear use.	Usual care, which included multidisciplinary interventions, such as physical therapy and mediation review.	Reduction of falls in intervention group, pre–post intervention (RR 0.79, CI 0.65-0.95), and intervention to control group (RR 0.71, 95% CI 0.55-0.90).

(continued)

Table 1. (continued)

Study	Size	Participants	Intervention	Control	Outcome
Kwok[67]	180. Intervention group with sensors used: 50. Intervention group with sensors not used: 40. Control: 90.	2 geriatric wards specialized in stroke rehabilitation.	Bed-chair pressure sensors were encouraged. Education regarding use of sensors and improved outcomes when restraints not used.	Usual care, which included physical restraints and a fall prevention program.	No difference in use of physical restraints, improvement in mobility, or fall rate.
Mador[68]	71. Intervention: 36. Control: 35.	2 hospitals. Patients with confusion and behavior disturbance, dementia, or delirium. >60 years old. Excluded if psychiatric illness as cause of behavior problems.	Assessment and advice from extended practice nurse on nonpharmacologic strategies for behavior.	Usual care, which included advice from a geriatrician regarding confusion and behavioral disturbance.	No significant change in number of patients who fell ($P = .083$). No difference in other outcome measures, such as agitation, medication use, length of stay, satisfaction, or discharge to nursing facility.
Mayo[69]	134 Intervention: 65. Control: 69.	Single rehabilitation facility. Patients with risk factors for falls or fractures only.	Bracelet identifying high-risk patients.	Usual care, which included a reminder to patients to be careful.	No difference in number of patients with falls (HR 1.3, 95% CI 0.8-2.4), injury from fall, or secondary end points.
Stenvall[70]	199. Intervention: 102. Control: 97.	Single center. Orthopedic and geriatric units. Femoral neck fracture.	1 or 2 patients per room, 2 occupational therapists, dietician, staff education, care planning including plan to reduce recurrent falls and complications, nutritionist support, patient training in rehabilitation with emphasis on fall reduction. Home visits by PT/OT.	1 to 4 patients per room, 0.5 occupational therapist, care planning was performed but not as frequently as intervention group, routine postoperative evaluation of complications. PT/OT provided, but no emphasis on fall risk factors.	Reduced rates of falls in intervention group (6.29 vs 16.28 per 1000 patient days). Fall incidence rate ratio 0.38 ($P = .006$, 95% CI 0.20-0.76) in favor of intervention units.
Tideiksaar[71]	70. Intervention: 35. Control: 35.	Single center, geriatric unit.	Performance-oriented environmental mobility screen. Bed alarm.	Usual care, which included nursing checks and physical restraints.	No statistical difference in falls ($P = 1.00$), but trend toward fewer falls in intervention group.
Vassallo[72]	825. Intervention: 275 (1 ward). Control group: 550 (2 wards).	Single center, rehabilitation unit. "Quasi-experimental." thought to be quasi-randomization because study had no control over process and patients were randomly placed on 3 wards.	Downtown fall risk score. Multidisciplinary team including physician, nurse, occupational therapy, social work and physiotherapist. Weekly medical examination and fall risk assessment. Discussion and individualized interventions targeted at weekly meetings.	Usual care, which included discussion of falls at general meetings. Interventions could be implemented if recommended by a member of the care team.	Fewer fallers in intervention group ($P = .033$), fewer with injury ($P = .025$), and fewer falls ($P = .045$) during the study period.

Abbreviations: aHR, adjusted hazard ratio; CI, confidence interval, HR, hazard ratio; IU, international unit; OT, occupation therapy; PT, physical therapy; RR, risk ratio; UTI, urinary tract infection.

but was based on 8 studies of patients admitted to acute wards, rehabilitation, or extended care.[2] A systematic review of 21 articles consisted of 2 randomized controlled trials, 1 prospective trial with parallel controls, and 18 articles that had historical controls. This review pooled the findings of the studies with historical controls and had a reduction in falls of 25%. The randomized and parallel control study interventions did not have a significant effect on the rate of falls.[38] A subsequent review of 43 articles, 13 of which were related to inhospital falls, showed a rate ratio of 0.82 (95% CI 0.68-0.997) for falls and 0.59 (95% CI 0.22-1.58) for fractures, but the fracture rate reduction did not meet statistical significance.[74] Limitations of prior systematic reviews include inclusion of studies which do not reflect the patient population seen in the typical acute care hospital.

Table 1 summarizes the studies of hospital fall reduction programs. Studies with variable sizes had a beneficial effect on fall rates, ranging from 199[70] to 10 264 patients.[63] The largest study that did not have a positive outcome had 3999 patients. It was not blinded, and the control group had fall reduction interventions instituted, as this was the hospital standard.[61] The other negative studies were small, ranging from 54[62] to 205 patients,[60] and may have insufficient power to determine a clinical significance.

Of the 8 studies which showed interventions that had statistically significant results, the interventions were varied. Of the 8 studies, 7 had an impact on the number of fallers,[58,63-66,70,72] while the remaining study had an effect on mobility.[59] Themes across studies included patient education[58,63-65,72] and rehabilitation modalities, such as exercise or physical therapy.[59,64-66,70,72] Patient education tactics could be short, less than 30 minutes,[58,65] and usually provided education that was specific to an individual patient.[58,63,64] Only 1 study demonstrated a reduction in fall rates using a single intervention, education. Multimedia education proved to be superior to written education in patients with normal cognition.[64]

Rehabilitation experts, such as physical and occupational therapy, were frequent members of multidisciplinary teams, and provided a variety of interventions. Physical therapists provided education to patients in 1 instance,[64] but provided exercise therapy in other studies.[59,65,66,70,72] The intensity and specificity of the therapy was variable, ranging from a referral[66] to 45-minute sessions targeted to a specific exercise program performed 3 times per week.[59,65]

The heterogenous nature of the positive studies makes identifying an effective single intervention or a combination of interventions difficult. Further investigation is needed to define interventions that will provide a significant reduction in falls or related harm in large populations in the acute care hospital.

Conclusion

In part 1, we defined the impact of falls on hospitalized patients as well as potentially effective interventions. One may be tempted to move directly to intervene once a problem is suspected. In order to effect real change, however, a true quality improvement initiative must be undertaken. This type of work is central to neurohospitalist practice, and part of what may distinguish a neurohospitalist from a neurologist who sees inpatients. Traditional neurology residency programs may touch on these processes, but quality improvement education more commonly occurs afterward, if at all.

Authors' Note

All authors have contributed substantively to the conception design and analysis, the drafting of the manuscript or critical revision for important intellectual content, and final approval of the version to be published.

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