Received: 14 July 2017 | Revised: 7 October 2017 | Accepted: 11 October 2017

DOI: 10.1111/iwj.12855

WILEY IWJ

ORIGINAL ARTICLE

Turning frequency in adult bedridden patients to prevent hospital-acquired pressure ulcer: A scoping review

H-S Jocelyn Chew[1] | Emelia Thiara[2] | Violeta Lopez[3] | Shefaly Shorey[3]

[1]The Nethersole School of Nursing, Chinese University of Hong Kong, China

[2]Paediatric Intensive Care Unit, National University Hospital, Singapore

[3]Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Correspondence
V Lopez, RN, PhD, FACN, Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Level 2, Clinical Research Centre, Block MD11, 10 Medical Drive, Singapore 117597, Singapore.
Email: nurvl@nus.edu.sg

The aim of this study was to identify current research on turning frequencies of adult bed-bound patients and inform future turning practices for hospitals based on evidence-based practice. We undertook a scoping review framework that provided a transparent and systematic methodology using 8 electronic databases (CINAHL, PubMed, Cochrane Library, ScienceDirect, PsycINFO, Scopus, ProQuest, and Web of Science) to identify articles published from 2000 to 2016. Articles were included if they focused on the prevention of hospital-acquired pressure ulcers related to the frequency of turning or repositioning of bed-bound patients. Literature search and data extraction were performed independently by 3 authors. The study followed the PRISMA guidelines. In total, 911 articles were identified, of which 10 were eligible. Of the eligible articles, 8 studies could not reach a conclusion on the effective frequency of turning and duration for repositioning patients to prevent the development of pressure ulcers. Only 2 studies found significant differences among the intervention and control groups. Results regarding turning and repositioning schedules are inconclusive; however, the topic needs further exploration to improve the outdated guidelines surrounding pressure ulcer prevention. This may, in turn, make the work of nurses more efficient and make treatment cost-effective for both the patients and the hospitals.

KEYWORDS

pressure injury, pressure ulcer, repositioning, scoping review, turning

1 | INTRODUCTION

Pressure ulcer (PU) is defined as the area of localised skin tissue damage, typically over a bony prominence, caused by unrelieved pressure that interrupts blood supplies to capillaries and deprives tissues of oxygen and nutrients.[1] Hospital-acquired PU is one of the top adverse events reported in hospitals,[2] a common cause for medical complications including infection, prolonged hospitalisation and permanent disabilities.[3] This results in pain, decreased quality of life, and a heavy illness burden on the individual, national, and global levels.[4] Patients at risk of PU include the elderly, especially those with impaired mobility and skin integrity.[5] The prevalence of PU remains high at 12.3% in the United States, costing the nation approximately US$11

Key Messages

- hospital-acquired pressure ulcer is one of the top adverse events reported in hospitals that can be prevented
- a scoping review of current literature was conducted to examine the frequency of turning in bedridden patients to prevent hospital-acquired pressure ulcers
- the results of studies on turning frequencies are inconclusive, and further research is needed
- it is the opportune time to conduct rigorous trials to examine the effectiveness of repositioning schedules to inform hospital guidelines and provide quality care to patients

billion annually, each PU costing between US$500 and US $70,000.[6] The world population is rapidly ageing, and this demographic shift presents an imminent global silver tsunami. Since the elderly are at risk of PU development, it could potentially be a public health issue.[7]

Although unavoidable, PUs are largely preventable by maintaining the quality and standard of key evidence-based practices (EBP), such as risk assessment, repositioning,[8] or turning[9] using pressure-relief devices; maintaining adequate nutrition and moisture; and education on PU prevention.[10,11] EBP is defined as the amalgamation of the best available research evidence, clinical expertise, and patient values to arrive at a clinical decision that enhances patient outcome.[12]

Several methods are adopted to reduce the risk of developing PUs.[13] However, as a PU is primarily developed due to long periods of uninterrupted pressure, regular repositioning is crucial in maintaining tissue vitality by redistributing pressure from a specific area of the body to another to prevent PU development.[14] Repositioning by 2-hourly turning is widely accepted as a provisional guideline for best practice as passed down since the time of Nightingale[15,16], where turning frequencies differ according to each patient's intensity of tissue loading and illness severity.[17] However, this is based on limited research evidence, where the efficient frequency of turning remains unclear.[18] Furthermore, repositioning patients at a 30° lateral tilt has been shown to be effective in reducing PU development, but it still remains unclear which repositioning method is the most effective when the patient is turned from side to side.[19] This is further confounded by the effectiveness of using different pressure-relieving devices and support surfaces, which can reduce the frequency of turning from 2-hourly to 4- or 6-hourly.[20] Therefore, this scoping review aimed to summarise the current state of research in PU prevention on the repositioning and turning frequency of adult bed-bound patients to help guidelines and health care professionals provide quality care to patients at risk of developing PUs.

2 | MATERIALS AND METHODS

To enhance the efficiency and sustainability of PU prevention through repositioning, there is a dire need to outline the nature and scope of available research studies on the most effective turning frequency to guide future empirical research.[21] In addition, it is crucial to consolidate methodological disparities among current research to enhance the conclusiveness of research evidence for translation into best practice.[22] A scoping review was therefore conducted to present an overview of the available evidence instead of a systematic review that aims to synthesise evidence from the selected studies that fulfil the chosen methodological quality assessment.[23] A scoping review focuses on mapping the available literature for various purposes, such as identifying research gaps and research findings and informing the necessity of conducting a systematic review.[24] To provide a transparent and systematic methodology to analyse the articles, a framework developed by[18] was employed. It constituted of 5 stages as described below:

Stage 1. Identifying the research question. The main aim of this review was to summarise the available literature on turning frequency of adult bed-bound patients to prevent PUs. This review specifically aimed to answer the following question: What is known about the frequency of turning in bedridden patients to prevent hospital-acquired PU?

Stage 2. Identifying relevant studies. A 3-step search strategy was utilised.[25] First, a systematic search for articles published from January 2000 to December 2016 was conducted using 8 electronic databases including CINAHL, PubMed, Cochrane Library, ScienceDirect, PsycINFO, Scopus, ProQuest and Web of Science. The timeframe was chosen to maintain relevancy of the research trend. Second, a search of keywords within the title and abstract of the retrieved papers was conducted. Third, a manual search on the bibliographies of the shortlisted articles was performed to identify articles that are more relevant.

Keywords for the search were derived from the concepts and broad categories of the research question and were combined using Boolean operators AND or OR (frequency*, schedule*, turn*, reposition*, hour*, pressure ulcer*, sore*, inpatients). To enhance the sensitivity of the search, more keywords were permuted from the Medical Subject Heading (MESH) browser and agreed upon by the researchers.

Stage 3. Study selection. Articles were included if they met the following inclusion criteria: (1) focused on the prevention of hospital-acquired PU, (2) included exploration on the frequency of turning or repositioning, (3) conducted on adults who have been hospitalised, (4) full texts available in English, and (5) published within January 2000 and December 2016. Articles were excluded if they explored the relationship between repositioning or turning frequency and other variables besides PU development. Grey literature from MedNar was also included in the search

Stage 4. Charting the data. To address the research question, relevant data was extracted and charted according to the following categories: author(s)/year of publication/country, aims/purpose, sample characteristics, methods, turning schedule/duration of intervention, outcome, and key findings related to the scoping review question. The data chart was tested on 2 random papers to ensure if it was suitable to extract relevant data from the included papers. The data chart was found suitable, and no further changes were made to it.

Stage 5. Collating, summarising, and reporting the results. Data were collated and reported descriptively as general

and specific aspects of the literature. To ensure reliability, 3 authors separately reviewed the literature, and after critical discussions, the results were approved.

3 | RESULTS

The search identified 911 articles: CINAHL ($n = 227$); Cochrane Library ($n = 31$), ProQuest ($n = 29$), PsycINFO ($n = 187$), PubMed ($n = 75$), ScienceDirect ($n = 122$), Scopus ($n = 215$), and Web of Science ($n = 25$). In total, 128 duplicate articles were excluded, followed by an exclusion of 768 articles from the title and abstract screen, resulting in the assessment of 15 full-text articles, in which 5 articles were further excluded because of reasons as shown in Figure 1. No bibliographical references were retrieved. Consensus on the articles selected according to the eligibility criteria for the review was achieved among the authors. In total, 10 studies were included in this review, of which 5 were randomised controlled trials (RCT)[19,26–29], 1 was a prospective cohort study,[17] 3 were systematic reviews[2,14,30] , and 1 was a literature review[31] .

The key findings of the 10 articles regarding the frequency of turning in bedridden patients to prevent hospital-acquired PUs have been summarised (Table 1). The general characteristics of the studies were that PUs are commonly affected by direct factors, namely the amount and duration of pressure. Common strategies used to tackle this problem were the use of support surfaces and turning, respectively.

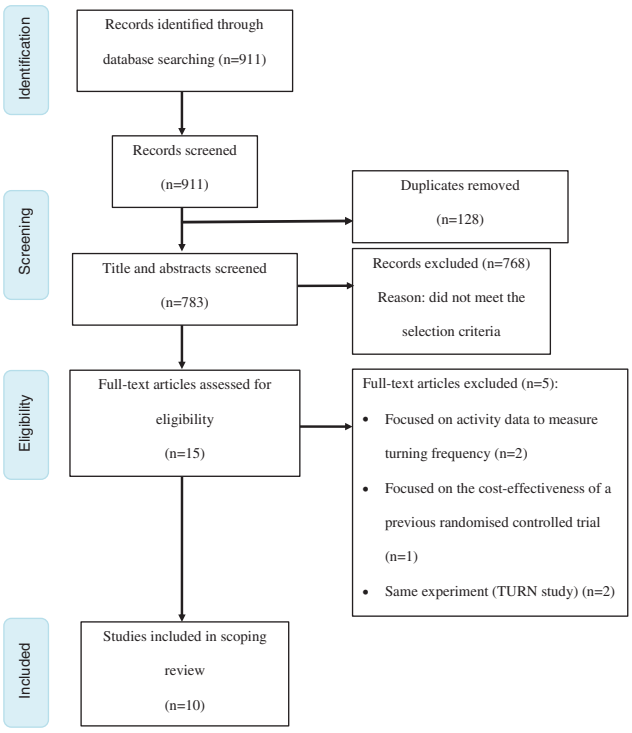

FIGURE 1 PRISMA flow diagram for study selection

3.1 | Specific aspect of the literature

3.1.1 | Experimental studies

In the 5 experimental studies, turning frequencies ranged from 2- to 6-hourly turning in various pressure-relieving positions[19,26–29] (Figure 2). One experimental study focused mainly on investigating the optimal frequency of repositioning in influencing the development of PU.[19] It was reported in the study that 3-hourly turning with a 30° tilt at night is more effective in preventing PUs compared to 6-hourly turning with a 90° tilt at night. Four of the experimental studies investigated the effectiveness of turning with additional support surfaces in their interventions.[26–29] Defloor et al[27] investigated the effect of 4 prevention schemes in a 4-week RCT that involved the use of a standard institutional mattress with more frequent turning (2- to 3-hourly) or the use of a viscoelastic polyurethane foam mattress (VEFM) with less frequent turning (4- to 6-hourly). The study reported a significant reduction in the number of PUs in participants who were turned 4-hourly on a VEFM compared to the 2 prevention schemes that used a standardised institutional mattress but with frequent turning (<4 hours). Three studies compared the effectiveness of the duration of repositioning in patients who were on an alternating pressure air mattress (APAM),[27] a high-density foam mattress[26], and a pressure-reducing mattress.[28] It was found that there was no difference in the incidence of PU between all 3 studies and that more frequent repositioning on support surfaces does not necessarily lead to lesser PU development. Furthermore, repositioning was more frequently more labour intensive, and an increased amount of device-related adverse events was reported.[27] Patients' rest might also be disturbed with frequent repositioning.[28]

3.2 | Reviews and non-experimental studies

One study[17] was a prospective cohort study that examined the association between repositioning and PUs in elderly bed-bound patients. However, there was no association between repositioning and the incidences of PU among bed-bound elderly. The remaining 3 studies were systematic reviews, all of which had inconclusive evidence with regards to the optimal turning frequency to prevent PUs.[2,14,20] Similarly, the last study, which was a general review, also yielded inconclusive evidence on the frequency of turning among PU incidences and concluded that the frequency of repositioning varies according to each patient's needs.[31]

4 | DISCUSSION

Overall, there was inconclusive evidence that supported the repositioning of patients to reduce the incidences of PU. Of the studies identified in this scoping review, 8 studies[2,14,20,26,28,30,31] were unable to reach a conclusion on the

TABLE 1 Details on studies included in the review

Author (s)/year of publication/country	Aims/purpose	Study population and sample size	Methodology/ methods	Intervention type/comparator/ duration of intervention	Outcome and details (eg measurements)	Key findings related to scoping review questions
Defloor et al[29] (2005), Belgium	To investigate the effectiveness of 4 PU prevention interventions	838 geriatric nursing home patients	Cluster	randomisation	Experimental group:	No difference between the groups in terms of incidence of non-blanchable erythema (34.8% to 38.1%)
4-hourly turning on VE mattress resulted in a significant reduction in the number of PU.						
		Experimental group:		4 different turning schedules (semi-fowler with head and bed elevated 30°, lateral 30°)	Incidence of stage II and higher PU was observed to be lower in the group with 4-hourly turning (3%) compared to the group with 2-hourly turning (14.3%) and 3-hourly turning (24.1%).	
		1. Turning 2-hourly on a standard institutional mattress (n = 63)		1. Turning 2-hourly on a standard institutional mattress		
		2. Turning 3-hourly on a standard institutional mattress (n = 65)		2. Turning 3-hourly on a standard institutional mattress		
		3. Turning 4-hourly on a viscoelastic polyurethane foam mattress (VEFM) (n = 67)		3. Turning 4-hourly on a viscoelastic polyurethane foam mattress (VEFM)		
		4. Turning 6-hourly on a VEFM (n = 65)		4. Turning 6-hourly on a VEFM		
		Control group: (n = 576)		Control group: interventions (eg air/water mattress) based on clinical judgement, excluding turning.		
		Male (19.8%)		4 weeks per experiment per ward		
Bergstrom et al[26] (2013), Canada, United States	To determine the optimal repositioning frequency of nursing home (NH) residents at risk for PU when cared on high-density foam mattress.	Data was collected in 20 NHs in the United States and 7 in Canada. Participants were aged 65 years old and older.	Multi-site randomised clinical trial	Experimental group:	No significant difference in PU incidence according to the experimental groups and that of patients with different levels of risks.	No difference in PU incidence when comparing 2-, 3- and 4-hourly turning of patients on high-density foam mattresses.
		Experimental group:		1. 2-hourly turning		
		1. 2-hourly turning (n = 335)		2. 3-hourly turning		
		2. 3-hourly turning (n = 333)		3. 4-hourly turning		
		3. 4-hourly turning (n = 299)		3 weeks		
		Females (77.6%)				

(*Continues*)

TABLE 1 (Continued)

Author (s)/year of publication/country	Aims/purpose	Study population and sample size	Methodology/ methods	Intervention type/comparator/ duration of intervention	Outcome and details (eg measurements)	Key findings related to scoping review questions
Vanderwee et al[28] (2007), Belgium	To investigate the effectiveness of turning with unequal time intervals on the incidence of pressure ulcer.	Patients without pressure ulcer lesions, stayed for >3 days and were able to be repositioned, were recruited over 16 Belgian elder care nursing homes	Two-arm RCT	Experimental group: alternate between 2 hour in lateral position and 4 hour in supine position (semi-fowler 30° [4 h], right-side lateral position 30° [2 h], semi-Fowler 30° [4 h], left-side lateral position 30° [2 h])	No statistical difference in incidence of PU between the experimental and control groups ($P = 0.40$)	More frequent repositioning on a pressure-reducing mattress does not lead to fewer pressure ulcers.
		Experimental group ($n = 122$)		Control group: reposition every 4 hour according to the same turning scheme as the experimental group	No patients developed pressure ulcer at hips	Using an ordinary pillow to maintain lateral 30° position is mostly inefficient as patients return to the supine position between turning intervals.
		Control group ($n = 113$)		September 2003 to May 2005	Mann–Whitney U-test, Student t-test,	
		Male ($n = 39$)			Fisher's exact test, logistic regression analysis, and Kaplan-Meier survival analysis (evaluate effectiveness of turning protocol on the incidence of pressure ulcers (≥grade 2))	
		Female ($n = 196$)				
		Median age = 84 years (IQR 82.6 to 88.6)				
		Median length of stay = 42 months (IQR 37 to 45)				
Manzano et al[27] (2014), Spain	To compare the effectiveness of repositioning every 2 and 4 hours on PU prevention in patients in the intensive care unit (ICU) under mechanical ventilation (MV) with alternating pressure air mattresses (APAM).	Patients with no PI, on APAM require invasive MV for at least 24 h in a university hospital in Spain.	Open-label RCT	Experimental group: 2-hourly turning with head and foot of bed elevated 30° (left side with 30° tilt, back, right side with 30° tilt, back).	A pressure ulcer of ≥stage 2 developed in 10.3% and 13.4% of the patients turned every 2 and 4 hours, respectively (HR 0.89, 95% CI 0.46 to 1.71, $P = 0.73$). Device-related adverse events were 47.9 versus 36.6% (HR 1.50, CI 95% 1.06 to 2.11,	Repositioning every 2 hour on APAM was not more effective than that of 4 hour in preventing PU. Furthermore, it is more labour-intensive and increased device-related adverse events.
		Experimental group ($n = 165$)		Control group: 4-hourly turning with head and foot of bed elevated 30° (left side with 30° tilt, back, right side with 30° tilt, back).	$P = 0.02$), unplanned extubation was 11.5 versus 6.7% (HR 1.77, 95% CI 0.84 to 3.75, $P = 0.13$), and endotracheal tube obstruction was 36.4 versus 30.5%, respectively (HR 1.44, 95% CI 0.98 to 2.12, $P = 0.065$).	
		Control group ($n = 164$)		February 2009 to January 2011	The median (interquartile range) daily nursing	
					workload for manual repositioning was 21 (14 to 27) versus 11 min/patient (8 to 15) ($P < 0.001$).	

(*Continues*)

TABLE 1 (Continued)

Author (s)/year of publication/country	Aims/purpose	Study population and sample size	Methodology/ methods	Intervention type/comparator/ duration of intervention	Outcome and details (eg measurements)	Key findings related to scoping review questions
Moore et al[19] (2011), Ireland	Compare effectiveness between 3-hourly repositioning regimens on PU incidence.	Patients without pressure ulcer lesions and at risk for PU development as assessed using the Braden scale were recruited over 12 long-term care hospitals.	Prospective cluster-RCT	Experimental group:	Chi-squared analysis	3-hourly turning with 30° tilt is more effective in preventing PU when compared to 6 hourly turning with 90° tilt.
		Experimental group (n = 114)		3-hourly turning at night (left side with 30° tilt, back, right side with 30° tilt, back [2000 to 0800 h]).	Incidence of PU was 11% and 3% in the control and experimental group respectively. (P = 0.035; 95% CI 0.031 to 0.038; ICC = 0.001)	
		Control group (n = 99)		Control group: 6-hourly turning at night (left side with 90° tilt, back, right side with 90° tilt, back [2000 to 0800 h]).	67% reduction in PU in experimental group.	
		Male (n = 45)				
		Female (n = 168)				
		66% aged between 81 to 100 years old.				
Rich et al[20] (2011), United States	To examine the association between repositioning and PU incidence.	Bed-bound elderly patients (≥65 years old) with hip fracture from 9 hospitals	Prospective cohort study	A specially trained research nurse performed full-body skin examinations at the baseline (as soon as possible after hospital admission) and on alternating days for 21 days for a total of 11 assessments.	Data on repositioning were collected from nursing flowsheets	No association was found between frequent repositioning of bedbound patients and lower PU incidence.
		Total (n = 269)		2004 to 2007	Simple counts proportions, chi-square test, 2-sample t-test, generalised estimating equations analysis, incidence rate ratio, and bi-nomial working model.	
					Rate of PU incidence (≥stage 2) at visit following an index visit (patients bed-bound during first 5 days of hospitalisation) per person-day of follow-up was similar regardless of reposition frequency on day of index visit (unadjusted IRR 1.22, 95% CI 0.65 to 2.30; covariate-adjusted IRR 1.12, 95% CI 0.73 to 6.60)	
Gillespie et al[2] (2014), Australia	To find out the most efficient repositioning schedule to prevent PU.	Systematic review of electronic databases that were searched:			3 RCTs and 1 economic study. Two trials compared the 30° and 90° tilt positions using similar repositioning frequencies.	There is inconclusive evidence on the optimal turning frequency to prevent PU.
		1. The Cochrane Wounds Group Specialised Register,				

(*Continues*)

TABLE 1 (Continued)

Author (s)/year of publication/country	Aims/purpose	Study population and sample size	Methodology/ methods	Intervention type/comparator/ duration of intervention	Outcome and details (eg measurements)	Key findings related to scoping review questions
					The third RCT compared alternative repositioning.	
		2. The Cochrane Central Register of Controlled Trials			Frequencies between 2-hourly and 3-hourly repositioning on standard	
		3. Ovid MEDLINE			hospital mattresses and 4-hourly and 6-hourly repositioning on viscoelastic foam mattresses.	
		4. Ovid EMBASE				
		5. EBESCO CINAHL, and				
		6. The reference sections of studies that were included in the review.				
		Only RCTs were included.				
Krapfl and Grey[14] (2008), United States	To review the effectiveness of repositioning to prevent PU.	Systematic review of electronic databases MEDLINE and CINAHL from January 1960 to July 2008. Studies were limited to prospective randomised controlled trials (RCTs) or quasi-experimental studies that compared repositioning to any other preventive interventions or compared various techniques of repositioning such as turning frequency. Only studies that measured PU incidence were included.			3 RCTs and 2 systematic reviews were identified. 2 RCT studies compared turning frequency and found no significant difference between the effectiveness of 2-hourly and 4-hourly repositioning on PU incidence.	Repositioning every 4 hours on a pressure redistribution surface is as effective as 2-hourly turning
						Best practice guidelines recommend 2-hourly turning if the patient is on a standard mattresses and 4-hourly turning if the patient is on a pressure redistribution surface.
Winkelman and Chiang[30] (2010), United States	To compare the effectiveness of manual 2-hourly turning with other turning schedules in PU prevention in patients undergoing MV.	Systematic review of electronic databases MEDLINE, CINAHL, and Ovid without date or language restriction. Studies were limited to RCTs, quasi-experimental studies, and systematic reviews that included the relevant search terms and adults receiving MV.			4 clinical trials, 2 systematic reviews, and 2 meta-analyses were identified.	Optimal turning schedule for adults receiving MV is still ambiguous.
	To compare the effectiveness of different degrees of lateral tilts in reducing adverse outcomes with bed rest.				The presence compared to the absence of manual turning was shown to reduce fever and the length of hospital stay in adults receiving MV. However, most data were collected from small samples more than 20 years ago and the reports showed methodological problems.	
					In systematic reviews, the effectiveness of frequent manual turning on the prevention of PU was inconclusive.	
Sprigle and Sonenblum[31]	To review current evidence supporting clinical measures addressing the magnitude and	Nil	Literature review	Nil	Manual repositioning was the most common intervention to prevent PU.	Evidence on turning frequency is limited.

(*Continues*)

TABLE 1 (Continued)

Author (s)/year of publication/country	Aims/purpose	Study population and sample size	Methodology/ methods	Intervention type/comparator/ duration of intervention	Outcome and details (eg measurements)	Key findings related to scoping review questions
(2011), United States	duration of pressure that precipitates PU.			Common practice is 2-hourly turning, although researchers have failed to identify strong evidence supporting its effectiveness. Earlier texts suggest the turning schedule to be adjusted according to the magnitude of loading and condition of the patient.	More frequent turning compared to 2-hourly turning may be needed for immobile patients.	Repositioning frequency varies according to patients' needs.

effective duration for repositioning patients to prevent the development of PUs, and only 2 studies found significant differences among the intervention (receiving shorter intervals of turning) and control (receiving longer intervals of turning) groups.

Moore et al[25] found that repositioning every 3 hours using a 30° lateral tilt was more effective than repositioning every 6 hours using a 90° lateral rotation in reducing the incidence of PU. This was not surprising because a shorter interval reduces the period of uninterrupted pressure. Furthermore, in terms of enhancing the effectiveness of repositioning, a 30° lateral tilt is found to be more effective than supine and 90° lateral positioning as a 30° lateral tilt minimises interface pressure, especially to the sacrum, enhancing blood flow and transcutaneous oxygen levels to the tissues.[19,32–35] This coincides with the results from a previous study that repositioning every 3 hours at a 30° tilt (right tilt, back, left tilt, back) was found to be significantly more effective in decreasing PU incidences than 6-hourly at a 90° lateral rotation.[36] This suggests that a 30° lateral tilt is more appropriate for a patient as less pressure is applied over bony prominences, allowing blood supply to the weight-bearing area. Moreover, repositioning patients at a 30° lateral tilt has been shown to reduce labour intensiveness and was thus more cost-effective than turning patients at a 90° lateral rotation.[36] However, the degree of tilt was not uniform between the experimental and control groups,[34] suggesting it as a confounding factor that may undermine the evidence that a 3-hourly turning frequency is more effective in preventing PU than a 6-hourly turning frequency.

In the subsequent experimental study, Defloor et al[27] reported that there was a reduction in PU development in the prevention schemes that used longer turning schedules (4- or 6-hourly) on foam mattresses, compared to shorter turning schedules (2- or 3-hourly) on standardised institutional mattresses. Hence, it is clear that foam mattresses play an important role in reducing incidences of PU, but the different turning schedules remain inconclusive. Compared with another study where they found that foam mattresses reduced the pressure by 20% to 30% compared to standardised institutional mattresses,[32] it can be discerned that the period of pressure and amount of pressure applied on the patient's bony prominence is an important factor in causing PUs. Similar to Moore et al,[25] both the type of mattress and the frequency of turning were not altered between the experimental and control groups, thus undermining the evidence, rendering it inconclusive in determining the most effective turning frequency.

The other 3 experimental studies included in this review[23–26] found that there were no differences in PU incidence among patients who were repositioned at different time intervals and those using pressure-relieving devices.[26,28] Pressure-relieving devices, as the name suggests, are capable of redistributing a patient's weight to

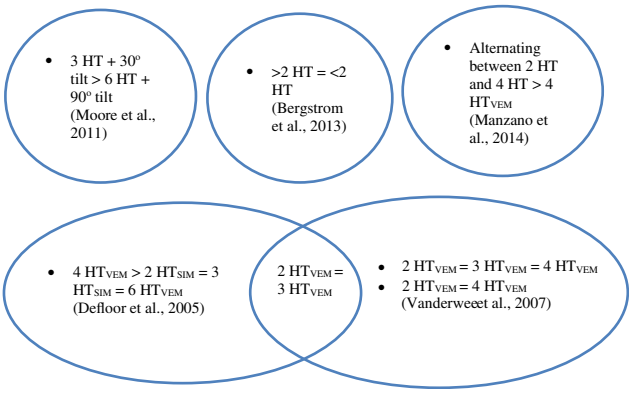

FIGURE 2 Summary of the results from experimental studies with reference to turning frequency in PU prevention. HT, hourly turning; SIM, standard institutional mattress; VEM, viscoelastic mattress; =, no statistical difference in PU prevention effectiveness; >: more effective than

relieve pressure points.[37] This shows that when patients are nursed on pressure-relieving devices, repositioning timing caused few differences in PU incidences. It may be logical to deduce that a higher pressure over a short period of time will cause PUs, whereas a lower pressure over an extended period of time is needed before PU develops. Similar to a systematic review, the use of pressure-relieving devices, coupled with repositioning, was reported to be able to reduce the incidence of PU development in people at risk.[11] Hence, the results from these studies show inconclusive evidence in determining the most effective turning schedules.

From the results of the studies included in this scoping review, it is logical to reason that, with the use of pressure-relieving devices, the turning frequencies for patients at risk of developing a PU can be longer compared to patients who are not on pressure-relieving devices. Therefore, nurses have more hours on hand and are able to concentrate on other nursing tasks and promote better adherence to repositioning guidelines. Moreover, the management of PU can also take a toll on the nursing taskforce as the development of PUs can lead to nurses putting in more time in the management of PU on top of preventing other areas from PU development. Hence, prevention is better than management, and using pressure-relieving devices can potentially reduce nurses' workload in nursing patients at risk of PU by freeing up more time for repositioning. The potentially longer repositioning intervals may relieve nurses of labour to focus on other nursing management for patients. This will also have an influence on the organisation's allocation of manpower in the wards given the global shortage of nurses that is taking a toll on the existing nursing workforce.

Despite the results from the experimental studies,[19,26–29] a prospective cohort study concluded that there was no association between the frequency of repositioning with the use of pressure-relieving mattresses and their incidence in PU development.[20] Among the 3 reviews included in this scoping review, which evaluated the frequency of turning and the use of pressure-reducing mattress, none of them were conclusive in determining the optimal turning schedule to reduce PU incidences in patients on pressure-relieving mattresses.[14,30,31] Similar to a literature review that included studies using standard mattresses and pressure-relieving mattresses with various turning frequencies, evidence was also inconclusive.[2] The inconsistent results stem from the fact that pressure-relieving mattresses were compared with standardised institutional mattresses. There were also differing repositioning timings, which could potentially introduce confounding factors into the study. This is similar to the experimental studies mentioned above, affecting the eventual results obtained. The comparison might not be accurate as there are more than 1 factor being manipulated in the studies, thus yielding inconsistent results and inconclusive evidences.

There are also several factors that could have accounted for the inconsistent results obtained from these studies. First, studies have shown that immobility is a major risk factor in the development of PUs; however, the prevalence of PUs is not solely influenced by the duration of repositioning.[38,39] This is because there is no single risk factor that can explain the development of PU but a complex interplay of factors that increases one's risk to PU development.[40] The literature has identified over 100 risk factors that may place adults at risk for PU, and this is especially so in bedridden patients because comorbidities also play a major role in influencing their risk in PU development.[41]

Another major key factor is the role of nurses in nursing patients at risk of PU. Guidelines that are currently available on the prevention of PUs do not specify the exact frequency of repositioning but, rather, encourage health care professionals to determine the frequency of repositioning by assessing a set of criteria.[42] Repositioning patients at risk for PU 2-hourly has been established as part of many clinical guidelines for PU prevention.[43,44] However, this was in place more than 20 years ago and was only based on small-scale studies.[45,46] Turning every 2 hours is not only labour intensive[47] but also not cost-effective, with the subsequent introduction of pressure-relieving mattresses. In several studies where the cost-effectiveness of prevention methods was analysed, prevention of PU, including providing pressure-relieving devices for all patients at risk, was in fact found to be more cost saving and resulted in greater expected effectiveness compared with standard care.[48,49]

However, with guidelines implemented and pressure-relieving mattresses introduced to prevent the development of PUs, there still appears to be a high prevalence of PUs in hospitals and nursing home. This could be explained by the adherence rate of nurses in repositioning patients who are at a high risk of PU. In a review conducted that was aimed at assessing how PU guidelines were implemented in nursing homes, the overall adherence to PU prevention guidelines was relatively low.[50] This could be due to the labour-intensive nature of repositioning patients as it takes more than 1 nurse to reposition a patient. This can have an effect on the development of PU; hence, there is also a need to

address the problem of staff adhering to the guidelines implemented.

Several studies have pointed out that there is actually no lack of evidence in the prevention of PU but rather a failure of nurses to put knowledge attained into practice.[51–53] Nurses were found to be lacking in PU prevention implementation despite the fact that PU prevention is being described as basic nursing care.[54] However, positive attitudes will not be enough to change practice because barriers need to be resolved first before effective prevention can be implemented.[53] Shortage of manpower and lack of time were the major barriers identified in carrying out PU prevention intervention.[55–58] Hence, on top of improving PU incidences by regular repositioning, organisations can tap into the latest technology to reduce pressure by using pressure-relieving mattresses. This can potentially be helpful for nurses by allowing longer intervals between repositioning. Longer intervals between repositioning may be able to address manpower allocation issues and promote adherence to repositioning schedules and PU management, thereby decreasing PU incidences.

5 | IMPLICATIONS FOR FUTURE RESEARCH

In general, there is a lack of studies examining turning frequency and its impact on the development of PU. The limited available studies have limitations in their methodological designs. There is a need for multiple well-designed RCTs consisting of lesser methodological limitations with a large sample size that compare just the frequency of turning while making other variables constant.Further studies should focus on changing only 1 variable such as turning frequency so that lesser confounding factors exist, yielding more reliable results. This scoping review identified that patients nursed under pressure-relieving devices are less susceptible to PU development. Specifically, repositioning patients coupled with the use of pressure-relieving devices is one of the most promising interventions to implement. However, the challenge is to identify what exactly is the optimal repositioning interval with pressure-relieving devices. Hence, further RCTs need to be conducted to confirm the results from these studies to allow organisations to relook into their intervention guidelines and adopt EBP. Studies should also focus on repositioning intervals on different patient populations to allow for generalisability across different patient populations. This can improve patients' quality of life and also relieve nurses of unnecessary workload.

6 | CONCLUSION

This scoping review provided an important summary of the results of studies regarding repositioning schedules. Given the current evidences in this scoping review, there appears to be varying results surrounding the most appropriate repositioning schedules. This could be due to more than 1 variable being manipulated in the studies. There should be less-manipulated variables, that is, the use of pressure-relieving devices throughout all groups to yield results that are more reliable. This scoping review did, however, provide valuable information on the appropriate interventions to implement that could potentially reduce PU, which is the use of pressure-relieving devices and repositioning. The cost-effectiveness of using pressure-relieving devices was also found, and although pressure-relieving devices are more costly, it is still more cost-effective than allocating more manpower for frequent turning. Hence, institutions can consider providing it to a wider patient group to reduce PU development.

ACKNOWLEDGEMENTS

The authors thank the National University Health System, Medical Publications Support Unit, for assistance in the language editing of this manuscript.

Author contribution

CHS, VL, SS, and ET contributed to data search, extraction of articles, and review of articles. CHS, VL, and SS contributed to data synthesis. CHS and VL contributed to draft manuscript. VL, SS, CHS, and ET contributed to final manuscript and approval.

ORCID

Violeta Lopez http://orcid.org/0000-0001-8844-0331
Shefaly Shorey http://orcid.org/0000-0001-5583-2814

REFERENCES

1. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers: Quick Reference Guide; 2014; http://www.epuap.org/wp-content/uploads/2016/10/quick-reference-guide-digital-npuap-epuap-pppia-jan2016.pdf. Accessed May 18, 2017.
2. Gillespie BM, Chaboyer WP, McInnes E, Kent B, Whitty JA, Thalib L. Repositioning for pressure ulcer prevention in adults. *Cochrane Database Syst Rev*. 2014;4:CD009958.
3. Smith IL, Nixon J, Brown S, Wilson L, Coleman S. Pressure ulcer and wounds reporting in NHS hospitals in England. Part 1: Audit of monitoring systems. *J Tissue Viability*. 2016;25(1):3–15.
4. Briggs M, Collinson M, Wilson L, et al. The prevalence of pain at pressure areas and pressure ulcers in hospitalised patients. *BioMed Central Nurs*. 2013;12(1):19.
5. Spilsbury K, Nelson A, Cullum N, Iglesias C, Nixon J, Mason S. Pressure ulcers and their treatment and effects on quality of life: hospital inpatient perspectives. *J Adv Nurs*. 2007;57(5):494–504.
6. McInnes E, Jammali-Blasi A, Bell-Syer S, Dumville J, Cullum N. Preventing pressure ulcers—are pressure-redistributing support surfaces effective? A Cochrane systematic review and meta-analysis. *Int J Nurs Stud*. 2012;49(3):345–359.
7. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment

of Pressure Ulcers: Quick Reference Guide; 2009. http://www.npuap.org/wp-content/uploads/2014/08/Updated-10-16-14-Quick-Reference-Guide-DIGITAL-NPUAP-EPUAP-PPPIA-16Oct2014.pdf. Accessed May 18, 2017.
8. Beard JR, Bloom DE. Towards a comprehensive public health response to population ageing. *Lancet*. 2015;385(9968):658–661.
9. Connell AO, Lockwood C, Thomas P. Pressure ulcers–prevention of pressure related tissue damage. *JBI Database Best Pract Inform Sheets Techn*. 2008;12(2):5–23.
10. Padula WV, Mishra MK, Makic MBF, Valuck RJ. A framework of quality improvement interventions to implement evidence-based practices for pressure ulcer prevention. *Adv Skin Wound Care*. 2014;27(6):280–284.
11. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. *JAMA*. 2006;296(8):974–984.
12. Hoffmann T, Bennett S, Del Mar C. *Evidence-Based Practice across the Health Professions*. 2nd ed. Australia: Elsevier Health Sciences; 2013.
13. Bååth C, Idvall E, Gunningberg L, Hommel A. Pressure-reducing interventions among persons with pressure ulcers: results from the first three national pressure ulcer prevalence surveys in Sweden. *J Eval Clin Pract*. 2014;20(1):58–65.
14. Krapfl LA, Gray M. Does regular repositioning prevent pressure ulcers? *J Wound Ostomy Cont Nurs*. 2008;35(6):571–577.
15. Black JM, Edsberg LE, Baharestani MM, et al. Pressure ulcers: avoidable or unavoidable? Results of the national pressure ulcer advisory panel consensus conference. *Ostomy Wound Manage*. 2011;57(2):24.
16. Low LL, Vasanwala FF, Tay AC. Pressure ulcer risk assessment and prevention for the family physician. *Proc Singapore Healthcare*. 2014;23(2):142–148.
17. Hagisawa S, Ferguson-Pell M. Evidence supporting the use of two-hourly turning for pressure ulcer prevention. *J Tissue Viability*. 2008;17(3):76–81.
18. Cooper KL. Evidence-based prevention of pressure ulcers in the intensive care unit. *Crit Care Nurse*. 2013;33(6):57–66.
19. Moore Z, Cowman S, Conroy RM. A randomised controlled clinical trial of repositioning, using the 30 tilt, for the prevention of pressure ulcers. *J Clin Nurs*. 2011;20(17-18):2633–2644.
20. Rich SE, Margolis D, Shardell M, et al. Frequent manual repositioning and incidence of pressure ulcers among bed-bound elderly hip fracture patients. *Wound Repair Regen*. 2011;19(1):10–18.
21. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1):19–32.
22. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review of scoping reviews: advancing the approach and enhancing the consistency. *Res Synth Method*. 2014;5(4):371–385.
23. Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc*. 2015;13(3):141–146.
24. Armstrong R, Hall BJ, Doyle J, Waters E. Scoping the Scope' of a Cochrane Review. *J Public Health*. 2011;33(1):147–150.
25. Aromataris E, Riitano D. Systematic reviews: constructing a search strategy and searching for evidence. *Am J Nurs*. 2014;114(5):49–56.
26. Bergstrom N, Horn SD, Rapp MP, Stern A, Barrett R, Watkiss M. Turning for ulcer reduction: a multisite randomized clinical trial in nursing homes. *J Am Geriatr Soc*. 2013;61(10):1705–1713.
27. Manzano F, Colmenero M, Pérez-Pérez AM, et al. Comparison of two repositioning schedules for the prevention of pressure ulcers in patients on mechanical ventilation with alternating pressure air mattresses. *Intensive Care Med*. 2014;40(11):1679–1687.
28. Vanderwee K, Grypdonck MHF, De Bacquer D, Defloor T. Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. *J Adv Nurs*. 2007;57(1):59–68.
29. Defloor T, De Bacquer D, Grypdonck MH. The effect of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers. *Int J Nurs Stud*. 2005;42(1):37–46.
30. Winkelman C, Chiang LC. Manual turns in patients receiving mechanical ventilation. *Crit Care Nurse*. 2010;30(4):36–44.
31. Sprigle S, Sonenblum S. Assessing evidence supporting redistribution of pressure for pressure ulcer prevention: a review. *J Rehabil Res Dev*. 2011;48(3):203–213.
32. Defloor T. The effect of position and mattress on interface pressure. *Appl Nurs Res*. 2000;13(1):2–11.
33. Manorama AA, Baek S, Vorro J, Sikorskii A, Bush TR. Blood perfusion and transcutaneous oxygen level characterizations in human skin with changes in normal and shear loads—implications for pressure ulcer formation. *Clin Biomech*. 2010;25(8):823–828.
34. Seiler WO, Allen S, Stähelin HB. Influence of the 30° laterally inclined position and the 'super-soft' 3-piece mattress on skin oxygen tension on areas of maximum pressure -implications for pressure sore prevention. *Gerontology*. 1986;32(3):158–166.
35. Moore Z, Cowman S. Using the 30 tilt to reduce pressure ulcers. *Nurs Times*. 2012;108(4):22–24.
36. Moore Z, Cowman S, Posnett J. An economic analysis of repositioning for the prevention of pressure ulcers. *J Clin Nurs*. 2013;22(15-16):2354–2360.
37. McInnes E, Jammali-Blasi A, Bell-Syer SE, Dumville JC, Cullum N. Support surfaces for pressure ulcer prevention. *Cochrane Database Syst Rev*. 2011;4:1–142. CD001735. https://doi.org/10.1002/14651858.CD001735.pub4
38. Lindgren M, Unosson M, Fredrikson M, Ek AC. Immobility–a major risk factor for development of pressure ulcers among adult hospitalized patients: a prospective study. *Scand J Caring Sci*. 2004;18(1):57–64.
39. Smit I, Harrison L, Letzkus L, Quatrara B. What factors are associated with the development of pressure ulcers in a medical intensive care unit? *Dimens Crit Care Nurs*. 2016;35(1):37–41.
40. Coleman S, Gorecki C, Nelson EA, et al. Patient risk factors for pressure ulcer development: systematic review. *Int J Nurs Stud*. 2013;50(7):974–1003.
41. Lyder CH, Ayello EA. Pressure ulcers: a patient safety issue. In: Hughes RG, ed. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2008.
42. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers: Quick Reference Guide; 2014; http://www.npuap.org/wp-content/uploads/2014/08/Quick-Reference-Guide-DIGITAL-NPUAP-EPUAP-PPPIA-Jan2016.pdf. Accessed May 18, 2017.
43. Registered Nurses' Association of Ontario. Risk Assessment and Prevention of Pressure Ulcers. Nursing Best Practice Guideline; 2005. http://rnao.ca/sites/rnao-ca/files/Risk_Assessment_and_Prevention_of_Pressure_Ulcers.pdf. Accessed May 18, 2017.
44. Wound Ostomy and Continence Nurses Society. *2010 Guideline for Prevention and Management of Pressure Ulcers (Injuries)*. Glenview, IL: WOCN; 2010.
45. Exton-Smith AN, Sherwin RW. The prevention of pressure sores significance of spontaneous bodily movements. *Lancet*. 1961;278(7212):1124–1126.
46. Smith AM, Malone JA. Preventing pressure ulcers in institutionalized elders: assessing the effects of small, unscheduled shifts in body position. *Adv Skin Wound Care*. 1990;3(4):20–25.
47. Helme TA. Position changes for residents in long-term care. *Adv Skin Wound Care*. 1994;7(5):57–61.
48. Padula WV, Mishra MK, Makic MBF, Sullivan PW. Improving the quality of pressure ulcer care with prevention: a cost-effectiveness analysis. *Med Care*. 2011;49(4):385–392.
49. Stern A, Chen W, Sander B, et al. Preventing pressure ulcers in long-term care: a cost-effectiveness analysis. *Arch Intern Med*. 2011;171(20):1839–1847.
50. Saliba D, Rubenstein LV, Simon B, et al. Adherence to pressure ulcer prevention guidelines: implications for nursing home quality. *J Am Geriatr Soc*. 2003;51(1):56–62.
51. Tannen A, Dassen T, Halfens R. Differences in prevalence of pressure ulcers between the Netherlands and Germany—associations between risk, prevention and occurrence of pressure ulcers in hospitals and nursing homes. *J Clin Nurs*. 2008;17(9):1237–1244.
52. Nuru N, Zewdu F, Amsalu S, Mehretie Y. Knowledge and practice of nurses towards prevention of pressure ulcer and associated factors in Gondar University Hospital, Northwest Ethiopia. *BMC Nurs*. 2015;14(1):34.
53. Pancorbo-Hidalgo PL, García-Fernández FP, López-Medina IM, López-Ortega J. Pressure ulcer care in Spain: nurses' knowledge and clinical practice. *J Adv Nurs*. 2007;58(4):327–338.
54. Sving E, Gunningberg L, Högman M, Mamhidir AG. Registered nurses' attention to and perceptions of pressure ulcer prevention in hospital settings. *J Clin Nurs*. 2012;21(9-10):1293–1303.
55. Tubaishat A, Aljezawi M, Al Qadire M. Nurses' attitudes and perceived barriers to pressure ulcer prevention in Jordan. *J Wound Care*. 2013;22(9):490–497.

56. Qaddumi J, Khawaldeh A. Pressure ulcer prevention knowledge among Jordanian nurses: a cross-sectional study. *BMC Nurs*. 2014;13(1):6.
57. Strand T, Lindgren M. Knowledge, attitudes and barriers towards prevention of pressure ulcers in intensive care units: a descriptive cross-sectional study. *Intensive Crit Care Nurs*. 2010;26(6):335–342.
58. Moore Z, Price P. Nurses' attitudes, behaviours and perceived barriers towards pressure ulcer prevention. *J Clin Nurs*. 2004;13 (8):942–951.

How to cite this article: Chew HSJ, Thiara E, Lopez V, Shorey S. Turning frequency in adult bedridden patients to prevent hospital-acquired pressure ulcer: A scoping review. *Int Wound J*. 2018;15:225–236. https://doi.org/10.1111/iwj.12855