

Turning for Ulcer Reduction (TURN) Study: An Economic Analysis

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Abstract

Background

The Turning for Ulcer Reduction (TURN) study was a multisite, randomized controlled trial that aimed to determine the optimal frequency of turning nursing facility residents with mobility limitations who are at moderate and high risk for pressure ulcer (PrU) development. Here we present data from the economic analysis.

Objectives

This economic analysis aims to estimate the economic consequences for Ontario of switching from a repositioning schedule of 2-hour intervals to a schedule of 3-hour or 4-hour intervals.

Data Sources

Costs considered in the analysis included those associated with nursing staff time spent repositioning residents and with incontinent care supplies, which included briefs, barrier cream, and washcloths.

Results

The total economic benefit of switching to 3-hour or 4-hour repositioning is estimated to be \$11.05 or \$16.74 per day, respectively, for every resident at moderate or high risk of developing PrUs. For a typical facility with 123 residents, 41 (33%) of whom are at moderate or high risk of developing PrUs, the total economic benefit is estimated to be \$453 daily for 3-hour or \$686 daily for 4-hour repositioning.

For Ontario as a whole, assuming that there are 77,933 residents at 634 LTC facilities, 25,927 (33%) of whom are at moderate or high risk of developing PrUs, the total economic benefits of switching to 3-hour or 4-hour repositioning are estimated to be \$286,420 or \$433,913 daily, respectively, equivalent to \$104.5 million or \$158.4 million per year.

Limitations

We did not consider the savings the Ontario Ministry of Health and Long-Term Care might incur should less frequent repositioning reduce the incidence of work-related injury among nursing staff, so our findings are potentially conservative.

Conclusions

A switch to 3-hour or 4-hour repositioning appears likely to yield substantial economic benefits to Ontario without placing residents at greater risk of developing PrUs.

Plain Language Summary

Ontario nursing homes currently change patients' position every 2 hours. This economic analysis estimates the cost for Ontario to switch from repositioning patients every 2 hours to every 3 or 4 hours.

The average cost for staff every 2 hours to reposition each resident who might develop bedsores was estimated to be \$32.10 daily. Repositioning patients every 3 or 4 hours instead lowers this estimated cost to \$21.40 or \$16.05, respectively. When patients are repositioned every 2 hours, supplies are estimated to cost \$3.68 per resident daily. This cost falls to \$3.34 when residents are repositioned every 3 hours or to \$3.00 every 4 hours, especially when patients are checked for wet briefs at the same time.

Total daily savings is estimated to be \$11.05 for repositioning every 3 hours or \$16.74 for repositioning every 4 hours for every resident at moderate or high risk of developing bedsores. Using data from 3 of the Ontario nursing homes that participated in the TURN study, we estimate that 33% of residents in Ontario nursing homes are at moderate or high risk of developing bedsores. For Ontario as a whole, assuming that there are 77,933 residents at 634 nursing homes, 25,927 (33%) of whom are at moderate or high risk of developing bedsores, the total economic benefits are estimated to be \$286,420 daily for 3-hour or \$433,913 daily for 4-hour repositioning, equivalent to \$104.5 million or \$158.4 million yearly.

Switching to 3-hour or 4-hour repositioning of residents who are at moderate or high risk of bedsores and who are cared for on high-density foam mattresses combined with guideline-based care and regular skin observations is likely to save money for Ontario without increasing the risk that residents would develop bedsores. These estimates are not "cost savings." They reflect staff time that could instead be spent on other valuable activities that will improve quality of care, such as feeding, toileting, socializing, and mobilizing residents. However, there is no evidence to support repositioning residents less frequently than every 2 hours if high-density foam mattresses are not provided.

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List of Abbreviations

LTC	Long-term care
NH	Nursing home
PSW	Personal support worker
PrU	Pressure ulcer
TURN	Turning for Ulcer Reduction

Background

The Programs for the Assessment of Technology in Health (PATH) Research Institute/Toronto Health Economics and Technology Assessment (THETA) Collaborative was commissioned by Health Quality Ontario to evaluate the cost-effectiveness and predict the long-term costs and effects of technology/technique for disease. Published economic evaluations are reviewed, and the structure and inputs of the economic model used to estimate cost-effectiveness are summarized. The results of the economic analyses are presented for technology/technique versus comparator, and the budget impact of implementing each intervention is estimated.

Health Quality Ontario conducts full evidence-based analyses, including economic analyses, of health technologies being considered for use in Ontario. These analyses are then presented to the Ontario Health Technology Advisory Committee, whose mandate it is to examine proposed health technologies in the context of available evidence and existing clinical practice, and to provide advice and recommendations to Ontario health care practitioners, the broader health care system, and the Ontario Ministry of Health and Long-Term Care.

DISCLAIMER: Health Quality Ontario uses a standardized costing method for its economic analyses of interventions. The main cost categories and the associated methods from the province's perspective are as follows:

Hospital: Ontario Case Costing Initiative (OCCI) cost data are used for in-hospital stay, emergency department visit, and day procedure costs for the designated International Classification of Diseases (ICD) diagnosis codes and Canadian Classification of Health Interventions (CCI) procedure codes. Adjustments may be required to reflect accuracy in estimated costs of the diagnoses and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, Health Quality Ontario normally defaults to considering direct treatment costs only.

Non-hospital: These include physician services costs obtained from the Ontario Schedule of Benefits (OSB), laboratory fees from the Ontario Schedule of Laboratory Fees (OSLF), drug costs from the Ontario Drug Benefit Formulary (ODB), and device costs from the perspective of local health care institutions whenever possible, or from the device manufacturer.

Discounting: For cost-effectiveness analyses, a discount rate of 5% is applied as recommended by economic guidelines.

Downstream costs: All numbers reported are based on assumptions of population trends (i.e., incidence, prevalence, and mortality rates), time horizon, resource utilization, patient compliance, health care patterns, market trends (i.e., rates of intervention uptake or trends in current programs in place in the Province), and estimates on funding and prices. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature, standard listing references, and educated hypotheses from expert panels. In cases where a deviation from this standard is used, an explanation is offered as to the reasons, the assumptions, and the revised approach. The economic analysis represents *an estimate only*, based on the assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied to the analysis.

NOTE: Numbers may be rounded to the nearest decimal, as they might be reported from an Excel spreadsheet.

The economic analysis represents *an estimate only*, based on the assumptions and costing methods explicitly stated above. These estimates will change if different assumptions and costing methods are applied to the analysis.

One of the most basic nursing care acts is repositioning residents. It is common practice to reposition residents every 2 hours. This practice was derived from a simple observational study and a small experimental study. (1) New technology, such as high-density foam mattresses, might allow less frequent repositioning without exposing residents to a greater risk of developing pressure ulcers (PrUs). This would allow residents to sleep for longer intervals, while staff could be exposed to less risk of injury and have time for other important care. This could transform fundamental aspects of nursing care.

The Registered Nurses Association of Ontario's guidelines for the assessment and prevention of PrUs recommend turning at-risk individuals every 2 hours. Nursing homes (NHs) in Ontario are also regulated according to this recommendation. (2) In practice, the actual turning frequency for high-risk residents is uncertain because NHs might not be adequately staffed to turn these residents every 2 hours. (3)

The Turning for Ulcer Reduction (TURN) study was a multisite randomized controlled trial led by Dr. Nancy Bergstrom with the purpose of determining the optimal frequency of repositioning NH residents with mobility limitations who are at moderate (Braden scores 13–14) and high risk (Braden scores 10–12) for PrU development cared for on high-density foam mattresses. The study recruited 942 residents (77.6% female, 80.5% white, mean age 85.1 years) from 20 United States and 7 Canadian NHs. Participants were cared for on high-density foam mattresses for the purpose of preventing PrUs. Participants were randomly allocated by risk group (moderate or high) to 1 of 3 repositioning schedules: 2-hour, 3-hour, or 4-hour intervals. Participants continued their usual daily activities. The trial continued for 3 weeks with weekly risk and skin assessment completed by assessors blinded to study group. Overall, no significant difference was found 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%]). The 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 mattresses. (4)

Table 1: Incidence of Pressure Ulcers With Each Repositioning (Turning) Schedule

Variables Measured	2-Hour Turning	3-Hour Turning	4-Hour Turning
Residents (n)	321	326	295
PrUs (n)	8	2	9
Incidence of PrUs (%)	2.49	0.61	3.05

Abbreviation: PrU, pressure ulcer.

Objective

This economic analysis aims to estimate the economic consequences for Ontario of switching from a repositioning schedule of 2-hour intervals to a schedule of 3-hour or 4-hour intervals.

Economic Analysis

Three repositioning strategies were considered, representing 2-hour, 3-hour, or 4-hour intervals. Because no significant difference in PrU incidence was found between these repositioning schedules, a cost-minimization analysis was conducted. This was justified on the grounds that, with no significant difference in the incidence of PrUs, the long-term health consequences associated with the development of PrUs and the quality-adjusted life expectancy of residents are not expected to differ significantly between the 3 strategies.

Costs Considered

The perspective of the analysis was that of the Ontario Ministry of Health and Long-Term Care. Only direct costs incurred by the Ontario Ministry of Health and Long-Term Care were considered relevant for the analysis. It is a general principle in economic analysis that the only costs considered when comparing more than 1 strategy are those that might differ between strategies—costs incurred regardless of the strategy chosen are excluded from the analysis. All costs were measured in 2012 Canadian dollars.

Various costs were considered for inclusion in the analysis. These included the costs associated with the following:

- nursing staff time spent repositioning residents
- supplies (briefs, skin cream, washcloths, and barrier cream)
- hospital visits, physician services, day surgery, and ambulatory procedures

The costs associated with treating injuries sustained by nursing staff while repositioning residents were not considered for inclusion in the analysis, as no available data assess whether 3-hour or 4-hour repositioning could reduce such injuries.

Cost of Nursing Staff Time Spent on Repositioning Residents

A small observational study conducted alongside the TURN study used an actigraph to investigate the amount of time that residents were moving during each reposition (Nikhil Padhye, written communication, 2011). This study found that proportional integral mode activity was triggered for an average of 7.14 minutes (standard deviation = 2.81 minutes), in 31 assisted repositions among 9 residents. In the absence of more reliable data, this finding was used to estimate the time each nurse spent on a typical reposition. However, this could overestimate time if repositioning triggers the resident's activity afterward.

The possibility that repositioning some residents would require more than 1 member of nursing staff was considered. Given the expert opinion of the TURN team members, we assumed that 20% of residents would require 2 members of the nursing staff and that the remaining 80% of residents would require 1 member of the nursing staff for repositioning.

All repositioning was expected to be carried out by personal support workers (PSWs). The minimum and maximum hourly cost of employing a PSW (as of April 2012, inclusive of salary and benefits) was reported by each of the 7 nursing facilities in Ontario participating in the TURN study (Table 2). The average hourly cost at each nursing facility was assumed to be the midpoint of the minimum and maximum hourly costs. A weighted average of the hourly cost was calculated across all 7 nursing facilities (\$18.73). In our calculations, this average was assumed to represent the average hourly cost of employing a PSW in Ontario, and the 7 nursing facilities are assumed to be broadly representative of nursing facilities across the province. This estimate is commensurate with the findings of a survey of long-term care (LTC) homes in Ontario conducted in 2008, which found that the average cost of employing a PSW at that time was \$16.97 per hour.

Cost of Supplies

Given that nursing staff often change briefs at the same time as repositioning residents, it is plausible that a change in the repositioning schedule from 2-hour intervals to 3-hour or 4-hour intervals would reduce the use of briefs and related supplies (including skin cream and barrier cream).

The TURN study found that the number of “wet observations” (requiring the changing of a resident's briefs) in Ontario residents was indeed lower in the 3-hour and 4-hour groups (Table 3), implying that fewer briefs changes took place. We assumed in our analysis that the observed differences in wet observations between strategies would translate 1:1 into differences in briefs changes in practice. Compared with 2-hour repositioning, 3-hour repositioning would therefore result in 0.420 fewer briefs changes per resident daily, while 4-hour repositioning would result in 0.829 fewer briefs changes per resident daily.

The costs associated with briefs, skin cream, and barrier cream (as of April 2012) were requested from each of the 7 nursing facilities in Ontario that participated in the TURN study (Table 4).

The reported cost of briefs ranged from \$0.45 to \$0.88, with an average cost of a medium brief of \$0.58. Skin cleanser, where used, adds approximately \$0.16 to the cost of a briefs change. Only one facility reported the cost of washcloths; assuming that an average of 2 washcloths are used per briefs change, these are estimated to add \$0.09 to the cost of each briefs change (the costs associated with laundry

facilities were not considered). Barrier cream and anti-sting spray are more expensive (\$1.89 and \$2.00 per briefs change, respectively) but are used infrequently. Excluding the cost of barrier cream and anti-sting spray, the supplies associated with a typical briefs change cost approximately \$0.83.

Cost of Hospital Visits, Physician Services, Day Surgery, and Ambulatory Procedures

The TURN study did not collect data on the frequency of physician visits, day surgery, or ambulatory procedures for enrolled residents. Although data were collected on hospitalization (Table 5), the relatively few events suggest that caution is warranted in drawing conclusions about differences in hospitalization between strategies. Further, given the frequency of PrUs was not substantially different between the 3 strategies, there is no clear basis on which to believe that the costs associated with hospital visits, physician services, day surgery, or ambulatory procedures would differ between residents assigned to each repositioning schedule. These costs were therefore not considered in the analysis.

Size of the Resident Population

In Ontario, there are 77,933 residents at 634 LTC facilities. (5) On the basis of patient-level data collected from 3 of the Ontario facilities participating in the TURN study, we estimate that approximately 33% of residents are at risk of developing PrUs. This implies that the average size of a LTC facility in Ontario is 123 residents, of whom 41 are at risk of developing PrUs.

Analyses Conducted

Three base case analyses were conducted:

First, the daily and annual costs associated with each of the 3 strategies (2-hour, 3-hour, and 4-hour repositioning) were analyzed for a typical Ontario LTC resident at risk of developing PrUs. The economic benefits of switching to 3-hour or 4-hour repositioning were then calculated for a typical resident.

Second, the daily and annual costs associated with each of the 3 strategies were analyzed for a typical Ontario nursing facility of 123 residents, in which 41 (33%) residents are at risk of developing PrUs. The economic benefits of switching to 3-hour or 4-hour repositioning were then calculated for a typical facility.

Third, the daily and annual costs associated with each of the 3 strategies were analyzed for all LTC residents at risk of developing PrUs across Ontario, on the assumption that 25,927 (33%) of 77,933 residents at 634 LTC facilities are at risk of developing PrUs. The economic benefits of switching to 3-hour or 4-hour repositioning were then calculated for the province as a whole.

A series of sensitivity analyses were then carried out to estimate the sensitivity of our estimates of the total economic benefit associated with switching to 3-hour or 4-hour repositioning. The following sensitivity analyses were carried out:

First, the total economic benefit per day for each resident at moderate or high risk of developing PrUs was estimated across a range of values for the following parameters:

- The average hourly cost of employing a PSW (from \$10 to \$25; base case \$18.73);
- The percentage of residents requiring 2 PSWs for repositioning (from 0% to 50%; base case 20%);
- The average time taken for each reposition (from 5 to 10 minutes; base case 7.14 minutes);

- The total cost of briefs and related supplies associated with each brief change (from \$0.50 to \$2.00; base case \$0.83).

Second, the total economic benefit per day was estimated for a nursing facility with a size ranging from 50 beds to 250 beds (base case 123 beds).

Third, the total economic benefit per day was estimated for a typical nursing facility and for Ontario as a whole, varying the proportion of residents at moderate or high risk of developing PrUs from 25% to 50% (base case 33%).

Table 2: Hourly Cost of Employing a Personal Social Worker at Each Long-Term Care Facility

Hourly Cost	Hourly Cost (\$) at Facility							Overall
	1	2	3	4	5	6	7	
Minimum	17.61	18.00	18.13	16.28	22.00	16.00	16.71	16.00 ^a
Maximum	19.39	20.00	19.72	19.53	24.00	18.00	17.58	24.00 ^b
Average	18.50	19.00	18.93	17.91	23.00	17.00	17.15	18.73^c

^aMinimum hourly cost across all 7 facilities.

^bMaximum hourly cost across all 7 facilities.

^cAverage hourly cost across all 7 facilities, weighted according to the size of each facility.

Table 3: Reported Wet Observations per Day by Repositioning Schedule

Turning Schedule	n	Mean	Standard Deviation	Minimum	25th Percentile	Median	25th Percentile	Maximum
2-Hour	163	4.439	1.180	0.429	3.900	4.381	5.048	7.667
3-Hour	170	4.019	0.902	0.762	3.429	3.976	4.667	6.238
4-Hour	172	3.610	1.007	0.190	3.119	3.610	4.074	6.714

Table 4: Cost of Supplies for Each Long-Term Care Facility

Supply (\$)	Facility							Average
	1	2	3	4	5	6	7	
Small briefs	\$0.54	M/D	M/D	M/D	\$0.53	M/D	\$0.46	\$0.51
Medium briefs	\$0.45	\$0.73	\$0.45	\$0.61	\$0.58	\$0.57	\$0.68	\$0.58
Large briefs	\$0.60	M/D	\$0.60	\$0.76	\$0.71	M/D	\$0.88	\$0.71
Skin cleanser	Soap and water	\$0.10	\$0.16	M/D	M/D	\$0.23	Soap and water	\$0.16^{a,c}
Barrier cream	No cost	No cost	\$0.60	No cost	\$3.17	M/D	M/D	\$1.89^{b,c}
Washcloth	M/D	\$0.09	M/D	M/D	M/D	M/D	M/D	\$0.09
Anti-sting spray	M/D	M/D	\$2.00	M/D	M/D	M/D	M/D	\$2.00^c

Abbreviation: M/D. missing data.

^aAverage cost of skin cleanser does not consider facilities who reported using soap and water.

^bSome facilities reported that barrier cream was provided at no cost from the government pharmacy.

^cSkin cleanser, barrier cream, and anti-sting spray are not used for every briefs change.

Table 5: Hospitalizations by Repositioning Schedule

Turning Schedule	n	Hospitalizations	Percentage Hospitalized
2-Hour	321	8	2.49
3-Hour	326	13	3.99
4-Hour	295	8	2.71

Results

Analysis 1: Per-Resident Costs and Economic Benefits

The per-resident costs associated with nursing staff time for each repositioning schedule are summarized in Table 6, on the assumptions that a) the average hourly cost of employing a PSW is \$18.73, b) a typical repositioning takes 7.14 minutes, and c) 20% of residents require 2 members of staff for repositioning. The total amount of staff time assumed to be spent repositioning each resident at risk of developing PrUs was therefore 102.8 minutes per day with 2-hour repositioning, 68.5 minutes per day with 3-hour repositioning, or 51.4 minutes per day with 4-hour repositioning.

Switching from a 2-hour repositioning schedule to a 3-hour schedule would free up 34.3 minutes of nursing staff time per day for each resident at risk of developing PrUs. This has a value of \$10.70 per day or \$3,905 per year. Switching to a 4-hour repositioning schedule would free up 51.4 minutes of nursing staff time per day for each resident at risk of developing PrUs, with a value of \$16.06 per day or \$5,857 per year.

There are further potential cost savings in terms of the reduced use of briefs and related supplies (Table 7). These savings are estimated with the assumptions that a) the supplies associated with a typical briefs change cost \$0.83 and b) 2-hour, 3-hour, and 4-hour repositioning is associated with 4.439, 4.019, and 3.610 briefs changes per resident daily, respectively.

Switching from a repositioning schedule with 2-hour intervals to a schedule with 3-hour intervals would reduce the cost of briefs and related supplies by \$0.35 per day or \$127 per year for each resident at risk of developing PrUs. Switching to a repositioning schedule with 4-hour intervals would reduce the cost of briefs and related supplies by \$0.69 per day or \$251 per year for each resident at risk of developing PrUs.

The total economic benefits of switching from 2-hour to 3-hour repositioning are estimated to be \$11.05 per resident daily or \$4,032 per resident yearly, while the total economic benefits of switching to 4-hour repositioning are estimated to be \$16.74 per resident daily or \$6,109 per resident yearly. Over a 2-year residency, the economic benefits of switching the repositioning schedule for a typical resident at moderate or high risk of developing PrUs are estimated to total \$8,064 for 3-hour repositioning or \$12,217 for 4-hour repositioning, while over a 3-year residency the economic benefits are expected to total \$12,097 for 3-hour or \$18,326 for 4-hour intervals (Table 8).

Table 6: Per-Resident Costs Associated with Staff Time by Repositioning Schedule

Turning Schedule	2-Hour	3-Hour	4-Hour
Daily cost of nursing staff time (\$)	32.10	21.40	16.05
Annual cost of nursing staff time (\$)	11,715	7,810	5,857

Table 7: Per-Resident Costs Associated with Supplies by Repositioning Schedule

Turning Schedule	2-Hour	3-Hour	4-Hour
Daily cost of supplies (\$)	3.68	3.34	3.00
Annual cost of supplies (\$)	1,345	1,218	1,094

Table 8: Per-Resident Economic Benefits of Switching to Each Repositioning Schedule

Turning Schedule	2-Hour	3-Hour	4-Hour
Total daily economic benefits (\$)	N/A	11.05	16.74
Total annual economic benefits (\$)	N/A	4,032	6,109
Total economic benefits over 2-year residency (\$)	N/A	8,064	12,217
Total economic benefits over 3-year residency (\$)	N/A	12,097	18,326

Abbreviation: N/A, not available.

Analysis 2: Per-Facility Costs and Economic Benefits

The per-facility costs associated with each strategy can be derived by scaling up the per-resident costs estimated above. These are summarized in Table 9, on the assumption that a typical Ontario nursing facility has a) 123 residents and b) 41 residents (33%) at risk of developing PrUs.

The total economic benefits of switching from 2-hour to 3-hour repositioning are estimated to be \$453 per facility daily or \$165,321 per facility yearly, while the total economic benefits of switching to 4-hour repositioning are estimated to be \$686 per facility per day or \$250,453 per facility yearly.

Table 9: Per-Facility Costs and Economic Benefits Associated with Each Repositioning Schedule

Turning Schedule	2-Hour	3-Hour	4-Hour
Daily cost of nursing staff time (\$)	1,316	877	658
Annual cost of nursing staff time (\$)	480,313	320,208	240,156
Daily cost of supplies (\$)	151	137	123
Annual cost of supplies (\$)	55,137	49,920	44,840
Total daily economic benefits (\$)	N/A	453	686
Total annual economic benefits (\$)	N/A	165,321	250,453

Abbreviation: N/A, not available.

Analysis 3: Ontario-Wide Costs and Economic Benefits

The costs associated with each strategy for all LTC residents at risk of developing PrUs across Ontario can also be derived by scaling up the per-resident cost estimates. These are summarized in Table 10, on the assumptions that: a) there are 77,933 residents at 634 LTC facilities and b) 25,927 residents (33%) are

at risk of developing PrUs. It was assumed that all facilities provide high-density foam mattresses to at-risk residents.

The total economic benefits for Ontario of switching from 2-hour to 3-hour repositioning are estimated to be \$286,420 per day or \$104.5 million per year, while the total economic benefits for Ontario of switching to 4-hour repositioning are estimated to be \$433,913 per day or \$158.4 million per year.

Table 10: Province-Wide Costs and Economic Benefits Associated with Each Repositioning Schedule

Turning Schedule	2-Hour	3-Hour	4-Hour
Daily cost of nursing staff time (\$)	832,146	554,764	416,073
Annual cost of nursing staff time (\$)	303,733,268	202,488,845	151,866,634
Daily cost of supplies (\$)	95,525	86,487	77,685
Annual cost of supplies (\$)	34,866,501	31,567,576	28,355,051
Total daily economic benefits (\$)	N/A	286,420	433,913
Total annual economic benefits (\$)	N/A	104,543,348	158,378,085

Abbreviation: N/A, not available.

Sensitivity Analyses

The results of the sensitivity analyses are summarized in Table 11.

Variation in each of a) the hourly cost of employing a PSW, b) the average number of PSWs required to reposition each patient, and c) the average time taken to reposition each patient has an approximately proportional effect on the per-resident estimates of economic benefit associated with switching to 3-hour or 4-hour repositioning. In other words, a doubling of the cost of employing a PSW would approximately double the estimates of economic benefit, while a halving of the average time taken to reposition patients would approximately halve the estimates of economic benefit.

By contrast, variation in the cost of briefs and related supplies has relatively little effect on the estimates of economic benefit. This is because the value of freed-up nursing staff time accounts for 95.9%–96.8% of the total economic benefit and because reductions in the cost of briefs and related supplies account for the remainder.

The economic benefits associated with each nursing facility are directly proportional to the size of the facility, while the economic benefits associated with each nursing facility and for Ontario as a whole are directly proportional to the percentage of residents at moderate or high risk of developing PrUs.

Table 11: Sensitivity of Estimates of Economic Benefits per Resident Associated With Daily Repositioning Schedule to Changes in Input Parameters

Parameter	Economic Benefit		
	Low	Base Case	High
Hourly cost of employing PSW \$ (3-hour; 4-hour)	10.00 (6.06; 9.26)	18.73 (11.05; 16.74)	20.00 (14.63; 22.11)
Residents requiring 2 PSWs to reposition % (3-hour; 4-hour)	0 (9.26; 14.06)	20 (11.05; 16.74)	50 (13.72; 20.75)
Time taken to reposition in minutes (3-hour; 4-hour)	5 (7.84; 11.93)	7.14 (11.05; 16.74)	10 (15.33; 23.16)
Total costs of briefs and related supplies per brief change \$ (3-hour; 4-hour)	0.50 (10.91; 16.46)	0.83 (11.05; 16.74)	2.00 (11.54; 17.71)
Number of beds in facility (3-Hour; 4-Hour)	50 (188; 285)	123 (453; 686)	250 (917; 1,389)
Patients at moderate or high risk of developing PrU (%) (3-Hour; 4-Hour)	25 (342; 519)	33 (453; 686)	50 (685; 1,038)
Patients at moderate or high risk of developing PrU % (3-hour; 4-hour)	25 (215,232; 326,066)	33 (286,420; 433,913)	50 (430,475; 652,149)

Abbreviation: PSW, personal social worker.

Limitations

There remain some limitations with our analysis. In particular, we did not consider the cost savings to the Ontario Ministry of Health and Long-Term Care that would likely arise should less frequent repositioning reduce the incidence of back injury among nursing staff. These costs include not only the long-term medical costs associated with treating back injury, but also the potential legal costs should nursing staff members be injured while repositioning a resident. If nursing staff cannot work because of back injuries, wider economic costs are also associated with lost productivity, although these are outside the perspective of our analysis. By not considering the costs associated with back injury, our findings are potentially conservative, because these costs would most likely be lower for the 3-hour or 4-hour repositioning schedule.

Discussion

The results of the TURN study suggest that, when nursing home residents at risk of developing PrUs are cared for on modern high-density foam mattresses, there is no significant difference in the incidence of PrUs between repositioning at 2-hour, 3-hour, or 4-hour intervals. Because common practice is to reposition residents at 2-hour intervals, a change in practice to less frequent repositioning has the potential for large economic benefits without putting residents at greater risk of developing PrUs.

We have estimated the economic benefit associated with switching from 2-hour to 3-hour repositioning to be \$11.05 per resident daily, and the economic benefit of switching to 4-hour repositioning to be \$16.74 per resident daily. Most of this economic benefit represents the value of freed-up nursing staff time that would have previously been spent repositioning residents. Variation from the base case estimates for each of a) the hourly cost of employing a PSW, b) the average number of PSWs required to reposition each patient, and c) the average time taken to reposition each patient has an approximately proportional effect upon these estimates of economic benefit.

Over a 2-year residency, the economic benefits of switching the repositioning schedule for a typical resident at moderate or high risk of developing PrUs are estimated to total \$8,064 for 3-hour repositioning or \$12,217 for 4-hour repositioning, and over a 3-year residency to total \$12,097 or \$18,326, respectively. By contrast, the cost of a high-density foam mattress (required in order to extend the repositioning interval beyond 2 hours) is approximately \$350. For nursing facilities that do not currently provide such residents with high-density foam mattresses, the potential economic benefits of doing so greatly outweigh the costs. The upfront cost of the high-density foam mattress is expected to be recovered in 30 days or less.

Because it is neither recommended nor feasible to employ fewer nursing staff given the high resident-to-staff ratios at Ontario's LTC facilities, these estimates of economic benefit do not represent cost savings. (3) These instead represent the value of staff time that could instead be spent undertaking such other valuable activities as feeding, toileting, socializing, and mobilizing residents. These time savings amount to 19.7% (3-hour repositioning) or 29.5% (4-hour repositioning) of the 2.9 hours per day of direct care provided to a typical Ontario resident in a LTC home. (6)

Our decision to use cost-minimization analysis rather than cost-effectiveness analysis was justified on the basis that the incidence of PrUs does not appear to be significantly different between the strategies. It is therefore reasonable to assume that the quality-adjusted life expectancy associated with residents undergoing each strategy would also not be significantly different, and so the findings of a cost-effectiveness analysis would be driven by cost differences between the strategies. It is also reasonable to assume that the costs associated with treating PrUs when they occur (including nursing staff time, supplies, physician services, hospital visits, etc.) would be similar across strategies, justifying the exclusion of these costs from our analysis. While our analysis is relatively simple, we believe that it appropriately captures the most important differences between the strategies under consideration and that a cost-effectiveness analysis would provide little further explanation of these differences.

We estimated that switching from a 2-hour turning schedule to a 3-hour or 4-hour schedule could reduce the cost of briefs and related supplies. Here, we might be overestimating any potential cost savings because there could be clinical consequences to reducing briefs changes that we did not consider in our analysis. This remains a limitation, although we expect little impact of this issue on our conclusion. We suggest that steps be undertaken to ensure adequate incontinence assessment and incontinence care when considering less frequent turning on high-density foam mattresses.

We estimate that switching to 3-hour or 4-hour repositioning would have an economic benefit for Ontario of \$104.5 million or \$158.4 million per year, respectively. These estimations do, however, assume that 2-hour repositioning is the standard in all nursing facilities across Ontario and that all nursing facilities would abide by any proposed change in the repositioning schedule. In reality, many nursing facilities might currently be repositioning residents at 3-hour or 4-hour intervals (or at even longer intervals), in which case our projections are overestimated.

The results of the TURN study support less frequent turning (e.g., a change from every 2-hour to 3- or 4-hour) for moderate- to high-risk residents on high-density foam mattresses. This finding should be considered in the context of risk assessment upon admission to nursing facilities and of high-density foam mattresses provided to moderate- to high-risk residents. In particular, the timing of the risk assessment is important. A previous study has suggested that most PrUs in LTC facilities occur within the first 3 weeks after admission. (7)

It should also be noted that all residents in the TURN study used high-density foam mattresses. Although providing high-density foam mattresses to Ontario nursing facility residents at moderate or high risk of developing PrUs has been found to be cost-effective, some nursing facilities in Ontario do not yet provide high-density foam mattresses to such residents. (8) There is no evidence to support repositioning residents at intervals of greater than 2 hours in cases where high-density foam mattresses are not provided.

Conclusions

Our results indicate strong economic incentives for nursing homes to provide high-density foam mattresses to residents at moderate to high risk for pressure ulcer development. The cost of high-density foam mattresses is \$350, on average. On the other hand, we estimated a cost saving between \$11.05 and \$16.74 per resident daily if turning is less frequent on high-density foam mattresses.

Overall, it appears that a switch to 3-hour or 4-hour repositioning would yield substantial economic benefits to Ontario without placing residents at greater risk of developing pressure ulcers.

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