Consequences of an Intervention to Reduce Restrictive Side Rail Use in Nursing Homes

Elizabeth Capezuti, PhD, RN, Laura M. Wagner, PhD, RN,† Barbara L. Brush, PhD, RN,‡ Marie Boltz, MSN, RN,* Susan Renz, MSN, RN,§ and Karen A. Talerico, PhD, RN‖*

(See editorial comments by Drs. Magaziner, Miller, and Resnick on pp 464–466.)

OBJECTIVES: To examine the effect of an advanced practice nurse (APN) intervention on restrictive side rail usage in four nursing homes and with a sample of 251 residents. A secondary question explored the association between restrictive side rail reduction and bed-related falls.

DESIGN: Pre- and posttest design.

SETTING: Four urban nursing homes.

PARTICIPANTS: All nursing home residents present in the nursing home at three time points (n = 710, 719, and 707) and a subset of residents (n = 251) with restrictive side rail use at baseline.

INTERVENTION: APN consultation with individual residents and facility-wide education and consultation.

MEASUREMENTS: Direct observation of side rail status, resident and nurse interview for functional status, mobility, cognition, behavioral symptoms, medical record review for demographics and treatment information, and incident reports for fall data.

RESULTS: At the institutional level, one of the four nursing homes significantly reduced restrictive side rail use ($P = .01$). At the individual participant level, 51.4% (n = 130) reduced restrictive side rail use. For the group that reduced restrictive side rails, there was a significantly ($P < .001$) reduced fall rate (-0.053; 95% confidence interval (CI) = -0.083 to -0.024), whereas the group that continued restrictive side rail did not demonstrate a significantly ($P = .17$) reduced fall rate (-0.013; 95% CI = -0.056–0.030).

CONCLUSION: An APN consultation model can safely reduce side rail use. Restrictive side rail reduction does not lead to an increase in bed-related falls. Although side rails serve many purposes, routine use of these devices to restrict voluntary movement and prevent falls is not supported. **J Am Geriatr Soc 55:334–341, 2007.**

Key words: treatment implementation; side rail; advanced practice nurse; nursing homes; physical restraint

With increasing evidence of the potential for negative consequences associated with the use of side rails, their routine use is no longer considered standard practice in U.S. nursing homes. Indeed, over the past decade, several key agencies, such as the U.S. Food and Drug Administration (FDA)[1] and Joint Commission for the Accreditation of Health Care Organizations,[2] and numerous researchers[3–5] have documented side rail-related deaths and injuries. Between January 1, 1985, and 2006, 691 incidents of side rail entrapment were reported to the FDA; 413 resulted in death.[6] In March 2006, the FDA issued guidelines for hospital bed design to reduce entrapment injuries that include recommendations for manufacturers of new hospital beds and suggestions for healthcare facilities on ways to assess existing beds.[1]

Although side rails have been used primarily to prevent individuals from falling from bed, there is no evidence that this practice accomplishes its goal.[7] In fact, more evidence is available to show that raised side rails may cause falls. For example, most nursing home residents for whom side rails are used lack the cognitive ability to use a call bell correctly when in need of assistance. Rather than see the raised side rail as a protective or safety measure, they perceive a side rail as a barrier to go over or around.[8,9] Climbing over side rails may increase the degree of injury from a fall, because rails add up to 2 feet to the fall height.[10,11] One study, comparing fall outcomes of nursing home residents with

From the *John A. Hartford Foundation Institute for Geriatric Nursing, New York University College of Nursing, New York, New York; †Kunin-Lunenfeld Applied Research Unit at Baycrest, Toronto, Ontario, Canada; ‡University of Michigan School of Nursing, Ann Arbor, Michigan; §RS Connection, Inc., West Chester, Pennsylvania; and ‖Amann Talerico Consulting, Portland, Oregon.

This article is based on a paper presented at the 2001 Annual Scientific Meetings of the Gerontological Society of America. Capezuti, E. Fall and injury prevention among cognitively impaired nursing home residents. Gerontologist 2001;41 (Special Issue 1):170.

Address correspondence to Elizabeth Capezuti, PhD, RN, FAAN, Associate Professor, Co-Director, John A. Hartford Foundation Institute for Geriatric Nursing, New York University College of Nursing, 246 Greene Street, 6th Floor, New York, NY 10003. E-mail: ec65@nyu.edu

DOI: 10.1111/j.1532-5415.2007.01082.x

0002-8614/07/$15.00

restrictive side rails with those with no or nonrestrictive side rail use over a 1-year period, reported no reduction in the risk or recurrence of falls with restrictive side rail use, controlling for cognitive, functional, and behavioral status.[12] Furthermore, studies examining the consequences of side rail reduction conducted in rehabilitation and hospital settings have demonstrated no significant increase in falls or serious injuries after side rail reduction.[13–15] A retrospective analysis examining the effect of substituting full-length side rails with half-length rails in one nursing home also found no significant increase in falls.[16] A second study reported an overall reduction of 27% in use of side rails in three units of one nursing home after an interdisciplinary intervention with no increase in falls or serious injuries.[17] Although the results of these studies are encouraging, both studies used unit-based data and did not follow individual residents over time.

Despite empirical evidence,[12–17] federal regulations,[18,19] and professional association consensus statements[20,21] discouraging restrictive side rail usage and citing clinical guidelines offering alternatives,[22–24] many nursing homes continue to use these devices inappropriately. For some institutions, side rails serve a dual purpose as a restraint and a bed mobility or transfer aid; thus, side rail reduction is not as simple as lowering the rail. The aim of any effort to reduce side rail use therefore is to address the underlying clinical problem for which the side rail was initially used to address.[23,24]

Side rail reduction challenges nursing home staff to drastically change their approach to preventing falls from bed.[25] This "paradigm" shift in practice patterns has been effectively achieved with advanced practice nurses (APNs) in the areas of restraint reduction;[26] restraint reduction coupled with falls prevention;[27] and improved treatment of incontinence, pressure ulcers, depression, and aggressive behaviors.[28,29] APNs in this role function primarily as quality improvement consultants, providing clinical expertise to staff and residents as gerontological specialists.[30,31] Central to this role is the APN's influence on staff practices through in-service education and bedside rounds with nurses.[32]

The purpose of this study was to examine the effect of an APN intervention on restrictive side rail usage in four nursing homes and with a sample of 251 residents. A secondary question explores the association between restrictive side rail reduction and bed-related falls. The underlying assumption of this study was that restrictive side rail reduction, similar to physical restraint reduction, can be successfully accomplished without compromising resident safety. Indeed, previous studies demonstrate that the use of an intervention that employs alternatives in addressing underlying clinical problems results in positive resident outcomes.[26,33]

METHODS

Design

To examine the APN effect on side rail use at the institutional level, a pre- and posttest design was used to evaluate changes in four urban nursing homes in restrictive side rail use across three time points: at baseline and 1 month and 1 year after completion of the APN intervention. A single-group pre- and posttest design was also used to evaluate the APN effect on side rail use and falls in a sample of 251 residents from these four homes.

Setting/Participants

Four medium-sized (bed size ranged from 120 to 235 beds) urban nursing homes participated in the study: two religiously affiliated nonprofit homes; one proprietary home; and a private, nonprofit university health system nursing home. At baseline (within 2 months before initiating the intervention), side rail usage of each resident in the four nursing homes (n = 710) was evaluated using observation rounds. To address the effect of the APN intervention at the institutional level, baseline usage was compared with all those present at each of the four nursing homes during rounds conducted within 1 month (n = 719) and 1 year after the completion of the APN intervention (n = 707).

Data from the 710 residents who were present in the four nursing homes during the baseline observation rounds were used to determine eligibility for participation in the intervention study. Consent was sought from the 376 residents with restrictive side rail usage at baseline and residing in the nursing home for at least 3 months before baseline. Of these, 80.1% of residents or their responsible party (in cases of cognitive incapacity) consented to participate (n = 301). Those opting not to participate were primarily surrogate decision-makers (generally the resident's adult children) who were non-English speaking or were concerned with the resident's illness (terminal phase of a chronic disease). For the final analysis, only those resident-participants who were present in the nursing home at least 3 months after the APN intervention and during the side rail rounds were included. Of the 301 consented participants, 83.4% (n = 251) met these criteria. Exclusions were mostly because of death or loss to follow-up due to a move to another facility or hospitalization during the side rail observation rounds. The University of Pennsylvania institutional review board approved the informed written consent procedure.

Data Collection Procedures

After informed written consent was obtained from the resident-participants or their proxy (in cases of impaired decision-making capacity), a trained research assistant obtained each resident's functional, cognitive, behavioral, mobility, and fall risk status using standardized instruments. The research assistant collected other demographic and clinical data from relevant healthcare records. When baseline data collection was completed, the APNs then initiated their evaluation.

Measures

Side rails are adjustable metal or rigid plastic bars that attach to the bed and come in an assortment of sizes (full-, three-quarter-, half-, and quarter-length rail, split rail configuration, and alternate split rail configuration) and shapes.[34] Two research assistants conducting observation rounds during the late evening and night shifts (between 9 p.m. and 6 a.m.) on all residents present in the nursing home directly evaluated side rail use. These times were chosen, because side rails are used when the resident is in bed, which

is usually late evening and nighttime. Evening staff were queried regarding the time that the residents participating in the study (n = 251) went to bed, and they reported that 97.7% were in bed between these hours. The observation rounds confirmed the time and the location (e.g., bedroom) and position (e.g., lying in bed) of each resident using the Restraint Use Observation Tool.[23,26]

These rounds were performed at baseline (within 2 months of the start of the intervention) and within 1 month and 1 year after the completion of the APN intervention. Although side rail status was also confirmed using nursing home record review, physician orders, and staff interview during the same period, direct observation was found, as in earlier studies, to be the most accurate method.[12] Baseline and post-APN intervention data were used for evaluating changes in restrictive side rail use at the institutional and individual resident-participant level. None of these homes employed physical restraints in bed. Side rail use was dichotomized as restrictive or nonrestrictive. Restrictive was operationalized as two full-length or four half-length raised side rails; all residents had restrictive side rail use at baseline. Continued restrictive side rail use meant restrictive side rails were observed at each observation round postintervention. Discontinued restrictive side rail use was observed when a resident's side rails were reduced to one full-length side rail, one to three half-length raised side rails, or no side rails during each of the post intervention rounds.

A trained research assistant obtained all falls data from a review of nursing home incident reports for a 1-year period before and after each resident's APN intervention. Post-APN intervention falls data were calculated as a proportion, based on their length of stay during the pre- and post-APN intervention period. The average number of months ± standard deviation that the resident-participants resided in the facility preintervention was 10.44 ± 2.53 and postintervention was 8.33 ± 2.58. Because this study concerns falls from bed, only bed-related or "nighttime" falls occurring between 9 p.m. and 6 a.m. in the resident's bedroom were included. Time of day was recorded for each fall, along with location, to verify that the fall occurred from bed. In addition to all bed-related falls, information about all bed-related falls resulting in serious injury (all fractures, dislocated joints, lacerations requiring sutures, or subdural hematoma) was collected.

Resident characteristics (physical and mental health and treatment) were collected at baseline (within a month before the APN intervention). Medical record review provided demographic information, including age, race/ethnicity, sex, and primary payor, as well as treatment (physical restraint and psychoactive drug use) measures. Mental health measures such as cognition[35] and behavioral symptoms[36] were evaluated using resident and staff interviews.

Physical health–related measures, including functional status[37] and fall risk,[38] were obtained by interviewing the resident's primary nurse. The nurse also provided information about life space, the extent of a resident's general mobility within the facility.[39] To measure mobility, a tool developed in a previous restraint study[40] was used that quantifies the resident's highest level of mobility in three areas: bed mobility, transfer ability, and ambulation.

Any restraint use (chest/vest, wrist/ankle, belt, or pelvic restraints and geriatric/recliner/wheelchair with fixed tray table) noted on the Minimum Data Set or physician order during the last month of record review was recorded. Because there was no nighttime (in bed) physical restraint use, these data reflect day or evening usage only. All antipsychotic, sedative-hypnotic, and antidepressant drug usage during day or night was ascertained from the medication administration records and collected over the 3-month period after the intervention.

Intervention

The intervention employed resident-specific and facility-wide strategies aimed at helping nursing home staff develop skills in the individualized assessment and management process in restrictive side rail reduction.[41] A master's prepared gerontological APN conducted an evaluation of each consented resident. The APN worked closely with the nursing staff, as well as the interdisciplinary team (geriatrician, geropsychiatrist, social worker, and physical and occupational therapists), depending on the individual resident's specific needs. The APN used the Individualized Assessment for Evaluation of Side rail Use tool[24] to systematically identify factors that influence side rail usage: fall risk from bed, in-bed mobility, transferring skills, sleep problems, and level of continence. The completed evaluation tool and the APN's recommendations regarding resident-specific interventions were summarized into a written plan of care.[22,23] Each care plan was reviewed with unit staff. The APN met with each facility's nursing director to review a written summary of all recommendations.

The APN also employed several institutional strategies. The APN conducted in-service sessions that described the study to each shift of nursing staff and provided education focusing on restrictive side rail reduction; falls and injuries while in or getting out of bed; bed mobility and transferring; and interventions to address sleep disturbance, incontinence, and pain.[23,24,42] The APN worked with facility committees (policy and procedure, restraint reduction, falls) and participated in each resident's multidisciplinary care conference. Side rail data collected during the intervention period were also shared with the quality improvement committee in each facility.[29] The APN also worked with facility administrative staff in each setting to develop a realistic plan for purchasing alternative interventions to side rails such as bed alarms, floor mats, transfer poles, and low beds. The APN intervention process took approximately 3 to 6 months to complete in each home.

Analyses

To evaluate the effect of the APN intervention on restrictive side rail usage in the four nursing homes at the institutional level, a logistic regression analysis (with factors for site and time) was used to determine whether there was a statistically significant change over time (from baseline to 1 month and 1 year postintervention) in the rate of restrictive side rail use for the four sites.

To examine the relationship between side rail usage and falls at the individual level, a multistep analysis was performed. First, the statistical significance of the bivariate associations between side rail status, resident characteris-

tics, and bed-related falls was determined using chi-square t statistics. There were some participants with missing values on one or more of these variables; therefore, a multiple imputation algorithm was used for the analysis, rather than having to exclude all patients with at least one missing covariate value. Multiple imputation analysis allows for retention of patients with missing covariates and thus increases statistical power and precision but incorporates the added statistical uncertainty into the final parameter estimates.[43]

Next, a mixed-model analysis of variance (ANOVA) was used to analyze the longitudinal pre- versus post-APN intervention bed-related fall rate. This analysis used the fall rate (computed as the total number of falls divided by time in study) to account for differences in the amount of time participants were in the study. This was computed separately for the pre- and post-APN intervention time periods. Two models were constructed. First, the site-adjusted model included terms for group (discontinued restrictive side rail vs continued restrictive side rail), time (pre vs post), site, and the interaction between group and time. Next, the multivariable model added potentially confounding covariates to the model in addition to the terms for group, time, and group-by-time interaction from the first model.

Potential covariates were considered as any baseline resident characteristics that were differentially distributed between the two side rail groups (i.e., discontinued vs continued use of side rails) and also related to the outcome (bed-related falls) that were targeted for inclusion in a final multivariable model. In addition, other variables that were found to be clinically significant in previous studies[12,27] and to be related to side rail group or falls in this sample were also added to the final model. Analyses were conducted using SPSS for Windows version 11.5 (SPSS Inc., Chicago, IL) and SAS (SAS Institute, Inc., Cary, NC).

RESULTS

Table 1 compares key institutional characteristics and changes in restrictive side rail prevalence of all residents present at baseline (n = 710), within 1 month (n = 719) and 1 year (n = 707) after the completion of the APN intervention for each of the four nursing homes participating in the study. At the institutional level, there were statistically significant effects of time and site, indicating a change in the rate of side rail use over time and that there were differences between the four sites in restrictive side rail use. The significant interaction between site and time mediated these main effects ($P = .004$), which showed that the change in side rail use over time depended on site. Further unadjusted post hoc contrasts that tested the effect of time within each site showed significant changes over time for Sites 3 and 4 ($P < .001$ and $P = .05$, respectively), whereas the P-values for Sites 1 and 2 were not significant ($P = .43$ and $P = .80$, respectively). However, when a Bonferroni adjustment for multiple contrasts was employed, only Site 3 showed a statistically significant decrease in the rate of restrictive side rail use over time (target alpha computed as 0.05/4 = 0.013).

At the individual participant level, the subsample of 251 residents all had restrictive side rail usage at baseline. Immediately after the intervention and for up to 12 months postintervention, 51.4% (n = 130) no longer used restrictive side rails. Table 2 provides resident characteristics at baseline. It also compares whether the distribution of baseline characteristics differed between the discontinued restrictive side rail and the continued restrictive side rail group, as well as the effect of each variable on the outcome of interest (bed-related fall rate). Life space, functional status, and antipsychotic medication use differed significantly between the two groups, and fall risk was significantly associated with bed-related falls. The only variable that showed both a differential distribution between side rail groups and a relationship to the bed-related fall rate was the mobility measure ($P = .002$ and $P = .05$, respectively). These significant variables were included as covariates in the final model.

To examine the relationship between side rail usage and bed-related falls, Table 3 provides the results of models comparing falls rates for residents continuing to have

Table 1. Restrictive Side Rail Use and Institutional Characteristics of the Four Nursing Homes

Nursing Home	Baseline (n = 710)	Immediately Post-APN Intervention (n = 719)	1 Year Post-APN Intervention (n = 707)
	%		
Site 1: 235-bed, nonprofit, religiously affiliated facility with Medicaid as primary payor (79%) and 0% minority residents	54.3	48.9	49.1
Site 2: 205-bed, for-profit, chain-affiliated facility with Medicaid as primary payor (41%) and 7% minority residents	59.6	60.3	62.7
Site 3: 170-bed, nonprofit, religiously affiliated facility with Medicaid as primary payor (93%) and 74% minority residents	42.1	32.7	17.5
Site 4: 120-bed, nonprofit, academic health center–affiliated facility with Medicaid as primary payor (83%) and 75% minority residents	8.8	57.0	53.4
Total	55.2	49.7	46.3

Table 2. Difference in Baseline Characteristics According to Postintervention Side Rail–Use Group

Characteristics	Discontinued Restrictive Side Rail Use n = 130*	Continued Restrictive Side Rail Use n = 121*	*P*-value	
			Side Rail Group Differences	Relationship to Bed-Related Falls
Demographic				
Age, mean ± SD	83.6 ± 8.9	84.0 ± 10.3	.10	.30
White	72.0	74.6	.66	.49
Female	77.7	72.7	.29	.12
Medicaid*	74.6	71.1	.57	.07
Physical health, mean ± SD				
Functional status†	21.6 ± 9.7	25.4 ± 7.2	.001	.63
Life space‡	19.1 ± 9.5	15.9 ± 7.4	.008	.53
Mobility§	12.3 ± 5.9	15.2 ± 4.4	.002	.05
Fall risk‖	50.6 ± 18.8	46.4 ± 18.8	.99	<.001
Mental health, mean ± SD				
Cognition¶	14.5 ± 10.1	12.93 ± 92	.34	.34
Behavioral symptoms#	6.1 ± 10.4	5.89 ± 9.2	.18	.15
Treatment, %				
Daytime physical restraint order	11.5	10.7	.84	.43
Any psychoactive drug use	80.0	74.4	.28	.41
Any psychoactive drug use at night	52.3	53.7	1.00	.64
Any hypnotic or sedative drug use	26.9	33.9	.27	.39
Any antidepressant drug use	57.7	57.0	1.00	.42
Any antipsychotic drug use	23.8	13.2	.04	.68

* Percentage of residents for whom Medicaid is the primary payor of nursing home care.
† Functional status was quantified with the physical function subscale of the Psychogeriatric Dependency Rating Scale; scores range from 0 to 39, with higher scores indicating poorer function.[37]
‡ Life Space was measured using the Life-Space Diameter Scale. Scores range from 0 (complete bedrest) to 100 (independently leaving the facility daily).[39]
§ Mobility assesses bed mobility, transfer ability, and ambulation; scores range from 1 to 25, with higher scores indicating reduced mobility. The Mobility Evaluation Tool is available from the contact author.[40]
‖ Fall risk was evaluated using the Morse Fall Scale; total scores range from 1 to 125, with scores greater than 44 indicating a high risk for falls.[38]
¶ Cognition was measured using the Mini-Mental State Examination; scores range from 0 to 30, with lower scores indicating poorer cognitive function.[35]
# Behavioral symptoms were measured using the Nursing Home Behavior Problem Scale; scores range from 0 to 116, with higher scores representing a greater number of behavioral symptoms.[36]
SD = standard deviation.

restrictive restraints (n = 121) and for those having their restrictive restraints discontinued (n = 130) for the pre- and post-APN intervention time periods. The bed-related fall rates and side rail status are also graphed in Figure 1. Because the study used a nonrandomized design, there were significant differences between the two groups in the bed-related fall rates at preintervention (discontinued restrictive = 0.115 vs continued restrictive = 0.034; $F(1,495) = 22.03$, $P < .001$) and postintervention (discontinued restrictive = 0.062 vs continued restrictive = 0.021; $F(1,495) = 6.27$, $P = .01$). Thus, the effects of interest center on the post/pre difference in bed-related fall rates within each side rail group.

As can be seen in Table 3 for the site-adjusted model (terms for group, time, and group-by-time interaction), the post/pre difference for the group that discontinued restrictive side rail use was −0.053 (reduction from 0.115 to 0.061), which was a statistically significant decrease from baseline ($P = .003$, unadjusted; and $P = .02$ using a Bonferroni adjustment for multiple comparisons). The unadjusted 95% confidence interval (CI) around this point estimate was −0.088 to −0.018, the Bonferroni-adjusted 95% CI was −0.099 to −0.006. Because both of these CIs were less than zero, it can be concluded that the true post/pre mean difference in bed-related fall rates decreased for the group that discontinued restrictive side rail usage.

In contrast, there was not a statistically significant change in bed-related fall rate (−0.013, reduction from 0.034 to 0.021) for the group with continued restrictive side

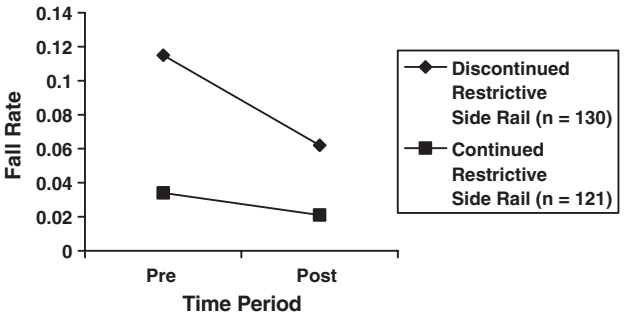

Figure 1. Comparison of changes in bed-related fall rates between discontinued and continued restrictive side rail users. "Pre" represents baseline or preintervention period that occurred within 2 months before the advanced practice nurse (APN) intervention; "post" represents 1 year after the completion of the APN intervention.

Table 3. Comparison of Changes in Bed-Related Fall Rates Between Discontinued and Continued Restrictive Side Rail Use

Group	Point Estimate of Mean Differences in Post-/Prefall Rate	Unadjusted 95% CI*	*P*-value	Adjusted 95% CI†	*P*-value
Site-adjusted model*					
Discontinued restrictive side rails (n = 130)	− 0.053	− 0.088 to − 0.018†	.003	− 0.099 to − 0.006‡	.02
Continued restrictive side rails (n = 121)	− 0.013	− 0.049–0.023†	.47	− 0.061–0.035‡	1.00
Multivariable adjusted model§					
Discontinued restrictive side rails (n = 130)	− 0.053	− 0.079 to –0.027‖	<.001	− 0.083 to − 0.024¶	<.001
Continued restrictive side rails (n = 121)	− 0.013	− 0.051–0.024*	.02	− 0.056–0.030¶	.17

* Included terms for group (discontinued, continued side rails), time (pre-, postintervention), group-by-time interaction, and site.
† No adjustment for multiple comparisons within each side rail group.
‡ Bonferroni adjustment for multiple comparisons within each side rail group.
§ Included terms for group (discontinued, continued side rails), time (pre-, postintervention), group-by-time interaction, site, and covariates including mobility, life space, functional status, fall risk, and antipsychotic medication use.
‖ Adjusted standard error for multiple imputations.
¶ Adjusted standard error for multiple imputations, Bonferroni adjustment for multiple comparisons.
CI = confidence interval.

rail use ($P = .47$, unadjusted; and $P = 1.00$, using a Bonferroni adjustment for multiple comparisons). The adjusted 95% CI around this point estimate was − 0.049–0.024, and the Bonferroni-adjusted 95% CI was − 0.061–0.035 (Table 3, Row 2). Because both of these CIs contained zero, it can be said that the true mean difference in fall rate for the group that had continued restrictive side rail usage did not significantly change from pre to post (it ranged from a net decrease of − 0.049 to a net increase of 0.023).

In the second multivariable-adjusted model, a variation of a mixed-model ANOVA was performed using terms from the first model and adding covariates that were considered potential confounders to the original model; these included mobility (differentially distributed between groups and related to falls), as well as life space, functional status, fall risk, and antipsychotic medication use (factors associated with groups or falls and cited from previous studies). Table 3 also summarizes the multivariable-adjusted model. For the group that discontinued restrictive side rails, the change in bed-related fall rate (post/pre) was − 0.053. The lower bound of the 95% CI was a decrease of − 0.079, and the upper bound was a decrease of − 0.027. The multiple imputation adjusted *P*-value for this post/pre difference was highly significant at $P < .001$. When adding an adjustment for multiple comparisons (computing *P*-values for the post- minus predifference scores separately for each side rail group), the lower bound of the 95% CI was a decrease of − 0.083, and the upper bound was a decrease of − 0.023. The target significance level for this comparison was computed as $0.05/2 = 0.025$, and the multiple imputation *P*-value of <.001 is well below this target significance level.

For the group that continued with restrictive side rails, there was not a statistically significant change in bed-related fall rate from pre- to post-APN intervention ($P = .17$, adjusted for multiple imputation only). The point estimate for the post/pre change in bed-related fall rate was − 0.013, and the unadjusted 95% CI ranged from a low of − 0.051 to a high of 0.024. When adding an adjustment for multiple comparisons (computing *P*-values for the post- minus predifference scores separately for each side rail group), the lower bound of the 95% CI was a decrease of − 0.056, and the upper bound was an increase of − 0.030. The target significance level for this comparison was computed as $0.05/2 = 0.025$, and the multiple imputation *P*-value of .17 remained nonsignificant.

Similarly, the bed-related serious injuries decreased from nine (3.68%) to five (1.99%) serious injuries after the APN intervention, with those in the discontinuing restrictive side rail group reducing from seven to four serious injuries and those in the restrictive side rail groups reducing from two to one serious injuries. There was insufficient sample size to conduct more-formal analyses of the serious bed-related fall injury data.

DISCUSSION

The APN consultation model reduced restrictive side rail usage, at the institutional and individual resident-participant level. This finding supports a growing literature that has demonstrated the efficacy of APNs working in a facilitative or consultative role, whether functioning as an external consultant or clinical nurse specialist or as part of a primary care/nurse practitioner position.[26,28–30,44]

Nevertheless, there were significant differences found between the four sites. The facility with the greatest reduction in restrictive side rail use (Site 3) had a high proportion of minority (mostly African-American) residents and depended mostly on Medicaid for reimbursement, whereas the nursing home with the increase in restrictive side rail use (Site 2) served a population with less Medicaid reimbursement and fewer minority residents. The Site 3 nursing home, a nonprofit, religiously affiliated facility, is not representative of the typical nursing home with a high Medicaid census. The facility's religious mission, with a highly committed administrative staff, most likely, as in other studies, facilitated positive changes in side rail usage.[45,46] Although this study was conducted after the issuing of federal guidelines that discourage restrictive side rail use,[18] none of the participating home were cited for restraint-related deficiencies during the study time period; the state surveys focused on pain management. Unfortunately, similar to physical restraints, reduction of their routine usage

often depends on enforcement by state surveyors of federal regulations.[47,48] Site 3 demonstrated continued high reduction in restrictive side rail use 1 year postintervention, which is consistent with the findings of other restraint studies; APN consultation can reduce restraint use, but long-term adherence depends on strong administrative support.[45,49] Data were not collected on other important institutional level factors that are known to be associated with high-quality care, such as registered nurse staff ratios, staffing levels, and managerial style.[45,46,49]

The finding that side rail reduction was associated with fewer bed-related falls, similar to physical restraint reduction,[27] is important. This supports the national movement to reduce restrictive side rail usage. The persistent use of side rail reflects a gradual consensus between law and medicine rather than an empirically driven practice.[50] The evidence from this study and others,[13–15] coupled with the negative consequences associated with these devices, clearly questions their role in nursing home safety. Nursing home residents spend a considerable amount of time in bed and require bed systems that provide a comfortable and safe resting environment.

Although the FDA has issued guidelines for hospital bed design to reduce entrapment,[1] many nursing homes contain beds that are greater than five years old. Many nursing homes purchase refurbished beds from hospitals. Replacing all beds with potential entrapment risk is a costly solution. Alternatively, nursing homes can conduct a comprehensive evaluation of their inventory, evaluate each bed or entrapment risk, and employ mitigation strategies.[1,51] The latter includes retrofit kits produced by bed manufacturers and accessories that reduce gaps in the bed system.[51]

The absence of a control group is the major limitation of this study. Although different types of nursing homes and participants were included, the sample is not representative of the typical U.S. facility. The participating facilities were all urban homes (compared with 60% of nursing homes nationally); with an average bed size of more than twice the national average. Moreover, the residents of these facilities were significantly poorer and less likely to be Caucasian than nationally.[52]

Similar to other multifaceted consultation models,[26,33] it was not possible to describe the effectiveness of any individual intervention on falls and injuries. Also, adherence to the APN's recommendations was not evaluated; thus, it is not known which interventions were the most frequently employed side rail alternatives. Nevertheless, differences in key resident characteristics may have influenced staff's decisions to change side rail status. Restrictive side rails were discontinued in residents who had more serious injuries and a significantly higher bed-related fall rate before the intervention, better functional and mobility status, and greater use of antipsychotic drugs. This combination of characteristics suggests that residents in the discontinued side rail group were more physically able and more likely to attempt to get out of bed with raised side rails. Although the APN provided detailed recommendations to reduce restrictive side rail use for all resident-participants, those that were more likely to harm themselves seemed to be those for whom staff chose to reduce side rails and employ alternatives such as adjustable low-height beds, bedside mats, and bed alarms. The less physically mobile residents who experienced fewer bed-related falls were likely viewed as not a priority for restrictive side rail use, and future research is indicated to evaluate the amount of APN "dose" to facilitate effective restrictive side rail reduction, regardless of the resident's mobility.[53]

Although side rails serve many purposes, the study findings do not support routine use of these devices to restrict voluntary movement and prevent bed-related falls. Individualized assessment by nursing home staff followed by implementation of interventions modified to residents' needs is the strategy most likely to reduce fall and fall-related injury risk.

ACKNOWLEDGMENTS

The authors are grateful to research assistant Tara Williams who collected the data, Betsy Weiss for obtaining consents, and those who helped to code and enter the data: Honore Becker, BSN, RN, Gerard Driscoll, MSN, RN, CS, Kelly Wiltse, BSN, RN, and Diana Ioana Popa, BSN, RN. We appreciate the statistical programming assistance of Sharon Hurley and the statistical consultation of Jacqui Cater, PhD, and Greg Maislin, MA, MS.

Financial Disclosure: Funded by grants from the University of Pennsylvania Research Foundation, American Nurses' Foundation, University of Pennsylvania School of Medicine Alzheimer's Disease Center Core, and NOVARTIS Foundation for Gerontological Research.

Author Contributions: Elizabeth Capezuti, the primary author, served as principal investigator and was responsible for study concept and design, analysis and interpretation of data, and preparation of the manuscript. Laura M. Wagner participated in acquisition of data, analysis and interpretation of data, and preparation of the manuscript. Barbara L. Brush was involved in the study concept and design and preparation of the manuscript.

Marie Boltz, Susan Renz, and Karen Talerico were responsible for designing and carrying out the intervention in the participating facilities, including acquisition of subjects and data, and participated in preparation of the manuscript.

Sponsor's Role: Not applicable.

REFERENCES

1. U.S. Food and Drug Administration. Draft. Guidance for Industry and FDA Staff: Hospital Bed System Dimensional Guidance to Reduce Entrapment [on-line]. Available atwww.fda.gov/cdrh/beds/guidance/1537.pdf Accessed March 13, 2006.
2. Joint Commission on the Accreditation of Healthcare Organizations. Sentinel Event Alert: Bed Rail-Related Entrapment Deaths [on-line]. Available atwww.jcaho.org/about+us/news+letters/sentinel+event+alert/sea_27.htm Accessed March 21, 2006.
3. Osculati A, Fassina G. Two cases of accidental asphyxia by neck compression between bed bars. Am J Forensic Med Pathol 2000;21:217–219.
4. Miles SH. Deaths between bedrails and air pressure mattresses. J Am Geriatr Soc 2002;50:1124.
5. Parker K, Miles SH. Deaths caused by bedrails. J Am Geriatr Soc 1997; 45:797–802.
6. U.S. Food and Drug Administration. FDA Issues. Guidance on Hospital Bed Design to Reduce Patient Entrapment [on-line]. Available atwww.fda.gov/bbs/topics/NEWS/2006/NEW01331.html Accessed March 13, 2006.
7. Frengley J. Bedrails. Do they have a benefit? J Am Geriatr Soc 1999;47: 529–531.
8. Capezuti E, Talerico K. Physical restraint removal, falls, and injuries. Res Prac Alzheimer's Disease 1999;2:338–355.

9. Guttman R, Altman RD, Karlan MS. Report of the Council on Scientific Affairs. Use of restraints for patients in nursing homes. Council on Scientific Affairs. Am Med Assoc Arch Fam Med 1999;8:101–105.
10. Ball MC, Hanger HC, Thwaites JH. Bed rails: A barrier to independence? Clin Rehabil 1997;11:347–349.
11. O'Keeffe S, Jack CIA, Lye M. Use of restraints and bedrails in a British hospital. J Am Geriatr Soc 1996;44:1086–1088.
12. Capezuti E, Maislin G, Strumpf N et al. Side rail use and bed-related fall outcomes among nursing home residents. J Am Geriatr Soc 2002;50:90–96.
13. Hanger HC, Ball MC, Wood LA. An analysis of falls in the hospital. Can we do without bedrails? J Am Geriatr Soc 1999;47:529–531.
14. Si M, Neufeld RR, Dunbar J. Removal of bedrails on a short-term nursing home rehabilitation unit. Gerontologist 1999;39:611–614.
15. van Leeuwen M, Bennett L, West S et al. Patient falls from bed and the role of bedrails in the acute care setting. Aust J Adv Nurs 2001;19:8–13.
16. Feinstod FM, Moore M, Levenson SA. Eliminating full-length bedrails from long-term care facilities. Nurs Home Med 1997;5:257–263.
17. Hoffman SB, Powell-Cope G, MacClellan L et al. BedSafe: A bed safety project for frail older adults. J Gerontol Nurs 2003;29:34–42.
18. Guidance to surveyors in the implementation of 42 CFR Part 483.13 (a) Medicare and Medicaid programs. State operations manual provider certification transmittal 20. PP-45. Washington, DC: Health Care Financing Administration, 2000.
19. Guidance to surveyors in the implementation of 42 CFR Part 482 Medicare and Medicaid programs. State operations manual provider certification transmittal 17. A-182-183. Washington, DC: Health Care Financing Administration, 2000.
20. American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons. Guideline for the prevention of falls in older persons. J Am Geriatr Soc 2001;49:664–672.
21. American Medical Directors Association, The American Health Care Association. Falls and Fall Risk. Clinical Practice Guideline. Columbia, MD: American Medical Directors Association, 2003.
22. Hospital Bed Safety Workgroup. Clinical guidance for the assessment and implementation of bed rails in hospitals, long term care facilities, and home care settings. Crit Care Nurs Q 2003;26:244–262.
23. Capezuti E, Talerico KA, Cochran I et al. Individualized interventions to prevent bed-related falls and reduced siderail use. J Gerontol Nurs 1999; 25:26–34.
24. Capezuti E, Talerico K, Strumpf N et al. Individualized assessment and intervention in bilateral siderail use. Geriatr Nurs 1998;9:322–330.
25. Miles SH. Restraints: Controlling a symptom or a symptom of control. HEC Forum 1998;10:235–243.
26. Evans LK, Strumpf NE, Allen-Taylor L et al. A clinical trial to reduce restraints in nursing homes. J Am Geriatr Soc 1997;45:675–681.
27. Capezuti E, Strumpf N, Evans L et al. The relationship between physical restraint removal and falls and injuries among nursing home residents. J Gerontol A Biol Sci Med Sci 1998;53A:M47–M52.
28. Krichbaum K, Pearson V, Savik K et al. Improving resident outcomes with GAPN organization level interventions. West J Nurs Res 2005;27:322–337.
29. Ryden MB, Snyder M, Gross CR et al. Value-added outcomes: The use of advanced practice nurses in long-term care facilities. Gerontologist 2000; 40:654–662.
30. Krichbaum K, Pearson V, Hanscom J. Better care in nursing homes: Advanced practice nurses' strategies for improving staff use of protocols. Clin Nurse Spec 2000;14:40–46.
31. Rapp MP. Opportunities for advance practice nurses in the nursing facility. J Am Med Dir Assoc 2003;4:337–343.
32. Rosenfeld P, Kobayashi M, Barber P et al. Utilization of nurse practitioners in long-term care: Findings and implications of a national survey. J Am Med Dir Assoc 2004;5:9–15.
33. Ray WA, Taylor JA, Meador KG et al. A randomized trial of a consultation service to reduce falls in nursing homes. JAMA 1997;278:557–596.
34. Capezuti E. Minimizing the use of restrictive devices in dementia patients at risk for falling. Nurs Clin North Am 2004;39:625–647.
35. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–198.
36. Ray WA, Taylor JA, Lichtenstein MJ et al. The nursing home behavior problem scale. J Gerontol 1992;47:M9–M16.
37. Wilkinson IM, Graham-White J. Psychogeriatric dependency rating scales (PGDRS): A method of assessment for use by nurses. Br J Psychiatry 1980; 137:558–565.
38. Morse JM. Preventing Patient Falls. Thousand Oaks, CA: Sage, 1997.
39. Tinetti ME, Ginter SF. The nursing home life-space diameter. A measure of extent and frequency of mobility among nursing home residents. J Am Geriatr Soc 1990;38:1311–1315.
40. Bourbonniere M, Strumpf NE, Evans LK et al. Organizational characteristics and physical restraint use for hospitalized nursing home residents. J Am Geriatr Soc 2003;51:1079–1084.
41. Wagner LM, Capezuti E, Brush B et al. An advanced practice nursing consultative model to reduce restrictive side rail use in nursing homes. Res Nurs Health in press.
42. Talerico KA, Capezuti E. Myths and facts about side rails. Am J Nurs 2001;101:43–48.
43. Rubin DB, Schenker N. Multiple imputation in health-care databases: An overview and some applications. Stat Med 1991;10:585–598.
44. Rantz MJ, Popejoy L, Petroski GF et al. Randomized clinical trial of a quality improvement intervention in nursing homes. Gerontologist 2001;41: 525–538.
45. Castle NG, Engberg J. Staff turnover and quality of care in nursing homes. Med Care 2005;43:616–626.
46. Castle NG. Deficiency citations for physical restraint use in nursing homes. J Gerontol B Psychol Sci Soc Sci 2000;55B:S33–S40.
47. Castle NG, Mor V. Physical restraints in nursing homes. A review of the literature since the nursing home reform act of 1987. Med Care Res Rev 1998;55:139–170.
48. Walshe K, Harrington C. Regulation of nursing facilities in the United States: An analysis of resources and performance of state survey agencies. Gerontologist 2002;42:475–487.
49. Rantz MJ, Hicks L, Grando V et al. Nursing home quality, cost, staffing, and staff mix. Gerontologist 2004;44:24–38.
50. Brush BL, Capezuti E. Historical analysis of siderail use in American hospitals. J Nurs Scholarsh 2001;33:381–385.
51. Powell-Cope G, Baptiste AS, Nelson A. Modification of bed systems and use of accessories to reduce the risk of hospital-bed entrapment. Rehabil Nurs 2005;30:9–17.
52. Centers for Disease Control and Prevention, National Center for Health Statistics. 1999 National Nursing Home Survey [on-line]. Available at www.cdc.gov/nchs/data/series/sr_13/sr13_152.pdf Accessed March 21, 2006.
53. Wells TJ. When a dose of advanced practice nursing is the treatment. J Am Geriatr Soc 2002;50:2092–2093.