
REVIEW

Pressure Ulcer Risk Assessment and Prevention for the Family Physician

Lian Leng Low¹, *MMed (Fam Med), MCFP*, Farhad Fakhrudin Vasanwala¹, *MRCP (UK), FCFP(S)*, Ai Choo Tay², *RN, BN*

¹Department of Family Medicine and Continuing Care, Singapore General Hospital, Singapore

²Division of Nursing, Singapore General Hospital, Singapore

ABSTRACT

Pressure ulcers are common and result in serious medical complications, prolonged hospital stay and frequent readmissions. With a rapidly ageing population and increasing chronic disease burden in Singapore, the prevalence of pressure ulcers will increase further. Family physicians will encounter more pressure ulcers in their practices in the primary, intermediate and long term care settings. We conducted a comprehensive literature review on established evidence on pressure ulcer risk assessment and prevention, and also reviewed current hospital protocols in Singapore. We found that many studies on pressure ulcer risk assessment and prevention lacked methodological quality to provide robust evidence and conclusions. Consequently, many of the recommendations in major international guidelines and protocols of major hospitals in Singapore are based on a combination of best available evidence, best practices and consensus opinion. We provided a summary of key recommendations for family physicians, based on the Strength of Recommendation Taxonomy (SORT) framework. We also hope to stimulate interest in regular updates of local guidelines and major hospital protocols in Singapore to reflect the latest evidence based strategies on risk assessment and prevention of pressure ulcers.

Keywords: Pressure ulcer, Prevention, Risk assessment, Family physician

INTRODUCTION

Pressure ulcers are caused by unrelieved pressure that disrupts the blood supply to the capillary network, impeding blood flow and depriving tissues of oxygen and nutrients¹. Pressure ulcers are common and result in serious medical complications, prolonged hospital stay and frequent readmissions. Even in developed countries like United Kingdom (UK), North America and Singapore, the prevalence of pressure ulcers can be as high as 32.1% and 22% in hospital and long term care settings respectively²⁻⁵. Management of pressure ulcers costs the UK and United States billions in health expenditure each year^{6,7}.

With a rapidly ageing population in Singapore, the prevalence of pressure ulcers will increase further. Family physicians will encounter more cases of pressure ulcers in their diverse practices which include the primary, intermediate and long term care settings. Many pressure ulcers are preventable and it is more cost effective to prevent than to treat established ulcers⁶. This narrative review provides a succinct discussion on the assessment

and prevention of pressure ulcers for the family physician with reference to the local tertiary hospitals guidelines along with recommendations based on the current evidence on pressure ulcer prevention^{8,9}.

METHODS

Multiple search strategies were used in September 2013 to ensure a comprehensive review of relevant articles. A PubMed search was conducted with "Pressure ulcer or pressure sore" and "sacral" and "prevention" as search terms, with article types restricted to reviews, guidelines, systematic reviews, clinical trials and human studies, and language restricted to English. The search obtained 51 articles, of which 3 articles were selected for a related search. Two hundred and thirty-four references were identified. References that were duplicated or did not study pressure ulcer prevention or measure pressure ulcer incidence as the primary outcome were eliminated. This elimination reduced the number of references to 21. Three articles were not available locally or through web based resources. Eighteen articles were obtained and reviewed. A search using "pressure ulcers" as a search term in

Table 1. Risk factors for development of pressure ulcer

Extrinsic factors	Intrinsic factors
Interface (axial) pressure	Impaired consciousness
Friction	Limited mobility
Shearing pressure	Diminished sensation
Excessive moisture	Skin factors (dry, maceration, trauma)
	Poor nutrition
	Disruption to arterial/venous/lymphatic system

Cochrane Reviews obtained 23 articles of which 3 were used. The American Family Physician¹⁰, Ministry of Health Singapore, European Pressure Ulcer Advisory Panel (EPUAP) and National Pressure Ulcer Advisory Panel (NPUAP) guidelines were screened for reviews on “pressure ulcers” and three relevant articles selected for this review. Another 10 articles were hand searched from relevant referenced articles. Personal communications were made with wound experts from tertiary hospitals in Singapore on their pressure risk assessment and prevention protocols.

Articles with studies done in the intensive care or operating theatre settings were excluded as these are not practice areas of family physicians. All three authors (two family physicians and a leading wound care expert in the local tertiary hospital) independently reviewed all references and reached a consensus on the level of evidence and recommendations.

RESULTS

A total of 35 articles were obtained and reviewed. The protocols for pressure ulcer prevention in major hospitals in Singapore were also reviewed. The level of patient-oriented evidence and recommendations are based on the Strength of Recommendation Taxonomy (SORT) framework^{11,12}. The SORT framework was jointly developed by prominent family medicine and primary care journals in the United States such as *The American Family Physician*, *Journal of Family Practice*, *Journal of American Board of Family Practice* and the *Family Practice Inquiries Network*, and is currently being adopted in these journals.

Pathophysiology

Pressure ulcers are caused by unrelieved pressure impeding blood flow and depriving tissues of oxygen and nutrients¹³. Risk factors either cause unrelieved pressure or reduce blood flow and can

be classified into “extrinsic” (external) or “intrinsic” (internal) (Table 1)¹⁴. Multiple risk factors are often present and can significantly increase the risk in combination. For example, excessive moisture causes maceration of the skin and increases the effect of friction and pressure by five times. Bony sites such as the sacrum, heels, greater trochanters, lateral malleoli and ischial tuberosities are most susceptible.

Risk assessment

A pressure ulcer is graded as stage I to IV, unclassified or suspected deep tissue injury based on the National Pressure Ulcer Advisory Panel (NPUAP) staging definitions¹⁵. The Braden scale is the most widely used risk assessment tool in Singapore and worldwide¹⁶. The Braden Scale has six subscales: sensory perception, activity, mobility, moisture, nutrition, friction and shear. The total Braden score is predictive of pressure ulcer development and ranges from 6 to 23 points. A score of 15–18 is mild risk (classified as at risk in some tertiary hospitals in Singapore), 13–14 is moderate risk, 10–12 is high risk and 6–9 is classified as very high risk. Among the Braden subscales, friction/shear had the best predictive power for pressure ulcer development (Evidence level 2, retrospective cohort study)¹⁷. Specific risk factors identified on the scale will also allow focused interventions.

Two earlier studies found the Braden scale to be the most sensitive^{18,19} and have the best risk estimate and balance between sensitivity and specificity (Evidence level 2, systematic review)¹⁸. However a subsequent Cochrane review by Moore *et al*²⁰ in 2008 disagreed and concluded that the risk assessment tools such as Braden, Norton and Waterlow scales have not been rigorously evaluated for reliability, sensitivity and specificity to be widely used for predicting risk for pressure ulcer development (Evidence level 2, systematic review)²⁰. No single risk assessment tool can detect

all pressure ulcers and structured risk assessment has not reduced the incidence of pressure ulcers compared to clinical judgement^{20,21}. The assessor should use a proven risk assessment tool such as the Braden scale as an aid in combination with frequent and ongoing clinical examination and skin inspection (Evidence level 2, systematic review and RCT)^{9,19–22}.

Prevention

Many pressure ulcers are preventable and interventions should be targeted at risk factors identified. Interventions can be classified into:

- (1) pressure ulcer risk assessment;
- (2) redistribution of pressure (such as repositioning and pressure relieving support surfaces);
- (3) reducing friction and shear (including topical agents and dressings);
- (4) alleviating contributing factors such as moisture and impaired nutrition; *and*
- (5) education to patients or caregivers²³.

The evidence for these interventions will be discussed in the following sections.

Repositioning frequency and position

Repositioning is recommended in most major guidelines and hospital protocols, although the ideal frequency and position remains debatable. Most tertiary hospitals in Singapore include two-hour turning or “frequent turning” in their protocols for pressure ulcer prevention, even when a pressure-relieving support surface is present. However this historical recommendation of two-hour turning by Kosiak was based on a clinical tradition and a study on skin changes rather than consistent patient oriented evidence (Evidence level 3, usual practice)²³.

Only three studies have explored the frequency of repositioning on the incidence of pressure ulcers. Both Defloor *et al* and Vanderwee *et al* did not find two-hour turning to be more effective than less frequent repositioning (Evidence level 2: RCT)^{23–25}. The frequency of turning may be reduced to four-hourly for patients on a pressure redistribution surface (Evidence level 2: RCT)²⁵. As a single intervention, 30-degree tilt position, which

is widely adopted in major Singapore hospitals, was not shown to be superior to a semi-fowler or 90-degree lateral position (Evidence level 2: RCT)²⁶.

To reduce shear, the head of the bed should be elevated no more than 30 degrees or at the lowest degree required to prevent medical complications such as congestive cardiac failure or aspiration (Evidence level 3: consensus guidelines)²⁷.

A 30-degree tilt combined with three-hour turning was able to save nursing time and prevent more pressure ulcers than the usual care of six-hour turning and 90-degree lateral position (Evidence level 2: RCT)^{28,29}.

Pressure redistributing support surfaces

Pressure redistributing support surfaces can be overlays, mattresses or sheepskins, and works by molding around the patient’s shape and redistributing the body weight over a large surface area to reduce the duration and/or magnitude of interface pressure⁹. The surfaces can be classified into “low tech” static devices (such as foam, air and mattresses or overlays) or “high tech” dynamic devices (such as low air loss, alternating pressure devices and air-fluidised surfaces) which use a power source to redistribute localised pressure. Dynamic devices are more costly but are useful in patients who are unable to reposition on their own. Pressure redistributing surfaces have been most intensively researched to compare the efficacy of various support surfaces with standard hospital mattresses, and among the different support surfaces.

Pressure redistributing support surfaces vs standard hospital mattresses: Foam-based, low pressure overlays and mattresses, sheepskins, and “higher-tech” alternating pressure support surfaces can prevent pressure ulcer development more effectively than standard hospital mattresses or standard care (Evidence level 2: systematic review)³⁰.

“Low-tech” devices vs “high-tech” devices: “High-tech” alternating pressure devices were not shown to be better than constant low pressure devices in preventing pressure ulcer development (Evidence level 2: systematic review)^{7,30,31}.

Comparing between different types of “high-tech” devices: There were not enough trials to

Table 2. SORT key recommendations for practice

Clinical Recommendation	Evidence Rating	References
Proven risk assessment tools (e.g. Braden Scale) should be combined with clinical examination, frequent skin inspection and clinical judgment to identify patients at risk for pressure ulcer development.	B	9, 19–22
Older persons at risk of pressure ulcers should be repositioned every three hours at night, using the 30-degree tilt	B	28, 29
Higher-spec foam mattresses should be used for all individuals assessed at being at risk for pressure ulcer development instead of standard hospital mattresses	B	30, 31
A constant low pressure device may be sufficient for prevention of pressure ulcer	B	30, 31
Multi-component interventions addressing various risk factors should be implemented.	B	39
A minimum calorie intake of 30–35 kcal per kg per day, protein intake of 1.25–1.5g per kg per day, fluid intake of 30 ml per kg per day is recommended to prevent pressure ulcer development	C	9, 12, 35, 36
Regular changing of diapers, application of barrier cream and insertion of an external catheter can minimise moisture from incontinence and contamination of pressure ulcer.	C	14
Lubricants and moisturizers to dry areas, and protective dressings are recommended to protect the skin during turning and transferring	C	38

demonstrate differences between alternating pressure overlays and mattresses, different types of alternating pressure air mattresses, and between various “high-tech” devices^{7,30,31}. Inflating and deflating the air cells of alternating low-pressure air mattresses (ALPAM) in multiple stages did not significantly reduce pressure ulcers compared to single-stage (Evidence level 2: RCT)³².

Australian sheepskin: A meta-analysis of three trials showed that Australian medical sheepskin overlays on mattresses prevent pressure ulcers compared to usual care (Evidence level 2: systematic review)³⁰.

For all patients at risk for pressure ulcer development, higher specification mattresses should be used instead of standard hospital mattresses³⁰. A constant low-pressure device may be sufficient for prevention of pressure ulcers, until more established evidence is available to recommend higher-end specification mattresses for high-risk patients. This is consistent with protocols of major hospitals in Singapore which recommend at least a higher-specification foam support mattress for at-risk patients and dynamic support surfaces mattresses for patients at high or very high risk.

Nutritional supplementation

Poor nutrition is associated with increased risk for pressure ulcer development³³ but a direct causal relationship has yet to be established. Twice daily oral supplemental drinks has shown to lower the incidence of pressure ulcer in a large trial but this finding was not consistent in other trials (Evidence level 2: RCT)³⁴. A Cochrane review concluded there was insufficient evidence to support routine supplementation with parenteral or enteral nutrition or the use of vitamins, zinc, and albumin or to prevent and treat pressure ulcers^{13,35,36}.

Major guidelines currently recommend a minimum calorie intake of 30–35 kilocalories per kg per day, protein intake of 1.25–1.5g per kg per day and fluid intake of 30 ml per kg per day for patients at risk (evidence level 3: consensus guidelines)⁹. The prescription of nutrition supplementation for at risk patients should consider the size of pressure ulcers and medical comorbidities that worsen nutritional intake. Nutritional screening tools can be used as part of this comprehensive assessment⁹. High-risk patients should be referred to a dietician for further dietary review⁹.

Protocols on pressure ulcer prevention in major hospitals in Singapore do not detail nutritional

Table 3. SORT levels of evidence

Level of evidence	Type of study (prevention studies)
Level 1 Good quality patient oriented evidence*	Systematic review/meta-analyses of RCT with consistent findings High quality individual RCT ⁺ All or none study ⁺⁺
Level 2 Limited quality patient oriented evidence	Systematic review/meta-analyses of lower quality clinical trials or of studies with inconsistent findings Lower quality clinical trial Cohort study Case control study
Level 3 Other evidence	Consensus guidelines, extrapolations from bench research, usual practice, opinion, disease oriented evidence (intermediate or physiologic outcomes only), and case series for studies of diagnosis, treatment, prevention or screening

*Patient oriented evidence measures outcomes that matter to patients: morbidity, mortality, symptom improvement, cost reduction, quality of life. Disease oriented evidence measures intermediate, physiologic, or surrogate endpoints that may or may not reflect improvements in patient outcomes for example blood pressure.

⁺High quality RCT: allocation concealed, blinding if possible, intention-to-treat analyses, adequate statistical power, adequate follow up (>80%).

⁺⁺An all or none study is one where the treatment causes a dramatic change in outcomes, such as antibiotics for meningitis or surgery for appendicitis, which precludes study in a trial.

supplementation but allow the option for referral to a dietician for at-risk patients.

Dressings and topical agents, skin care

Dressings and topical agents applied to skin and bony prominences are frequently used in clinical practice to reduce friction and shear even though there has been insufficient evidence from RCTs to support their use (Evidence level 2: systematic review)³⁷. Due to frequent skin inspections required, the practicality of dressings is also questionable³⁷. Applying lubricants and moisturizers to dry areas, protective dressings and a sliding sheet are among current recommendations in HIGN (Hartford Institute for Geriatric Nursing), WOCN (Wound Ostomy and Continence Nurses society) guidelines and Singapore hospitals to protect the skin integrity during turning and transferring (Evidence level 3: consensus guidelines)³. Vigorous rubbing and massage over bony prominences should be avoided³⁸.

The etiology of urinary incontinence should also be identified and eliminated. Changing the diapers regularly, application of barrier cream and insertion of an external catheter can minimize moisture from incontinence and contamination of the pressure ulcer¹⁴. These are recommended in protocols of major Singapore hospitals (Evidence level 3: consensus guidelines).

Multi-disciplinary Interventions

Multi-component interventions addressing the various risk factors in an at-risk patient was more effective in preventing pressure ulcer development than single-component initiatives (Evidence level 2: systematic review)³⁹. Core components include formation of a multi-disciplinary team, use of skin champions, education and training of staff, developing protocols for assessment and documentation of wounds, audit and feedback to staff, improving documentation and reporting of hospital acquired pressure ulcer. Most tertiary hospitals in Singapore have a reporting system for any occurrence of hospital acquired pressure ulcer.

DISCUSSION

This review article has appraised and summarised the best current evidence on pressure ulcer risk assessment and prevention for the family physician (Table 2), and makes recommendations based on the SORT framework (Tables 3 and 4). Pressure-relieving support surfaces have been intensively researched with the most robust evidence.

Current protocols in major tertiary hospitals in Singapore are fairly consistent with our recommendations in risk assessment, pressure redistributing support surfaces, nutritional supplementation, skin care and multi-component

Table 4. SORT strength of recommendation

Strength of recommendation	Definition
A	Recommendation based on consistent and good quality patient-oriented evidence
B	Recommendation based on inconsistent or limited quality patient-oriented evidence
C	Recommendation based on consensus, usual practice, opinion, disease oriented evidence, and case series for studies of diagnosis, treatment, prevention or screening

interventions. The ideal repositioning frequency and position remain debatable and the current recommendation of two-hourly turning and 30-degree tilt position in our hospitals are not supported by evidence. The use of dynamic support surfaces mattresses in high or very high risk patients locally has benefits in those who are unable to reposition on their own, but its superiority in preventing pressure ulcers compared to other pressure redistributing support surfaces need to be proven before routine use in all high risk patients.

LIMITATIONS OF CURRENT STUDIES

Many studies on pressure ulcer risk assessment and prevention lacked methodological quality to provide robust evidence and conclusions. Consequently, our knowledge in prevention of pressure ulcers is limited and more robust research studies are required to identify the ideal repositioning frequency and position, and stratify the efficacy of different pressure redistributing support surfaces.

CONCLUSION

Pressure ulcer reduction can occur through the triad of:

- 1) pressure ulcer risk assessment;
- 2) attention to evidence-based preventive measures — repositioning, redistributing pressure, nutritional supplementation, and skin care; *and*
- 3) interventions that are multi-component and multi-disciplinary — formation of multi-disciplinary team, skin champions, training of staff, protocols, documentation, and audit of practices.

While waiting for better designed trials to provide more evidence on various risk assessment tools

and preventive strategies, family physicians can recommend preventive strategies based on best current evidence (Table 3).

REFERENCES

1. Levi B, Rees R. Diagnosis and management of pressure ulcers. *Clin Plast Surg* 2007;34(4):735–48 doi: 10.1016/j.cps.2007.07.007.
2. Kaltenthaler E, Whitfield MD, Walters SJ, Akehurst RL, Paisley S. UK, USA and Canada: how do their pressure ulcer prevalence and incidence data compare? *J Wound Care* 2001;10(1):530–5.
3. Coleman EA, Martau JM, Lin MK, Kramer AM. Pressure ulcer prevalence in long-term nursing home residents since the implementation of OBRA '87. Omnibus Budget Reconciliation Act. *J Am Geriatr Soc* 2002;50(4):728–32 doi: 10.1046/j.1532-5415.2002.50169.x.
4. Moore Z, Cowman S. Pressure ulcer prevalence and prevention practices in care of the older person in the Republic of Ireland. *J Clin Nurs* 2012;21(3–4):362–71 doi: 10.1111/j.1365-2702.2011.03749.x.
5. Chan EY, Tan SL, Lee CKS, Lee JY. Prevalence, incidence and predictors of pressure ulcers in a tertiary hospital in Singapore. *J Wound Care* 2005;14(8):383–8.
6. Dealey C, Posnett J, Walker A. The cost of pressure ulcers in the United Kingdom. *J Wound Care* 2012;21(6):261–6.
7. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. *JAMA* 2006;296(8):974–84 doi: 10.1001/jama.296.8.974.
8. Ministry of Health Singapore. Nursing management of pressure ulcers in adults. MOH nursing clinical practice guidelines 2/2001 [Internet]. Singapore: Ministry of Health; 2001 Dec [cited 2013 Dec 30]. Available from: http://www.moh.gov.sg/content/moh_web/healthprofessionalsportal/nurses/guidelines/cpg_nursing/cpgnursing_nursing_management_pressure_ulcers_adults.html.
9. European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel: Prevention and treatment of pressure ulcers: quick reference guide. Washington DC: National Pressure Ulcer Advisory Panel; 2009. 24 p.
10. Bluestein D, Javaheri A. Pressure ulcers: prevention, evaluation, and management. *Am Fam Physician* 2008;78(10):1186–94.
11. Ebell MH, Siwek J, Weiss BD, Woolf SH, Susman J, Ewigman B et al. Strength of recommendation taxonomy (SORT): a patient centered approach to grading evidence in the medical literature. *J Am Board Fam Pract* 2004; 17(1):59–67.
12. Ebell MH, Siwek J, Weiss BD, Woolf SH, Susman J, Ewigman B et al. Strength of recommendation taxonomy (SORT): a patient centered approach to grading evidence in the medical literature. *Am Fam Physician* 2004;69(3):548–56.
13. Catherine N, Tchanque-Fossuo, William M. Kuzon Jr. An evidence-based approach to pressure sores.

- Plast Reconstr Surg 2011;127(2):932–9 doi: 10.1097/PRS.0b013e3182046a02.
14. Efraim J. Assessment and management of pressure ulcers in the elderly. *Drugs Aging* 2010; 27(4):311–25 doi: 10.2165/11318340-000000000-00000.
 15. National Pressure Ulcer Advisory Panel. Pressure Ulcer Category/Staging Illustrations [Internet]. Washington, DC: National Pressure Ulcer Advisory Panel; [cited 2013 Dec 24]. Available from: <http://www.npuap.org/pr2.htm>.
 16. Vasanwala F, Matthew Ng JM, Tay AC. Pressure sore management for the primary care physician. *Singapore Fam Physician* 2009;35(4):44–7.
 17. Ann N. Tescher, Megan E. Branda, T.J.O Bryne, James M. Nassens. All at-risk patients are not created equal. analysis of Braden pressure ulcer risk scores to identify specific risks. *J Wound Ostomy Continence Nurs* 2012;39(3):282–91 doi: 10.1097/WON.0b013e3182435715.
 18. Pancorbo-Hidalgo PL, Garcia-Fernandez FP, Lopez-Medina IM et al. Risk assessment scales for pressure ulcer prevention: a systematic review. *J Adv Nurs* 2006;54(1):94–110 doi: 10.1111/j.1365-2648.2006.03794.x.
 19. Balzer K, Pohl C, Dassen T, Halfens R. The Norton, Waterlow, Braden, and Care Dependency Scales: comparing their validity when identifying patients' pressure sore risk. *J Wound Ostomy Continence Nurs* 2007;34(4):389–98 doi: 10.1097/01.WON.0000281655.78696.00.
 20. Moore ZEH, Cowman S. Risk assessment tools for the prevention of pressure ulcers. *Cochrane Database Syst Rev* 2008;(3):CD006471 doi: 10.1002/14651858.CD006471.
 21. Webster J, Coleman K, Mudge A, Marquart L, Gardner G et al. Pressure ulcers: effectiveness of risk-assessment tools. A randomised controlled trial (the ULCER trial). *BMJ Qual Saf* 2011;20(4):297–306 doi: 10.1136/bmjqs.2010.043109.
 22. Serpa, LF, Santos VLCG, Peres GRP, Cavicchioli MGS, Hermida, MM. Validity of the Braden and Waterlow subscales in predicting pressure ulcer risk in hospitalized patients. *Appl Nurs Res* 2011;24(4):e23–8 doi: 10.1016/j.apnr.2010.05.002.
 23. Krapfl LA, Gray M. Does regular repositioning prevent pressure ulcers? *J Wound Ostomy Continence Nurs* 2008;35(6):571–7 doi: 10.1097/01.WON.0000341469.33567.61.
 24. 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* 2006;57(1):59–68 doi: 10.1111/j.1365-2648.2006.04060.x.
 25. 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 doi: 10.1016/j.ijnurstu.2004.05.013.
 26. Young T. The 30-degree tilt position versus the 90 lateral and supine positions in reducing the incidence of non-blanching erythema in a hospital inpatient population: a randomized controlled trial. *J Tissue Viability* 2004;14(3):89–96 doi: 10.1016/S0965-206X(04)43004-6.
 27. Whitney J, Phillips L, Aslam R, Barbul A, Gotttrup F, Gould L et al. Guidelines for the treatment of pressure ulcers. *Wound Rep Reg* 2006;14(6):663–79 doi: 10.1111/j.1524-475X.2006.00175.x.
 28. Moore Z, Cowman S, Posnett J. An economic analysis of repositioning for the prevention of pressure ulcers. *J Clin Nurs* 2013;22(15–16):2354–60 doi: 10.1111/j.1365-2702.2012.04310.x.
 29. Moore Z, Cowman S, Conroy RM. A randomized controlled clinical trial of repositioning, using the 30° tilt, for the prevention of pressure ulcers. *J Clin Nurs* 2011;20(17–18):2633–44 doi: 10.1111/j.1365-2702.2011.03736.x.
 30. McInnes E, Jammali-Blasi A, Bell-Syer SEM, Dumville JC, Cullum N. Support surfaces for pressure ulcer prevention. *Cochrane Database Syst Rev* 2011;(4): CD001735 doi: 10.1002/14651858.CD001735.pub4.
 31. Sprigle S, Sonenblum S. Assessing evidence supporting redistribution of pressure for pressure ulcer prevention: A review. *J Rehabil Res Dev* 2011;48(3):203–14 doi: 10.1682/JRRD.2010.05.0102.
 32. Demarre L, Beeckman D, Defloor T, Grypdonck M, Verhaeghe S. Multi-stage versus single-stage inflation and deflation cycle for alternating low pressure air mattresses to prevent pressure ulcers in hospitalized patients: A randomized-controlled clinical trial. *Int J Nurs Stud* 2012;49(4):416–26 doi: 10.1016/j.ijnurstu.2011.10.007.
 33. Berlowitz DR, Wilking SR. Risk factors for pressure sores. A comparison of cross-sectional and cohort-derived data. *J Am Geriatr Soc* 1989;37(11):1043–50.
 34. Bourdel M, Barateau M, Rondeau V, Dequae-Merchadou L, Salles-Montaudon N, Emeriau JP et al. A multi-center trial of the effects of oral nutritional supplementation in critically ill older inpatients. GAGE Group. Groupe Aquitain Geriatrique d'Evaluation. *Nutrition* 2000;16(1):1–5 doi: 10.1016/S0899-9007(99)00227-0.
 35. Doley J. Nutrition management of pressure ulcers. *Nutr Clin Pract* 2010;25(1):50–60 doi: 10.1177/0884533609359294.
 36. Langer G, Knerr A, Kuss O, Behrens J, Schlomer GJ. Nutritional interventions for preventing and treating pressure ulcers. *Cochrane Database Syst Rev* 2003;(4):CD003216 doi: 10.1002/14651858.CD003216.
 37. Moore ZEH, Webster J. Dressings and topical agents for preventing pressure ulcers. *Cochrane Database Syst Rev* 2013;(8):CD009362 doi: 10.1002/14651858.CD009362.pub2.
 38. National Guideline Clearinghouse (NGC). Guideline synthesis: Prevention of pressure ulcers. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2006 Dec [updated 2011 Jan; cited 2013 Oct 25]. Available from: <http://www.guideline.gov/syntheses/synthesis.aspx?id=47794>.
 39. Sullivan N, Schoelles K. Preventing in-facility pressure ulcers as a patient safety strategy. A systematic review. *Ann Intern Med*. 2013;158(5 Pt 2):410–6 doi: 10.7326/0003-4819-158-5-201303051-00008.