Acute care patient mobility patterns and documented pressure injury prevention — an observational study and survey

McInnes E, Chaboyer W, Allen T, Murray E & Webber L

ABSTRACT

Background

Repositioning is widely recommended to prevent pressure injury (PI). Documentation of implemented pressure injury prevention (PIP) strategies is necessary for continuity of care. This pilot observational study aimed to describe the positioning patterns of patients at risk of developing PIs and to identify gaps in documentation of PIP strategies.

Methods

Patients were recruited from neurology and orthopaedic wards. Positions adopted were recorded during a two-hour observational period over three consecutive nursing shifts (day, evening, night). Demographic data, clinical details and recommended or implemented PIP strategies was obtained from medical records. Data were analysed descriptively using frequencies, percentages, medians, ranges and interquartile ranges as appropriate.

Results

Twenty-six out of 38 patients participated; the majority were orthopaedic patients with a median age of 66 years. Twenty-four had a PI risk assessment completed; 12 (50%) were scored at moderate to very high risk of PI. Four (33%) of those in the PI moderate to very high risk categories were prescribed a turning regime; 2 (17%) had received PIP education; and 6 (50%) had a pressure-relieving device recommended. The most observed positions for day shift were supine 46°–90° and sitting out; for afternoon shift were supine 46°–90° and supine 1°–45°, and for night shift left lateral or supine 1°–45°.

Conclusions

Acute care patients were most often observed in positions that place them at risk of PIs. Targeted PIP strategies are required that take into account patient movement patterns and address deficiencies in documentation of care.

Key points on what is already known on the topic

- Acute care patients are at high risk of PI.
- A suite of PIP strategies including repositioning are commonly recommended.
- Implementation of PI clinical guidelines is suboptimal.
- The positioning patterns of patients at risk of developing PIs has been little studied.

Manuscript contribution

- Acute care patients are most often observed adopting positions that place them at risk of PIs.
- Patients who can independently redistribute pressure should be educated to do so and taught to frequently change position.
- Targeted strategies for PIP are required to account for patient movement patterns and to address deficiencies in documentation of care.

***Keywords**: pressure injury, prevention, repositioning, nursing practice.*

BACKGROUND

Pressure injuries (PI), have been defined as a "localised injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear" (European Pressure Ulcer Advisory Panel — EPUAP)[1]. International data shows that PI prevalence rates in hospitalised patients range from 10.2 to 18.1%[2-6]. Hospital-acquired pressure injuries (HAPI), that is those that originate in hospital, range from 6.4% to 17.4%[2,4,7]. PIs thus pose a major health care challenge and adversely affect quality of life in patients who acquire them[8,9]. Preventing PI is one of the Australian National Safety and Quality Health Service Standards[10], acknowledging the gravity and preventability of PIs.

PIs result in increased hospital length of stay (LOS) and higher hospitalisation costs[11,12]. Hospital LOS is increased by two- to threefold for patients with a PI. This equates to a mean LOS of 10.2–14.1 days, in comparison to those without a PI, whose LOL is substantially less at an average of 4.6 days[2,13]. Economic analysis has shown that 95,695 cases of PI incurred a median 'opportunity cost' of A$285 million[14]. Recently, HAPIs were found to cost the health care system an additional $24 million in one year in two Australian states (Victoria and Queensland)[12]. International evidence also demonstrates the high cost of PIs. In the UK the costs of treating a PI varies from £1214 (category 1) to £14,108 (category IV)[15]. In an Irish study, the cost to successfully treat one patient was Euros 119,000. On the basis of this figure it was estimated that it costs Euros 250 million to manage PIs across all care settings in Ireland per year[16]. It is, therefore, of great importance to both patients and the health system to prevent PIs from occurring.

For these reasons, clinical practice guidelines have been developed to assist clinicians in PI prevention (PIP) and management[17,18]. Most of these guidelines include strategies such as PI risk assessment, allocation of pressure-relieving devices and support surfaces to those at risk of PIs, nutrition screening and encouraging patients, where possible, to mobilise and reposition themselves. However, it is frequently the case that implementation of PI clinical guidelines is suboptimal, as demonstrated in research studies. For example, an American study of nearly 2,000 patients found that the implementation of PIP strategies by health care professionals ranged from 8% for use of pressure-relieving devices to 94% for skin assessment[19]. Similarly, a large Dutch study found that 27% of at-risk patients received appropriate PIP strategies[20]. More recent studies have found that the inadequate or inappropriate management of PIs remains a problem in a number of health care settings. Less that 10% of patients requiring preventative care, received it[5]. In terms of risk assessment, similar gaps in practice exist: 40% of 1,192 patients had a risk assessment completed[4] and in Queensland a prevalence survey found only 24% in a sample of 8,000 were assessed for PI risk[21].

Although there are gaps in knowledge about the relationship between support surfaces[22], repositioning practices and tissue interface pressures in the context of PIP[23,24], repositioning is widely recommended as a key component of PIP strategies[17,18]. The theoretical assumption underlying repositioning is that it prevents tissue death by reducing pressure over bony prominences, thereby facilitating reperfusion of the overlying tissue and maintaining oxygenation and nutrient supply to the area[24]. The sound theoretical rationale that underpins

Associate Professor Elizabeth McInnes*
BA(Hons), GradDipAppSci(Nursing), MPH, PhD
Deputy Director, Nursing Research Institute,
St Vincent's and Mater Health Sydney and Australian Catholic University, St Vincent's Hospital,
Level 5, deLacy Building, 390 Victoria Street,
Darlinghurst, NSW 2010, Australia
Email liz.mcinnes@acu.edu.au
Tel (02) 8382 3793

Professor Wendy Chaboyer
RN, BSc(Nurs), MNurs, PhD
Director, NHMRC National Centre for Research Excellence in Nursing (NCREN), Centre for Health Practice Innovation, Griffith Health Institute, Griffith University — Gold Coast campus, Griffith University, QLD 4222, Australia

Mr Todd Allen
RN, BN(Hons)
Registered Nurse, St Vincent's Hospital, Darlinghurst NSW, Australia

Ms Edel Murray
RN, GradDipNursMgn, MCN
Clinical Nurse Consultant, Policy and Procedure and Practice Development, St Vincent's Private Hospital, Sydney, NSW, Australia

Ms Louise Webber
RN, BN(Hons)
Wound Consultant, Lincs Healthcare, Sunshine Coast and Nurse Practitioner Candidate Brisbane, QLD, Australia

* Corresponding author

the practice of repositioning has led to its endorsement in national wound management guidelines[17]. Repositioning can range from small shifts in position undertaken by the patient with encouragement from staff to full lateral repositioning/turning by health care staff on behalf of the patient[25]. A recent Cochrane review found that the ideal frequency of repositioning and the most effective position to prevent PIs is uncertain[23].

Understanding the actual mobility patterns of acute care hospitalised patients who have some ability to move themselves either assisted or unassisted, and the positions they most frequently adopt, is important for a number of reasons. Firstly, some positions favoured by patients may increase the risk of PI. Secondly, understanding patient preferences for certain potentially harmful positions may help raise awareness amongst health care practitioners to give reminders about regular repositioning. Thirdly, information about existing patient movement patterns can inform the development of a patient-mediated intervention, which incorporates reminders about regular repositioning and avoidance of sitting in potentially harmful positions and for assessing whether such an intervention is required. Although certain medical conditions or recent surgeries may limit some patients' ability to move or reposition, for those that are able, regular repositioning is a practical preventative measure that is within the control of some groups of patients. Patients who can independently redistribute and relieve pressure should be educated and reminded to do so[26].

The aims of this pilot study were to describe the positioning patterns of hospitalised patients at risk of developing PIs and to identify gaps in documentation of PIP strategies. The study findings will enable the development of interventions for PIP that take into account spontaneous patient positioning patterns and which addresses gaps in documented PIP care.

METHODS

Study design

An observational study of hospitalised patients and medical record audit of PIP practices implemented or recommended were undertaken.

Setting

The orthopaedic and neurology wards of a large metropolitan university teaching hospital campus (private and public hospitals co-located on one campus).

Sample

The inclusion criteria required that participants be: admitted to a neurology or orthopaedic ward (as most patients admitted to these wards are at risk of PI); aged 18 or older; English-speaking; and hospitalised for 24 hours or more. Exclusion criteria included those who were severely ill or immobilised, that is did not have any capacity to move independently due to impairment or being in traction.

Recruitment

The day prior to the intended observation period, patients that met the eligibility criteria were identified in consultation with nursing staff. Potential participants were asked if they would like to participate in the study and, if agreeable, were informed of the study procedure and processes and asked to sign a consent form. If a patient declined, the next eligible patient was identified and asked if they would like to participate.

Data collection

A standardised structured observation form was used to record the activity patterns of patients. Specifically, data were recorded on: frequency and type of change in the participant's position; the participant's movements, such as walking, sitting in chair; the use of equipment, which inhibit or restrict movement, such as surgical drains and infusion lines, mattress types and the visible presence of turning sheets and support surfaces. Positions while in bed were classified as: supine 0°, 1°–45° (which incorporates semi-Fowler's position of 30°) and 46°–90° (which incorporates the full Fowler's position of 60°–90°); right and left lateral positions lying down. Sitting out of bed and walking was also noted. Each time a patient changed position and the position they adopted on position change were noted. The frequency of position changes and the newly adopted position type were recorded throughout each observation period. The frequency of minor repositioning was also recorded. These were defined as small changes or shifts in position (such as small weight shifts) and were differentiated from the bigger movements such as turning from side to side or changing from sitting in bed to lying in bed.

Each patient was observed for a 2 x 30 minutes per shift, totalling 3 hours of observation for each patient over a period of 24 hours. That is one hour total of observation time per three consecutive shifts (day, evening and night). The pilot observational period found this frequency of observation was acceptable to patients and ward staff. Observations ceased during times where privacy was required, such as during bed baths, consultations and treatments, and resumed upon completion of the task after assent was granted by the patient and the health care professional attending to the patient's care.

Observers were registered nurses who underwent a training process. During the piloting of data collection, inter-rater agreement of observations was assessed for each observer against an observer who was designated as the gold standard. Four periods of observational data per data collector were obtained to assess agreement. Kappa (κ) was calculated for the observational data collection process relating to observations of movement and position changes. This showed good agreement (κ=0.78) between observers as measured against the gold standard data collector.

A standardised piloted data collection form was used to collect demographic and clinical data for each patient from their medical records. This included admission diagnosis, baseline observations, comorbidities, mobility status, medications, history of PI, PI status, PI risk status (as measured by the Waterlow or Braden scale — at the time of the study the Waterlow scale was used in one co-located site and the Braden scale in the other), skin assessment, nutritional screening, and PI preventative strategies such as education or allocation of pressure-relieving devices or support surfaces.

Data analysis

Descriptive data were summarised using frequencies, percentages, medians, ranges and interquartile ranges as appropriate (SPSS for Windows, Version 18.0). We analysed movement data by counting for

each shift the number of times each participant (who had a full set of observations across the three shifts) adopted one of seven positions over the period observed. The denominator was the total number of position changes observed per shift for all patients. We calculated the percentage each position was observed using this denominator.

Ethics approval

The study was approved by the hospital ethics committee and all patients signed consent forms. Cluster consent to incidentally observe nursing practice during the observation periods was obtained from the nursing unit manager on each participating hospital ward.

RESULTS

Thirty-eight patients who met the inclusion criteria were approached to participate in the study. Twelve declined; reasons given included feeling unwell and preferring not to be observed. The final observed sample consisted of 26 participants (68% participation rate). Seventeen full sets of observations (that is, the participant was observed at all three shifts) and nine sets of partial observations (that is, the participant was not observed at every shift as the patient had either been discharged or moved to another ward) were obtained.

Patient demographics and clinical characteristics

Table 1 shows that the majority of participants were female and orthopaedic patients with a median age of 66 years (range 19–82, interquartile range 21). The median length of stay at the time of data collection was five days (range 2–29, interquartile range 6). Most patients had a history of cardiovascular disease and half of the sample had a body mass index (BMI) categorised as overweight or obese. The majority were prescribed five or more medications and the most frequently prescribed medication was narcotic-based analgesia (77%).

In terms of mobility status while in bed, four participants required assistance in the form of physical assistance or a transfer aid; out of bed four participants required a mobility aid (for example, a walking frame or wheelchair) and three required assistance by one or more nurses. For one patient there was no documentation of mobility information. Seven patients had either urinary or faecal incontinence. Seventeen participants were screened for nutrition status. Fourteen (78%) had one or more of the following in situ: in-dwelling catheter, intravenous line, nasogastric tube, percutaneous endoscopic gastrostomy feeding tube or oxygen nasal prongs.

Table 1 shows that 24/26 patients had a risk assessment completed. Twelve participants were deemed at low (Braden) or no risk (Waterlow). The remainder were deemed at high or very high risk of PI. Two patients had a PI; one had a PI Stage II on the right heel and for the other there was no documentation of PI stage or location. No patient had a documented history of PI in the 12 months prior to admission. Over a third of patients (n=10) had a formal PI management plan documented.

Table 2 shows that of those in the Waterlow high to very high and Braden moderate to very high risk categories 4 (33%) had been prescribed a turning regime, two (17%) (or their carers) had received PIP education and six (50%) had a pressure-relieving device recommended (confirmed on observation). These devices included alternating mattresses (n=4) and a pressure-relieving cushion (n=2). All other participants used standard hospital mattresses and chairs. Only two (17%) in the moderate to very high risk group had documented recommendations for daily skin evaluation and 10 (83%) were recommended for increased mobility

Movement data

Figure 1 shows that the least favoured position at any time for those with a complete set of observations across all shifts (n=17) was supine 0°. During the day shift supine 46°–90° and sitting out were most adopted. During the afternoon shift the supine 46°–90° and supine 1°–45° were most adopted and for the night shift either left lateral or supine 1°–45° was favoured. The frequency of supine 46°–90°, sitting and walking declined, while the frequency of supine 1°–45° and lateral positions increased from day to night shifts.

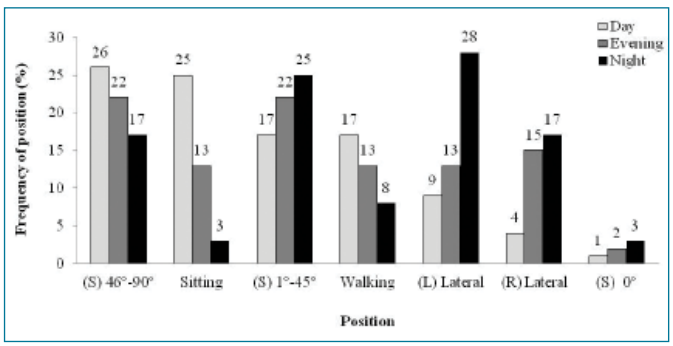

Figure 1. Frequency of position adopted by shift (n=17). Graph indicates (S) supine, (R) right and (L) left.

In terms of the number of times participants changed position during the observational periods, during the day shift position changes occurred a median of 3.0 times (IQR, 2.50; range 1–9); in the afternoon shift position changes occurred a median of 4.0 times (IQR, 3.0; range 0–7), and for night shift, a median of 4.0 times (IQR, 3.0; range 1–8). Minor changes in position, such as small weight shifts, were observed and recorded as follows: for day shift the median number of times minor changes in position occurred was 13 (IQR, 9; range 0–29); for afternoon shift a median of 13 minor changes (IQR:15; range 0–44) and for night shift a median of 10 (IQR 15; range 3–39) minor changes were observed.

DISCUSSION

This is the first observational study to our knowledge that has attempted to observe and quantify acute care patient positions in a naturalistic setting. We also examined gaps in documentation relating to PI risk and preventative strategies. Patients who were observed in this study most often assumed the supine 46°–90° position or sitting out of bed in the early part of the day and were more often observed in the supine 1°–45° in the later part of the day. These positions may be most harmful in terms of increasing PI risk. Adopting a supine posture with the head of the bed elevated alters loading on the buttocks, increasing both the normal and frictional forces on the sacrum[26]. Nevertheless it appears to be a functional posture preferred by many patients as they can converse with others, read and eat with ease. As this was the most commonly observed patient position, there is scope to educate and encourage patients to alternate between this and other positions.

Noteworthy also was that sitting out of bed and walking activity decreased throughout the day. We found documented evidence that 17 patients were recommended to increase their mobility; however, this may also have been recommended to increase postoperative mobilisation rather than as a specific PI strategy. The frequency with which walking was observed was relatively low compared to the supine 46°–90° position or sitting out of bed. While hospitalised people may be fatigued after the morning routine of showering and being encouraged to sit out of bed, this finding suggests that staff need to educate those patients who are physically capable to alternate between walking, sitting and resting in bed.

Another finding of interest was the frequency with which small shifts in position occurred. This suggests that people may gain pressure relief from these movements and that self-initiated movements, in addition to actual changes in position, should be actively encouraged. Currently robust evidence on how often a weight shift should be performed[26] and on the frequency of repositioning schedules remains limited[23]. Observational studies suggest that repositioning frequency varies from person to person[26]. The effects of small shifts in body weight have been investigated in relation to blood flow and interface pressure but not in terms of PI incidence[27]. Reminders for patients who are able to make small movements or minor alterations in position may complement other PIP strategies and assist with the reduction of sustained pressure at pressure points. It has recently been suggested that studies investigating the efficacy of small weight shifts for preventing PIs are urgently needed[28].

No one was observed in the 30° tilt commonly advocated as a pressure-relieving position[25,29]. This position is where the patient is placed in a laterally-inclined position, supported by pillows, with their back making a 30° angle with the support surface. Only four patients out of the 12 in the high-risk category were prescribed turning or repositioning schedules according to their medical records. Even for moderate- to high-risk patients who are independent, reminders to keep active and to regularly change position are needed. Patients were more often observed in positions that increase pressure and consequently the risk of PI. This suggests that health care professionals may need to take a more active role in educating patients about the importance of repositioning and reminding and assisting patients to do so, when required.

In accordance with similar studies with larger sample sizes, our findings highlight that the implementation of PIP strategies appears to be inconsistent across all PI risk categories[30-32]. Risk assessment rates vary between 27% and 47%[4,20] and up to 75%[21]. Consistent with Lyder's study on the care of patients at risk of PIs in USA hospitals[19], the current study found an alarmingly low use of pressure-relieving devices and support surfaces for patients assessed as at risk of PI or above. In addition, gaps in documentation relating to one of the two patients with a PI, namely stage and location of PI was noted in our

Table 1: Participant demographics and clinical information (n=26)

	Median (IQR) Range	n	%
Age	66 (21) 19–82		
Female		15	58
Ward:			
Orthopaedic		17	65
Neurology		9	35
Length of stay at time of data collection	5 (6) 2–29		
Admission type:			
Medical		6	23
Surgical		20	77
Number of days postop (n=20)	3 (5) 1–7		
Medical history#			
Cardiovascular disease		16	62
Respiratory disease		6	23
Malignancy or metastatic cancer		4	15
Diabetes mellitus		3	11
Immuno-compromised		1	4
Skin disease		2	8
BMI (kg/m^2) category (n=19)^			
Normal (BMI 20–25)		6	23
Overweight (BMI 26–30)		11	42
Obese (BMI >30)		2	8
Class of medications prescribed#			
Steroids		6	23
Cytotoxic		1	4
Antiemetic		15	58
Aperient		6	23
Sedative		9	35
Narcotic		20	77
Non-narcotic analgesia		14	54
Assistance required in bed		4	23
Assistance required out of bed			
Mobility aid (including walking frame, wheelchair)		4	21
Assist by >1		3	16
IDC, IV line, NGT or PEG in situ O_2 therapy in situ		14	78
Current pressure injury		2	8
Admission risk category:^			
Waterlow at risk or higher		12	46
Braden moderate risk or higher		12	46

Where totals add to >100%, more than one response was possible. ^ Data missing

Table 2: Documented PI strategy by PI risk status

Type of strategy documented	No or low risk n=12 n (%)	Moderate, high to very high risk n=12 n (%)
Pressure-relieving device/ support surface	1 (8)	6 (50)
Patient/carer pressure injury education	2 (17)	2 (17)
Daily skin evaluation	0 (0)	2 (17)
Turning/repositioning schedule	3 (25)	4 (33)
Recommendation for increasing mobility	7 (58)	10 (83)

study. Considering that PI is now regarded as a serious breach of care quality (Australian standard eight) this omission is striking.

There is a growing body of evidence that demonstrates the importance of all patients, and particularly those at high risk of PI, to receive nutritional screening[17]. A multicentre cross-sectional study showed that malnutrition was associated with at least twice the odds ratio of having a PI in health care facilities in Queensland[33,34]. Despite this, only two-thirds of our sample had documentation of completed nutrition screening and four patients in the moderate- to high-risk group had an incomplete nutrition screen.

Documentation of PI care is an important way of communicating patient risk, management and treatment of PI. Recent studies, however, have identified that documentation content and quality is lacking, a shortcoming in nursing practice which has not improved over the last decade[35]. Recent studies have found that adherence to best practice guidelines is variable and, in the case of education provision and pressure-relieving device use, is often guided not by decisions about patient risk but by facility-related factors[36] or nurses' attitudes and beliefs[37]. Until high-quality evidence of the effectiveness of various PIP strategies is available, it is possible that guideline implementation may remain suboptimal.

Strengths and limitations

This was a small but data-rich observational study. It included patient groups that are commonly regarded as being at higher than usual risk of PI because of compromised mobility. Most of the samples were independent while in bed (only four required a transfer aid or assistance to move while in bed) and approximately two-thirds were fully independent while out of bed. While these are acute care hospitalised patients who are at elevated risk of developing PI and

thus reflect one main target group for PIP, two other important target groups were excluded. These were those who were at very high risk such as the totally bedfast or dependent and those who were cognitively impaired. Twelve patients declined to be observed and it is likely that some of those who declined would have moved less due to ill health. In relation to the observation method used in this pilot study we found that multiple observational snapshots across shifts were acceptable to patients. We can recommend this snapshot approach to obtain accurate data of preferred positions and as a data collection technique for observation of patient movements. In other fields of inquiry, a time sampling approach to data collection is well established[38]. In addition, the κ was high between observers indicating good agreement. Ideally 24-hour continuous observation would be conducted; however, this may be less acceptable to patients and would be considerably more resource-intensive. Another less resource-intensive alternative to continuous observation is the use of movement sensors. This method, however, needs to be tested and assessed to establish its effectiveness and the relative cost benefit when compared to constant or intermittent observation.

We extracted data on PI risk assessment and risk management strategies from patient medical records. It is accepted that documented practice may not reflect actual practice. Nevertheless, the shortcomings in practice we identified have also been found in both large-scale prospective and retrospective studies.

As this was a pilot observational study of a small sample we did not adjust the position patterns for severity of illness and condition of patient, for example, by functional ability of the patient.

Policy/practice implications

Periodic weight shifts (such as wriggling in bed and shifting from side to side) and self-repositioning are important PIP strategies. Patients who can independently redistribute pressure should be educated on the importance of frequent position changes.

Many patients in this study were observed in the Fowler or semi-Fowler position often and for long periods of time. Patients should be encouraged by nursing staff to regularly change their position, relieving pressure from areas particularly prone to PI. The lack of documentation of PIP actions indicates that those at high risk of PIs did not receive the full suite of preventative care and suggests that strategies are required to improve these nursing practices.

Research recommendations

A trial of a patient-focused intervention that reminds patients to move more often and to avoid potentially harmful positions, and to adhere to other recommended PIP strategies such as maintaining good nutrition and keeping hydrated. This pilot observational study supports the need to develop and test proactive PIP strategies.

CONCLUSION

This pilot study found that patients most often adopted positions associated with developing PIs. In addition, frequency of walking and sitting out of bed diminishes over time throughout a 24-hour period. The findings of this study provides a foundation to enable the development of targeted strategies for PIP that take into account patient movement patterns and which target a reduction in harmful positions adopted by patients while in hospital. This study has also contributed to a body of evidence that continues to show that inconsistent assessment and poor documentation of strategies to prevent PI continues to be a problem for hospitals.

FUNDING

This study was financially supported by a Multidisciplinary Research Grant awarded by the St Vincent's Clinic Foundation and funding from the Curran Foundation.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

All authors meet at least one of the following criteria (recommended by the ICMJE: http://www.icmje.org/ethical_1author.html) and have agreed on the final version:

- Substantial contributions to conception and design, acquisition of data, or analysis, and interpretation of data.
- Drafting the article or revising it critically for important intellectual content.

REFERENCES

1. European Pressure Ulcer Advisory Panel & National Pressure Ulcer Advisory Panel. Prevention of Pressure Ulcers: Quick Reference Guide. Washington: National Pressure Ulcer Advisory Panel, 2009.
2. VanGilder C, Amlung S, Harrison P & Meyer S. Results of the 2008–2009 International Pressure Ulcer Prevalence Survey and a 3-year, acute care, unit-specific analysis. Ostomy Wound Manage 2009; 55(11):39–45.
3. James J, Evans JA, Young T & Clark M. Pressure ulcer prevalence across Welsh orthopaedic units and community hospitals: surveys based on the European Pressure Ulcer Advisory Panel minimum data set. Int Wound J. 2010; 7(3):147–52.
4. Gunningberg L, Stotts NA & Idvall E. Hospital-acquired pressure ulcers in two Swedish County Councils: cross-sectional data as the foundation for future quality improvement. Int Wound J 2011; 8(5):465–73.
5. Vanderwee K, Defloor T, Beeckman D *et al.* Assessing the adequacy of pressure ulcer prevention in hospitals: a nationwide prevalence survey. BMJ Qual Saf. 2011;20(3):260–7.
6. Kottner J, Wilborn D, Dassen T & Lahmann N. The trend of pressure ulcer prevalence rates in German hospitals: results of seven cross-sectional studies. J Tissue Viability 2009; 18(2):36–46.
7. Mulligan S, Prentice J & Scott L. WoundsWest Wound Prevalence Survey State-wide Overview Report. Perth, WA: Department of Health, 2011.
8. Gorecki C, Brown JM, Nelson EA *et al.* Impact of pressure ulcers on quality of life in older patients: a systematic review. J Am Geriatr Soc 2009; 57(7):1175–83.
9. Spilsbury K, Nelson EA, Cullum NA, Iglesias CP, Nixon J & Mason S. Pressure ulcers and their treatment effects on quality of life: hospital inpatient perspective. J Adv Nurs 2007; 57(5):494–504.
10. Australian Commission on Safety and Quality in Health Care. Sydney: National Safety and Quality Health Service Standards, 2011.
11. Bennett G, Dealey C & Posnett J. The cost of pressure ulcers in the UK. Age Ageing 2004; 33(3):230–5.
12. Jackson T, Nghiem HS, Rowell D, Jorm C & Wakefield J. Marginal costs of hospital-acquired conditions: information for priority-setting for patient safety programmes and research. J Health Serv Res Policy 2011; 16(3):141–6.

13. Russo CA & Elixhauser A. Hospitalizations related to pressure sores. HCUP Statistical Brief #3. Rockville, MD: Agency for Healthcare Research and Quality, 2006.
14. Graves N, Birrell FA & Whitby M. Modeling the economic losses from pressure ulcers among hospitalized patients in Australia. Wound Repair Regen 2005; 13(5):462–7.
15. Dealey C, Posnett J & Walker A. The cost of pressure ulcers in the United Kingdom. J Wound Care 2012; 21(6):261–6.
16. Gethin G, Jordan-O'Brien J & Moore Z. Estimating costs of pressure area management based on a survey of ulcer care in one Irish hospital. J Wound Care 2005; 14(4):162–5.
17. Australian Wound Management Association. Pan Pacific Clinical Practice Guidelines for the Prevention and Management of Pressure Injuries. Osborne Park, WA: Cambridge Media, 2012.
18. National Institute for Health and Clinical Excellence. Pressure ulcer management (CG29). 2005.
19. Lyder CH, Preston J, Grady JN *et al.* Quality of care for hospitalized Medicare patients at risk for pressure ulcers. Arch Intern Med 2001; 161(12):1549–54.
20. Bours GJ, Halfens RJ, Abu-Saad HH & Grol RT. Prevalence, prevention, and treatment of pressure ulcers: descriptive study in 89 institutions in the Netherlands. Res Nurs Health 2002; 25(2):99–110.
21. Centre for Healthcare Improvement. Statewide 2011 patient safety bedside audit report. Brisbane: Queensland Health, 2012.
22. McInnes E, Jammali-Blasi A, Bell-Syer SE, Dumville JC & Cullum N. Support surfaces for pressure ulcer prevention. Cochrane Database Syst Rev [Online]. 2011; (4):CD001735.
23. Gillespie BM, Chaboyer WP, McInnes E, Kent B & Whitty JA. Repositioning for pressure ulcer prevention in adults. Cochrane Database Syst Rev 2012; 7.
24. Krapfl LA & Gray M. Does Regular Repositioning Prevent Pressure Ulcers? J Wound Ostomy Continence Nurs 2008; 35(6):571–7.
25. Wilson M. Repositioning patient to prevent pressure ulcer formation: the 30 degree tilt. Wound Essentials 2008; 3:100–1.
26. Sprigle S & Sonenblum S. Assessing evidence supporting redistribution of pressure for pressure ulcer prevention: A review. J Rehabil R D 2011; 48 (3):203–14.
27. Oertwich PA, Kindschuh AM & Bergstrom N. The effects of small shifts in body weight on blood flow and interface pressure. Res Nurs Health 1995; 18(6):481–8.
28. Krapfl LA & Gray M. Does regular repositioning prevent pressure ulcers? J Wound, Ostomy Continence Nurs 2008; 35(6):571–7.
29. Moore Z, Cowman S & Conroy RM. A randomised controlled clinical trial of repositioning, using the 30 degree tilt, for the prevention of pressure ulcers. J Clin Nurs 2011; 20:2633–44.
30. Källman U & Suserud B-O. Knowledge, attitudes and practice among nursing staff concerning pressure ulcer prevention and treatment — a survey in a Swedish healthcare setting. Scand J Caring Sci 2009; 23(2):334–41.
31. Moore Z & Price P. Nurses' attitudes, behaviours and perceived barriers towards pressure ulcer prevention. J Clin Nurs 2004; 13(8):942–51.
32. Sutherland-Fraser S, McInnes E, Maher E & Middleton S. Peri-operative nurses' knowledge and reported practice of pressure injury risk assessment and prevention: A before-after intervention study. BMC Nurs 2012; 11(1):25.
33. Banks M, Bauer J, Graves N & Ash S. Malnutrition and pressure ulcer risk in adults in Australian health care facilities. Nutrition 2010; 26(9):896–901.
34. Banks MD, Graves N, Bauer JD & Ash S. The costs arising from pressure ulcers attributable to malnutrition. Clin Nutr 2010; 29(2):180–6.
35. Wang N, Hailey D & Yu P. Quality of nursing documentation and approaches to its evaluation: a mixed-method systematic review. J Adv Nurs 2011; 67(9):1858–75.
36. Baumgarten M, Margolis D, Orwig D *et al.* Use of Pressure-Redistributing Support Surfaces Among Elderly Hip Fracture Patients Across the Continuum of Care: Adherence to Pressure Ulcer Prevention Guidelines. Gerontologist 2010; 50(2):253–62.
37. Beeckman D, Defloor T, Schoonhoven L & Vanderwee K. Knowledge and Attitudes of Nurses on Pressure Ulcer Prevention: A Cross-Sectional Multicenter Study in Belgian Hospitals. Worldviews Evid Based Nurs 2011; 8(3):166–76.
38. Chaboyer W, Johnson J, Hardy L, Gehrke T & Panuwatwanich K. Transforming care strategies and nursing-sensitive patient outcomes. J Adv Nurs 2010; 66(5):1111–9.