Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.1081

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

# Pressure Ulcer Prevention: Examine Best Practices for Managing Pressure Ulcers in Immobile Patients and Evaluate the Efficacy of Prevention Strategies

**Atika Noreen[1], Noreen Fatima[2], Aqsa Arshed[3], Faisal Ali[1], Attiq-Ur-Rehman[4], Ahsan Elahi[5], Naeem Ullah Khan[6]**

[1]University of Health Science, Lahore, Punjab, Pakistan.
[2]Gulfreen Nursing College, ACMC, Lahore, Punjab, Pakistan.
[3]Sheikha Fatima Institute of Nursing and Allied Health Sciences, Lahore, Punjab, Pakistan.
[4]Nantong University, Nantong, Jiangsu, China.
[5]Sir Ganga Ram Hospital, Lahore, Punjab, Pakistan.
[6]Shalimar College of Nursing, Lahore, Punjab, Pakistan.

## ARTICLE INFO

**Keywords**

Pressure Ulcer, Immobile Patients, Healthcare, Micronutrients, NPIAP.

**Corresponding Author:** Atika Noreen, University of Health Science, Lahore, Punjab, Pakistan.
Email: atikanoreen606@gmail.com

**Declaration**

**Authors' Contribution:** All authors equally contributed to the study and approved the final manuscript.
**Conflict of Interest:** No conflict of interest.
**Funding:** No funding received by the authors.

**Article History**

Received: 26-01-2025 Revised: 28-03-2025
Accepted: 14-04-2025 Published: 24-04-2025

## ABSTRACT

Pressure ulcers, also known as bedsores or decubitus ulcers, are localized injuries to the skin and underlying tissue, primarily caused by prolonged pressure, shear, or friction. Immobile patients, especially those confined to bed or wheelchair-bound, are at a heightened risk. he management of pressure ulcers requires an interdisciplinary approach, incorporating clinical assessment, patient-specific risk evaluation, use of support surfaces, optimal nutrition, skin care regimens, and scheduled repositioning. Evidence-based tools such as the Braden Scale, Norton Scale, and Waterlow Score have demonstrated efficacy in identifying patients at risk, thereby enabling early intervention. Repositioning protocols—typically recommended every two hours—remain a cornerstone of preventive care. Specialized pressure-relieving devices, including low-air-loss mattresses, gel cushions, and heel protectors, have also shown to significantly reduce the incidence of pressure injuries by minimizing mechanical forces on vulnerable areas.Skin integrity maintenance, through the use of barrier creams, gentle cleansing agents, and moisture-wicking materials, further supports the prevention process, especially in patients with incontinence or compromised skin health. Nutritional support is equally crucial; adequate protein, caloric intake, and essential micronutrients enhance skin repair and immune function, reducing susceptibility to breakdown. This abstract also evaluates recent technological advancements and innovations such as wearable pressure sensors and smart beds, which provide real-time feedback and automated repositioning alerts. These innovations have been associated with improved compliance and outcomes in various clinical settings.In conclusion, the prevention and management of pressure ulcers in immobile patients rely heavily on early risk identification, consistent implementation of preventative protocols, and the integration of technological and clinical best practices. While current strategies are largely effective, continuous education, individualized care plans, and the adoption of emerging technologies will be essential in further reducing pressure ulcer prevalence and improving patient outcomes. This research paper explores the best practices for managing and preventing pressure ulcers in immobile patients and evaluates the efficacy of various prevention strategies. A combination of literature review and collected data from healthcare facilities has been used to assess outcomes.

## INTRODUCTION

Pressure ulcers represent a significant healthcare challenge worldwide, leading to increased patient morbidity, extended hospital stays, and rising healthcare costs. According to the National Pressure Injury Advisory Panel (NPIAP), approximately 2.5 million patients in the U.S. develop pressure ulcers annually. Immobile patients, due to their inability to reposition themselves, are particularly susceptible. Prevention strategies are paramount, as pressure ulcers are largely avoidable with proper care protocols. Pressure ulcers, also known as bedsores or decubitus ulcers, are localized injuries to the skin and underlying tissue resulting from prolonged pressure, often occurring in immobile patients. These wounds are not only painful and debilitating but also pose significant risks for infection, extended hospital stays, and increased healthcare costs. Effective prevention is critical, especially in vulnerable populations such as the elderly, individuals with spinal

cord injuries, and critically ill patients. This paper explores best practices in the management and prevention of pressure ulcers in immobile patients, with an emphasis on evidence-based strategies including repositioning techniques, specialized support surfaces, skin care protocols, and nutritional support. Furthermore, it evaluates the efficacy of these preventive measures to inform clinical decision-making and improve patient outcomes. These wounds most commonly develop in individuals who are bedridden, immobile, or have limited ability to change positions, such as patients in hospitals, long-term care facilities, or home-bound individuals. Pressure ulcers are a significant concern in healthcare due to their impact on patient quality of life, risk of complications, and the financial burden associated with their treatment and management.

Prevention of pressure ulcers is a key priority in healthcare settings as these injuries are largely avoidable with timely and appropriate interventions. Effective pressure ulcer prevention not only improves patient outcomes but also reduces the cost of care and enhances overall healthcare quality indicators. The development of a pressure ulcer is often viewed as an indicator of the quality of care provided, and its prevention is both a clinical and ethical obligation for caregivers and healthcare professionals.The process of preventing pressure ulcers involves a comprehensive approach that includes risk assessment, regular repositioning of patients, use of pressure-relieving devices, skin care management, nutritional support, and staff education. Risk assessment tools, such as the Braden Scale, help in identifying patients at high risk of developing pressure ulcers and allow for targeted preventive strategies to be implemented promptly.

Education and awareness among healthcare professionals, patients, and caregivers play a crucial role in prevention. Ensuring that staff are trained to recognize early signs of skin damage and understand the principles of pressure management can significantly reduce incidence rates. In addition, advancements in technology and materials have led to the development of specialized mattresses, cushions, and wearable devices that aid in reducing pressure on vulnerable areas.

In conclusion, pressure ulcer prevention is a multifaceted and proactive approach aimed at protecting vulnerable individuals from a preventable but potentially serious condition. Through coordinated care, routine assessments, and consistent adherence to evidence-based guidelines, pressure ulcers can be effectively prevented, leading to improved patient well-being and more efficient healthcare delivery.

## LITERATURE REVIEW

According to the National Pressure Injury Advisory Panel (NPIAP), pressure ulcers affect millions of individuals globally and are associated with increased morbidity, mortality, healthcare costs, and decreased quality of life. The literature emphasizes the importance of implementing evidence-based prevention and management strategies to mitigate the risk of pressure ulcers in immobile patients.

The cornerstone of effective pressure ulcer prevention begins with identifying at-risk patients. Various validated risk assessment tools are widely employed in clinical settings: Braden Scale for Predicting Pressure Sore Risk: The most frequently cited tool in literature, assessing sensory perception, moisture, activity, mobility, nutrition, and friction/shear. Studies (e.g., Bergstrom et al., 1987; Ayello & Braden, 2002) have confirmed its predictive validity, though its sensitivity may vary depending on clinical settings.Norton Scale and Waterlow Scale: These tools are also used, with the Waterlow Scale offering a more detailed risk profile. However, some researchers (e.g., Anthony et al., 2000) suggest inconsistencies in reliability between assessors using these scales.

Frequent repositioning is a universally acknowledged preventive measure:Repositioning Frequency: Traditional guidelines recommend repositioning every 2 hours, though recent studies (Defloor et al., 2005) suggest that with advanced support surfaces, intervals can be extended without increased risk.Individualized Positioning Schedules: Evidence (Moore & Cowman, 2012) supports tailoring repositioning based on individual risk profiles and tolerance levels to pressure and shear.Early Mobilization: Encouraging even minimal patient movement, when feasible, has been linked to significantly reduced incidence of ulcers (Chou et al., 2013).

Support surfaces are crucial for pressure ulcer prevention, particularly in immobile patients:Specialized Mattresses and Overlays: Studies highlight the effectiveness of alternating pressure mattresses, low-air-loss mattresses, and high-specification foam mattresses in reducing ulcer incidence (Cullum et al., 2016; McInnes et al., 2015).Seating Cushions: For patients in wheelchairs or seated positions, gel, foam, and air cushions are proven to redistribute pressure effectively (Consortium for Spinal Cord Medicine, 2000).Comparative Studies: A Cochrane review by McInnes et al. (2015) concluded that high-specification foam mattresses significantly reduce pressure ulcer development compared to standard hospital mattresses.

Maintaining skin integrity is vital, particularly for patients with incontinence or excessive perspiration:Barrier Creams and Moisturizers: Research shows that the use of barrier products significantly reduces skin breakdown (Beeckman et al.,

2012).Incontinence Management: Prompt cleansing and use of absorbent products reduce exposure to moisture, a key contributor to skin maceration and ulcer formation.

Malnutrition is a recognized risk factor for pressure ulcers:Nutritional Assessment and Supplementation: A systematic review by Langer & Fink (2014) supports the role of adequate protein and calorie intake in pressure ulcer prevention.Micronutrients: Zinc, vitamin C, and arginine are identified as essential in wound healing and skin maintenance (Cereda et al., 2015).

Education remains one of the most sustainable and cost-effective prevention strategies:Staff Training Programs: Ongoing training on pressure ulcer prevention protocols leads to improved compliance and outcomes (Moore & Price, 2004).Patient and Family Education: Informing patients and caregivers about early signs of pressure ulcers and preventive measures contributes to earlier detection and response (National Institute for Health and Care Excellence - NICE, 2014).

Technological advancements are transforming pressure ulcer prevention:Pressure-Sensing Devices: Wearable sensors that monitor pressure duration and intensity have shown promise in early studies for reducing ulcer risk (Gefen, 2020).Electronic Health Records (EHR**)**: Integration of risk assessment tools in EHR systems facilitates timely interventions and enhances documentation and care continuity.

Studies evaluating the efficacy of these interventions consistently report positive outcomes:A large-scale RCT by Nixon et al. (2006) found that pressure-redistributing mattresses combined with regular repositioning significantly reduced ulcer incidence.A meta-analysis by Chou et al. (2013) concluded that multifaceted approaches—combining skin care, support surfaces, nutrition, and repositioning—are the most effective in preventing pressure ulcers.

The literature strongly supports a multifactorial approach to pressure ulcer prevention in immobile patients. Best practices include comprehensive risk assessments, individualized repositioning, use of advanced support surfaces, proper skin care, nutritional optimization, and education. While no single intervention guarantees complete prevention, the integration of multiple evidence-based strategies significantly reduces the risk of pressure ulcers. Continued research and innovation, particularly in technology-assisted prevention and care personalization, promise further advancements in managing this critical aspect of patient care.

Pressure ulcers develop due to unrelieved pressure, shear forces, moisture, poor nutrition, and underlying medical conditions. Key risk factors include:

- Immobility
- Advanced age
- Malnutrition
- Incontinence
- Neurological impairment
- Decreased sensory perception

## METHODOLOGY

### Research Design

This section outlines the detailed methodology employed to examine best practices for managing pressure ulcers in immobile patients and to evaluate the efficacy of various prevention strategies. The methodology consists of a structured approach involving research design, participant selection, data collection methods, intervention implementation, and data analysis. A mixed-methods approach was employed, combining both qualitative and quantitative methodologies to provide a comprehensive understanding of best practices and the effectiveness of pressure ulcer prevention strategies. The study included:

- **Observational analysis** of current practices in clinical settings.
- **Systematic review** of existing literature and guidelines.
- **Interventional study** to evaluate the impact of selected preventive measures.
- **Interviews and surveys** with healthcare professionals and caregivers.

This design allows for triangulation of data to enhance reliability and validity.

### Participant Selection

- **Setting**: The study was conducted in three clinical environments – a tertiary care hospital, a long-term care facility, and a home care agency.
- **Participants**
  - Immobile patients (n=100) identified using the **Braden Scale** for pressure ulcer risk.
  - Healthcare professionals (n=30) including nurses, caregivers, and physicians.

### Inclusion Criteria

- Patients aged 18 and older.
- Patients with limited mobility (bedridden or wheelchair-bound).
- Consent to participate in the study (from patient or legal guardian).

### Exclusion Criteria

- Patients with terminal illness in palliative care.
- Patients with existing stage III or IV pressure ulcers.

### Data Collection Methods

**a. Baseline Assessment**

- Comprehensive skin assessments conducted by trained nurses.
- Risk assessment using the **Braden Scale** to categorize patients into low, moderate, or high risk.

**b. Implementation of Preventive Interventions**

Patients were randomly assigned to receive standard care or enhanced preventive measures, including:

- **Repositioning protocols**: Every 2 hours for bed-bound patients, every 1 hour for wheelchair-bound.
- **Pressure-relieving devices**: Use of specialized mattresses, cushions, and overlays.
- **Skin care regimens**: Application of moisture barriers, regular cleansing, and moisturization.
- **Nutritional support**: Assessment and supplementation based on a nutritionist's evaluation.
- **Education**: Training provided to caregivers and healthcare workers on prevention protocols.

**c. Monitoring and Follow-up**

- Weekly skin assessments for 8 weeks.
- Documentation of any new pressure ulcer development, changes in skin condition, and adherence to protocols.
- Surveys and interviews with healthcare providers to assess perceptions of strategy effectiveness and implementation challenges.

**Data Analysis**

**Quantitative Analysis**

- Incidence rate of pressure ulcers in intervention vs. control group.
- Statistical analysis using **Chi-square test** and **ANOVA** to evaluate differences.
- **Regression analysis** to determine predictive factors for ulcer development.

**Qualitative Analysis**

- Thematic analysis of interviews and open-ended survey responses.
- Coding of qualitative data to identify recurring themes regarding best practices, barriers, and facilitators in prevention.

**Ethical Considerations**

- Approval obtained from the Institutional Review Board (IRB).
- Informed consent collected from all participants or their legal representatives.
- Confidentiality maintained through anonymized data handling.

**Limitations**

- Short duration of follow-up may not capture long-term outcomes.
- Limited generalizability due to specific clinical settings.
- Potential variability in caregiver adherence to repositioning schedules.

A mixed-method approach was employed. Quantitative data was collected from five long-term care facilities over six months, documenting incidence rates before and after the implementation of prevention strategies. Qualitative data included interviews with nursing staff and patients to understand the practical challenges of prevention.

## RESULTS

**Data Summary**

- **Facility A**: Incidence dropped from 12% to 4% after repositioning schedules and use of pressure-relieving mattresses.
- **Facility B**: Introduction of nutritional support reduced incidence from 10% to 3%.
- **Facility C**: Use of moisture-wicking bedding and barrier creams saw a reduction from 15% to 5%.
- **Facility D**: Comprehensive staff training program led to a decrease from 13% to 4%.
- **Facility E**: Combination of interventions resulted in a decrease from 11% to 2%.

**Best Practices in Pressure Ulcer Prevention**

1. **Repositioning and Mobility Support**
   - Repositioning patients every 2 hours
   - Use of mobility aids and physical therapy
2. **Pressure-Relieving Devices**
   - High-specification foam mattresses
   - Alternating pressure air mattresses and overlays
3. **Skin Care and Moisture Management**
   - Use of barrier creams
   - Routine skin inspection
   - Keeping skin dry and clean
4. **Nutritional Support**
   - Adequate protein and calorie intake
   - Supplementation with vitamins C and E, zinc, and arginine
5. **Staff Training and Patient Education**
   - Regular in-service training for caregivers
   - Patient and family education about pressure ulcer risks

## DISCUSSION

The data reveals that multi-modal strategies are significantly more effective than single interventions. Prevention is most successful when care is individualized and incorporates risk assessment tools like the Braden Scale. Staff training and consistent implementation of care protocols are essential components of effective prevention programs. Pressure ulcers, often resulting from unrelieved pressure over bony prominences, present a significant challenge in the care of immobile patients. Their prevention and management require a multidisciplinary approach involving clinical expertise, patient-centered care, and adherence to evidence-based guidelines. In immobile patients—such as those with spinal cord injuries, advanced age, or critical illnesses—the risk is particularly elevated, making preventive strategies not only necessary but potentially lifesaving.

The cornerstone of pressure ulcer prevention is early identification of at-risk individuals. The Braden Scale is one of the most widely used tools for assessing risk. It evaluates six criteria: sensory perception, moisture, activity, mobility, nutrition, and friction/shear. Patients identified as high risk require immediate and individualized prevention plans. Research indicates that structured use of risk assessment tools leads to earlier intervention and reduces the incidence of pressure ulcers, particularly in long-term care settings.

One of the most fundamental and effective strategies is frequent repositioning to offload pressure from vulnerable areas. Guidelines recommend repositioning immobile patients at least every two hours. In intensive care units (ICUs), more frequent turning schedules may be adopted based on patient condition.The use of assistive devices such as sliding sheets, hoists, or repositioning wedges helps to reduce shear and friction forces during repositioning. In facilities with adequate staffing and training, consistent repositioning practices significantly reduce pressure ulcer rates. However, the efficacy of this strategy heavily depends on adherence, documentation, and staff awareness.

Advanced support surfaces—including pressure-redistributing mattresses, overlays, and cushions—are integral to prevention. These devices redistribute pressure and reduce shear forces, especially in high-risk patients. Low-air-loss and alternating pressure mattresses have shown particular efficacy in high-acuity environments like ICUs.Clinical trials and meta-analyses have demonstrated that specialized mattresses significantly reduce the risk of pressure ulcer development when compared to standard hospital mattresses. However, their effectiveness is maximized when used alongside comprehensive care strategies, not as a standalone solution.

Proper skin care is essential, particularly in managing excess moisture from incontinence, perspiration, or wound drainage, which weakens skin integrity. The use of barrier creams, absorbent pads, and incontinence management systems helps protect skin from maceration.Routine inspection of the skin—at least once per shift—is crucial for early detection of redness, discoloration, or breakdown. This proactive surveillance allows for immediate intervention and prevents the progression of Stage I ulcers to more severe stages.Malnutrition and dehydration are closely linked to poor skin health and delayed wound healing. Ensuring adequate protein, calorie, and micronutrient intake is critical for both prevention and healing. Nutritional assessments should be part of the care plan, and patients at risk of malnutrition should receive supplements or referral to a dietitian.Studies have demonstrated that nutritional interventions reduce healing time and lower the incidence of pressure ulcers, especially in elderly or chronically ill patients.

Ongoing staff education programs—covering risk identification, repositioning techniques, skin inspection, and the use of equipment—are key to reducing pressure ulcer incidence.Interdisciplinary teams comprising nurses, physicians, physiotherapists, dietitians, and wound care specialists can provide holistic care. Facilities with active wound care teams tend to report lower ulcer prevalence and better outcomes due to their specialized knowledge and coordination.Studies have consistently shown that a bundle approach—where multiple strategies are used together—is most effective in reducing pressure ulcer rates. Programs that combine assessment tools, repositioning protocols, support surfaces, nutrition, and staff training can reduce incidence by over 50%.

Audits, outcome tracking, and quality improvement initiatives help measure the effectiveness of prevention programs. Tools like the National Pressure Injury Advisory Panel (NPIAP) guidelines and root cause analysis frameworks allow facilities to identify gaps and improve continuously.

Managing and preventing pressure ulcers in immobile patients is a dynamic and multi-dimensional challenge that demands vigilance, skill, and coordination. The best practices—when consistently applied—can dramatically reduce the incidence, severity, and complications associated with pressure ulcers. Evidence supports that an integrated strategy involving risk assessment, regular repositioning, use of support surfaces, skin and moisture care, adequate nutrition, and continuous staff education is the most effective approach. Ultimately, prevention is more humane, cost-effective, and clinically sound than treatment, making it a priority in all care settings.

## CONCLUSION

Pressure ulcer prevention in immobile patients requires a comprehensive, proactive approach. Best practices such as frequent repositioning, specialized support surfaces, diligent skin care, proper nutrition, and staff training are highly effective in reducing incidence. Ongoing evaluation and adherence to evidence-based guidelines are crucial to sustain progress. The management and prevention of pressure ulcers in immobile patients require a comprehensive, interdisciplinary approach that addresses the multiple risk factors contributing to ulcer development. Immobile patients are particularly susceptible due to prolonged pressure on bony prominences, impaired circulation, nutritional deficiencies, and decreased sensory perception. Therefore, best practices in managing pressure ulcers must encompass early risk assessment, continuous monitoring, and the implementation of individualized care plans that integrate evidence-based interventions.

One of the most effective strategies in pressure ulcer prevention is routine risk assessment, using validated tools such as the Braden, Norton, or Waterlow scales. These tools help clinicians identify at-risk individuals early, allowing for timely preventive measures. Regular repositioning of immobile patients, typically every two hours, is a cornerstone of prevention, as it helps redistribute pressure and maintain blood flow to vulnerable tissues. Additionally, the use of support surfaces, including specialized mattresses, cushions, and overlays, has been shown to significantly reduce pressure and shear forces, thereby decreasing the incidence of ulcer formation.

Skin care management is another critical component, emphasizing the importance of keeping the skin clean, dry, and moisturized. The early identification of skin changes—such as non-blanchable erythema or skin temperature differences—can prompt timely interventions to halt ulcer progression. Moreover, nutrition plays a pivotal role in maintaining skin integrity and supporting tissue repair. Adequate intake of protein, vitamins (especially A and C), zinc, and fluids is essential in both prevention and treatment phases.

Equally important is the education and training of healthcare providers and caregivers. Staff must be well-informed about pressure ulcer risk factors, preventive techniques, and early signs of skin damage. Ongoing training programs, audits, and adherence to clinical guidelines can reinforce best practices and foster a culture of proactive prevention.

Evaluating the efficacy of these prevention strategies reveals that a multimodal approach yields the best outcomes. Studies consistently show that institutions employing bundled care strategies—combining risk assessment, repositioning schedules, use of support surfaces, nutritional management, and staff education—report significantly lower rates of pressure ulcer development compared to those with isolated or inconsistent interventions. Moreover, the integration of technology, such as pressure sensors, electronic monitoring systems, and mobile health applications, enhances the consistency and precision of preventive efforts.

In conclusion, the prevention of pressure ulcers in immobile patients is both a clinical priority and a moral responsibility. By adhering to best practices—including systematic risk assessments, frequent repositioning, appropriate use of support devices, diligent skin and nutritional care, and continuous staff education—healthcare providers can significantly reduce the incidence of pressure ulcers. These efforts not only improve patient comfort and outcomes but also reduce healthcare costs, prevent complications such as infections and prolonged hospital stays, and uphold the standards of quality and compassionate care. The continued evaluation and refinement of prevention strategies, supported by research and innovation, are essential to sustaining and improving these outcomes in the long term.

## REFERENCES


1. National Pressure Injury Advisory Panel (NPIAP). (2022). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline.
2. Pacific, P. (2019). *Prevention and treatment of pressure ulcers/injuries: quick reference guide*. EPUAP/NPIAP/PPPIA. https://static1.squarespace.com/static/6479484083027f25a6246fcb/t/647dc6c178b260694b5c9365/1685964483662/Quick_Reference_Guide-10Mar2019.pdf
3. Coleman, S., Nixon, J., Keen, J., Wilson, L., McGinnis, E., Dealey, C., Stubbs, N., Farrin, A., Dowding, D., Schols, J. M., Cuddigan, J., Berlowitz, D., Jude, E., Vowden, P., Schoonhoven, L., Bader, D. L., Gefen, A., Oomens, C. W., & Nelson, E. A. (2014). A new pressure ulcer conceptual framework. *Journal of Advanced Nursing*, *70*(10), 2222-2234. https://doi.org/10.1111/jan.12405
4. Gefen, A., et al. (2021). Patient-specific biomechanical analysis as a tool for risk assessment and prevention of pressure ulcers. *Advances in Skin & Wound Care*, *34*(1), 21-27.
5. Langer, G., Wan, C. S., Fink, A., Schwingshackl, L., & Schoberer, D. (2024). Nutritional interventions for preventing and treating pressure ulcers. *Cochrane Database of Systematic Reviews*, (2). https://doi.org/10.1002/14651858.CD003216.pub3
6. Moore, Z., & Cowman, S. (2012). Pressure ulcer prevalence and prevention practices in care of the older person in the Republic of Ireland. *Journal of Clinical Nursing*, *21*(3-4), 362-371. https://doi.org/10.1111/j.1365-2702.2011.03749.x
7. Ayello, E. A., & Braden, B. (2002). How and why to do pressure ulcer risk assessment. *Advances in Skin & Wound Care*, *15*(3), 125-131. https://doi.org/10.1097/00129334-200205000-00008
8. Beeckman, D., Van Lancker, A., Van Hecke, A., & Verhaeghe, S. (2014). A systematic review and meta-analysis of incontinence-associated

dermatitis, incontinence, and moisture as risk factors for pressure ulcer development. *Research in Nursing & Health*, *37*(3), 204–218. https://doi.org/10.1002/nur.21699

9. Langer, G., Wan, C. S., Fink, A., Schwingshackl, L., & Schoberer, D. (2024). Nutritional interventions for preventing and treating pressure ulcers. *The Cochrane Database of Systematic Reviews*, *2*(2), CD003216. https://doi.org/10.1002/14651858.CD003216.pub3
10. McInnes, E., Jammali-Blasi, A., Bell-Syer, S. E., Dumville, J. C., Middleton, V., & Cullum, N. (2015). Support Surfaces for Pressure Ulcer Prevention. *Cochrane Database of Systematic Reviews*, *9*(9). https://doi.org/10.1002/14651858.cd001735.pub5
11. Moore, Z. E., & Cowman, S. (2012). Repositioning for treating pressure ulcers. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.cd006898.pub3
12. National Pressure Ulcer Advisory Panel (NPUAP). (2019). *Prevention and treatment of pressure ulcers/injuries: Clinical practice guideline*. https://npuap.org
13. US Department of Health and Human Services. (1994). Agency for Health Care Policy and Research. Pressure Ulcer in Adults: Prediction and Prevention. *Clinical Practice Guideline*, (3).
14. Allman, R. M. (1997). Pressure ulcer prevalence, incidence, risk factors, and impact. *Clinics in geriatric medicine*, *13*(3), 421-436. https://doi.org/10.1016/S0749-0690(18)30152-6
15. Bennett, G. (2004). The cost of pressure ulcers in the UK. *Age and Ageing*, *33*(3), 230-235. https://doi.org/10.1093/ageing/afh086
16. Brown, G. (2003). Long-term outcomes of full-thickness pressure ulcers: healing and mortality. *Ostomy/wound management*, *49*(10), 42-50. https://europepmc.org/article/med/14652420
17. Butcher, M., & Thompson, G. (2009). Dressings can prevent pressure ulcers: fact or fallacy? The problem of pressure ulcer prevention. *Wounds uk*, *5*(4), 80-93. https://wounds-uk.com/wp-content/uploads/2023/02/content_9317.pdf
18. Colin, D., Abraham, P., Preault, L., Bregeon, C., & Saumet, J. L. (1996). Comparison of 90 and 30 laterally inclined positions in the prevention of pressure ulcers using transcutaneous oxygen and carbon dioxide pressures. *Advances in Skin & Wound Care*, *9*(3), 35-38. https://journals.lww.com/aswcjournal/abstract/1996/09030/Comparison_of_90_degrees__and_30_degrees_.8.aspx
19. Dealey, C., Posnett, J., & Walker, A. (2012). The cost of pressure ulcers in the United Kingdom. *Journal of Wound Care*, *21*(6), 261-266. https://doi.org/10.12968/jowc.2012.21.6.261
20. Defloor, T., Bacquer, D. D., & Grypdonck, M. H. (2005). The effect of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers. *International Journal of Nursing Studies*, *42*(1), 37-46. https://doi.org/10.1016/j.ijnurstu.2004.05.013
21. Donner, A., & Klar, N. (2004). Pitfalls of and controversies in cluster randomization trials. *American Journal of Public Health*, *94*(3), 416-422. https://doi.org/10.2105/ajph.94.3.416
22. Bennett, G., Clark, M., Schols, J., Benati, G., Langer, G., Jackson, P., & Kerry, B. (2003). EPUAP guidelines: On the role of nutrition in pressure ulcer prevention and management. *European Pressure Ulcer Advisory Panel*, *5*(2), 50-63. https://www.southampton.ac.uk/isolutions/outage-pages/eprints.page
23. European Pressure Advisory Panel and National Pressure Ulcer Advisory Panel. Prevention and Treatment of Pressure Ulcers: Quick Reference Guide. *Prevention and Treatment of Pressure Ulcers: Quick Reference Guide*. Washington DC: National Pressure Ulcer Advisory Panel, 2009.
24. Gallagher, P., Barry, P., Hartigan, I., McCluskey, P., O'Connor, K., & O'Connor, M. (2008). Prevalence of pressure ulcers in three university teaching hospitals in Ireland. *Journal of Tissue Viability*, *17*(4), 103-109. https://doi.org/10.1016/j.jtv.2007.12.001
25. Gethin, G., Jordan-O'Brien, J., & Moore, Z. (2005). Estimating costs of pressure area management based on a survey of ulcer care in one Irish hospital. *Journal of Wound Care*, *14*(4), 162-165. https://doi.org/10.12968/jowc.2005.14.4.26759
26. Gorecki, C., Brown, J. M., Nelson, E. A., Briggs, M., Schoonhoven, L., Dealey, C., Defloor, T., & Nixon, J. (2009). Impact of pressure ulcers on quality of life in older patients: A systematic review. *Journal of the*

*American Geriatrics Society*, *57*(7), 1175-1183. https://doi.org/10.1111/j.1532-5415.2009.02307.x

27. Gottrup, F. (2004). Oxygen in wound healing and infection. *World Journal of Surgery*, *28*(3), 312-315. https://doi.org/10.1007/s00268-003-7398-5
28. Haalboom, J. (2000). The Dutch experience of pressure ulcers — a personal view. *Journal of Wound Care*, *9*(3), 121-122. https://doi.org/10.12968/jowc.2000.9.3.26268
29. Higgins, J. P. (2003). Measuring inconsistency in meta-analyses. *BMJ*, *327*(7414), 557-560. https://doi.org/10.1136/bmj.327.7414.557
30. Higgins, J. P., & Altman, D. G. (2008). Assessing risk of bias in included studies. *Cochrane Handbook for Systematic Reviews of Interventions*, 187-241. https://doi.org/10.1002/9780470712184.ch8
31. Hopkins, A., Dealey, C., Bale, S., Defloor, T., & Worboys, F. (2006). Patient stories of living with a pressure ulcer. *Journal of Advanced Nursing*, *56*(4), 345-353. https://doi.org/10.1111/j.1365-2648.2006.04007.x
32. Husain, T. (1953). An experimental study of some pressure effects on tissues, with reference to the bed-sore problem. *The Journal of Pathology and Bacteriology*, *66*(2), 347-358. https://doi.org/10.1002/path.1700660203
33. Kosiak, M. (1959). Etiology and pathology of ischemic ulcers. *Arch Phys Med Rehabil*, *40*, 62-69. https://cir.nii.ac.jp/crid/1571980075794548224