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Abstract

Background

Pressure at the interface between bony prominences and support surfaces, sufficient to occlude or reduce blood flow, is thought to cause pressure ulcers (PrUs). Pressure ulcers are prevented by providing support surfaces that redistribute pressure and by turning residents to reduce length of exposure.

Objective

We aim to determine optimal frequency of repositioning in long-term care (LTC) facilities of residents at risk for PrUs who are cared for on high-density foam mattresses.

Methods

We recruited residents from 20 United States and 7 Canadian LTC facilities. Participants were randomly allocated to 1 of 3 turning schedules (2-, 3-, or 4-hour intervals). The study continued for 3 weeks with weekly risk and skin assessment completed by assessors blinded to group allocation. The primary outcome measure was PrU on the coccyx or sacrum, greater trochanter, or heels.

Results

Participants were mostly female (731/942, 77.6%) and white (758/942, 80.5%), and had a mean age of 85.1 (standard deviation [SD] ± 7.66) years. The most common comorbidities were cardiovascular disease (713/942, 75.7%) and dementia (672/942, 71.3%). Nineteen of 942 (2.02%) participants developed one superficial Stage 1 (n = 1) or Stage 2 (n = 19) ulcer; no full-thickness ulcers developed. Overall, there was no significant difference in PrU incidence ($P = 0.68$) between groups (2-hour, 8/321 [2.49%] ulcers/group; 3-hour, 2/326 [0.61%]; 4-hour, 9/295 [3.05%]. Pressure ulcers among high-risk (6/325, 1.85%) versus moderate-risk (13/617, 2.11%) participants were not significantly different ($P = 0.79$), nor was there a difference between moderate-risk ($P = 0.68$) or high-risk allocation groups ($P = 0.90$).

Conclusions

Results support turning moderate- and high-risk residents at intervals of 2, 3, or 4 hours when they are cared for on high-density foam replacement mattresses. Turning at 3-hour and at 4-hour intervals is no worse than the current practice of turning every 2 hours. Less frequent turning might increase sleep, improve quality of life, reduce staff injury, and save time for such other activities as feeding, walking, and toileting.

Plain Language Summary

Bedsores are caused by pressure where bones under the skin meet support surfaces (like mattresses). Pressure reduces blood flow. Bedsores cause problems for many older patients. Bedsores increase the rate of patients' death by as much as 400%, increase hospitalization, and decrease quality of life. Treating bedsores is costly.

One way to prevent bedsores among long-term care (LTC) residents is to turn patients throughout the day to reduce pressure in areas likely to develop ulcers. High-density foam mattresses can reduce how often residents must be turned. Currently Ontario LTC facilities turn patients every 2 hours.

This study aimed to determine the best interval to use in turning LTC residents (cared for on high-density foam mattresses) who are at risk for bedsores. We examined the benefits and costs of turning patients every 2, 3, and 4 hours in a randomized controlled trial that recruited residents from 20 United States and 7 Canadian LTC homes. Residents had no bedsores at the beginning of the study, were 65 years or older, and had moderate (scores 13–14) or high (scores 10–12) risk for bedsores. Participants continued their usual daily activities. The study continued for 3 weeks while study coordinators who did not know which group patients were in assessed patients' risk and skin every week.

Overall, results of the study support turning moderate- and high-risk residents at intervals of 2, 3, or 4 hours when they are cared for on high-density foam mattresses. Turning at 3- and 4-hour intervals is no worse than turning every 2 hours. Less frequent turning could be better for LTC residents because it can increase sleep, improve quality of life, reduce staff injury, and save time for such other activities as feeding, walking, and using the toilet.

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List of Abbreviations

BMI	Body mass index
CNA	Certified nursing assistant
LTC	Long-term care
OHTAC	Ontario Health Technology Advisory Committee
PSW	Personal Support Worker
PrU	Pressure ulcer
SD	Standard deviation
TURN Study	Turning for Ulcer Reduction Study
THETA	Toronto Health Economics and Technology Assessment

Background

The most basic strategy recommended by physicians and nurses to prevent pressure ulcers (PrUs) is the practice of turning or repositioning residents at 2-hour intervals. Turning every 2 hours, 12 times daily, 365 days annually, results in 4,380 turning episodes per patient yearly. Estimating 5 minutes per turn, 21,900 minutes, 365 hours, or 9.125 weeks of staff time per resident is required annually. Turning often requires 2 staff members, doubling the cost of the intervention.

Pressure at the interface between bony prominences and support surfaces, sufficient to occlude or reduce blood flow, is thought to cause PrUs. (1, 2) By providing support surfaces that redistribute pressure and by turning residents to reduce length of exposure, some PrUs can be prevented. High-density foam mattresses distribute pressure more evenly and are replacing springform mattresses used almost exclusively before the 2000s. A recent study by Li et al (3) found a steady decrease in PrUs in 2-year increments from 2002 to 2008. The authors speculated that increased use of high-density foam mattresses likely reduced exposure to pressure, providing a margin of error so that, even when turning didn't occur as recommended, pressure-relief properties of the mattresses protected residents from excessive pressure. (4)

Turning residents every 2 hours, recommended in many guidelines to reduce exposure to pressure, is not practised uniformly. Bates-Jensen and colleagues demonstrated through hourly observation and thigh sensors that residents are in practice turned less frequently than every 2 hours. (5) Turning is not benign. It decreases quality of life for residents because of repeated awakenings at night. Staff risk injury and the facility risks loss of its workforce. Determining the appropriate frequency of turning when high-density foam mattresses are used is important to keep residents safe, to improve quality of life (e.g., increase in ambulation, feeding assistance, toileting), and to make judicious use of staff time.

This clinical trial aimed to determine the optimal frequency of turning long-term care (LTC) facility residents with mobility limitations who were cared for on high-density foam mattresses for the purpose of preventing PrUs. Participants stratified by 2 levels of risk according to the Braden Scale for Predicting Pressure Sore Risk (hereafter Braden Scale) were compared as follows: (a) moderate-risk (Braden Scale score 13–14) participants randomly assigned to turning at every 2 compared with every 3 or 4 hours; or (b) high-risk (Braden Scale score 10–12) participants randomly assigned to turning every 2 compared with every 3 or 4 hours. (6, 7)

Research Methods

Design and Participants

This multicentre clinical trial had 2 levels of stratification, random allocation to 1 of 3 turning frequencies, and masked assessment of the outcome. Participants were randomly allocated via numbered envelopes in blocks of 6 according to risk-stratification group (moderate versus high) to 1 of 3 repositioning schedules (2-, 3-, or 4-hour intervals) when in bed. The study continued for 3 weeks after randomization with weekly risk and skin assessment completed by assessors blinded to treatment group.

The outcome, PrUs on the coccyx or sacrum, trochanter, or heel (sites most susceptible to pressure while people lie in bed), was determined by weekly blinded assessment. Residents were stratified by risk level because lower risk hypothetically is associated with fewer PrUs. The protocol continued for 3 weeks, because 90% of PrUs developed in the first 3 weeks after facility admission in a previous study. (8)

Data were collected from LTC facilities in the United States (n = 20) and in Ontario, Canada (n = 7). The LTC facilities in the United States were identified through quality-improvement organizations, corporate nurses of proprietary chains, the Advancing Excellence Campaign, and other contacts. Canadian LTC facilities identified by The Toronto Health Economics and Technology Assessment (THETA) Collaborative had to be situated in the greater Toronto area and be willing to participate in research.

Criteria for including LTC facilities were stable leadership, high-density foam mattresses on participants' beds, overall quality according to Nursing Home Compare in the United States, and the ability to respond promptly to investigators. High-density foam mattresses of various brands and models were included because no product has demonstrated superiority. In the United States, quality of the LTC facilities was reported to be 4- or 5-star according to Nursing Home Compare with low (below 5%) incidence of PrUs to ensure above-average preventive care where outcomes could be related to turning rather than to less effective care. (9) Participants in Canadian facilities were provided with new high-density foam mattresses because of variation in the types and ages of existing mattresses.

Ethics Committees at the University of Texas Health Science Center at Houston, University of Toronto, and one clinical site approved the protocol. Each LTC facility in the United States completed Federal Wide Assurance indicating acceptance of this ethics review before on-site training.

Participants were 65 years of age or older, free of PrUs when the study began, at moderate (Braden Scale score 13–14) or high (Braden Scale score 10–12) risk for PrUs, had mobility limitations (≤3 on Braden mobility subscale), and were on high-density foam mattresses. Participants were newly admitted short-stay residents (in facility for ≤7 days) or long-stay residents (in LTC facility for ≥90 days). These resident groups are different in that short-stay residents have had recent illness or surgery or a physiologic or cognitive transition that could be associated with stress (perhaps predisposing to PrUs); long-stay residents would likely be more physiologically stable but more challenged by needs for assistance with activities of daily living.

Residents were excluded on the basis of length of stay; of Braden Scale mobility scores indicating independent mobility (4); or of Braden Scale scores indicating very high risk (6–9), low risk (15–18), or not at risk (19–23). Residents at no risk or low risk do not lie in one position for 2 hours, are in and out of bed, and (as pilot work indicates) do not comply with a turning regimen. Residents at very high risk (scores ≤9) are often cared for on a powered mattress or alternating pressure-relief overlays.

On-site LTC Facility Training

On-site training by the study team was completed at each LTC facility in 2 to 3 days. A study coordinator, recruiter(s), assessor(s), and record managers received individual training, and inter-rater reliability was determined for assessors during training and at quarterly intervals. Licensed nurse supervisors were trained to observe and document position, record adverse events, and document skin care orders should a PrU develop. Certified nursing assistants (CNAs) in the United States and personal support workers (PSWs) in Canada were trained to carry out the intervention: to turn and check briefs according to assigned schedule and to document position change, heel elevation, skin condition, briefs status, and incontinence care at each repositioning. These CNAs and PSWs were trained in shift hand-off so that oncoming shifts could identify study participants. Following training, a mock trial was conducted. The LTC facilities participated until all eligible, consenting residents were studied.

Residents were screened and asked for consent by the recruiter. Consent was obtained from residents judged competent to sign on the basis of satisfactory answers to 3 questions related to the protocol after the study was explained; alternatively, consent from a legal representative was obtained.

Participants were allocated to study groups when consent was obtained. Two sets of numbered envelopes were used, one each for high and moderate risk. Each envelope contained another envelope with the turning frequency. Because sites varied in size, turning frequency was randomized in blocks of 6 to ensure equal distribution of turning at each site. The recruiter placed study materials and documentation in participant rooms and notified staff of start time. Given staff constraints, units studied up to 3 subjects at one time; as one subject completed, another began.

Staff were expected to turn patients within 30 minutes of the scheduled time and to record each turn. The study focused on turning in bed and documented time patients spent in a chair. Skin over bony prominences was inspected, and the condition of the skin was documented. Supervisors were notified of changes in skin condition.

Facility-wide PrU prevention measures in LTCs, such as use of chair cushions, heel-protector boots, or heel elevation, were continued throughout the study. Participants would sit in chairs, go to meals, bathe, and go to therapy as usual. Practices were generally consistent with guidelines for prevention of PrUs, and effectiveness was judged by relatively low incidence of new PrUs reported by each LTC facility. (10, 11)

Supervisors observed and recorded participants' positions hourly. Supervisor-observed positions, compared with CNA- and PSW-reported turns, were one measure of treatment fidelity. Adverse events were reported, study forms checked for completeness, documentation faxed to Texas, and forms mailed to the project office (at the University of Toronto) for data verification and storage.

Treatment fidelity was assessed in 3 ways:

- Documentation from CNAs and PSWs was evaluated monthly for percent on-time turning (reported turns occurring within 30 minutes of assigned turning time/total expected turns);
- Documentation from CNAs and PSWs of mean length of time patients spent in one position;
- Percent agreement between participant position and length of time in position as documented on CNA or PSW repositioning forms and supervisor-reported hourly position status.

Project staff sent printed reports to study sites for monthly quality-assessment teleconferences with a goal of 80% on-time turning and 80% of position changes in agreement. If agreement was below 80%, improvement was discussed.

Inter-rater reliability between the trainer and nurse assessors was examined during training sessions (R = 0.926) and evaluated quarterly (r = 0.897) to prevent drift in measurement of the Braden Scale.

Statistical Analysis

Stage 1 PrUs were identified if they were present at 2 separate observations. Descriptive statistics were used: frequencies for categorical participant, intervention, and outcome measures, and mean and standard deviation (SD) for continuous measures. Bivariate analyses were used to test the relationships between each risk group and within risk group by allocation to groups in which patients were turned every 2, 3, or 4 hours. For discrete variables, contingency tables were created and Wilcoxon tests (for ordered categories) were performed with Fisher's exact tests for 2 x 2 tables. For continuous variables, 2-sample *t* tests or analysis of variance were used. Logistic regression analyses were used to predict likelihood of PrU development. A 2-sided *P* value <0.05 was considered statistically significant. Analyses were performed using SAS, version 9.2 (SAS Institute, Inc., Cary, NC).

Results

Among 6,240 residents screened, 1,400 met eligibility requirements; 967 agreed to participate (Figure 1). Moderate- and high-risk participants were allocated to turning every 2 (335 patients), 3 (333 patients), or 4 hours (299 patients). However, 25 residents who were allocated to a study group, but did not receive the intervention because of death, hospitalization by choice, or for other reasons that surfaced before the beginning of the study period, are not included in the final analysis, resulting in 942 participants (321 turned every 2 hours, 326 turned every 3 hours, and 295 turned every 4 hours).

Participants were predominantly female (731/942, 77.6%) and white (758/942, 80.5%), with a mean age of 85.1 (SD ± 7.66) years. The most common comorbidities were cardiovascular disease (713/942, 75.7%) and dementia (672/942, 71.3%) (Table 1). There was no significant difference in age between moderate- and high-risk groups; however, high-risk participants included more women (267/325, 82.2%) versus moderate-risk participants (464/617, 75.2%) and had a higher prevalence of dementia (251/325, 77.2%) than moderate-risk participants (421/617, 68.2%). High-risk participants had significantly lower body mass index (BMI), Braden Scale total, and Braden Scale subscale scores; lower percentage of meals eaten; and higher percentage of wet briefs observed ($P \leq 0.004$) than moderate-risk patients.

More moderate- (n = 617) than high-risk (n = 325) residents participated. Fewer high-risk participants were allocated to 4- (n = 97) versus 2- (n = 111) and 3-hour turning (n = 117), because allocation of 4-hour turning of high-risk participants was delayed in the United States. There were no significant differences between turning groups for moderate-risk participants (Table 3), except BMI, which was lower in the 2-hour group (2-hour, 24.88 ± 5.36; 3-hour, 26.19 ± 6.28; 4-hour, 26.03 ± 6.15; $P = 0.053$) and except wet observations, which were more frequent among those allocated to 2- rather than 3- or 4-hour turning ($P < 0.001$). High-risk participants did not differ by turning group except for wet observations, which occurred more frequently in the 2-hour group than in 3- or 4-hour groups ($P < 0.001$) (Table 5). The overall mean percentage of meals eaten during the study was 75.1% (±21.6 %); high-risk participants ate significantly less than moderate-risk participants ($P = 0.004$).

Pressure ulcers developed on the coccyx or sacrum (n = 16), trochanter (n = 1), or heels (n = 2) of 19 of 942 (2.02%) participants. Pressure ulcers were limited to superficial stage 1 (n = 1) and stage 2 (n = 18) ulcers. One participant's condition deteriorated and 2 developed ulcers, one of which could have become a deep tissue injury; this patient was withdrawn from the study. Otherwise, no stage 3, stage 4, or unstageable ulcers developed (Table 7). Overall, there was no significant difference in PrU incidence ($P = 0.68$) between groups (2-hour, 8/321 [2.49%] ulcers/group; 3-hour, 2/326 [0.61%]; 4-hour, 9/295 [3.05%]). Pressure ulcers among high-risk (6/325, 1.85%) versus moderate-risk (13/617, 2.11%) participants were not significantly different ($P = 0.79$), nor between moderate-risk ($P = 0.68$) or high-risk ($P = 0.90$) allocation groups. When short-stay (≤7 days) or long-stay (≤90 days) admissions and allocation groups were compared, no significant differences were apparent.

Logistic regressions predicting PrU development were computed for the total population, and separately for moderate- and high-risk groups, allowing determination of a Braden Scale risk level on admission. Severity scores, country, BMI, age, diagnosis groups, mean percentage of meals eaten and mean wet episodes were entered into regression models (Table 9). Pressure ulcer development was significantly related to a diagnosis of nutritional deficiency among the total and moderate-risk participants. The only variable predicting PrU in the high-risk population was fracture diagnosis.

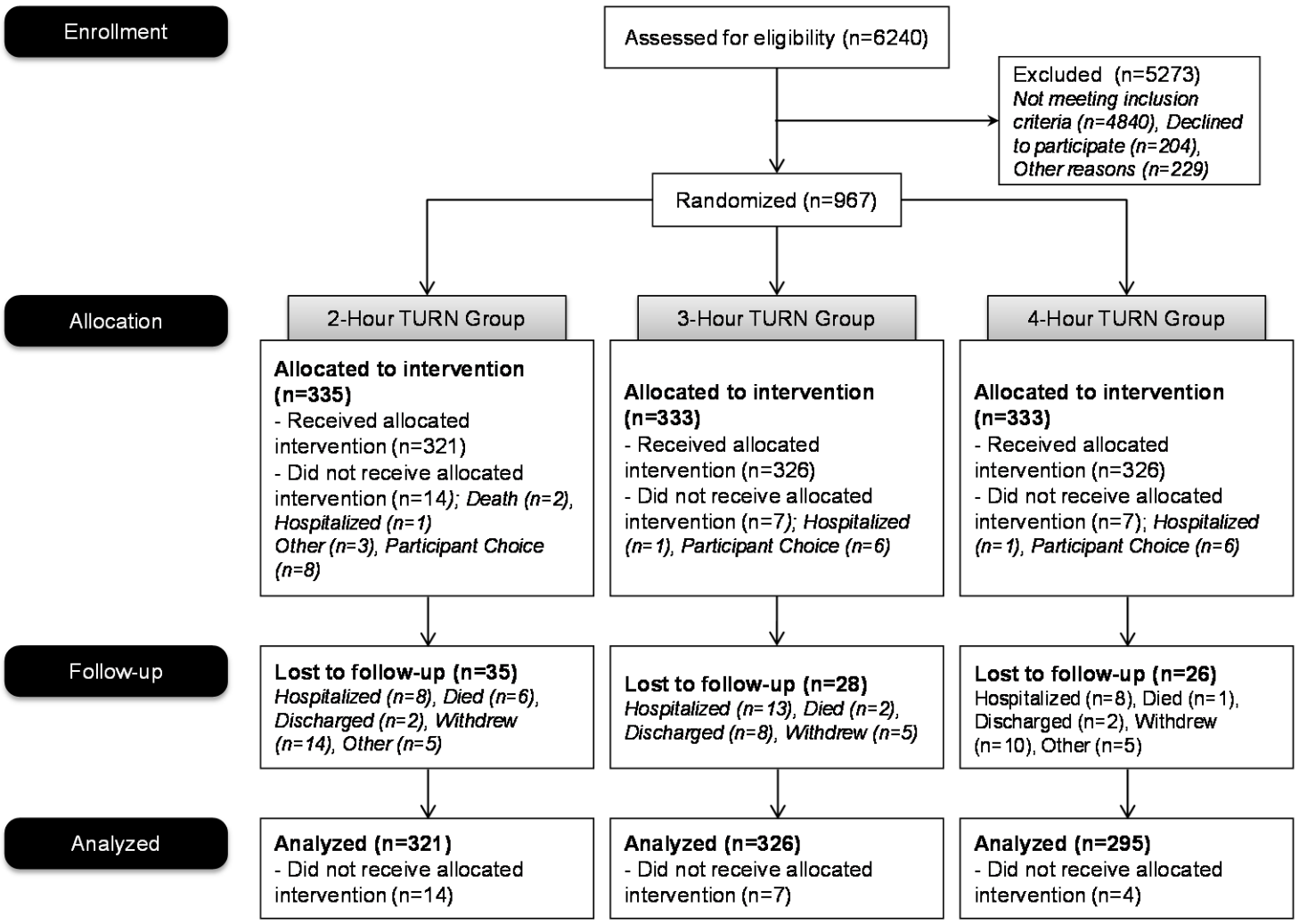

Figure 1: Patient Flow Diagram

Table 1: Demographic and Risk Status Characteristics for All Participants—Differences between Moderate- and High-Risk Participants (United States and Canadian Data Combined)

Variable	Patients (N = 942)	Mean (SD) or %	Moderate Risk (n = 617)	Mean (SD) or %	High Risk (n = 325)	Mean (SD) or %	Difference (High vs. Moderate)
Age (years)	939	85.07 (7.66)	615	85.24 (7.65)	324	84.75 (7.69)	0.357[a]
BMI (measured as kg/m^2)	905	25.11 (6.04)	598	25.69 (5.95)	307	23.99 (6.06)	<0.001[a]
Braden Total Score	931	12.84 (1.17)	613	13.57 (0.50)	318	11.44 (0.73)	<0.001[a]
Sensory perception	931	2.65 (0.65)	613	2.88 (0.58)	318	2.21 (0.55)	<0.001[a]
Moisture	931	2.02 (0.66)	613	2.16 (0.63)	318	1.76 (0.64)	<0.001[a]
Activity	931	2.02 (0.31)	613	2.07 (0.33)	318	1.94 (0.25)	<0.001[a]
Mobility	931	2.06 (0.51)	613	2.21 (0.46)	318	1.77 (0.48)	<0.001[a]
Nutrition	931	2.68 (0.65)	613	2.75 (0.61)	318	2.54 (0.72)	<0.001[a]
Friction	931	1.40 (0.49)	613	1.50 (0.50)	318	1.21 (0.41)	<0.001[a]
Mean percentage of meals eaten over study	941	75.06 (21.63)	616	76.53 (20.94)	325	72.29 (22.66)	0.004[a]
All data severity	927	25.25 (21.31)	610	24.70 (19.83)	317	26.30 (23.92)	0.310[a]
Wet times/day	942	4.17 (1.59)	617	4.04 (1.58)	325	4.43 (1.57)	<0.001[a]
Women	731	77.60	464	75.20	267	82.15	0.017
Race/ethnicity							
White	758	80.47	506	82.01	252	77.54	0.056
Black	55	5.84	37	6.00	18	5.54	
Asian	101	10.72	59	9.56	42	12.92	
Hispanic	22	2.34	14	2.27	8	2.46	
Other	6	0.64	1	0.16	5	1.54	
Diagnosis category							
Dementia	672	71.34	421	69.02	251	79.18	
Cerebrovascular	341	36.20	216	35.41	125	39.43	
Diabetes	252	26.75	173	28.36	79	24.92	
Cardiovascular	713	75.69	491	80.49	222	70.03	
Musculoskeletal	506	53.72	333	54.59	173	54.57	
Thyroid disorder	167	17.73	111	18.20	56	17.67	
Nutritional	18	1.91	5	0.82	13	4.10	

Admission eligibility							
Long stay	814	86.41	527	85.41	287	88.31	0.231
Short stay	128	13.59	90	14.59	38	11.69	
Country							
Canada	505	53.61	336	54.46	169	52.00	0.492
United States	437	46.39	281	45.54	156	48.00	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]*t* test performed.

Table 2: Demographic and Risk Status Characteristics for All Participants—Differences Between Moderate- and High-Risk Participants (Ontario Data Only)

Variable	Patients	Mean (SD) or %	Moderate Risk	Mean (SD) or %	High Risk	Mean (SD) or %	Difference (High vs. Moderate)
Age (years)	505	85.90 (7.38)	336	86.06 (7.26)	169	85.59 (7.61)	0.496[a]
BMI (measured as kg/m^2)	501	24.28 (5.47)	335	25.08 (5.62)	166	22.68 (4.80)	<0.001[a]
Braden Total Score	504	12.89 (1.16)	336	13.60 (0.49)	168	11.48 (0.74)	<0.001[a]
Sensory perception	504	2.69 (0.69)	336	2.94 (0.59)	168	2.19 (0.59)	<0.001[a]
Moisture	504	2.04 (0.56)	336	2.11 (0.55)	168	1.90 (0.56)	<0.001[a]
Activity	504	2.04 (0.25)	336	2.07 (0.28)	168	1.98 (0.15)	<0.001[a]
Mobility	504	2.03 (0.52)	336	2.21 (0.45)	168	1.68 (0.49)	<0.001[a]
Nutrition	504	2.76 (0.62)	336	2.84 (0.56)	168	2.58 (0.70)	<0.001[a]
Friction	504	1.34 (0.47)	336	1.43 (0.50)	168	1.14 (0.35)	<0.001[a]
Mean percentage of meals eaten over study	505	81.52 (18.25)	336	83.67 (16.09)	169	77.24 (21.33)	<0.001[a]
All data severity	504	21.52 (16.18)	336	21.85 (15.23)	168	20.86 (17.95)	0.537[a]
Wet times/day	505	4.02 (1.09)	336	3.95 (1.14)	169	4.14 (0.97)	0.049[a]
Women	384	76.04	244	72.62	140	82.84	0.011
Race/ethnicity							
White	379	75.05	262	77.98	117	69.23	0.053
Black	21	4.16	12	3.57	9	5.33	
Asian	97	19.21	57	16.96	40	23.67	
Hispanic	6	1.19	5	1.49	1	0.59	
Other	2	0.40	0	0.00	2	1.18	

Diagnosis category							
Dementia	361	71.63	223	66.37	138	82.14	
Cerebrovascular	209	41.47	136	40.48	73	43.45	
Diabetes	121	24.01	86	25.60	35	20.83	
Cardiovascular	348	69.05	244	72.62	104	61.90	
Musculoskeletal	285	56.55	188	55.95	97	57.74	
Thyroid disorder	75	14.88	49	14.58	26	15.48	
Nutritional	2	0.40	0	0.00	2	1.19	
Admission eligibility							
Long stay	473	93.66	312	92.86	161	95.27	0.338
Short stay	32	6.34	24	7.14	8	4.73	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]*t* test performed.

Table 3: Demographic and Risk-Status Characteristics for Moderate-Risk Participants Allocated to 2-, 3-, or 4-Hour Turning (United States and Canadian Data Combined)

Variable	Moderate Risk (n = 617)	Mean (SD) or %	2-Hour (n = 210)	Mean (SD) or %	3-Hour (n = 210)	Mean (SD) or %	4-Hour (n = 210)	Mean (SD) or %	Moderate-Risk *P* Values (Random Group Comparison)
Age (years)	615	85.24 (7.65)	210	85.60 (7.77)	208	84.35 (7.75)	197	85.80 (7.36)	0.114[a]
BMI (measured as kg/m^2)	598	25.69 (5.95)	206	24.88 (5.36)	201	26.19 (6.28)	191	26.03 (6.15)	0.053[a]
Braden Total Score	613	13.57 (0.50)	209	13.58 (0.49)	207	13.56 (0.56)	197	13.56 (0.50)	0.888[a]
Sensory perception	613	2.88 (0.58)	209	2.93 (0.61)	207	2.83 (0.56)	197	2.87 (0.55)	0.166[a]
Moisture	613	2.16 (0.63)	209	2.17 (0.62)	207	2.12 (0.64)	197	2.20 (0.64)	0.418[a]
Activity	613	2.07 (0.33)	209	2.07 (0.29)	207	2.07 (0.37)	197	2.06 (0.32)	0.874[a]
Mobility	613	2.21 (0.46)	209	2.21 (0.47)	207	2.23 (0.46)	197	2.20 (0.44)	0.845[a]
Nutrition	613	2.75 (0.61)	209	2.71 (0.62)	207	2.81 (0.56)	197	2.73 (0.64)	0.235[a]
Friction	613	1.50 (0.50)	209	1.49 (0.51)	207	1.51 (0.50)	197	1.51 (0.50)	0.944[a]
Mean percentage of meals eaten over study	616	76.53 (20.94)	210	75.81 (20.91)	209	77.03 (20.46)	197	76.75 (21.54)	0.823[a]
All data severity	610	24.70 (19.83)	208	25.85 (20.13)	206	24.72 (19.85)	196	23.47 (19.50)	0.486[a]

Wet times/day	617	4.04 (1.58)	210	4.55 (1.72)	209	4.05 (1.42)	198	3.49 (1.41)	<0.001[a]
Women	464	75.20	156	74.29	155	74.16	153	77.27	0.715
Race/ethnicity									
White	506	82.01	178	84.67	175	83.73	153	77.27	0.225
Black	37	6.00	12	5.71	7	3.35	18	9.09	
Asian	59	9.56	16	7.62	20	9.57	23	11.62	
Hispanic	14	2.27	4	1.90	6	2.87	4	2.02	
Other	1	0.16	0	0.00	1	0.48	0	0.00	
Diagnosis category									
Dementia	421	69.02	140	67.31	142	68.93	139	70.92	
Cerebrovascular	216	35.41	73	35.10	80	38.83	63	32.14	
Diabetes	173	28.36	61	29.33	63	30.58	49	25.00	
Cardiovascular	491	80.49	161	77.40	171	83.01	159	81.12	
Musculoskeletal	333	54.59	118	56.73	102	49.51	113	57.65	
Thyroid disorder	111	18.20	39	18.75	36	17.48	36	18.37	
Nutritional	5	0.82	2	0.96	1	0.49	2	1.02	
Admission eligibility									
Long stay	527	85.41	181	86.19	176	84.21	170	85.86	0.829
Short stay	90	14.59	29	13.81	33	15.79	28	14.14	
Country									
Canada	336	54.46	114	54.29	112	53.59	110	55.56	0.922
United States	281	45.54	96	45.71	97	46.41	88	44.44	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]Analysis of variance performed.

Table 4: Demographic and Risk Status Characteristics for Moderate-Risk Participants Allocated to 2-, 3-, or 4-Hour Turning (Ontario Data Only)

Variable	Moderate Risk	Mean (SD) or %	2-Hour	Mean (SD) or %	3-Hour	Mean (SD) or %	4-Hour	Mean (SD) or %	Moderate-Risk *P* Values (Random Group Comparison)
Age (years)	336	86.06 (7.26)	114	85.52 (7.71)	112	85.63 (7.30)	110	87.06 (6.68)	0.208[a]
BMI (measured as kg/m^2)	335	25.08 (5.62)	113	23.86 (4.89)	112	25.40 (6.11)	110	25.99 (5.62)	0.013[a]
Braden Total Score	336	13.60 (0.49)	114	13.61 (0.49)	112	13.59 (0.49)	110	13.61 (0.49)	0.950[a]
Sensory perception	336	2.94 (0.59)	114	3.05 (0.64)	112	2.85 (0.59)	110	2.92 (0.53)	0.030[a]
Moisture	336	2.11 (0.55)	114	2.13 (0.52)	112	2.07 (0.51)	110	2.14 (0.61)	0.619[a]
Activity	336	2.07 (0.28)	114	2.04 (0.18)	112	2.10 (0.35)	110	2.06 (0.28)	0.242[a]
Mobility	336	2.21 (0.45)	114	2.18 (0.43)	112	2.24 (0.49)	110	2.19 (0.42)	0.582[a]
Nutrition	336	2.84 (0.56)	114	2.79 (0.59)	112	2.88 (0.55)	110	2.85 (0.56)	0.437[a]
Friction	336	1.43 (0.50)	114	1.41 (0.49)	112	1.45 (0.50)	110	1.45 (0.50)	0.842[a]
Mean percentage of meals eaten over study	336	83.67 (16.09)	114	81.92 (17.93)	112	85.47 (13.66)	110	83.66 (16.31)	0.253[a]
All data severity	336	21.85 (15.23)	114	23.86 (17.69)	112	20.99 (14.40)	110	20.65 (13.08)	0.222[a]
Wet times/day	336	3.95 (1.14)	114	4.32 (1.19)	112	3.95 (0.96)	110	3.56 (1.12)	<0.001[a]
Women	244	72.62	81	71.05	81	72.32	82	74.55	0.839
Race/ethnicity									
White	262	77.98	92	80.70	91	81.25	79	71.82	0.318
Black	12	3.57	4	3.51	1	0.89	7	6.36	
Asian	57	16.96	16	14.04	19	16.96	22	20.00	
Hispanic	5	1.49	2	1.75	1	0.89	2	1.82	
Other	.		.		.		.		
Diagnosis category									
Dementia	223	66.37	72	63.16	74	66.07	77	70.00	
Cerebrovascular	136	40.48	48	42.11	49	43.75	39	35.45	
Diabetes	86	25.60	32	28.07	29	25.89	25	22.73	

Cardiovascular	244	72.62	80	70.18	87	77.68	77	70.00	
Musculoskeletal	188	55.95	66	57.89	55	49.11	67	60.91	
Thyroid disorder	49	14.58	19	16.67	11	9.82	19	17.27	
Nutritional	.		.		.		.		
Admission eligibility									
Long stay	312	92.86	111	97.37	100	89.29	101	91.82	0.054
Short stay	24	7.14	3	2.63	12	10.71	9	8.18	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]Analysis of variance performed.

Table 5: Demographic and Risk Status Characteristics for High-Risk Participants Allocated to 2-, 3-, or 4-Hour Turning (United States and Canadian Data Combined)

Variable	High Risk (n = 325)	Mean (SD) or %	2-Hour (n = 111)	Mean (SD) or %	3-Hour (n = 117)	Mean (SD) or %	4-Hour (n = 97)	Mean (SD) or %	High-Risk *P* Values (Random Group Comparison)
Age (years)	324	84.75 (7.69)	111	84.77 (7.78)	117	84.35 (7.79)	96	85.22 (7.50)	0.715[a]
BMI (measured as kg/m^2)	307	23.99 (6.06)	107	24.25 (5.54)	107	24.48 (7.55)	93	23.11 (4.49)	0.240[a]
Braden Total Score	318	11.44 (0.73)	109	11.48 (0.70)	113	11.42 (0.73)	96	11.42 (0.76)	0.808[a]
Sensory perception	318	2.21 (0.55)	109	2.19 (0.54)	113	2.20 (0.58)	96	2.25 (0.54)	0.740[a]
Moisture	318	1.76 (0.64)	109	1.80 (0.68)	113	1.70 (0.63)	96	1.79 (0.61)	0.441[a]
Activity	318	1.94 (0.25)	109	1.94 (0.25)	113	1.95 (0.26)	96	1.94 (0.24)	0.939[a]
Mobility	318	1.77 (0.48)	109	1.79 (0.47)	113	1.74 (0.48)	96	1.78 (0.49)	0.750[a]
Nutrition	318	2.54 (0.72)	109	2.53 (0.71)	113	2.61 (0.74)	96	2.47 (0.70)	0.359[a]
Friction	318	1.21 (0.41)	109	1.23 (0.42)	113	1.22 (0.42)	96	1.19 (0.39)	0.747[a]
Mean percentage of meals eaten over study	325	72.29 (22.66)	111	72.16 (23.27)	117	73.68 (22.44)	97	70.76 (22.35)	0.643[a]
All data severity	317	26.30 (23.92)	107	27.37 (25.27)	114	27.69 (25.10)	96	23.44 (20.70)	0.373[a]
Wet times/day	325	4.43 (1.57)	111	4.94 (2.02)	117	4.41 (1.33)	97	3.86 (0.94)	<0.001[a]
Women	267	82.15	92	82.88	97	82.91	78	80.41	0.867
Race/ethnicity									
White	252	77.54	86	77.48	93	79.49	73	75.26	0.655

Black	18	5.54	3	2.70	7	5.98	8	8.25	
Asian	42	12.92	18	16.22	12	10.26	12	12.37	
Hispanic	8	2.46	2	1.80	4	3.42	2	2.06	
Other	5	1.54	2	1.80	1	0.85	2	2.06	
Diagnosis category									
Dementia	251	79.18	83	77.57	91	79.82	77	80.21	
Cerebrovascular	125	39.43	45	42.06	43	37.72	37	38.54	
Diabetes	79	24.92	26	24.30	29	25.44	24	25.00	
Cardiovascular	222	70.03	83	77.57	78	68.42	61	63.54	
Musculoskeletal	173	54.57	60	56.07	57	50.00	56	58.33	
Thyroid disorder	56	17.67	23	21.50	15	13.16	18	18.75	
Nutritional	13	4.10	7	6.54	2	1.75	4	4.17	
Admission eligibility									
Long stay	287	88.31	94	84.68	103	88.03	90	92.78	0.192
Short stay	38	11.69	17	15.32	14	11.97	7	7.22	
Country									
Canada	169	52.00	49	44.14	58	49.57	62	63.92	0.014
United States	156	48.00	62	55.86	59	50.43	35	36.08	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]Analysis of variance performed.

Table 6: Demographic and Risk Status Characteristics for High-Risk Participants Allocated to 2-, 3-, or 4-Hour Turning (Ontario Data Only)

Variable	High Risk	Mean (SD) or %	2-Hour	Mean (SD) or %	3-Hour	Mean (SD) or %	4-Hour	Mean (SD) or %	High-Risk *P* Values (Random Group Comparison)
Age (years)	169	85.59 (7.61)	49	86.27 (7.61)	58	84.76 (8.00)	62	85.82 (7.29)	0.570[a]
BMI (measured as kg/m^2)	166	22.68 (4.80)	49	22.66 (4.91)	57	22.78 (5.09)	60	22.61 (4.50)	0.983[a]
Braden Total Score	168	11.48 (0.74)	49	11.49 (0.74)	57	11.46 (0.73)	62	11.48 (0.76)	0.969[a]
Sensory perception	168	2.19 (0.59)	49	2.20 (0.54)	57	2.18 (0.66)	62	2.19 (0.57)	0.968[a]
Moisture	168	1.90 (0.56)	49	1.94 (0.56)	57	1.86 (0.61)	62	1.90 (0.53)	0.772[a]
Activity	168	1.98 (0.15)	49	1.96 (0.20)	57	1.98 (0.13)	62	1.98 (0.13)	0.654[a]
Mobility	168	1.68 (0.49)	49	1.65 (0.48)	57	1.68 (0.51)	62	1.71 (0.49)	0.835[a]
Nutrition	168	2.58 (0.70)	49	2.63 (0.73)	57	2.65 (0.69)	62	2.48 (0.67)	0.366[a]
Friction	168	1.14 (0.35)	49	1.10 (0.31)	57	1.11 (0.31)	62	1.21 (0.41)	0.169[a]
Mean percentage of meals eaten over study	169	77.24 (21.33)	49	77.52 (20.28)	58	76.93 (22.94)	62	77.30 (20.91)	0.990[a]
All data severity	168	20.86 (17.95)	49	19.31 (16.41)	58	22.29 (17.60)	61	20.74 (19.56)	0.693[a]
Wet times/day	169	4.14 (0.97)	49	4.71 (1.11)	58	4.15 (0.76)	62	3.69 (0.77)	<0.001[a]
Women	140	82.84	45	91.84	49	84.48	46	74.19	0.046
Race/ethnicity									
White	117	69.23	28	57.14	43	74.14	46	74.19	0.176
Black	9	5.33	2	4.08	3	5.17	4	6.45	
Asian	40	23.67	16	32.65	12	20.69	12	19.35	
Hispanic	1	0.59	1	2.04	0	0.00	0	0.00	
Other	2	1.18	2	4.08	0	0.00	0	0.00	
Diagnosis category									
Dementia	138	82.14	38	77.55	48	82.76	52	85.25	
Cerebrovascular	73	43.45	21	42.86	25	43.10	27	44.26	
Diabetes	35	20.83	7	14.29	14	24.14	14	22.95	
Cardiovascular	104	61.90	35	71.43	32	55.17	37	60.66	

Musculoskeletal	97	57.74	32	65.31	27	46.55	38	62.30	
Thyroid disorder	26	15.48	11	22.45	7	12.07	8	13.11	
Nutritional	2	1.19	1	2.04	1	1.72	0	0.00	
Admission eligibility									
Long stay	161	95.27	46	93.88	57	98.28	58	93.55	0.411
Short stay	8	4.73	3	6.12	1	1.72	4	6.45	

Abbreviations: BMI, body mass index; SD, standard deviation.
[a]Analysis of variance performed.

Table 7: Incidence of Pressure Ulcers Overall, by Risk-Group Stratification and by Allocation to Turning Frequency (United States and Canadian Data Combined)

Group	Ulcers/Group (%)	Ulcers/2-Hour Turning (%)	Ulcers/3-Hour Turning (%)	Ulcers/4-Hour Turning (%)	Random Group Comparison (*P*)
All subjects	19/942 (2.02)	8/321 (2.49)	2/326 (0.61)	9/295 (3.05)	0.68
Moderate risk	13/617 (2.11)	6/210 (2.86)	0/209 (0.0)	7/198 (3.54)	0.68
High risk	6/325 (1.85)	2/111 (1.80)	2/117 (1.71)	2/97 (2.06)	0.90
Moderate vs. high risk					1.00

Table 8: Incidence of Pressure Ulcers Overall, by Risk-Group Stratification and by Allocation to Turning Frequency (Ontario Data Only)

Group	Ulcers/Group (%)	Ulcers/2-Hour Turning (%)	Ulcers/3-Hour Turning (%)	Ulcers/4-Hour Turning (%)	Random Group Comparison (*P*)
All subjects	10/505 (1.98)	4 /163 (2.45)	2 /170 (1.18)	4 /172 (2.33)	0.95
Moderate risk	5/336 (1.49)	2 /114 (1.75)	0 /112 (0.00)	3/110 (2.73)	0.57
High risk	5/169 (2.96)	2/49 (4.08)	2/58 (3.45)	1 /62 (1.61)	0.44
Moderate vs. High Risk					0.26

Table 9: Regression Analysis Predicting Pressure Ulcer Development (United States and Canadian Data Combined)

Independent Variable	Total Population (N = 942) (c = .681)			Total Moderate-Risk Population (n = 617) (c = .583)			Total High-Risk Population (n = 325) (c = .685)		
	C	Odds Ratio	*P*	C	Odds Ratio	*P*	C	Odds Ratio	*P*
Intercept	−3.2982		<0.0001	−4.5005		<0.0001	−4.4998		<0.0001
Fracture diagnosis							1.9095	6.75	0.022
3-Hour turn	−1.5216	0.218	0.0428						
Cerebrovascular accident diagnosis	−1.2885	0.276	0.0866						
Severity score				0.0205	1.021	0.0538			
Nutritional diagnosis				2.8657	17.56	0.0153			

Abbreviations: c, regression model concordance; C, coefficient.

Table 10: Regression Analysis Predicting Pressure Ulcer Development (Ontario Data Only)

Independent Variable	Total Population (n = 505)			Total Moderate-Risk Population (n = 336) (c = .638)			Total High-Risk Population (n = 169) (c = .654)		
	C	Odds Ratio	*P*	C	Odds Ratio	*P*	C	Odds Ratio	*P*
Intercept	−3.9		<0.0001	-5.3488		<0.0001	−3.898		<0.0001
Fracture diagnosis							1.8837	6.578	0.0479
3-Hour turn				0.0421	1.043	0.0648			

Abbreviations: c, regression model concordance; C, coefficient.

Discussion

Demographic characteristics of participants in the Turning for Ulcer Reduction Study (TURN Study) were similar to 3 previous studies of repositioning completed in Belgium and Ireland, with mostly white (80%), female participants (77% to 87%), and ranging in mean age from 85 to 87 years. (12-15)

The incidence of PrUs in the TURN Study was low (2.02%) among the moderate- and high-risk participants allocated to 3 turning intervals. Further, only superficial (stages 1 and 2) ulcers developed (with one potential deep tissue injury on a participant who became terminally ill and was removed from the study) and no stages 3 and 4 ulcers. There was no significant difference in PrU development between high- and moderate-risk residents, or among moderate- and high-risk residents allocated to 2-, 3-, or 4-hour turning. The 2.02% incidence is consistent among moderate- and high-risk subjects with the incidence of PrU among low-risk, long-stay residents (2%) in United States nursing facilities, and is considerably lower than the 10% prevalence reported among high-risk, long-stay residents. (9)

Considering only 2-, 3-, 4-, or 6-hour turning intervals (15)in previous randomized studies of turning (Table 11), the low incidence of PrUs in the TURN Study is similar to the 3% (2 ulcers/66 participants) incidence reported by Defloor and Grypdonck (15) for the 4-hour turning group on viscoelastic mattresses, and is similar to the 2% (2 ulcers/99 participants) incidence reported by Moore et al (13) for those on powered mattresses who were turned every 3 hours. The incidence of stages 2 to 4 PrUs reported by Defloor and Grypdonck (15), Moore et al (13), and Vanderwee et al (12) in the comparison groups without high-density foam mattresses or longer turning intervals ranged from 14.3% to 24.1%. No stages 3 or 4 PrUs were reported in the TURN Study or in the 4-hour turning groups of Defloor et al (14) and Moore et al (13), suggesting that longer turning intervals, powered beds, spring mattresses, and overlays do not protect against PrUs as well as high-density foam mattresses do.

Overall, results of the TURN Study support turning moderate- and high-risk residents at intervals of 2, 3, or 4 hours when they are cared for on high-density foam mattresses. Turning at 3- and 4-hour intervals is no worse than the current practice of turning every 2 hours in United States and Canadian LTC facilities. Two-hour turning could expose residents to increased risk from friction during repositioning.

The 4-hour turning result of few superficial and no deeper ulcers is consistent with the result in Defloor et al (14), and 4-hour frequency should be considered for implementation in nursing facilities. This recommendation, however, requires caution. First, in the protocols of the TURN and Defloor et al (14) studies, high-density foam mattresses replaced older, spring-type mattresses. Replacing old mattresses with high-density foam mattresses is an important system change and is a prerequisite for changing turning frequency.

Second, participants were at moderate and high risk on the Braden Scale, suggesting that the findings of this study might be limited to these risk levels. Most studies of risk assessment to date are limited to testing existing prognostic tools or creating new or better tools. (12, 16-20) These studies of turning frequency demonstrate the clinical utility of the Braden Scale.

Third, the overall quality of care in the TURN, Defloor et al (14), Vanderwee et al (12), and Moore et al (13) studies was identified as “guideline-based” care delivered by facility nursing staff to prevent PrUs with specific mention of protecting and elevating heels, providing incontinence care, and meeting nutritional needs.

Fourth, vigilant assessment of skin likely reduced the incidence of deep ulcers in the TURN and other studies. (8) As guidelines are developed in which turning recommendations go from the traditional 2- to 3- hour turning to 3- to 4- hour turning, skin observations could ensure that early signs of PrUs are noted.

Table 11: Comparison of Pressure Ulcer Risk, Support Surface, and Incidence of Grades 2 to 4 Ulcers by Turning Frequency in 4 Randomized Controlled Trials

Study	Braden Scale Score	Support Surface	2-Hour	3-Hour	4-Hour	6-Hour
Defloor et al (14)	Mean 13.0 ± 2	Standard viscoelastic mattress	9/63 (14%)	14/58 (24%)	Stage 2 2/66 (3%)	Stage 2 10/63 (15.9%)
Vanderwee et al (12)	Mean 15.0 ± 3	Viscoelastic foam overlay (7 cm), not high-density foam mattress			Stage 2 17/122 (13.9%), Stages 3 or 4 (2.5%)	Stage 2 22/113 (19.5%), Stages 3 or 4 (1.8%)
Moore et al (13)	Activity and mobility subscales	99% had powered pressure redistribution device		2/99 (2%)		7/114 (6%)
TURN Study	Moderate (13–14), High (10–12)	Viscoelastic, high-density foam mattresses	Moderate: 6/210 (2.86%) High: 2/111 (1.8%)	Moderate: 0/209 (0.00%) High: 2/117 (1.71%)	Moderate: 7/198 (3.54%) High: 2/97 (2.06%)	

Abbreviation: TURN, Turning for Ulcer Reduction.

Conclusions

Residents of high-performing nursing facilities who are at moderate or high risk of PrUs according to the Braden Scale may be turned at 3- or 4-hour intervals if they are cared for on high-density foam replacement mattresses. Clinicians should follow best-practice guidelines and be observant of skin changes, modifying turning frequency if skin changes are observed. These findings, reported as similar for subjects in 3 countries, have important implications for improving quality of life by permitting residents to sleep for longer intervals. In a broader sense, these findings will likely influence first, public policy and regulations regarding the frequency of turning for preventing PrUs; and second, reallocation of staff time spent repositioning patients every 2 hours to activities that improve residents' quality of life, such as increased assistance at mealtime, mobilization, toileting, and social engagement.

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