Preventing Pressure Ulcers: A Multi-site RCT in Nursing Homes

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Executive Summary

Context

Pressure at the interface between bony prominences and support surfaces, sufficient to occlude or reduce blood flow, is thought to cause pressure ulcers (PrUs). PrUs are prevented by providing support surfaces that redistribute pressure, and turning residents to reduce length of exposure. High density foam mattresses may reduce the frequency with which residents must be turned.

Objective

To determine optimal frequency of repositioning in Nursing Home (NH) residents at risk for PrUs when cared for on high density foam mattresses.

Design, Setting, and Participants

The Turning for Ulcer Reduction (TURN) Study, a Phase 3 Randomized, Controlled Trial, recruited residents from 20 United States and 7 Canadian NHs. Residents were ≥65 years, at moderate (scores 13-14) or high (scores 10-12) risk according to Braden Scale, and without PrUs.

Interventions

Participants were randomly allocated by risk stratification group (moderate versus high risk) to one of three turning schedules (2- 3- or 4-hour intervals) when in bed. Participants continued daily activities. The study continued for 3 weeks with weekly risk and skin assessment completed by masked assessors

Main Outcome Measures

PrU on the coccyx/sacrum, trochanter or heels

Results

Participants were mostly female (731/942, 77.6%) and Caucasian (758/942, 80.5%), and had a mean age 85.1 (SD ±7.66) years. The most common co-morbidities were cardiovascular disease (713/942, 76.9%) and dementia (672/942, 72.5%). Nineteen of 942 (2.02%) participants developed one superficial stage 1 (n=1) or stage 2 (n=19) ulcers; 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%). PrUs among high (6/325, 1.85%) versus moderate (13/617, 2.11%) risk 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).

Conclusion

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 replacement mattresses. Turning at 3- hour intervals may be superior to, and turning at 4-hour intervals no worse than, the current practice of turning every 2-hours. Less frequent turning may increase sleep, improve quality of life, reduce staff injury and save time for other activities such as feeding, walking and toileting. Careful monitoring of skin is recommended as always.

Background

The most basic strategy recommended by physicians and nurses to prevent pressure ulcers (PrUs) is the practice of turning or repositioning residents at two hour intervals. Turning every two hours, 12 times per day, 365 days per year, results in 4,380 turning episodes per year. Estimating 5 minutes per turn, 21,900 minutes or 365 hours or 9.125 weeks of staff time per resident is required annually. Turning often requires two 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] PrUs are prevented by providing support surfaces that redistribute pressure, and turning residents to reduce length of exposure. High density foam mattresses distribute pressure more evenly and are replacing springform mattresses used almost exclusively prior to the 2000s. A recent study by Li and colleagues[3] found a steady decrease in PrUs in two year increments from 2002 to 2008. It was hypothesized that increased use of high density foam mattresses likely reduced pressure exposure providing a margin of error so that, even when turning didn't occur as recommended, pressure relief properties of the mattresses protected residents from exposure to pressure.[4]

Turning residents every two hours, recommended in many guidelines to manage exposure to pressure, is not practiced uniformly. Bates-Jensen and colleagues demonstrated through hourly observation and thigh sensors that residents are in practice turned less frequently than every 2 hours.[55] Turning is not benign. It places residents at risk for decreased quality of life due to repeated awakenings at night. Staff are exposed to the risk of injury and the facility risks the loss of its workforce. Determining the appropriate frequency of turning in the presence of high density foam mattresses is important to keep residents safe, improve quality of life (e.g., increase in ambulation, feeding assistance, toileting), and make judicious use of staff time.

The objective of this clinical trial was to determine the optimal frequency of turning NH residents with mobility limitations who were cared for on high density foam mattresses for the purpose of preventing PrUs. Participants stratified by two levels of risk according to the Braden Scale for Predicting Pressure Sore Risk© [6,7] (hereafter Braden Scale) were compared as follows:

1. moderate risk (Braden Scale Score, 13-14) participants randomly assigned to turning at 2-, compared with 3- or 4- hours; or
2. high risk (Braden Scale Score, 10-12) participants randomly assigned to turning at 2- compared with every 3- or 4-hours.

Methods

Design and Participants

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

The outcome, PrU on the coccyx/sacrum, trochanter, or heel sites most susceptible to pressure while lying in bed, was determined by weekly masked assessment. Residents were stratified by risk level since lower risk hypothetically is associated with fewer PrUs. The protocol continued for three weeks, since 90% of PrUs developed in the first three weeks after facility admission in a previous study.[8]

Data were collected in the United States (US) (20 NH) and Canada (CAN) (7 NH). US NHs were identified through Quality Improvement Organizations, corporate nurses of proprietary chains, the Advancing Excellence Campaign, and other contacts. Canadian NHs, identified by The Toronto Health Economic Technology Assessment (THETA) collaborative, had to be situated in the Greater Toronto Area and be willing to participate in research.

NH inclusion criteria included: stable leadership, high density foam mattresses on participants' beds, and overall quality according to Nursing Home Compare in the US, and the ability to respond promptly to investigators. High density foam mattresses of various brands and models were included since no product has demonstrated superiority. In the US Quality of the NH was reported to be 4 or 5 star according to Nursing Home Compare[9] with low (below 5%) incidence of PrUs to ensure above average preventive care where outcomes could be related to turning rather than less effective care. Participants in Canadian facilities were provided with new high density foam mattresses due to variable types and ages of existing mattresses.

Ethics Committees at University of Texas Health Science Center at Houston (US), University of Toronto (CAN), and one clinical site approved the protocol. Each NH in the US completed Federal Wide Assurance indicating acceptance of UTHealth ethics review prior to onsite training.

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

Residents were excluded based on length of stay, Braden Scale mobility scores of 4 indicating independent

mobility, Braden Scale scores indicating as 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 based on pilot work are not compliant with a turning regimen. Residents at very high risk (scores $\leq$ 9) are often cared for on a powered mattress or alternating pressure relief overlays.

Protocol with Onsite NH Training

Onsite training by the study team was completed at each NH in two to three 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 US, and Personal Support Workers (PSWs) in Canada were trained to carry out the intervention: turn and check briefs according to assigned schedule, and document position change, heel elevation, skin condition, brief status, and incontinence care at each repositioning. CNAs/PSWs were trained in shift hand-off so that oncoming shifts could identify study participants. Following training, a mock trial was conducted. NHs participated until all eligible, consenting residents were studied.

Residents were screened and consented by the recruiter. Consent was obtained from residents judged competent to sign based on satisfactory answers to three questions related to the protocol following the study explanation; alternatively, consent from a legal representative was obtained.

Participant allocation was done 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. Since sites varied in size, turning frequency was randomized in blocks of six 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. Due to staff constraints, units studied up to three subjects at one time; as one subject completed, another began.

Turning was expected to occur (within plus or minus 30 minutes of scheduled time) with documentation recorded at each turn. The study focused on turning in bed, and documented time 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.

NH-wide PrU prevention measures 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 pressure ulcers reported by each NH.[10,11]

Supervisors observed and recorded participant position hourly. Supervisor observed positions, compared with CNA/PSW reported turns, were one measure of treatment fidelity. Adverse events were reported, study forms were checked for completeness, faxed to

ISIS, and mailed to the project office (UT) for data verification and storage.

Treatment fidelity was maintained in three ways: (1) CNA/PSW documentation was evaluated monthly for percent on-time turning (reported turns occurring within ±30 minutes of assigned turning time/total expected turns); (2) mean length of time in one position documented on CNA/PSW documentation; and (3) percent agreement between participant position and length of time in position as documented on CNA/PSW Repositioning forms and supervisor reported hourly position status. Project staff sent printed reports to study sites for monthly quality 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 was examined between the trainer and nurse assessors during training sessions ($r = 0.926$) and evaluated quarterly ($r = 0.897$) to prevent drift in measurement of the Braden Scale.

Data Analysis

Pressure ulcer outcome data were reviewed. Stage 1 PrUs were identified when noted to be present at two separate observations. Descriptive statistics were used: frequencies for categorical participant, intervention, and outcome measures, and mean and standard deviation for continuous measures. Bivariate analyses were used to test the relationships between each risk group and within risk group by allocation to 2, 3, or 4 hour turning. For discrete variables, contingency tables were created and chi-square tests 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 two-sided p value <0.05 was considered statistically significant.

Results

Among 6,240 residents screened, 1,400 met eligibility requirements, with 967 agreeing to participate (Figure 1). Moderate and high risk participants were allocated to 2, 3, or 4 hour turning (n= 335, 333, 299, respectively); however, 25 residents who were allocated, but did not receive the intervention due to death, hospitalization by choice, or for other reasons prior to the beginning of the study period are not included in the final analysis resulting in 942 participants (n= 321, 326, 295, respectively).

Participants were predominantly female (731/942, 77.6%) and Caucasian (758/942, 80.5%), with a mean age of 85.1 (SD $\pm$ 7.66) years. The most commonly occurring comorbidities were cardiovascular disease (713/942, 76.9%) and dementia (672/942, 72.5%) (See Table 1a).There was no significant difference in age between moderate and high risk groups; however high risk participants included more females (267/325, 82.2% versus 464/617, 75.2%) and had a higher prevalence of dementia (251/325, 79.2% versus 421/617, 69.0%) than moderate risk. High risk participants had significantly lower BMI, Braden Scale total and subscale scores, lower percentage of meals eaten and higher percentage of wet briefs observed ($p \leq 0.004$) than moderate risk.

More moderate (n=617) than high (n=325) risk residents participated. Fewer high risk participants were allocated to 4- (n=97) versus 2- and 3-hour turning (n=111,117, respectively), due to delayed allocation of 4-hour turning of high risk participants in the US. There were no significant differences between turning groups for moderate risk participants (See Table 1b), except BMI which was lower in the 2- hour group (2-hour, 24.88 $\pm$ 5.36; versus 3-hour, 26.19 $\pm$ 6.28; or 4-hour, 26.03 $\pm$ 6.15; p=0.053) and 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 ($p<0.001$)(See Table 1c). The overall mean percentage of meals eaten during the study was 75.1% ($\pm$ 21.6 %); high risk participants ate significantly less than moderate risk (p=0.004).

PrUs developed on the coccyx/sacrum (n=16), trochanter (1), or heels (2) of 19 of 942 (2.02%) participants. PrUs were limited to superficial stage 1 (n=1) and stage 2 (n=18) ulcers, with one participant's condition deteriorating and two ulcers developing, one of which may have become deep tissue injury; this patient was withdrawn from the study. Otherwise, no stage 3, 4, or unstageable ulcers developed (See Table 2). Overall, there was no significant difference in PrU incidence (p=0.07) between groups (2-hour, 8/321(2.49%) ulcers/group; 3-hour, 2/326 (0.61%); 4-hour, 9/295 (3.05%). PrUs among high (6/325, 1.81%) versus moderate (13/617, 2.05%) risk participants were not significantly different (p=1.00), nor was there a difference between high risk allocation groups (p=0.98). A significant difference (p=0.03) is present between moderate risk allocation groups. When short stay ($\leq$ 7 days) or long stay ($\leq$90 days) admissions and allocation groups were compared there were no significant differences.

Logistic regressions predicting pressure ulcer development were computed for the total population, and separately for moderate, and high risk groups, allowing

Braden Scale risk level on admission, Severity scores, Country, BMI, age, diagnosis groups, mean percent eaten, and mean wet episodes to enter into regression models (See Table 3). PrU development was significantly related to a diagnosis of nutritional deficiency among the total and moderate risk participants. The only variable significantly predicting PrU in the high risk population was fracture diagnosis.

Figure 1. TURN Study CONSORT Flow Diagram

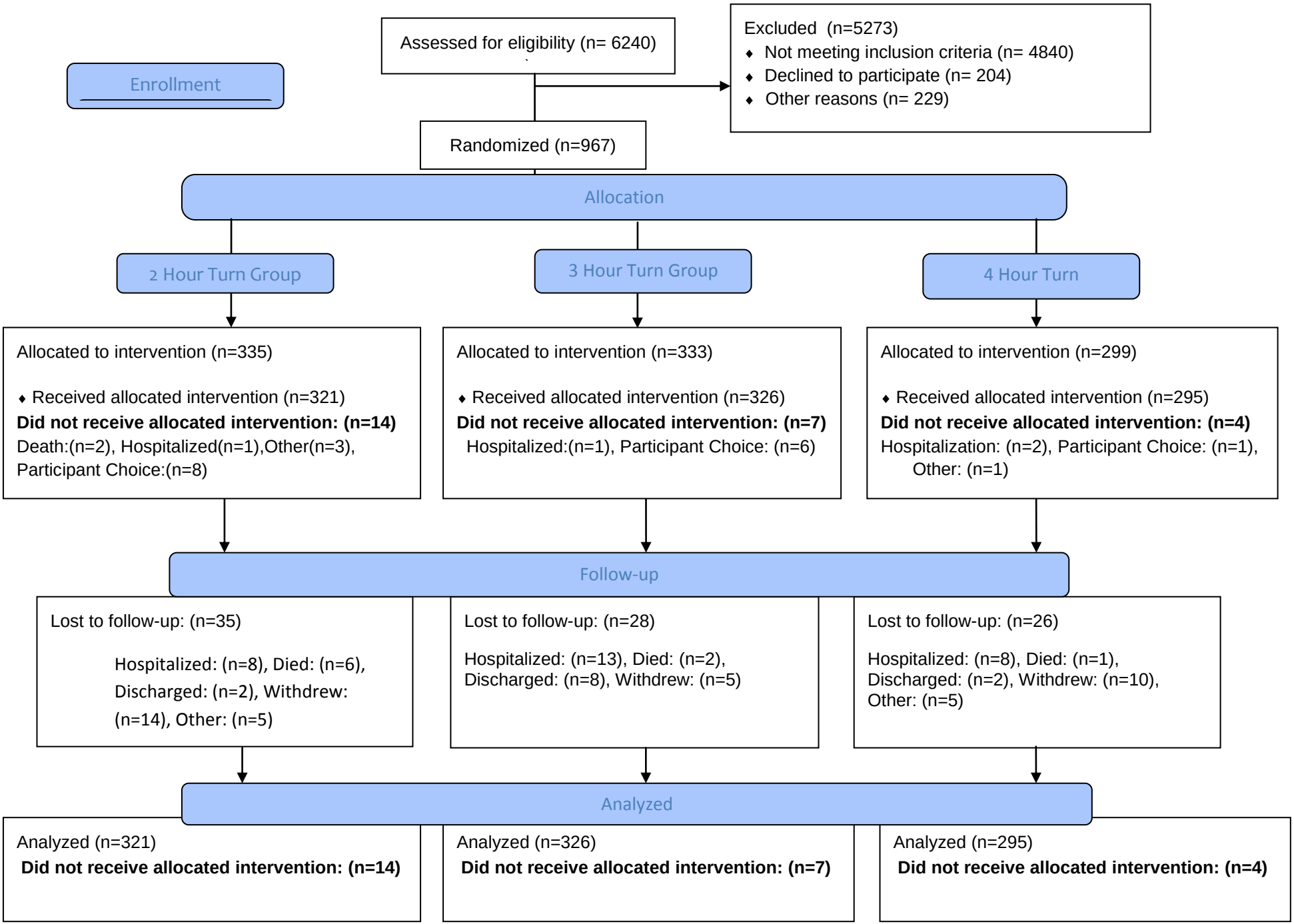

Table 1a. Demographic and Risk Status Characteristics for All Participants, Differences for Moderate and High Risk Participants.

Variable Name	Overall (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*
BMI (kg/m^2)	905	25.11 (6.04)	598	25.69 (5.95)	307	23.99 ± 6.06	<.001*
Braden Total Score	931	12.84 (1.17)	613	13.57 (0.50)	318	11.44 ± 0.73	<.001*
Sensory Perception	931	2.65 (0.65)	613	2.88 (0.58)	318	2.21 ± 0.55	<.001*
Moisture	931	2.02 (0.66)	613	2.16 (0.63)	318	1.76 ± 0.64	<.001*
Activity	931	2.02 (0.31)	613	2.07 (0.33)	318	1.94 ± 0.25	<.001*
Mobility	931	2.06 (0.51)	613	2.21 (0.46)	318	1.77 ± 0.48	<.001*
Nutrition	931	2.68 (0.65)	613	2.75 (0.61)	318	2.54 ± 0.72	<.001*
Friction	931	1.40 (0.49)	613	1.50 (0.50)	318	1.21 ± 0.41	<.001*
Mean Percent Eaten Over Study	941	75.06 (21.63)	616	76.53 (20.94)	325	72.29 ± 22.66	0.004*
All Data Severity	927	25.25 (21.31)	610	24.70 (19.83)	317	26.30 ± 23.92	0.310*
Wet Times/Day	942	4.17 (1.59)	617	4.04 (1.58)	325	4.43 ± 1.57	<.001*
Gender (female)	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	72.49%	421	69.02%	251	79.18%	
Cerebrovascular	341	36.79%	216	35.41%	125	39.43%	
Diabetes	252	27.18%	173	28.36%	79	24.92%	
Cardiovascular	713	76.91%	491	80.49%	222	70.03%	
Musculoskeletal	506	54.58%	333	54.59%	173	54.57%	
Thyroid Disorder	167	18.02%	111	18.20%	56	17.67%	
Nutritional	18	1.94%	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
US	437	46.39%	281	45.54%	156	48.00%	

* T-test performed
† ANOVA performed

Table 1a-1. Demographic and Risk Status Characteristics for All Participants, Differences for Moderate and High Risk Participants. (**Ontario data only**).

Variable Name	Overall N	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*
BMI (kg/m^2)	501	24.28+/-5.47	335	25.08+/-5.62	166	22.68+/-4.80	<.001*
Braden Total Score	504	12.89+/-1.16	336	13.60+/-0.49	168	11.48+/-0.74	<.001*
Sensory Perception	504	2.69+/-0.69	336	2.94+/-0.59	168	2.19+/-0.59	<.001*
Moisture	504	2.04+/-0.56	336	2.11+/-0.55	168	1.90+/-0.56	<.001*
Activity	504	2.04+/-0.25	336	2.07+/-0.28	168	1.98+/-0.15	<.001*
Mobility	504	2.03+/-0.52	336	2.21+/-0.45	168	1.68+/-0.49	<.001*
Nutrition	504	2.76+/-0.62	336	2.84+/-0.56	168	2.58+/-0.70	<.001*
Friction	504	1.34+/-0.47	336	1.43+/-0.50	168	1.14+/-0.35	<.001*
Mean Percent Eaten Over Study	505	81.52+/-18.25	336	83.67+/-16.09	169	77.24+/-21.33	<.001*
All Data Severity	504	21.52+/-16.18	336	21.85+/-15.23	168	20.86+/-17.95	0.537*
Wet Times/Day	505	4.02+/-1.09	336	3.95+/-1.14	169	4.14+/-0.97	0.049*
Gender (female)	384	76.04%	244	72.62%	140	82.84%	0.011
Race							
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%	

* T-test performed
† ANOVA performed

Table 1b. Demographic and Risk Status Characteristics for Moderate Risk Participants Allocated to Turning at 2-, 3-, or 4- hour Turning.

Variable Name	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 %	Mod 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†
BMI (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†
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†
Sensory Perception	613	2.88 ± 0.58	209	2.93 ± 0.61	207	2.83 ± 0.56	197	2.87 ± 0.55	0.166†
Moisture	613	2.16 ± 0.63	209	2.17 ± 0.62	207	2.12 ± 0.64	197	2.20 ± 0.64	0.418†
Activity	613	2.07 ± 0.33	209	2.07 ± 0.29	207	2.07 ± 0.37	197	2.06 ± 0.32	0.874†
Mobility	613	2.21 ± 0.46	209	2.21 ± 0.47	207	2.23 ± 0.46	197	2.20 ± 0.44	0.845†
Nutrition	613	2.75 ± 0.61	209	2.71 ± 0.62	207	2.81 ± 0.56	197	2.73 ± 0.64	0.235†
Friction	613	1.50 ± 0.50	209	1.49 ± 0.51	207	1.51 ± 0.50	197	1.51 ± 0.50	0.944†
Mean Percent 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†
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†
Wet Times/Day	617	4.04 ± 1.58	210	4.55 ± 1.72	209	4.05 ± 1.42	198	3.49 ± 1.41	<.001†
Gender (female)	464	75.20%	156	74.29%	155	74.16%	153	77.27%	0.715
Race									
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
US	281	45.54%	96	45.71%	97	46.41%	88	44.44%	

* T-test performed
† ANOVA performed

Table 1b-1. Demographic and Risk Status Characteristics for Moderate Participants Allocated to Turning at 2-, 3-, or 4- hour Turning. (**Ontario data only**).

Variable Name	Moderate Risk N	Mean ± SD or %	2 Hour N	Mean ± SD or %	3 Hour N	Mean ± SD or %	4 Hour N	Mean ± SD or %	Mod Risk P values (Random group comparison)
Age (years)	336	86.06+/-7.26	114	85.52+/-	112	85.63+/-	110	87.06+/-	0.208†
BMI (kg/m^2)	335	25.08+/-5.62	113	23.86+/-	112	25.40+/-	110	25.99+/-	0.013†
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†
Sensory Perception	336	2.94+/-0.59	114	3.05+/-0.64	112	2.85+/-0.59	110	2.92+/-0.53	0.030†
Moisture	336	2.11+/-0.55	114	2.13+/-0.52	112	2.07+/-0.51	110	2.14+/-0.61	0.619†
Activity	336	2.07+/-0.28	114	2.04+/-0.18	112	2.10+/-0.35	110	2.06+/-0.28	0.242†
Mobility	336	2.21+/-0.45	114	2.18+/-0.43	112	2.24+/-0.49	110	2.19+/-0.42	0.582†
Nutrition	336	2.84+/-0.56	114	2.79+/-0.59	112	2.88+/-0.55	110	2.85+/-0.56	0.437†
Friction	336	1.43+/-0.50	114	1.41+/-0.49	112	1.45+/-0.50	110	1.45+/-0.50	0.842†
Mean Percent 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†
All Data Severity	336	21.85+/-15.23	114	23.86+/-	112	20.99+/-	110	20.65+/-	0.222†
Wet Times/Day	336	3.95+/-1.14	114	4.32+/-1.19	112	3.95+/-0.96	110	3.56+/-1.12	<.001†
Gender (female)	244	72.62%	81	71.05%	81	72.32%	82	74.55%	0.839
Race									
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%	

* T-test performed
† ANOVA performed

Table 1c. Demographic and Risk Status Characteristics for High Risk Participants Allocated to Turning at 2-, 3-, or 4- hour Turning.

Variable Name	High Risk (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†
BMI (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†
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†
Sensory Perception	318	2.21 ± 0.55	109	2.19 ± 0.54	113	2.20 ± 0.58	96	2.25 ± 0.54	0.740†
Moisture	318	1.76 ± 0.64	109	1.80 ± 0.68	113	1.70 ± 0.63	96	1.79 ± 0.61	0.441†
Activity	318	1.94 ± 0.25	109	1.94 ± 0.25	113	1.95 ± 0.26	96	1.94 ± 0.24	0.939†
Mobility	318	1.77 ± 0.48	109	1.79 ± 0.47	113	1.74 ± 0.48	96	1.78 ± 0.49	0.750†
Nutrition	318	2.54 ± 0.72	109	2.53 ± 0.71	113	2.61 ± 0.74	96	2.47 ± 0.70	0.359†
Friction	318	1.21 ± 0.41	109	1.23 ± 0.42	113	1.22 ± 0.42	96	1.19 ± 0.39	0.747†
Mean Percent 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†
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†
Wet Times/Day	325	4.43 ± 1.57	111	4.94 ± 2.02	117	4.41 ± 1.33	97	3.86 ± 0.94	<.001†
Gender (female)	267	82.15%	92	82.88%	97	82.91%	78	80.41%	0.867
Race									
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
US	156	48.00%	62	55.86%	59	50.43%	35	36.08%	

* T-test performed
† ANOVA performed

Table 1c-1. Demographic and Risk Status Characteristics for High Risk Participants Allocated to Turning at 2-, 3-, or 4- hour Turning. (**Ontario data only**).

Variable Name	High Risk N	Mean ± SD or %	2 Hour N	Mean ± SD or %	3 Hour N	Mean ± SD or %	4 Hour N	Mean ± SD or %	High Risk P values (Random group comparison)
Age (years)	169	85.59+/-7.61	49	86.27+/-	58	84.76+/-	62	85.82+/-	0.570†
BMI (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†
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†
Sensory Perception	168	2.19+/-0.59	49	2.20+/-0.54	57	2.18+/-0.66	62	2.19+/-0.57	0.968†
Moisture	168	1.90+/-0.56	49	1.94+/-0.56	57	1.86+/-0.61	62	1.90+/-0.53	0.772†
Activity	168	1.98+/-0.15	49	1.96+/-0.20	57	1.98+/-0.13	62	1.98+/-0.13	0.654†
Mobility	168	1.68+/-0.49	49	1.65+/-0.48	57	1.68+/-0.51	62	1.71+/-0.49	0.835†
Nutrition	168	2.58+/-0.70	49	2.63+/-0.73	57	2.65+/-0.69	62	2.48+/-0.67	0.366†
Friction	168	1.14+/-0.35	49	1.10+/-0.31	57	1.11+/-0.31	62	1.21+/-0.41	0.169†
Mean Percent 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†
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†
Wet Times/Day	169	4.14+/-0.97	49	4.71+/-1.11	58	4.15+/-0.76	62	3.69+/-0.77	<.001†
Gender (female)	140	82.84%	45	91.84%	49	84.48%	46	74.19%	0.046
Race									
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%	

* T-test performed
† ANOVA performed

Table 2. Incidence of Pressure Ulcers Overall, by Risk Group Stratification and by Allocation to Turning Frequency.

Group	Ulcers/Group (% ulcers)	Ulcers/Allocation 2-hour (% ulcers)	Ulcers/Allocation 3-hour (% ulcers)	Ulcers/Allocation 4-hour (% ulcers)	Random Group Comparison (p=)
All Subjects	19/942 (2.02%)	8/321 (2.49%)	2/326 (0.61%)	9/295 (3.05%)	(0.07)
Moderate Risk	13/617 (2.05%)	6/210 (2.86%)	0/209 (0.0%)	7/198 (3.54%)	(0.03)
High Risk	6/325 (1.81%)	2/111 (1.80%)	2/117 (1.71%)	2/97 (2.06%)	(0.98)
Moderate vs. High Risk					(1.00)

Table 2-1. Incidence of Pressure Ulcers Overall, by Risk Group Stratification and by Allocation to Turning Frequency. (**Ontario data only**).

Group	Ulcers/Group (% ulcers)	Ulcers/Allocation 2-hour (% ulcers)	Ulcers/Allocation 3-hour (% ulcers)	Ulcers/Allocation 4-hour (% ulcers)	Random Group Comparison (p=)
All Subjects	10/505 (1.98%)	4 /163 (2.45%)	2 /170 (1.18%)	4 /172 (2.33%)	(0.651)
Moderate Risk	5/336 (1.49%)	2 /114 (1.75%)	0 /112 (0.00%)	3/110 (2.73%)	(0.235)
High Risk	5/169 (2.96%)	2/49 (4.08%)	2/58 (3.45%)	1 /62 (1.61%)	(0.721)
Moderate vs. High Risk					(0.314)

Table 3. Regression analysis predicting pressure ulcer development

Independent Variable	Total Study Population (N=942) (c=.681)			Total Moderate Risk Population (N=617) (c=.583)			Total High Risk Population (N=325) (c=.685)		
	Coefficent:	*Odds ratio:*	*P Values:*	*Coefficent:*	*Odds ratio:*	*P Values:*	*Coefficent:*	*Odds ratio:*	*P Values:*
Intercept	-3.2982		<.0001	-4.5005		<.0001	-4.4998		<.0001
Fracture Diagnosis							1.9095	6.75	0.022
Three Hour Turn	-1.5216	0.218	0.0428						
CVA Diagnosis	-1.2885	0.276	0.0866						
Severity Score				0.0205	1.021	0.0538			
Nutritional Diagnosis				2.8657	17.56	0.0153			

Table 3-1. Regression analysis predicting pressure ulcer development (**Ontario data only**).

Independent Variable	Total Study Population (N=505) (c=)			Total Moderate Risk Population (N=336) (c=.638)			Total High Risk Population (N=169) (c=.654)		
	Coefficent:	*Odds ratio:*	*P Values:*	*Coefficent:*	*Odds ratio:*	*P Values:*	*Coefficent:*	*Odds ratio:*	*P Values:*
Intercept	-3.9		<.0001	-5.3488		<.0001	-3.898		<.0001
Ate67to75 pct							1.8837	6.578	0.0479
All Data Severity				0.0421	1.043	0.0648			

Discussion

Demographic characteristics of participants in the TURN study were similar to three 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 pressure ulcers in the TURN Study was low (2.02%) among the moderate and high risk participants allocated to three turning intervals. Furthermore, only superficial (stage one and two) ulcers developed (with one potential deep tissue injury on a participant who became terminally ill and was removed from the study) and no stage 3 and 4 ulcers. There was no significant difference in PrU development between high and moderate risk residents, or among high risk residents allocated to 2-, 3-, or 4-hour turning. There was a difference in moderate risk participants since no ulcers occurred in the 3-hour group, and 2- and 4- hour groups showed little difference: 2.86% and 3.54%, respectively. This small difference may not have clinical significance. 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 US nursing facilities, and considerably lower than the 10% prevalence reported among high risk, long stay residents.[9]

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

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-hour intervals may be superior to, and turning at 4-hour intervals no worse than, the current practice of turning every 2-hours in US and Canadian long-term care facilities. Two-hour turning may expose residents to increased risk from exposure to friction during repositioning.

The finding of few superficial and no deeper ulcers is consistent with the 4-hour turning result in the Defloor study[15] and should be considered for implementation in nursing facilities. This recommendation, however, requires caution. First, in the protocols of TURN and Defloor et al.[15] 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[12,16-20] or creating new or better tools.[16-18] 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.,[15] Vanderwee, et al.,[13] and Moore, et al.,[14] studies was identified as "guideline based" care delivered by facility nursing staff to prevent PrUs with specific mention of protecting/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 may ensure that early signs of PrUs are noted.

Table 4. Comparison of Pressure Ulcer Risk, Support Surface, and Pressure Ulcer Grade 2 to 4 Incidence 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.,{{429 Defloor,T. 2005}}	Mean 13.0 ± 2	Standard Visco elastic mattress	9/63 (14%)	14/58 (24%)	2/66 (3%) stage 2	10/63 (15.9%) Stage 2
Vanderwee et al.,{{851 Vanderwee ,K. 2007}}	Mean 15.0 ± 3	Visco elastic foam **overlay** (7 cm), not high density foam mattress			17/122 stage 2 (13.9%) stage 3 or 4 (2.5%)	22/113 Stage 2 (19.5%) Stage 3 or 4 (1.8%)
Moore et al., {{994 Moore,Z. 2011}}	Braden Activity and Mobility Subscales	99% had powered pressure redistributio n device		2/99 (2%)		7/114 (6%)
TURN Study	Braden Moderate Risk (13-14) High Risk (10-12)	Visco elastic, 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%)	

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 similarly from subjects in three 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: (1) public policy and regulations regarding the frequency of turning for preventing PrUs; (2) reallocation of staff time spent repositioning every two hours to activities that improve resident quality of life such as increased assistance at mealtime, mobilization, toileting, and social engagement.

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