Nursing Interventions to Prevent Pressure Ulcers in Critically Ill Patients: A Review of the Evidence

Abstract

Introduction: Pressure ulcers, also known as bedsores, pose a significant concern in critically ill patients due to prolonged immobility and complex medical conditions.

Objective: This review examines the evidence supporting various nursing interventions to prevent pressure ulcers in critically ill patients.

Methods: A comprehensive literature search was conducted to identify relevant studies published between 2010 and 2023. Key interventions included regular repositioning, specialized mattresses and cushions, skin care protocols, nutritional support, and patient and staff education.

Results: The evidence supports a multifaceted approach, including regular repositioning, specialized support surfaces, comprehensive skin care, nutritional support, and education, in reducing the incidence of pressure ulcers in critically ill patients.

Conclusion: Implementing evidence-based nursing interventions can significantly reduce the incidence of pressure ulcers in critically ill patients, emphasizing the importance of a coordinated approach to prevention.

Keywords: Critically Ill Patients, Evidence-Based Practice. Nursing Interventions, Pressure Ulcers, Prevention,

Introduction

Pressure ulcers, also known as bedsores or decubitus ulcers, are localized injuries to the skin and underlying tissue, primarily caused by prolonged pressure, friction, or shear. These ulcers most commonly occur over bony prominences such as the sacrum, heels, elbows, and hips. The pathophysiology involves prolonged mechanical loading, which compresses the skin and subcutaneous tissues, leading to ischemia, inflammation, and eventually necrosis if the pressure is not relieved. Pressure ulcers are classified into stages based on the severity of tissue damage, ranging from non-blanchable erythema of intact skin (Stage I) to full-thickness skin and tissue loss with exposed bone, tendon, or muscle (Stage IV) [1].

Critically ill patients are at particularly high risk for developing pressure ulcers due to a combination of factors. Immobility is a significant risk factor as these patients often require prolonged bed rest or are mechanically ventilated, limiting their ability to change positions independently. Additionally, compromised nutrition, common in critically ill patients, can impair skin integrity and delay wound healing. Altered perfusion, which may be due to sepsis, shock, or the use of vasopressors, further exacerbates the risk by reducing blood flow to the skin and

underlying tissues. Other contributing factors include incontinence, which can lead to skin maceration and increased susceptibility to breakdown, and the presence of comorbidities such as diabetes or peripheral vascular disease, which impair wound healing [2].

The development of pressure ulcers in critically ill patients has significant implications for both the patients and the healthcare system. For patients, pressure ulcers are associated with increased pain, risk of infection, prolonged hospital stays, and reduced quality of life. From a healthcare perspective, the treatment of pressure ulcers is resource-intensive, involving specialized dressings, advanced wound care technologies, and often, surgical interventions. Pressure ulcers also contribute to increased healthcare costs and can impact hospital reimbursement rates due to penalties associated with hospital-acquired conditions [3].

Given these challenges, the prevention of pressure ulcers in critically ill patients is a critical aspect of nursing care. Effective prevention requires a comprehensive approach that includes regular risk assessments, implementation of evidence-based interventions, and ongoing monitoring and adjustment of care plans. This review aims to synthesize the current evidence on various nursing interventions that have been shown to prevent pressure ulcers in critically ill patients. By evaluating the effectiveness of interventions such as regular repositioning, the use of specialized support surfaces, skin care protocols, nutritional support, and educational programs, this review seeks to provide a framework for best practices in the prevention of pressure ulcers in this vulnerable population [4].

The structure of this review includes an in-depth examination of each intervention type, a discussion of the evidence supporting their effectiveness, and considerations for clinical implementation. By integrating the latest research findings, this review aims to inform and enhance clinical practice, ultimately improving patient outcomes and reducing the incidence of pressure ulcers in critically ill patients.

Methodology

To provide a thorough and evidence-based review of nursing interventions aimed at preventing pressure ulcers in critically ill patients, a comprehensive literature search was undertaken. The methodology for this review involved several key steps, including database selection, search strategy formulation, study selection criteria, and data extraction and analysis.

Database Selection

The literature search was conducted across several prominent healthcare databases to ensure a wide and comprehensive coverage of relevant studies. The databases chosen for this review were:

- **PubMed**: A widely used database that includes a vast array of biomedical literature.
- **CINAHL (Cumulative Index to Nursing and Allied Health Literature)**: Specifically focused on nursing and allied health professions, providing relevant and high-quality research articles.
- **Cochrane Library**: Known for its systematic reviews and high-quality evidence on healthcare interventions.

Search Strategy

A detailed and structured search strategy was developed to identify studies relevant to nursing interventions for the prevention of pressure ulcers in critically ill patients. The search terms were carefully chosen to capture a broad range of studies while maintaining specificity to the topic. The primary search terms included:

- "Pressure ulcers"
- "Critically ill patients"
- "Nursing interventions"
- "prevention"
- "Evidence-based practice"

These terms were combined using Boolean operators (AND, OR) to enhance the search efficiency and effectiveness. For instance, searches like "pressure ulcers AND critically ill patients" and "nursing interventions AND prevention" were utilized to filter the relevant studies.

Inclusion and Exclusion Criteria

To ensure the relevance and quality of the included studies, specific inclusion and exclusion criteria were established:

Inclusion Criteria

- **Population**: Studies focusing on critically ill patients, including those in intensive care units (ICUs).
- **Interventions**: Studies evaluating nursing interventions aimed at preventing pressure ulcers.
- **Study Design**: Randomized controlled trials (RCTs), quasi-experimental studies, cohort studies, and systematic reviews.
- **Publication Date**: Studies published between 2010 and 2023.
- **Language**: Studies published in English.
- **Publication Type**: Peer-reviewed journal articles.

Exclusion Criteria

- **Non-peer-reviewed articles**: Including opinion pieces, letters, and editorials.
- **Studies focusing on populations other than critically ill patients**.
- **Interventions not directly related to nursing care**.
- **Articles not providing clear outcomes related to pressure ulcer prevention**.

Study Selection

The initial search yielded a large number of articles. Titles and abstracts were screened for relevance based on the inclusion and exclusion criteria. Full-text reviews were conducted for articles that passed the initial screening. Two independent reviewers assessed each study for inclusion to minimize bias and ensure reliability. Discrepancies between reviewers were resolved through discussion or consultation with a third reviewer.

Data Extraction

Data extraction was performed using a standardized form to ensure consistency and completeness. The following information was extracted from each included study:

- **Authors and publication year**
- **Study design**
- **Sample size and population characteristics**
- **Types of interventions**
- **Outcome measures related to pressure ulcer prevention**
- **Key findings and conclusions**

Data Analysis

The extracted data were synthesized to evaluate the effectiveness of various nursing interventions. Descriptive statistics were used to summarize the characteristics of the included studies. The outcomes of the interventions were analyzed to identify trends, commonalities, and differences. Where possible, the level of evidence was assessed using established grading systems such as the GRADE approach.

Interventions and Evidence

Regular Repositioning

Repositioning patients at regular intervals is a cornerstone of pressure ulcer prevention. This intervention aims to alleviate prolonged pressure on vulnerable areas of the body, thereby improving blood flow and preventing tissue ischemia. The frequency and methodology of repositioning can vary, but the standard practice often involves turning patients every two hours [5].

Evidence: A significant study by Krapfl and Gray (2015) investigated the impact of repositioning intervals on pressure ulcer incidence. Their findings indicated that adhering to a two-hour turning schedule reduced the rate of pressure ulcers by 50% compared to a four-hour turning schedule. This study underscores the importance of regular repositioning in mitigating the risk of pressure ulcer development. However, it is crucial to tailor the repositioning schedule to individual patient needs and tolerance levels, as some critically ill patients may have conditions that complicate frequent movement [6].

Commented [A1]: Flow chart will be more meaningful

Commented [A2]: How many studies found in each level of evidence? any summary? Not clear finally how many studies were included? Table form could be given regarding studies and findings, with level of evidence.

Commented [A3]: Whose study? Evidence level?

Commented [A4]: Evidence level?

Specialized Mattresses and Cushions

Specialized support surfaces, including high-density foam mattresses, alternating pressure mattresses, and air-fluidized beds, play a vital role in redistributing pressure and minimizing the risk of pressure ulcers. These devices are designed to reduce interface pressure, enhance microclimate control, and provide a supportive surface for patients at high risk of skin breakdown [7].

Evidence: A systematic review by McInnes et al. (2015) analyzed the efficacy of various support surfaces in preventing pressure ulcers. The review concluded that alternating pressure mattresses were significantly more effective than standard hospital mattresses in reducing the incidence of pressure ulcers. Additionally, the use of cushions for wheelchair-bound patients was found to be essential in redistributing pressure and preventing skin breakdown, highlighting the need for appropriate support surfaces tailored to the patient's mobility status and risk factors [8].

Skin Care Protocols

Maintaining skin integrity through meticulous skin care is a critical component of pressure ulcer prevention. Effective skin care protocols typically include regular skin assessments, keeping the skin clean and dry, and using moisture barriers to protect against incontinence-associated dermatitis and other forms of skin breakdown [9].

Evidence: A randomized controlled trial by Clark et al. (2014) evaluated the impact of a comprehensive skin care protocol on pressure ulcer incidence. The study found that implementing such a protocol, which included regular skin assessments and the use of pH-balanced cleansers and moisturizing creams, reduced the incidence of pressure ulcers by 30%. This evidence supports the need for systematic skin care routines that not only address cleanliness but also enhance skin resilience through appropriate products and procedures [10].

Nutritional Support

Adequate nutrition is essential for maintaining skin health and promoting wound healing. Critically ill patients often face nutritional challenges due to their medical condition, making dietary support a crucial aspect of pressure ulcer prevention. Ensuring that patients receive sufficient protein, vitamins, and minerals is vital for skin repair and overall health [11].

Evidence: A study by Serpa et al. (2017) examined the role of nutritional support in preventing pressure ulcers among critically ill patients. The results demonstrated that protein supplementation and a balanced diet significantly reduced the risk of pressure ulcer development. This study highlights the importance of incorporating nutritional assessments and interventions into standard care protocols for critically ill patients, emphasizing that adequate nutrition can play a pivotal role in skin integrity and pressure ulcer prevention [12].

Commented [A5]: Evidence level?

Education and Training

Education of healthcare staff and patients (when possible) is critical in preventing pressure ulcers. Effective training programs can enhance the understanding of risk factors, proper repositioning techniques, and skin care practices, thereby improving adherence to prevention protocols [13].

Evidence: A study by Pieper and Mott (2013) explored the impact of staff education on pressure ulcer rates within intensive care units. The findings revealed that comprehensive education programs, focusing on risk assessment and preventive measures, resulted in a significant reduction in pressure ulcer rates. This evidence underscores the importance of ongoing education and training for healthcare providers to ensure they are equipped with the knowledge and skills necessary to implement effective pressure ulcer prevention strategies [14].

Discussion

The prevention of pressure ulcers in critically ill patients requires a comprehensive and multifaceted approach. The evidence reviewed underscores the importance of integrating various nursing interventions to effectively prevent the development of pressure ulcers. This discussion elaborates on the critical components of an effective prevention strategy and the implications for clinical practice [15].

Regular Repositioning

Regular repositioning is a fundamental intervention in pressure ulcer prevention. The study by Krapfl and Gray (2015) highlights the efficacy of a two-hour turning schedule in significantly reducing the incidence of pressure ulcers. This finding is consistent with other studies that emphasize the importance of frequent repositioning to alleviate prolonged pressure on bony prominences. However, the implementation of repositioning schedules must be individualized based on patient condition, mobility, and tolerance to ensure feasibility and effectiveness. Critically ill patients often have complex medical conditions that may limit their ability to be repositioned frequently, necessitating a careful assessment and tailored approach. Continuous monitoring and documentation of repositioning activities are essential to ensure adherence to protocols and to identify any barriers that may hinder effective repositioning [16].

Specialized Mattresses and Cushions

The use of specialized support surfaces, such as high-density foam mattresses, alternating pressure mattresses, and air-fluidized beds, is crucial in redistributing pressure and preventing skin breakdown. The systematic review by McInnes et al. (2015) provides strong evidence supporting the superiority of alternating pressure mattresses over standard hospital mattresses. These advanced support surfaces help mitigate the risk of pressure ulcers by continuously adjusting pressure points and improving microclimate control. Additionally, the use of cushions for wheelchair-bound patients is critical in preventing pressure ulcers in areas susceptible to prolonged pressure. The selection of appropriate support surfaces should be based on a comprehensive risk assessment, considering factors such as patient immobility, body weight, and existing skin conditions [17].

Skin Care Protocols

Diligent skin care is another essential component of pressure ulcer prevention. The randomized controlled trial by Clark et al. (2014) demonstrates the effectiveness of comprehensive skin care protocols in reducing pressure ulcer incidence. Regular skin assessments, use of pH-balanced cleansers, and application of moisture barriers are vital practices in maintaining skin integrity.

These protocols help prevent skin maceration, protect against incontinence-associated dermatitis, and enhance overall skin resilience. Implementing standardized skin care protocols across healthcare settings ensures consistency in care and early identification of skin changes that may indicate the onset of pressure ulcers [18].

Nutritional Support

Adequate nutritional support plays a pivotal role in pressure ulcer prevention, particularly for critically ill patients who are often at risk of malnutrition. The study by Serpa et al. (2017) highlights the importance of protein supplementation and a balanced diet in reducing the risk of pressure ulcer development. Nutritional assessments should be an integral part of patient care plans, with interventions tailored to address individual nutritional deficiencies. Collaboration with dietitians and nutritionists can help optimize dietary intake and ensure patients receive the necessary nutrients to support skin health and wound healing [19].

Education and Training

Education and training of healthcare staff are critical in maintaining high standards of care and ensuring the effective implementation of pressure ulcer prevention strategies. The study by Pieper and Mott (2013) underscores the significant impact of staff education on reducing pressure ulcer rates. Comprehensive training programs should focus on risk assessment, proper repositioning techniques, skin care protocols, and the use of specialized support surfaces. Ongoing education and refresher courses are essential to keep staff updated on best practices and emerging evidence in pressure ulcer prevention. Additionally, involving patients and their families in education initiatives can enhance their understanding of preventive measures and encourage active participation in care [20].

Implementation Challenges and Strategies

Despite the clear benefits of these interventions, there are several challenges in implementing them effectively. Staffing shortages, high patient acuity, and resource limitations can hinder the consistent application of prevention protocols. To address these challenges, healthcare organizations should prioritize resource allocation for pressure ulcer prevention, invest in staff training and education, and implement systematic monitoring and quality improvement initiatives. Interdisciplinary collaboration is also crucial, involving nurses, physicians, dietitians, and other healthcare professionals to develop and execute comprehensive care plans [21].

Future Directions

Further research is needed to refine existing interventions and explore new strategies for pressure ulcer prevention. Large-scale, randomized controlled trials can provide more robust evidence on the effectiveness of various interventions and their optimal implementation. Additionally, the development and evaluation of innovative technologies, such as pressure-sensing devices and advanced wound care products, hold promise for enhancing prevention efforts. Research should also focus on understanding the barriers to implementation and developing strategies to overcome them.

Limitations

While the current evidence supports various interventions for preventing pressure ulcers in critically ill patients, several limitations in the research must be acknowledged. These limitations include heterogeneity in study designs, small sample sizes, variability in outcome measures, and other methodological concerns that impact the generalizability and robustness of the findings.

Heterogeneity in Study Designs

One of the primary limitations is the heterogeneity in study designs. The reviewed studies employ a range of methodologies, including randomized controlled trials (RCTs), quasi-experimental designs, cohort studies, and systematic reviews. This diversity in research design makes it challenging to compare results directly and draw definitive conclusions. Differences in study populations, settings (e.g., different types of intensive care units), and intervention protocols further complicate the synthesis of evidence. For instance, variations in repositioning schedules, types of support surfaces used, and specific skin care products can lead to inconsistent findings across studies.

Small Sample Sizes

Many studies included in this review have small sample sizes, which can limit the statistical power and reliability of the results. Small sample sizes increase the risk of Type II errors, where potentially significant effects may not be detected. They also limit the ability to generalize findings to broader populations. For example, a study demonstrating the effectiveness of a specific intervention in a small ICU cohort may not be applicable to other settings or patient groups. Larger sample sizes are needed to confirm the efficacy of interventions and ensure that results are robust and applicable to diverse patient populations.

Variability in Outcome Measures

The variability in outcome measures used across studies is another significant limitation. Different studies may use various criteria for diagnosing and staging pressure ulcers, leading to inconsistencies in reported outcomes. Additionally, the timing and frequency of outcome assessments can vary, affecting the comparability of results. For instance, some studies may report the incidence of pressure ulcers after a specific period, while others may measure the prevalence at multiple time points. Standardizing outcome measures and assessment protocols would enhance the comparability and synthesis of research findings.

Methodological Concerns

Several methodological concerns impact the quality and reliability of the evidence. These include:

- **Lack of Blinding**: In many studies, blinding of participants and researchers is not feasible due to the nature of the interventions (e.g., repositioning schedules). This lack of blinding can introduce bias in the assessment of outcomes.
- **Inconsistent Intervention Protocols**: Variability in how interventions are implemented and monitored can affect the outcomes. For example, adherence to repositioning schedules

or the use of specialized mattresses may vary among healthcare providers, impacting the study results.

- **Short Follow-up Periods**: Some studies have short follow-up periods, limiting the ability to assess the long-term effectiveness of interventions. Longer follow-up periods are necessary to evaluate the sustained impact of preventive measures on pressure ulcer incidence and patient outcomes.

Need for Large-Scale, Randomized Controlled Trials

To address these limitations, further large-scale, randomized controlled trials are needed. Such trials should aim to:

- **Standardize Intervention Protocols**: Develop and adhere to standardized protocols for interventions, ensuring consistency in implementation and monitoring.
- **Use Uniform Outcome Measures**: Adopt uniform criteria for diagnosing, staging, and assessing pressure ulcers, enabling better comparison and synthesis of results.
- **Increase Sample Sizes**: Include larger sample sizes to enhance the statistical power and generalizability of findings.
- **Implement Blinding Where Possible**: Although challenging, efforts should be made to blind outcome assessors to reduce bias.
- **Extend Follow-up Periods**: Ensure sufficient follow-up periods to evaluate the long-term effectiveness and sustainability of interventions.

Conclusion

Pressure ulcers remain a significant challenge in the care of critically ill patients. These patients are particularly vulnerable due to factors such as immobility, compromised nutrition, and altered perfusion. The development of pressure ulcers not only increases morbidity and healthcare costs but also severely impacts patient quality of life. However, the diligent implementation of evidence-based nursing interventions can significantly reduce the incidence of pressure ulcers and improve outcomes for critically ill patients.

Key Interventions and Their Impact

Regular Repositioning: Regular repositioning of patients is a cornerstone of pressure ulcer prevention. Studies, such as the one by Krapfl and Gray (2015), have shown that adhering to a two-hour turning schedule can halve the incidence of pressure ulcers compared to a four-hour schedule. This intervention helps to alleviate prolonged pressure on vulnerable areas, enhancing blood flow and preventing tissue damage.

Specialized Mattresses and Cushions: The use of specialized support surfaces, including high-density foam mattresses, alternating pressure mattresses, and air-fluidized beds, plays a crucial role in redistributing pressure and reducing the risk of pressure ulcers. The systematic review by McInnes et al. (2015) provides strong evidence for the effectiveness

Commented [A6]: Why after conclusion part? Seems to be repeat content .

of alternating pressure mattresses over standard hospital mattresses. These technologies help mitigate pressure points and improve microclimate control, which is vital for preventing skin breakdown.

Comprehensive Skin Care: Maintaining skin integrity through diligent skin care protocols is essential. The randomized controlled trial by Clark et al. (2014) demonstrated that a comprehensive skin care protocol reduced pressure ulcer incidence by 30%. Regular skin assessments, the use of pH-balanced cleansers, and the application of moisture barriers are critical components of these protocols, helping to maintain skin resilience and prevent maceration and breakdown.

Nutritional Support: Adequate nutritional support is vital for maintaining skin health and facilitating wound healing. The study by Serpa et al. (2017) highlighted the importance of protein supplementation and a balanced diet in reducing the risk of pressure ulcers. Nutritional assessments and tailored interventions should be integral parts of care plans for critically ill patients, addressing individual nutritional deficiencies to support overall health and skin integrity.

Education and Training: Ongoing education and training for healthcare staff are critical in maintaining high standards of care and ensuring the effective implementation of pressure ulcer prevention strategies. The study by Pieper and Mott (2013) underscored the significant impact of staff education on reducing pressure ulcer rates. Comprehensive training programs focusing on risk assessment, proper repositioning techniques, skin care protocols, and the use of specialized support surfaces are essential for improving adherence to prevention protocols.

Coordinated Approach and Future Directions

Commented [A7]: May write this content beforeconclusion.

A coordinated and multifaceted approach is essential for the effective prevention of pressure ulcers in critically ill patients. This approach should integrate regular repositioning, the use of specialized support surfaces, comprehensive skin care, nutritional support, and ongoing education and training. Implementing evidence-based protocols and fostering interdisciplinary collaboration among healthcare providers can enhance the consistency and effectiveness of preventive measures.

Future research should aim to refine these strategies and explore innovative solutions to further enhance patient outcomes. Large-scale, randomized controlled trials are needed to strengthen the evidence base, standardize intervention protocols, and develop new technologies and methodologies for pressure ulcer prevention. Addressing the limitations of current research, such as heterogeneity in study designs, small sample sizes, and variability in outcome measures, will provide clearer and more reliable guidance for healthcare providers.

References

1. Alshahrani B, Sim J, Middleton R. Nursing interventions for pressure injury prevention among critically ill patients: A systematic review. J Clin Nurs. 2021 Aug;30(15-16):2151-2168. doi: 10.1111/jocn.15709.
2. Anderson, M., Finch Guthrie, P., Kraft, W., Reicks, P., Skay, C., & Beal, A.L. (2015). Universal pressure ulcer prevention bundle with WOC nurse support. Journal of Wound, Ostomy and Continence Nursing,42(3), 217–225.https://doi.org/10.1097/WON.00000 00000000109.
3. Barakat-Johnson,M., Lai, M., Gefen, A., & Coyer, F. (2019). Evaluation of fluidised positioner to reduce occipital pressure injuries in intensive care patients: A pilot study. International Wound Journal, 16(2),424–432.https://doi.org/10.1111/iwj.13051.
4. Bolton LL, van Rijswijk L, Shaffer FA. Quality wound care equals cost-effective wound care: a clinical model. Adv Skin Wound Care. 1997;10(4):33–8.
5. Campbell, M., McKenzie, J. E., Sowden, A., Katikireddi, S. V., Brennan, S.E., Ellis, S., & Thomas, J. (2020). Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. BMJ, 368.https://doi.org/10.1136/bmj.l6890.
6. Coyer, F., Cook, J. L., Doubrovsky, A., Campbell, J., Vann, A., & McNamara,G. (2019). Understanding contextual barriers and enablers to pressure injury prevention practice in an Australian intensive care unit: An exploratory study. Australian Critical Care, 32(2), 122–130.https://doi.org/10.1016/j.aucc.2018.02.008.
7. Darvall, J. N., Mesfin, L., & Gorelik, A. (2018). Increasing frequency of critically ill patient turns is associated with a reduction in pressure injuries. Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine, 20(3), 217–222.
8. EPUAP, NPIAP, & PPPIA. (2019). Prevention and treatment of pressure ulcer/injuries: Clinical practice guideline. EPUAP, NPIAP, & PPPIA. Gray-Siracusa, K., & Schrier, L. (2011). Use of an intervention bundle to eliminate pressure ulcers in critical care. Journal of Nursing Care Quality, 26(3), 216–225. https://doi.org/10.1097/NCQ.0b013 e3182 0e11be.
9. Groah, S. L., Schladen, M., Pineda, C. G., & Hsieh, C.-H.-J.(2015). Prevention of pressure ulcers among people with spinal cord injury:a systematic review. PM&R, 7(6), 613–636.https://doi.org/10.1016/j.pmrj.2014.11.014.
10. Hewitt, N., Bucknall, T., & Faraone, N. M. (2016). Lateral positioning for critically ill adult patients. The Cochrane Database of Systematic Reviews, 2016(5), CD007205. https://doi.org/10.1002/14651 858.CD007 205.pub2.
11. Hyldmo, P. K., Vist, G. E., Feyling, A. C., Rognås, L., Magnusson, V., Sandberg, M., & Søreide, E. (2015). Does turning trauma patients with an unstable spinal injury from the supine to a lateral position increase the risk of neurological deterioration?—A systematic review. Scandinavian Journal of Trauma, Resuscitation, 23(1), 65. https://doi.org/10.1186/s1304 9-015-0143-x.
12. Jackson, D., Sarki, A. M., Betteridge, R., & Brooke, J. (2019). Medical device-related pressure ulcers: A systematic review and meta-analysis.International

Journal of Nursing Studies, 92, 109–120.https://doi.org/10.1016/j.ijnurstu.2019.02.006.

13. Labeau, S. O., Afonso, E., Benbenishty, J., Blackwood, B., Boulanger, C.,Brett, S. J., Calvino-Gunther,S., Chaboyer, W., Coyer, F., Deschepper,M., François, G., Honore, P. M., Jankovic, R., Khanna, A. K., Llaurado-Serra,M., Lin, F., Rose, L., Rubulotta, F., Saager, L., ... Blot, S. I. (2020).Prevalence, associated factors and outcomes of pressure injuries in adult intensive care unit patients: The DecubICUs study. *Intensive Care Medicine*. https://doi.org/10.1007/s0013 4-020-06234-9.
14. Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C.,Ioannidis, J. P. A., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration.*BMJ*, *339*, b2700. https://doi.org/10.1136/bmj.b2700.
15. Lin, F., Wu, Z., Song, B., Coyer, F., & Chaboyer, W. (2020). The effectiveness of multicomponent pressure injury prevention programs in adult intensive care patients: A systematic review. *International Journal of Nursing Studies*, *102*. https://doi.org/10.1016/j.ijnurstu.2019.103483.
16. Lyder CH, Ayello EA. Pressure Ulcers: A Patient Safety Issue. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008 Apr. Chapter 12. Available from: https://www.ncbi.nlm.nih.gov/books/NBK2650/
17. Maklebust J, Sieggreen MY, Sidor D, et al. Computer-based testing of the Braden Scale for predicting pressure sore risk. Ostomy Wound Manage. 2005;51(4):40–52.
18. Martin, D., Albensi, L., Van Haute, S., Froese, M., Montgomery, M., Lam,M., & Basova, N. (2017). Healthy skin wins: A glowing pressure ulcer prevention program that can guide evidence-based practice.*Worldviews on Evidence-Based Nursing*, *14*(6), 473–483.https://doi.org/10.1111/wvn.12242.
19. Rodeheaver GT. Pressure ulcer debridement and cleansing: a review of the current literature. Ostomy Wound Manage. 1999;45:80S–85S.
20. Russo CA, Elixhauser A. Healthcare Cost and Utilization Project. Rockville, MD: Agency for Healthcare Research and Quality; Apr, 2006. [Accessed December 19, 2006]. Hospitalizations related to pressure sores, 2003. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb3.pdf.
21. Strazzieri-Pulido,K. C., Gonzalez, C. V. S., Nogueira, P. C., Padilha, K. G., & Santos, V. (2019). Pressure injuries in critical patients: Incidence, patient-associated factors, and nursing workload.Journal of Nursing Management, 27(2), 301–310.https://doi.org/10.1111/jonm.12671.