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Melissa J. Krauss

Washington University School of Medicine in St. Louis

Nhial Tutlam

Washington University School of Medicine in St. Louis

Eileen Constantinou

Barnes-Jewish Hospital

Shirley Johnson

Barnes-Jewish Hospital

Diane Jackson

Barnes-Jewish Hospital

See next page for additional authors

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Authors

Melissa J. Krauss, Nhial Tutlam, Eileen Constantinou, Shirley Johnson, Diane Jackson, and Victoria J. Fraser



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Author(s): Melissa J. Krauss, Nhial Tutlam, Eileen Costantinou, Shirley Johnson, Diane Jackson, Victoria J. Fraser

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ORIGINAL ARTICLE

Intervention to Prevent Falls on the Medical Service in a Teaching Hospital

Melissa J. Krauss, MPH; Nhial Tutlam, MPH; Eileen Costantinou, MSN, RN; Shirley Johnson, RN, MS, MBA; Diane Jackson, RN, BSN; Victoria J. Fraser, MD

OBJECTIVE. To evaluate an intervention to prevent falls at a hospital.

DESIGN. A quasi-experimental intervention with historical and contemporaneous control groups.

SETTING AND PARTICIPANTS. Nursing staff and patients in the medicine service (comprising 2 intervention floors and 2 control floors) at an academic hospital.

INTERVENTION. Nursing staff were educated regarding fall prevention during the period from April through December 2005. Data on implemented prevention strategies were collected on control and intervention floors. Mean monthly fall rates were compared over time and between intervention and control floors, using repeated-measures analysis of variance.

RESULTS. Postintervention fall knowledge test scores for the nursing staff were greater than preintervention test scores (mean postintervention test score, 91%; mean preintervention test score, 72%; $P < .001$). Use of prevention strategies was greater on intervention floors than it was on control floors, including patient education via pamphlets (46% vs 15%; $P < .001$), use of toileting schedules (36% vs 25%; $P = .016$), and discussion of high-risk medications (51% vs 30%; $P < .001$). The mean fall rate for the first 5 months of the intervention was 43% less than that for the 9-month preintervention period for intervention floors (3.81 falls per 1,000 patient-days vs 6.64 falls per 1,000 patient-days; $P = .043$). Comparisons of mean rates for the overall 9-month intervention period versus the 9-month preintervention period showed a 23% difference in the fall rate for intervention floors, but this did not reach statistical significance (5.09 falls per 1,000 patient-days vs 6.64 falls per 1,000 patient-days; $P = .182$).

CONCLUSION. The nursing staff's knowledge and use of prevention strategies increased. Fall rates decreased for 5 months after the educational intervention, but the reduction was not sustained.

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Falls and injuries at hospitals are a common occurrence and a major concern to healthcare personnel, patients, and their families. Between 4 and 12 falls per 1,000 patient-days occur in hospitals.¹ Falls can result in physical and psychological harm to patients.^{1–3}

Although many successful fall prevention interventions have been conducted in community and nursing home settings,^{4–9} fewer studies have been conducted in hospitals. Many of the fall prevention programs in hospitals are multifaceted and have had varying results.^{10–12} Few hospital fall prevention studies are randomized, controlled trials.^{1,13} A meta-analysis of 13 multifaceted interventions in hospitals, however, suggests that multifaceted interventions can be an effective means to reduce the incidence of falls in hospitals (rate ratio, 0.82 [95% confidence interval, 0.68–0.997]). There was no significant effect on the number of patients who fell (rate ratio, 0.95 [95% confidence interval, 0.71–1.27]) or on the number of fractures (rate ratio, 0.59 [95% confidence interval, 0.22–1.58]).¹⁴

Despite concerted efforts to prevent patient falls in hospitals, gaps still exist in the literature. Compliance with the intervention or fall prevention practices is often not analyzed, control units are often not included, the studies are often short in duration, and some studies do not analyze injuries from falls as an outcome. Therefore, we conducted a prospective study in which a multifaceted fall prevention program was implemented on medicine floors in an acute care academic hospital. We measured staff compliance with the intervention and analyzed the effectiveness of the intervention in decreasing fall rates and fall-related injuries, using historical and contemporaneous control groups.

METHODS

Study Setting and Participants

This study was performed on general medicine floors at Barnes-Jewish Hospital, a 1300-bed urban tertiary-care academic hospital associated with Washington University School

From Washington University School of Medicine (M.J.K., N.T., V.J.F) and Barnes-Jewish Hospital (E.C., S.J., D.J.), St. Louis, Missouri

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of Medicine (St. Louis, MO). Two of the 9 general medicine floors served as intervention floors, and 2 similar medicine floors served as control floors. The 2 intervention floors were chosen because the nurse manager and unit practice committee for those floors asked for help in reducing the rate of patient falls. The 2 control floors were similar to the intervention floors with respect to the severity of the patients' conditions (the illness acuity scores on the intervention floors in 2005 were 1.3 and 1.4 on a scale of 1 to 6, with 1 being the least complex medical care and 6 being the most complex medical care; the illness acuity score was 1.3 on both of the control floors) and fall rates (in 2005, the fall rates for the intervention floors were 6.4 falls per 1,000 patient-days and 5.1 falls per 1,000 patient-days, and the fall rates for the control floors were 7.5 falls per 1,000 patient-days and 6.9 falls per 1,000 patient-days).

Research staff developed fall prevention self-study modules (with preintervention tests and postintervention tests) that included an enhanced protocol for fall prevention based on patient fall data collected previously at the hospital¹⁵⁻¹⁷ and input from the nurse manager and unit practice committee. Nurses, patient care technicians, and unit secretaries from all shifts on the intervention floors took part in self-study modules and in-services as mandated by the nurse manager. Although nurses and patient care technicians are the primary drivers of fall prevention, unit secretaries were included to increase their awareness and facilitate communication with patients and staff. Staff members who were hired after the intervention began were given self-study modules and postintervention tests, but they were not required to take preintervention tests, to facilitate implementation of fall prevention strategies as soon as possible. Because nurses are rarely pulled from their assigned floor to help on other floors within their service, there was little potential for the intervention to be diffused to the control floors.

This study was reviewed and approved by the Human Studies Committee at Washington University School of Medicine. The requirement for written informed consent was waived, because implementation of fall prevention strategies is the standard of care.

Intervention Components

The fall prevention protocol outlined in the modules and in-services indicated that nurses must educate all patients on fall prevention and modify each patient's environment to make it safer. If a patient had a high risk of falling (as determined by nurses with use of a modified Morse Fall Scale¹⁸), nursing staff were to implement the following fall prevention measures:

1. Alert other staff to the patient's risk of falling (eg, by placement of a green armband on the patient's arm, placement of a green fall prevention sign above the patient's bed or on the door, specification of mobility needs on the patient's dry erase board, and verbal communication of the patient's fall prevention status at change of shift).

2. Reinforce fall prevention teaching with the patient and family.

3. Implement a toileting schedule and/or safety rounds (every 2 hours during the day and every 4 hours at night).

4. Review medications that may contribute to a patient's fall risk, and discuss the effects of these medications with the patient and/or family.

5. Ask the doctor to order a physical therapy and/or occupational therapy consultation (or to provide the patient with a walking aid if they already used one at home).

Once these measures were in place, the staff could choose from a myriad of other fall prevention strategies (eg, use of bed alarms or a low bed and floor mat, placement of the patient in a room close to the nurses' station, and request that family members sit with the patient). The protocol described above primarily differed from the hospital's usual protocol in that it mandated writing mobility needs on the patient's dry erase board, implementing a toileting schedule, reviewing medications, and asking the physician to order physical therapy and/or occupational therapy consultations for every patient at high risk for falling or providing walking aids if the patient used one at home. Some of these strategies have been used in other multifaceted programs described in the literature, and others were chosen on the basis of findings from prior studies performed at this hospital.^{15,16}

Implementation of the Intervention

Preintervention tests were distributed to staff on intervention floors in March 2005. Self-study modules with postintervention tests were distributed in early April 2005. In-services were given in April and May 2005. The 2 control floors were not given any fall prevention self-study modules or in-services. They continued with the regular fall prevention policy used at the hospital (ie, daily assessment of fall risk, review of fall prevention with the patient and/or their family, use of fall prevention signage, and implementation of other prevention strategies as needed).

The fall prevention strategies were to be used on intervention floors from April through December 2005. April was included in the intervention period, because education via self-study modules and in-services should have already started to influence awareness of and increase the use of fall prevention strategies. Research staff provided monthly feedback of fall rates for the floor to nursing staff at lunchtime and via flyers posted on the unit. Beginning in late August 2005, charge nurses performed audits of fall prevention strategies once per week to help remind new staff of the fall prevention strategies and to increase their use.

Data Collection

At Barnes-Jewish Hospital, a fall is defined as an unplanned descent to the floor (or to an extension of the floor, such as a trash can or other equipment) with or without injury to the patient. Assisted falls, defined as falls in which a staff member

TABLE 1. Preintervention and Postintervention Test Scores for Staff on Intervention Floors

Staff type	No. (%) of staff members	No. (%) of staff members who took both tests	Preintervention test score, mean (\pm SD)	Postintervention test score, mean (\pm SD)	<i>P</i>
All staff	100 (100)	52 (52.0)	71.7 (7.3)	90.7 (6.9)	<.001
Nurses	56 (56)	33 (58.9)	70.0 (6.0)	91.4 (7.2)	<.001
Patient care technicians	35 (35)	11 (31.4)	72.2 (7.5)	89.6 (6.7)	<.001
Unit secretaries	9 (9)	8 (88.9)	78.1 (8.8)	89.6 (6.3)	.009

NOTE. Scores and statistical comparisons are for only those staff members who took both the preintervention test and the postintervention test. SD, standard deviation.

attempts to minimize the impact of a fall, are included. Falls are reported by hospital staff into an intranet-based adverse event reporting system, the Safety Event System. In this study, injurious falls included all falls resulting in physical injury, including minor and major injury.

The risk management department e-mailed daily Safety Event System fall reports to research staff during the intervention period. After a patient fell on either an intervention or control floor, research assistants collected data on fall prevention strategies through observing the patient's room, reviewing the nursing electronic medical record, and asking the patient or nurse for information. For each patient who fell, 3 patients on that floor who were also at high risk for falling were randomly selected. Data were collected on these high-risk patients, as well, to provide a larger, more representative sample of patients at high risk for falling. This data collection began when research assistants were available to begin collecting data and after all in-services had been completed (May 20, 2005). Data on falls, fall-related injuries, and patient-days were collected for both intervention and control floors for both the preintervention period (from July 2004 through March 2005) and the intervention period (from April through December 2005).

Data Analysis

Preintervention and postintervention test scores were compared using the paired-samples *t* test. Fall prevention strategies, demographic characteristics of patients who fell, and fall circumstances were compared using the *t* test and the Pearson χ^2 test or Fisher exact test, as appropriate ($P < .05$ was considered to be statistically significant). Comparisons were made using SPSS software, version 14.0 (SPSS).

Monthly fall rates were calculated as the number of falls per 1,000 patient-days. Monthly fall injury rates were calculated as number of fall-related injuries per 1,000 patient-days. Repeated-measures analysis of variance was used to compare fall and injury rates, using PROC MIXED in SAS, version 9.1 (SAS Institute). With fall and injury rates as dependent variables, mixed models were built with fixed effects for the intervention group versus the control group (between subjects factor); time, by month (within subjects factor); and the interaction of group and time. A random effect was included for floor. The data were modeled with a first-order autoregressive covariance structure to account for autocorrelation in the time

series data. With these models, we used contrast statements for the specific comparisons in which we were interested: first, to compare mean rates before the intervention with mean rates after the intervention, and second, to compare mean rates between intervention floors and control floors during the period of the intervention.

RESULTS

Staff Education

Preintervention and postintervention test scores are shown in Table 1. Seventy-four staff members (74.0%) took the preintervention test, and 66 staff members (66.0%) took the postintervention test. Some staff left their positions, some were new during the latter stages of the intervention, and some simply did not complete the tests. Therefore, 52 staff members (52.0%), including 33 nurses (58.9%), 11 patient care technicians (31.4%), and 8 unit secretaries (88.9%), took both the pre- and postintervention tests, and statistical comparisons were made on the basis of data for these staff members. Significant differences were seen in preintervention and postintervention test scores for each type of staff.

TABLE 2. Falls on Intervention Floors Versus on Control floors During the Intervention Period

Variable	No. (%) of patients		<i>P</i>
	Intervention floors (<i>n</i> = 57)	Control floors (<i>n</i> = 78)	
Age, mean \pm SD, years ^a	65.5 \pm 18.1	65.5 \pm 17.5	.985
Sex ^a			
Female	28 (58)	36 (51)	.460
Male	20 (42)	34 (49)	
Assisted falls	5 (10)	2 (3)	.119
Toileting-related falls	22 (69)	32 (65)	.748
Repeat falls	9 (16)	8 (10)	.339

^a When the demographic data from the intervention and control floors were compared, only first falls were included, to reduce the bias of counting demographic information more than once for patients who fell more than once.

TABLE 3. Fall Prevention Strategies Used During the Intervention Period on Intervention and Control Floors for a Sample of Patients Who Fell and Other Patients at High Risk for Falling

Fall prevention strategy, by type	No. (%) of patients		P
	Intervention floors	Control floors	
Environment			
Pathway clear	147 (88.6)	190 (83.0)	.122
Nonskid slippers	119 (77.3)	162 (76.4)	.848
Items in reach	154 (93.3)	202 (88.6)	.113
Bed low	144 (88.9)	194 (84.7)	.235
Bed brakes on	153 (94.4)	199 (87.3)	.019 ^a
Communication of fall risk			
Wristband	139 (90.3)	160 (71.1)	<.001 ^a
Sign on door and/or above the bed	95 (57.6)	124 (53.7)	.442
Dot on chart	79 (48.5)	70 (31.0)	<.001 ^a
Dot on census board	98 (59.4)	81 (35.8)	<.001 ^a
Activity level on dry erase board ^b	26 (15.8)	13 (5.7)	.001 ^a
Patient education			
Patient given pamphlet	55 (45.8)	28 (15.0)	<.001 ^a
Staff discussed fall prevention with patient and/or family	78 (58.2)	79 (40.9)	.002 ^a
Patient instructed on use of call light	140 (96.6)	198 (91.7)	.062
Toileting			
Toileting schedule maintained ^b	56 (36.4)	50 (24.6)	.016 ^a
Physical therapy/occupational therapy			
Physical therapy/occupational therapy consultation ^b	112 (66.7)	164 (73.2)	.160
Walking aid provided ^b	84 (52.2)	115 (50.4)	.736
Medication			
Medications associated with fall risk discussed with patient and/or family ^b	64 (51.2)	55 (29.6)	<.001 ^a
Other			
Exit alarm	39 (24.2)	24 (10.7)	<.001 ^a
Low bed	13 (7.8)	13 (5.7)	.410
Floor mat	10 (6.5)	10 (4.4)	.465
Room close to nurses' station	83 (50.6)	100 (43.7)	.174
Bed nearest bathroom	107 (64.5)	139 (60.4)	.415
Diversion activities	5 (3.5)	11 (6.0)	.315
Family asked to stay with patient	11 (7.9)	14 (7.0)	.742
Sitter	6 (3.7)	3 (1.3)	.123
Bedside commode	94 (56.3)	110 (47.6)	.088
Restraints	6 (3.6)	7 (3.0)	.735

NOTE. Missing data were excluded from analysis.

^a Statistically significant.

^b Indicates a strategy that was emphasized strongly in the intervention.

Falls

During the intervention, 57 falls occurred on intervention floors (48 patients fell; 39 fell once, and 9 fell twice), and 78 falls occurred on control floors (70 patients fell; 62 fell once, and 8 fell twice). Table 2 presents demographic information for patients who fell and basic information about the falls. There were no statistically significant differences between intervention and control floors with respect to patient demographic characteristics, percentage of falls that were assisted falls, percentage of falls that were toileting related, or percentage of falls that were repeat falls. There were also no differences in these variables for the intervention floors when falls that occurred

during the intervention period (57 falls) were compared with falls that occurred during the preintervention period (79 falls).

Intervention Compliance

For the intervention floors, data were collected for 44 (77%) of the falls and for 132 other patients who were at high risk to fall; for the control floors, data were collected for 61 (78%) of the falls and for 183 other patients who were at high risk to fall. Comparisons of the fall prevention strategies used on intervention and control floors are displayed in Table 3. The educational intervention increased the use of strategies that were already part of the hospital's fall prevention policy, as well as

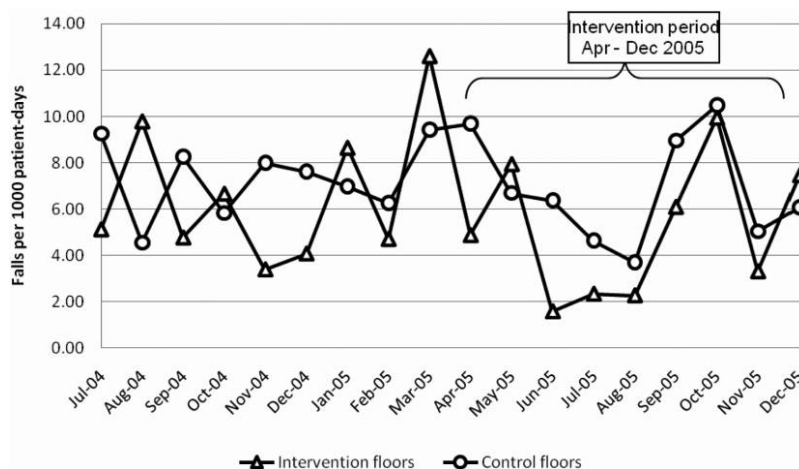


FIGURE. Fall rates for the intervention and control floors. Fall rates are shown over time for intervention and control floors from July 2004 through December 2005. The intervention took place from April through December 2005.

use of some of the new strategies that were strongly emphasized in the intervention.

Fall Rates

Fall rates (expressed as the number of falls per 1,000 patient-days) for the intervention and control floors are presented in the Figure; fall rates for the 2 intervention floors and for the 2 control floors have been combined for easier interpretation. It appears that, following the intervention, fall rates generally decreased for the intervention floors during the first 5 months (from April through August 2005) and then increased again.

The overall model for fall rates showed non-statistically significant differences in effects for the intervention group versus the control group ($P = .410$), time ($P = .152$), and the interaction of group and time ($P = .727$). Comparisons of mean rates for the overall 9-month intervention period versus the 9-month preintervention period showed a 23% difference in the fall rate for intervention floors, but this did not reach statistical significance (5.09 falls per 1,000 patient-days in the intervention period vs 6.64 falls per 1,000 patient-days in the preintervention period; $P = .182$). For the intervention floors, the mean fall rate for the first 5 months of the intervention period (ie, from April through August 2005) was 43% less than the mean fall rate for the 9-month preintervention period, and the difference was statistically significant (3.81 falls per 1,000 patient-days for the first 5 months of the intervention period vs 6.64 falls per 1,000 patient-days for the preintervention period; $P = .043$). The results of a similar comparison for control floors were not statistically significant (6.24 falls per 1,000 patient-days for the first 5 months of the intervention period vs 7.37 falls per 1,000 patient-days for the preintervention period; $P = .407$). The mean fall rate on intervention floors for the 9-month intervention period was 26% less than that on the control floors, but this difference did not reach statistical significance (5.09 falls per 1,000 patient-days on the intervention

floors vs 6.85 falls per 1,000 patient-days on the control floors; $P = .307$). The mean fall rate for the first 5 months of the intervention period was 39% less on the intervention floors than it was on the control floors, but this difference did not reach statistical significance either (3.81 falls per 1,000 patient-days on the intervention floors vs 6.24 falls per 1,000 patient-days on the control floors; $P = .228$).

Injury Rates

The overall model for fall injury rates showed non-statistically significant differences in effects for the intervention group versus the control group ($P = .659$), time ($P = .262$), and the interaction of group and time ($P = .184$). When comparing injury rates for the intervention period with those for the preintervention period, significant differences were observed for control floors (0.78 fall-related injuries per 1,000 patient-days for the intervention period vs 2.01 fall-related injuries per 1,000 patient-days for the preintervention period; $P = .038$) but not for the intervention floors (1.14 fall-related injuries per 1,000 patient-years for the intervention period vs 1.28 fall-related injuries per 1,000 patient-years for the preintervention period; $P = .810$). Fall-related injury rates did not differ significantly between intervention and control floors during the intervention period (1.14 fall-related injuries per 1,000 patient-days on the intervention floors vs 0.78 fall-related injuries per 1,000 patient-days on the control floors; $P = .530$).

DISCUSSION

This intervention was associated with decreased fall rates on intervention floors, although the decrease did not reach statistical significance. Prior hospital fall prevention studies often do not report the degree of staff compliance with the intervention or report fall rates over an extended period of time. Therefore, this study can help to provide some insight into compliance for long-term fall prevention interventions.

Patient fall rates were reduced on intervention floors during the study, as evidenced by the overall 23% reduction in fall rates for the entire intervention period and the 43% reduction in fall rates during the first 5 months of the intervention period (although fall rates began to increase again after the first 5 months). The pronounced reduction in fall rates during the first 5 months of the intervention could have been attributable to increased fall prevention awareness and to the use of strategies, regression to the mean, or the Hawthorne effect (because of the presence of research staff on the floors). Reduction of fall rates in other multifaceted fall prevention studies similar to ours have also had mixed or nondefinitive results. Vassallo et al.¹⁹ analyzed a multidisciplinary fall prevention intervention in a rehabilitative hospital with no definitive results. Healey et al.²⁰ used a targeted intervention for specific risk factors in elderly care wards in a general hospital and saw a significant decrease in the number of falls during the 6-month intervention, but it is unclear whether fall rate reductions were sustained. Schwendimen et al.¹¹ did not observe a decrease in the frequency of falls in a long-term study (conducted during 1999–2003) of an interdisciplinary fall prevention program in a 300-bed public hospital, whereas another long term study (performed during 2001–2003) of a multistrategy fall prevention approach in an aged care services ward by Fonda et al.²¹ observed a significant 19% decrease in falls. It is difficult to determine why some multifaceted programs have more success than others. Based on our experience and hypotheses, a simplified, standardized approach, buy-in from staff, and strong leadership and support could be critical components.

Our intervention did not have a substantial impact on injury rates. These results are consistent with the findings of many recent hospital fall prevention studies that have also not observed statistically significant decreases in fall-related injuries.^{11,19,20,22} More research is needed to determine how to effectively prevent fall-related injuries.

Increasing the use of fall prevention strategies was also a goal of the intervention. Most studies do not report monitoring staff compliance with the intervention. Van der Helm et al.²¹ and Fonda et al.²³ audited completion of fall assessment tools but did not audit other prevention strategies. Our study showed that compliance with prevention strategies increased on the intervention floors, but the use of fall prevention strategies was still not optimal. Less-than-optimal compliance could be attributable to a number of things, including staff turnover; high patient-to-nurse ratios; high patient turnover or high patient volume; increasingly complex demands on nursing staff, in addition to those demands imposed by this intervention; or lack of buy-in from hands-on caregivers.

One example of below-optimal compliance was poor compliance with toileting schedules (there was only 36% compliance on the intervention floors). Because so many falls are toileting related, toileting schedules have been used as one of the fall prevention strategies in multifaceted programs.^{11,12} Although this strategy may be effective as a component of a multifaceted program, it was difficult to implement, and we did not

see a significant decrease in toileting-related falls on the intervention floors. When toileting schedules were implemented, many patients frequently opted not to go to the bathroom. Because such a large percentage of falls are toileting related, it may be worth working to increase the implementation of toileting schedules for patients who are at high risk for falling and then critically evaluate the impact of such programs.

This study had some limitations. The study was conducted on general medicine floors, and the results may not be generalizable to other services. Because of limited resources and the fact that nursing staff have historically been the primary drivers of fall prevention, our educational intervention did not include physicians and pharmacists. Physicians and pharmacists were members of the research team or the fall prevention team and advised on the components of the intervention. However, future interventions should include physicians and pharmacists, because they also should be aware of fall risk and can help to direct fall prevention measures. Data collectors were not blinded to the fall status of the patients when collecting data on fall prevention strategies, which could be a source of bias. Different sources were used to collect data on fall prevention strategies (ie, direct observation, interview of nurses or patients, and review of electronic records), leading to missing data when nurses or patients were unavailable to answer questions or when the patient in question had already been discharged from the hospital. The presence of research assistants on the control floors to collect data could have reminded staff to make sure that fall prevention measures were in place, perhaps decreasing the difference in compliance and fall rates between intervention and control floors. Finally, the adverse event reporting system that we used is a self-reporting system. It is not known what proportion of falls is reported. However, falls have been tracked aggressively throughout this hospital for more than a decade.

The strengths of this study include use of both historical and contemporaneous control subjects and the assessment of compliance. This intervention increased the nursing staff members' knowledge, increased use of fall prevention strategies (although not to optimal levels), and reduced fall rates (although reductions were not statistically significant). This suggests that multifaceted fall prevention programs that incorporate staff education could be effective. However, future research should examine ways in which to improve compliance, sustain reduced fall rates over time, significantly reduce fall-related injuries, and determine which aspects of a multifaceted program are most effective.

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Address reprint requests to Melissa J. Krauss, MPH, Washington University School of Medicine, Department of Internal Medicine, Division of Infectious Diseases, 660 S. Euclid Ave., Campus Box 8051, St. Louis, MO 63110 (mkrauss@im.wustl.edu).

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