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The Role of Nurses in Preventing Pressure Ulcers in Intensive Care Patients

A Scoping Review

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Abstract/Summary

Aim: To outline the causes of pressure ulcers in patients undergoing intensive care and the interventions nurses could implement to prevent its development.

Method: The study incorporated descriptive analysis and did a scoping review of nine scientific journals. Jean Watson's Theory of Transpersonal Caring was employed to emphasize the necessity for nurses to provide care for patients and promote the healing process.

Results: The findings were organised into two primary categories: factors contributing to the development of pressure ulcers in ICU patients and effective nursing interventions for preventing pressure ulcer formation in ICU patients. The initial theme outlined two sub-themes: systemic factors such as age, weight loss, incontinence, immobility, hypotension, malnutrition, impaired sensory perception due to sedative use, and impaired tissue perfusion; and local factors including pressure, shear, friction, and duration of stay in the ICU. The study highlighted useful nursing practices, including repositioning, comprehensive skin assessment and inspection, utilization of suitable dressings, enhancement of nutrition, administration of barrier cream, and implementation of pressure redistributing surfaces.

Conclusion: The study showed that ICU patients are at heightened risk for pressure ulcers due to factors such as immobility, sedatives, and inadequate nutrition. Therefore, it is essential to implement strategies including repositioning, application of moisturizing creams on dry skin, comprehensive skin inspections for any lesions, utilization of pressure-relieving surfaces, thorough nutritional assessments, and the application of hydrocolloid or silicone dressings to prevent the development of pressure ulcers in critically ill patients.

Language: English
Key words: Pressure ulcers, critically ill, nursing interventions, ICU.

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1 Introduction

A pressure ulcer (PU) is a condition in which the epidermis and/or underlying tissue are damaged locally due to pressure or pressure in combination with shear. PUs typically develop on bony prominences but may also be associated with medical devices or other objects. (EPUAP, NPIAP, PPPIA, 2019)

The advancement of PUs is intricate and multi-faceted. Notwithstanding advancements in medical technology and the implementation of structured prevention programs grounded on clinical practice guidelines, the incidence of PUs during hospitalisation persists in rising to about 80%. The prevalence rates of acquired PUs among hospitalised patients are highest in the intensive care unit (ICU), ranging from 14% to 42%. Mortality is also associated with PUs. (Gedamu, Hailu & Amano, 2014). Critical care patients face an elevated risk of all PUs especially medical device-related pressure ulcers (MDRPUs), owing to the extensive use of devices within this demographic. These patients are more prone to diminished consciousness, hallucinations, sensory perception impairment, decreased mobility, vasopressor administration, renal replacement treatment, malnutrition, hypovolemia, and hypotension. Consequently, they show more dependence on medical devices (Heywood, Worthington, Arrowsmith, Jenkins & Herring, 2022).

PU expenses range from 1.4% to 4% of total medical expenses (EPUAP, NPIAP, PPPIA, 2019). Based on the data mentioned in Tervo-Heikkinen et al. (2022) from the Finnish Institute for Health and Welfare (2019), the estimated value for fiscal year 2018 ranges between 295 to 844 million Euros. The expenses associated with treating PUs exceed those of preventing them, significantly affecting hospital budgets (Demarré et al., 2015).

Mitigating the onset of PUs to alleviate the burden on patients and healthcare systems is seen as a fundamental objective of healthcare organisations. Consequently, to deliver effective prevention interventions and to make better use of resources in practice, it is necessary to identify and comprehend the elements that pose a risk. (Coyer & Tayyib, 2017). Even though nurses prioritise the prevention and management of PUs, they continue to face obstacles in the process, despite implementing numerous interventions.

2 Study Background

The study background highlights the evolution of PUs terminologies, aetiology, classification, risk assessment tools, and some preventive measures for PUs.

Nurses must have the knowledge and skills necessary to accurately diagnose and assess patients at risk for PUs, as these wounds are regarded as an indicator of the quality of nursing care delivered to patients. Nurses function as the primary point of contact for patients in a healthcare environment, needing their expertise in applying evidence-based practices to alleviate pain, retain healthy skin, and reduce the risk of PUs. Unfortunately, despite the significant incidence and prevalence rates of patients with PUs, it has been proved that most nurses face challenges and barriers in delivering patient care and preventing the occurrence of these conditions. (Kim & Lee, 2019).

2.1 Evolution of Terminologies of Pressure Ulcers

Since the first description of these injuries, there has been ongoing discussion concerning the right terminology. The earliest term is decubitus, initially defined as gangraena per decubitum by Wohlleben in 1777, referring to necrotic tissue resulting from prolonged pressure while lying down. The term "bedsore" was introduced by Florence Nightingale. This term denotes its connection to the bed, while the inclusion of sore suggests a sensitive or painful area on the body. In the 1980s, the term pressure sore gained prominence, diminishing the obvious connection between the injury and a bed. The term "pressure ulcer" has been in widespread use since the early 1990s, and it refers to an open wound on the skin's surface. (EPUAP, NPIAP, PPPIA, 2019).

2.2 Aetiology of Pressure Ulcers

PUs will develop if the applied pressure exceeds the local capillary pressure. Chronic diseases with extended duration push patients to the limits of their functional capacity. Chronic diseases that persist over time can lead to diminished mobility and weight loss, resulting in a heightened risk for PUs. Physical inactivity, weaker muscles, and decreased weight are symptoms of sarcopenia and frailty, which are cellular-level biological complications. (Jaul, Baron, Rosenzweig & Menczel, 2018).

According to the research conducted by Coyer and Tayyib, 2017, the three primary elements that led to the development of PU were immobility or decreased activity, changes in perfusion (such as in diabetes, inadequate circulation, blood pressure changes, smoking, or oedema), and skin or PU status (such as a prior PU occurrence).

In 2014, Coleman et al. established a theoretical framework for potential causes of PU. The two main PU professional advisory committees, National Pressure Ulcer Advisory Panel and European Pressure Ulcer Panel have endorsed this concept. The framework is built around features that are classified as key direct, indirect, and possibly indirect causative risk factors. Key causal factors encompass immobility, the condition of skin/ PUs, and inadequate perfusion. Some examples of indirect causes include sensory perception, diabetes, low albumin, and insufficient nourishment, as well as moisture. Additional potential indirect factors includes advanced age, pharmaceutical treatments, pitting oedema, and various aspects pertaining to overall health status, such as infections, acute illnesses, elevated body temperature, and chronic wounds (Coleman et al., 2014). According to Bouten, Oomens, Baaijens, and Bader (2003), as cited in Jaul et al., (2018), the etiological mechanisms that result in the development of PUs are localised ischaemia, reperfusion injury, impaired lymphatic drainage, and sustained cell deformation. These mechanisms interact with damaged skin and subcutaneous tissue to cause the development of PUs.

Bhattacharya and Mishra (2015) also in agreement, state that there are two types of PU causes: direct and indirect. A primary cause of PUs is pressure, leading to internal soft tissue distortion and skin atrophy. A principal cause of this condition is shear, which occurs when adequate pressure is exerted on particular body areas; conversely, friction also arises from pressure, leading to skin degradation and total skin destruction. PUs can arise from immobility or an extended inability to move, leading to pressure on particular parts of the body. The probability of developing PUs is heightened by an individual's lack of sensation, inability to generate reactive hyperaemia, and the presence of two or more of the previously stated disorders. Nevertheless, additional indirect factors contributing to PUs encompass mobility impairments such as paralysis and loss of sensation. Incontinence, ageing skin, contractures, stiffness, malnutrition, moisture, cardiovascular disease, diabetes, and various other medical conditions are additional indirect causes of this wound.

Poor self-care and personal hygiene, coupled with a mental health condition, increase an individual's susceptibility to getting PUs. (Bhattacharya & Mishra, 2015)

2.3 Staging of Pressure Ulcers

PUs are categorised based on the extent of observable tissue loss, using a systematic classification framework for PUs. The classification of PUs relies on the visual and sensory assessment of various tissues, encompassing skin, subcutaneous fat, bone, muscle, tendon, and ligament. In full-thickness PUs, necrotic tissue manifests as slough and eschar. (EPUAP, NPIAP, PPPIA, 2019).

The development of PU occurs in four distinct stages. In stage I, the skin stays intact yet exhibits a localised redness that does not blanch under pressure, characterised as non-blanchable erythema. Visual alterations may arise from variations in hardness (whether firm or soft), temperature (ranging from warm to cold), and feeling of touch. Stage II is marked by a partial loss of skin, which may involve both the dermis and the epidermis. At this stage, the wound presents as an open blister or small crater, characterised by a pinkish or reddish wound bed. The adjacent tissues may display signs of inflammation, and there may be a discharge present. In stage III, the wound exhibits increased depth as the ulcer extends into the subcutaneous tissue. The complete loss of skin reveals adipose tissue and heightens the risk of infection in the area; however, fascia, bone, tendon, ligament, and cartilage remain concealed beneath the surface. In stage IV, there is a notable visibility of muscle, bone, tendons, fascia, ligaments, and cartilage resulting from considerable tissue loss. Alongside the considerable risk of infection and other potential complications such as osteomyelitis or cellulitis, the wound is generally profound. The extent of the damaged tissue differs depending on the specific region of the body involved. Additionally, there exists a category known as unstageable, wherein certain PUs are still obscured from observation due to the presence of necrotic tissue (eschar) or tissue exhibiting hues of yellow, grey, green, or brown (slough). Removing the dead tissue is a significant factor in deciding the stage of the PU. (Zaidi & Sharma, 2024).

2.4 Pressure Ulcers Risk Assessment Tools

A risk assessment tool serves as a critical instrument upon which a health professional relies when applying their clinical judgement. The predominant risk assessment tools presently

accessible have been formulated through literature reviews, expert insights, and/or modifications of pre-existing scales (EPUAP, NPIAP, PPPIA, 2019).

Three predominant instruments used in the evaluation of PUs risk include the Waterlow scale (1985), the Norton scale (1962), and the Braden scale (1987). A recently developed tool for assessing the risk of PUs is known as PURPOSE – T.

2.4.1 Braden Scale

The Braden scale encompasses six domains: sensory perception, moisture, activity, mobility, nutrition, and friction and shear. These domains are assessed and categorised as follows: at risk (score of 15), moderate risk (scores of 13 to 14), high risk (scores of 10 to 12), and very high risk (scores of 9 or below). (Brown, 2023). The Braden scale is extensively used by healthcare professionals to evaluate the risk of PU development, proving to be instrumental in guaranteeing that patients are provided with the essential preventive interventions. An illustration can be found in the Appendix 1.

2.4.2 Waterlow Scale

The Waterlow scale encompasses seven recognised risk factors: build/weight for height, incontinence, skin type/visual risk areas, mobility, sex/age, malnutrition, and special risks. Scores are categorised as follows: a score of 10 indicates at risk, a score ranging from 15 to 20 denotes high risk, and any score exceeding 20 is classified as very high risk. (Brown, 2023). The scores assigned to each category are combined to yield the total Waterlow Scale score, which spans from 1 to 64. An illustration can be found in the Appendix 2.

2.4.3 Norton Scale

The Norton scale comprises five parameters: physical condition, mental condition, activity, mobility, and incontinence. A low Norton score signifies an elevated risk of PUs. (Brown, 2023). Every parameter is evaluated using a scoring range that spans from 5 to 20. An illustration can be found in the Appendix 3.

2.4.4 PURPOSE-T Scale

The PURPOSE-T (Pressure Ulcer Programme Of reSEarch) (Nixon et al., 2015) has been recently developed, comprising three distinct steps: screening, full assessment, and

assessment decision. The system employs a colour-coding scheme: blue signifies the absence of issues, yellow suggests a possible impact on the risk of PUs, orange denotes an existing risk, and a patient who is currently suffering from a PU or an ulcer scar is indicated by the colour pink. The patient undergoes an initial screening to assess mobility status, followed by a determination based on the observed colouration. The second stage, which entails a comprehensive assessment, consists of eight sections that encompass the analysis of independent movement, prior PU history, sensory evaluation, perfusion status, nutritional assessment, medical devices, moisture levels, and diabetes management. Step three entails the allocation of assessment decisions. (Nixon et al., 2015). An illustration can be found in the Appendix 4.

It is imperative to consider the risk elements that the tool does not measure while utilising a risk assessment tool. The subscale scores of the Braden Scale, for instance, pertain to various risk factors associated with mobility, activity, friction and shear, nutrition, moisture, and sensory perception. Numerous facilities employ subscale scores to discern modifiable risk factors, serving as a foundation for risk-based prevention strategies. Nonetheless, a thorough risk assessment must encompass risk factors, both modifiable and non-modifiable, that are absent from the risk assessment tool (EPUAP, NPIAP, PPPIA, 2019).

2.5 Preventive Measures for Pressure Ulcers

Preventing PUs is a significant focus for numerous healthcare institutions globally, particularly within the intensive care unit, as it is considered a crucial element of effective nursing practice (Getie, Baylie, Bante, Geda & Mesfin, 2020). To mitigate risk factors for individual patients and decrease instances of extended skin pressure, the prevention of PUs emphasises the application of appropriate padding at critical pressure points or the regular repositioning of patients (Boyko, Longaker & Yang, 2018).It is essential to acknowledge that bodily excretions, such as faeces, sweat, and urine, contribute to the softening of the skin. Consequently, when a specific pressure point is obscured by skin, it may ultimately lead to skin degradation and the formation of PUs. It is therefore imperative to ensure that a patient's skin remains clean and dry, as this should be a primary consideration in the prevention of PUs. Furthermore, it is crucial to implement regular positioning adjustments and ensure that patients receive adequate cushioning to effectively prevent PUs in those who are immobile (Boyko et al., 2018).

According to Mitchell (2018), there is a five-point technique for preventing PUs called the SSKIN bundle. The steps are as follows: (1) surface; (2) skin inspection; (3) keep moving; (4) moisture and incontinence; and (5) Nutrition and hydration. Applying supports or equipment surfaces specifically engineered to alleviate pressure and minimise skin damage stands as a paramount objective within the SSKIN bundle's strategy for preventing PUs. It is important to prioritise skin examination and assessment, as they play a crucial role in managing pre-existing PUs, preventing future skin deterioration, and safeguarding against any form of skin damage. A fundamental aspect of the PU prevention strategy involves the maintenance of skin hygiene, which encompasses the cleansing of the skin and the protection of the most susceptible regions using devices designed to redistribute or alleviate pressure.

According to the SSKIN bundle, the relationship of moisture and incontinence signifies another pivotal phase in the prevention of PUs. It is essential for healthcare professionals to emphasise the importance of effective skin care management in their patients, while also addressing any issues related to continence, to effectively prevent PUs. This is particularly crucial given that extrinsic moisture plays a significant role in the deterioration of skin integrity (Beeckman, Van Lancker, Van Hecke, and Verhaeghe, 2014). Ultimately, given their essential role in facilitating the process of tissue repair, both diet and hydration should be prioritised in the battle against PUs. Consequently, it is vital for nurses and other healthcare professionals to diligently evaluate the nutritional and hydration status of patients (Mitchell, 2018).

3 Aim

The purpose of this research is to provide an overview of the underlying elements that contribute to pressure ulcers in patients who are undergoing intensive care. Additionally, the study aims to provide nursing professionals with solutions that they could employ to mitigate pressure ulcer occurrence.

3.1 Research Questions

1. What are the risk factors of pressure ulcers in intensive care patients?
2. What nursing practices can be employed to prevent the development of pressure ulcers in intensive care patients?

4 Theoretical Framework

Theoretical frameworks and theoretical models in nursing serve as valuable instruments for promoting excellence in nursing practice and therapeutic interventions (Younas & Quennell, 2019).The theoretical framework selected for this study is Jean Watson's Philosophy and Theory of Transpersonal Caring because of its focus on the human caring process and preventive interventions.

The core idea behind Watson's theory of Caring Science is that "human beings cannot be treated as objects and cannot be separated from self, other, nature, and the universe." Consequently, the theory is founded on the transpersonal caring that occurs at specific moments or during instances of care, along with the awareness of caring, which facilitates our healing (Delgado Galean, Ibáñez-Alfonso, Villamizar Carvajal & Durán de Villalobos, 2023).

In a moment of compassion, the nurse comprehends the entirety of the situation and can perceive the underlying dynamics, transcending the superficial aspects of the patient and their actions. The moment becomes one of profound connection when the nurse perceives and engages with the essence of others, embracing the vast potential of what may unfold. The connection between individuals enhances our empathy and nurturing spirit, sustaining the essence of our shared humanity (Watson, 2012).

Watson’s theory of human care posits that it is crucial for society to uphold the principles of human care. It further asserts that nurses are capable of exhibiting and engaging in acts of compassion. Providing care for patients fosters development; an environment rooted in compassion embraces individuals as they currently are, while envisioning their potential for the future. In this context, Watson articulated ten “carative” factors within her human care theory that nurses may employ, which include: the establishment of a humanistic-altruistic value system, the instillation of faith and hope, the nurturing of sensitivity towards oneself and others, the cultivation of a helping-trusting relationship, the acceptance of both positive and negative emotional expressions, providing a safe space for people to study and grow in all aspects of their being (mental, physical, social, and spiritual), using scientific methods to solve problems and make informed decisions, helping people accomplish their fundamental needs, and the allowance for existential-phenomenological influences (Watson, 1979 as cited in Watson, 2012).

5 Methodology

This study utilized a scoping review with descriptive analysis. Scoping reviews are an iterative and methodical method of finding and synthesising the current and prospective literature on a specific subject. (Thomas, Lubarsky, Durning & Young, 2017). It is a type of evidence synthesis that is aimed at finding and organising evidence that is pertinent to the reviewed subject, area, context, idea, or problem according to established inclusion criteria. Scoping reviews differ from traditional systematic reviews in that they use a more generalised review question to inform their methodology. Scoping reviews are a kind of systematic literature reviews that aim to find and synthesise all relevant published and emerging works on a specific subject. (Mak & Thomas, 2022).

A scoping review is mostly used to investigate and assess the degree of knowledge on a given issue in a certain field. (Thomas et al., 2017).It methodically examines and highlights the extent of evidence about a specific topic, field, concept, or issue, frequently regardless of the source within or among distinct contexts. It can elucidate essential concepts and definitions in the literature and assess the attributes of a concept, particularly those pertinent to methodological study. (Munn et al., 2022).

5.1 Data Collection

The initial phase of conducting a scoping review involves formulating a search strategy to identify pertinent data. During data collection, I utilised the "FINNA" search engine available on the Tritonia library website (Tritonia.fi), which provides complimentary access to e-journals, articles, and electronic databases affiliated with Novia University of Applied Sciences. Databases including EBSCO, CINAHL, Cochrane Library, and PubMed have been employed to explore pertinent articles associated with research enquiries.

5.1.1 Selection criteria

In the pursuit of data, it is vital to establish a search strategy that incorporates deliberate decisions regarding the delineation of selection criteria boundaries. This decision ought to be clear, ensuring that no bias is created. The criteria employed for the selection of pertinent articles in relation to the research questions will encompass both inclusion and exclusion parameters, as shown below.

5.1.1.1 Inclusion Criteria

Nine articles were used in this research study. Mainly, “AND” and “OR” Boolean operator has been included to combine keywords such as, “prevention of pressure ulcers OR pressure sores OR bed sores OR decubitus” AND “ICU OR critical care OR intensive care unit” AND “nursing interventions OR nursing care OR nursing support OR best practice OR nursing treatment” together for searching appropriate studies. Furthermore, studies written in English and published from the year 2014 – till date were included since the study was aimed at best and recent evidence-based practices. Materials type “e-articles” and “Full text available” were selected. Before selecting a relevant article, a title and an abstract were reviewed meticulously. Finally, all significant studies were applied for this thesis.

5.1.1.2 Exclusion Criteria

Studies using language other than English, inaccessible full text, and period before 2014 AD, were excluded from search *criteria*. After making this necessary adjustment, a PRISMA flow chart was then developed.

5.2 Prisma

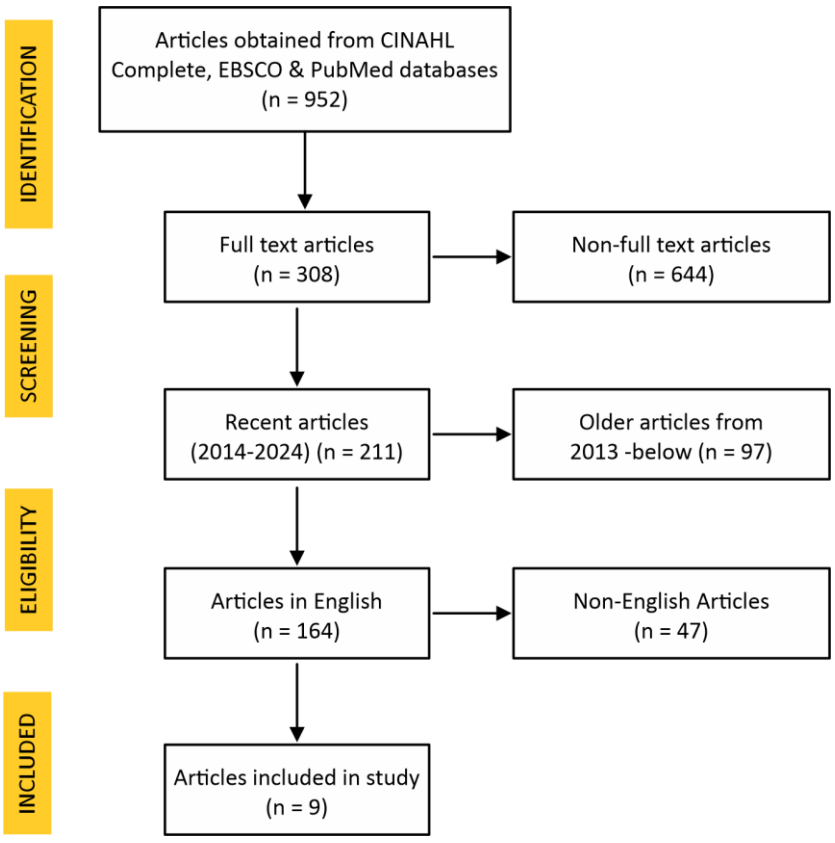


Figure 1: Prisma Flow Chart.

5.3 Data Analysis

This research employed descriptive analysis. Descriptive analysis is an essential element of any research, and thorough descriptive analysis is required to fully comprehend the features of the sample. In most research investigations, it is impossible to provide data on all participants. It defines and summarises the data by offering an overview of the relevant attributes of the sample. Descriptive statistics present essential information for the reader to comprehend the findings and ascertain their applicability to their patient, a vital element of evidence-based practice. (Fulk, 2023).

5.4 Ethical Consideration

In a literature review, exhibiting ethical considerations entails honouring the contributions of the authors whose works supports the thesis. A keen understanding of ethical principles is crucial for elevating research standards and mitigating the recurrence of mistakes. Numerous ethical considerations warrant meticulous attention, including integrity, reliability, accountability, the avoidance of result falsification, and the prevention of bias or plagiarism. To guarantee reliability, one must prioritise the quality of the research design, methodology, and analysis through meticulous planning, execution, and documentation of the research process.

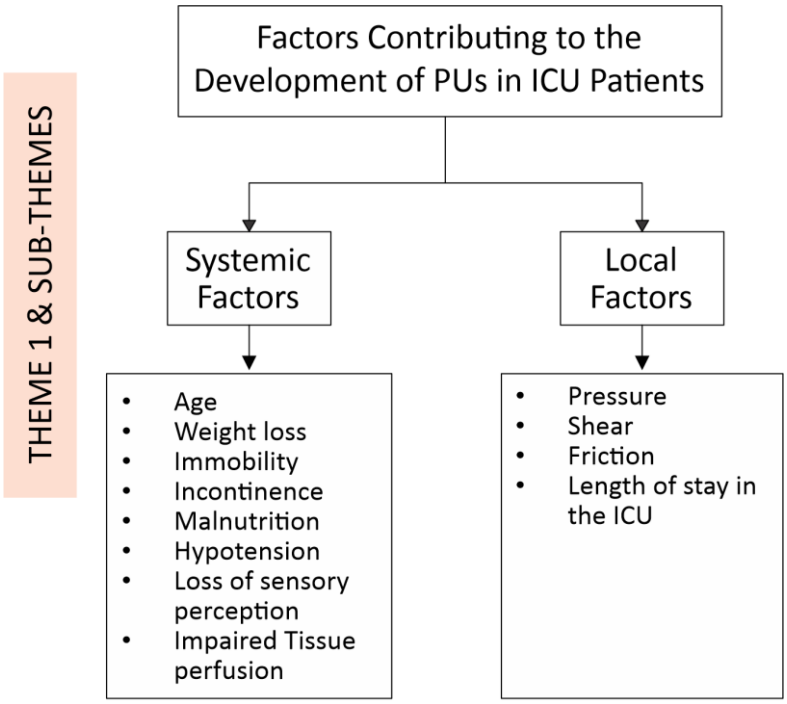
Furthermore, the implications of falsification and plagiarism in research encompass the misleading of research-derived knowledge, the misguidance of the research community, decision-makers, and the general populace, the devaluation of research outcomes, a lack of respect for academic inquiry, and the potential harm inflicted upon both researchers and research participants.

To circumvent unethical practices, researchers may adopt several cautious measures: meticulously cite and reference all utilised sources to prevent plagiarism, ensure that research findings are represented with accuracy, free from manipulation or distortion, uphold transparency in research methodologies and data management, avoid falsification, comply with ethical guidelines and standards established by relevant institutions and governing bodies, seek counsel from research integrity advisers while adhering to best practices in research conduct, consistently review and assess research methodologies to identify and rectify any potential ethical problems, and engage in responsible and ethical collaboration with peers and colleagues to maintain the integrity of research endeavours.

The meticulous citation of sources is essential to prevent the risks of both plagiarism and self-plagiarism in the process of engaging with and expanding upon established works. To address bias, it is essential to interact with articles that offer diverse perspectives. Furthermore, a comprehensive reading and understanding of the content are crucial to prevent misinterpretation of the author's arguments (TENK, 2019).

6 Results Findings

A total of nine scientific articles were carefully chosen based on defined inclusion and exclusion criteria to fulfil the objectives of the thesis. The articles have been carefully summarised and organised, categorising them by study name, authors, research objectives, methodology, and findings, as detailed in Appendix 5. A deductive methodology was employed to conduct a descriptive analysis of the data. Through this examination, and considering the research enquiries, literature reviews, and theoretical constructs, two principal themes emerged: factors contributing to the development of PUs in ICU patients and effective nursing strategies in prevention of PUs in ICU patients. Every theme is segmented into categories and subcategories, as elaborated below.



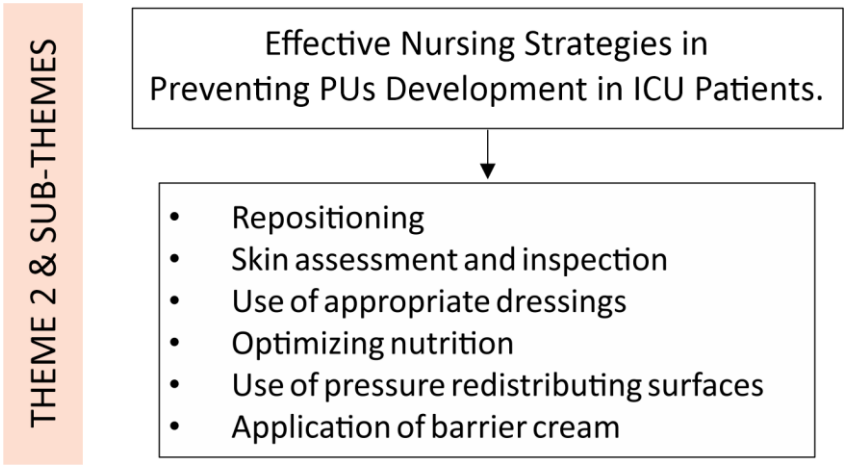


Figure 2: Overview of Themes, Categories and Sub-Categories

6.1 Factors Contributing to the Development of PUs in ICU Patients

The most common cause of PUs is tissue damage resulting from restricted blood supply to a particular area of the skin. Predisposing factors leading to PU development include systemic factors and local factors.

6.1.1 Systemic Factors

Systemic factors encompass the internal elements that play a role in the formation of PUs. The factors include age, weight loss, immobility, incontinence, malnutrition, hypotension, loss of sensory perception, and impaired tissue perfusion.

Age serves as a significant factor in the formation of PUs, as highlighted in the research conducted by Lima Benevides Fonseca, Victor Coutinho, Braga Gomes Tomé, do Amaral Gubert and Karanini Paz de Oliveira (2017) and (Bai, Liu, Chou, and Hsu (2020). This was further emphasised by research conducted by Chen et al. (2022), which elucidated that elderly patients suffering from liver failure exhibit a higher vulnerability to PUs due to factors such as diminished skin integrity, insufficient support and elasticity, a decelerated metabolic rate, and challenges in the recovery process following injury. Wang et al., (2021) concurred that research indicates a significant correlation between the incidence of PUs in elderly patients who are confined to bed for extended periods and their age. Patients in the ICU who are elderly exhibit diminished skin elasticity, with the majority presenting in a state characterised by looseness and dryness. With advancing age, there is a reduction in

the patient's subcutaneous capillaries, leading to a thinning of the skin. The patient's skin exhibits resilience to external environmental factors.

Additionally, oxygenation and perfusion of tissues are systemic risk factors for PU development. One of the major causes of pressure injuries in patients in intensive care is changes in perfusion, which is the circulation of blood enriched with oxygen to the tissues. Research indicates that suboptimal perfusion, as indirectly indicated by elevated lactic acid levels or reduced oxygenation, adversely impacts healing outcomes (Alderden et al., 2019). A study by Cox and Schallom (2017) revealed that the risk factor with the highest consensus among participants was impaired tissue perfusion, with an agreement rate of 81% based on a sample size of 266. The intrinsic conditions present in critically ill patients encompass unstable haemodynamic status during repositioning, significant cardiopulmonary compromise resulting in diminished tissue oxygenation and inadequate tissue perfusion, shock states, and the administration of vasoactive medications aimed at elevating mean arterial pressure in those facing hypotension and compromised tissue perfusion. These conditions are recognised as non-modifiable risk factors that may lead to inevitable PU. This was similarly identified as a risk factor by the authors Almeida et al. (2020); Cox et al. (2022); Edsberg et al. (2022).

Malnutrition is regarded as an intrinsic factor contributing to the development of PUs, standing as the second most significant risk factor following stress. Malnutrition leads to a deterioration in immune function and the regulation of stress metabolism, resulting in muscle atrophy and a reduction in subcutaneous fat. The localised skin tissue, when compressed, is deprived of the protecting layers of muscle and fat, resulting in a diminished capacity to endure pressure. This condition increases the susceptibility to local circulatory disturbances and the development of PUs (Chen et al., 2022). Numerous studies (Almeida et al., 2020; Bai et al., 2020; Cox & Schallom, 2017; Edsberg et al., 2022; Wang et al., 2021) have listed malnutrition or nutritional imbalance as a significant risk factor contributing to the development of PUs.

The phenomenon of immobility or inactivity emerges as a significant contributor to the development of PUs in patients within the intensive care unit, as evidenced by research conducted by Bai et al. (2020) and Lima Benevides et al. (2017). The findings of Cox & Schallom (2017) indicated that nurses recognised immobility as a risk factor for unavoidable PUs, a conclusion that aligns with the outcomes of the 2014 consensus

conference. The phenomenon of immobility constitutes a significant risk factor for the development of pressure injuries, which is evaluated through the application of standardised risk assessment instruments, including the Braden Scale. The discussion highlighted that in critical care scenarios, immobility can be essential due to the unstable haemodynamic status that may arise from repositioning, traumatic injuries like unstable pelvic fractures, or an overall need to manage a critically ill patient in a vulnerable position. Nonetheless, in numerous clinical contexts, immobility remains an essential aspect of patient care. A study conducted by Edsberg et al. (2022) posited that immobility represents the most significant risk factor for the onset of PUs, as their findings indicated that patients experiencing immobility exhibited the highest severity of PUs.

The impairment of sensory perception resulting from the administration of sedatives or analgesics represents a significant element in the emergence of PUs among patients in the ICU (Bai et al., 2020; Edsberg et al., 2022; Lima Benevides et al., 2017). Additional systemic risk factors identified by various researchers include weight loss (Chen et al., 2022; Lima Benevides et al., 2017; Wang et al., 2021), hypotension (Cox et al., 2022; Edsberg et al., 2022; Lima Benevides et al., 2017), and incontinence (Bai et al., 2020; Cox & Schallom, 2017; Lima Benevides et al., 2017).

6.1.2 Local Factors

Local factors pertain to external factors that contribute to the development of PUs in patients within the intensive care unit. These factors include pressure, shear, friction, and duration of stay in the ICU.

According to Chen et al. (2022), pressure serves as the most immediate factor contributing to the development of PUs. Long-term bed rest denotes a state wherein significant parts of the body, particularly the sacrococcygeal region and buttocks when supine, the sacrococcygeal area in a semi-sitting posture, and the shoulders and buttocks in a lateral orientation, experience sustained pressure. This condition results in skin pressure and obstruction, disrupting microvascular circulation. Consequently, it leads to localised tissue ischaemia and hypoxia, along with a deficiency in nutrient supply, culminating in necrosis and the eventual development of PUs. Tissue damage is thought to be intricately connected to both the magnitude of pressure applied and the length of time that compression is sustained. Should the pressure surpass 9.3kPa for a duration of 2 hours, it may result in

irreversible harm to tissue cells. Bai et al. (2020; Lima Benevides et al. (2017); Wang et al. (2021) have also identified this as a significant risk factor for PUs.

Bai et al. (2020) articulated that shear is a mechanical force generated by a tangential load, which induces a sliding motion of the body against the resistance encountered between a contact surface and the skin. During the occurrence of shear, the dermis and epidermis maintain their position, whereas the skeleton moves in conjunction with the deep fascia. This may result in alterations within the lymphatic system and blood vessels, potentially culminating in capillary occlusion and thrombosis. According to Chen et al. (2022), the percolating tissue experiences shear force that induces relative transverse displacement in the soft tissue, resulting in the twisting of the deep blood vessels within the superficial fascia. Prolonged twisting can result in inadequate blood supply over an extensive region, potentially causing micro thrombosis and diminished tissue oxygen levels. Shear forces pose a significant threat, capable of inflicting irreversible harm on deep tissues within a mere 30 minutes, while the indicators of damage to the skin's surface may remain subtle or entirely imperceptible. The influence of shear forces on blood vessels and the dynamics of blood circulation is more detrimental than that of pressure. The coexistence of both factors correlates with an increased incidence of PUs. Wang et al. (2021) articulated that the compressive forces exerted by the pelvis, alongside shear forces induced by static or dynamic frictional interactions—such as when a patient descends in the bed due to gravitational pull or during repositioning—subject the soft tissues surrounding the sacrum to prolonged deformations, potentially resulting in a PU.

Friction, as defined by Bai et al. (2020), is a mechanical force that arises when two surfaces navigate one another, generating resistance at the interface between the contact surface and the skin. The interaction between friction and skin epithelial tissues results in the outer layer of the skin protecting the stratum corneum, which subsequently leads to an elevation in local skin temperature, tissue metabolism, and oxygen consumption. PUs tend to manifest in tissues that are subjected to compression, ischaemia, and hypoxia. (Chen et al., 2022).

Bai et al. (2020) and Edsberg et al. (2022) posited that an extended duration of stay in the ICU constitutes an additional risk factor for the development of PUs.

6.2 Effective Nursing Strategies for the Prevention of PUs in ICU Patients

Critical care nurses are required to effectively navigate the complexities of preventing adverse patient safety conditions, such as PUs, within an environment where numerous competing and frequently lifesaving technologies demand priority. Critical care nurses, positioned as primary carers, shoulder a huge portion of the responsibility for executing strategies aimed at preventing PUs. Several strategies can be effectively employed to prevent the onset of PUs, including repositioning, utilising pressure redistributing surfaces or mattresses, optimising nutritional intake, conducting thorough skin assessments and inspections, applying barrier creams, and selecting suitable dressings.

6.2.1 Repositioning

Consistent manual repositioning, such as turning every two hours, serves as a proficient method for the prevention of PUs by alleviating or redistributing pressure from specific areas of the body (Bai et al., 2020). Edsberg et al. (2022) noted in their study that routine repositioning has been associated with a 14% reduction in the likelihood of hospital-acquired PUs. Cox et al. (2022) concurred that repositioning constitutes one of the five strategies for preventing PUs. Almeida et al. (2020) posited the necessity of formulating repositioning plans that define the frequency and duration of positional transitions. The analysis of the scales revealed that the alternation period varied between 2 and 4 hours.

6.2.2 Pressure Redistributing Surfaces

In addition to manual repositioning, employing a pressure-relieving support surface serves as an alternative method for redistributing pressure by minimising shear or friction between the user and the surface (Bai et al., 2020). Friction manifests in numerous contexts, particularly in the presence of creases and remnants on the surface of the sheet. Furthermore, increased resistance will be observed as the patient engages in movement. According to Chen et al. (2022), there is a significant necessity for an effective pressure redistributing surface to assist in the prevention of PUs in patients within the ICU. Support surfaces, including mattresses, cushions, and pillows designed for pressure redistribution, play a crucial role in mitigating the risk of PUs. The occurrence of PU development is markedly reduced in patients using these devices designed to distribute pressure and safeguard bony prominences (Lima Benevides et al., 2017).

Support surfaces are used to facilitate the redistribution of pressure, aimed at managing tissue loads, microclimate, and therapeutic functions (such as mattresses, integrated bed systems, mattress replacements, overlay mattresses, seat cushions, or seat cushion overlays). The selection ought to emphasise the unique requirements of each individual, considering the patient's necessity for pressure redistribution and various therapeutic functions. (Almeida et al., 2020).

Linens are commonly employed beneath patients; however, they can influence the characteristics of support surfaces. This includes the mattress's capacity for microclimate management, as they may impede airflow in low-air-loss systems, as well as its effectiveness in pressure redistribution. (Edsberg et al., 2022).

According to Alderden et al. (2019), if the area's pressure cannot be eased, nurses should think about using a sophisticated support surface and positioning devices that enable "bridging" to bring the pressure down to neighboring tissues.

While air-filled and water-filled support surfaces serve particular purposes in the prevention of PUs, their cost-effectiveness and practicality are questionable. Alternatively, foam mattresses or overlays, particularly those designed with pressure redistributing properties, have emerged as a favoured approach to mitigating the onset of PUs while maintaining patient comfort. The current investigation reveals that pressure redistributing foam mattresses (PRFM) exhibit superior support characteristics, enhanced cushioning quality, and improved elasticity compared to non-pressure redistributing foam mattresses (NPRFM). The physical attributes of the PRFM facilitate an optimal contact area between the body and the mattress surface, thereby diminishing the potential mechanical force exerted by the mattress and effectively lowering the interface pressure. An examination was conducted on a mattress composed of identical materials to assess its efficacy in alleviating pressure. The findings indicated that the average body pressure experienced was 17.2% lower in comparison to a conventional nursing institutional mattress. The primary distinctions between PRFM and NPRFM encompass thickness, density, firmness (or stiffness), and elasticity, all of which significantly influence the pressure-distributing characteristics of foam mattresses. The relationship between thickness and density significantly influences the supportive qualities of a foam mattress, where increased thickness and density correlate with enhanced bodily support. Among the participants, 1.6% of the patients using a PRFM experienced PUs, in contrast to 10.2% of those using an

NPRFM. In comparison to the NPRFM, the PRFM demonstrated an 88% decrease in the probability of developing PUs. The study findings indicate that this PRFM resulted in an average delay of 4.2 days in the onset of PUs when compared to the NPRFM. (Bai et al., 2020).

The silicone mattress consists of an innovative semisolid material, featuring an outer layer encased in silicone and an inner layer composed of silicone gel. This mattress exhibits a remarkable lack of fluidity while maintaining commendable flexibility and resistance to pressure, allowing it to conform seamlessly to the contours of the human body. Furthermore, its surface is characterized by a smooth texture, waterproof properties, and resistance to pollution, enabling multiple uses post-disinfection without causing harm to human skin. Additionally, it possesses exceptional airtightness, X-ray transmission capabilities, and static electricity. In regions susceptible to PUs, particularly around bony prominences, the application of silicone mattresses facilitates an even distribution of the patient's weight, thereby augmenting the area of force. This mechanism significantly diminishes pressure, shear, and friction on a per-unit-area basis of the skin, thereby preventing skin damage and the onset of PUs. The utilisation of the mattress serves to proficiently modulate the shearing force, thereby preventing deep tissue injury. Moreso, the polished texture of the material significantly mitigates the risk of friction. (Chen et al., 2022).

6.2.3 Skin Assessment and Inspection

The skin serves as the main defence for immunity and is more susceptible to wound infections when the immune function of critically ill patients is compromised(Chen et al., 2022). Cox et al. (2022) indicate that skin assessment constitutes one of the five strategies which are: skin assessment, support surface (pressure redistribution) use, repositioning, moisture management, and nutritional support for preventing PUs. A thorough evaluation of the skin surface facilitates the timely identification of PUs, thereby contributing to their prevention. Timely identification is crucial in ICU patients to implement measures that avert its complete progression.

Skin assessment must identify hyperaemic regions, evaluate the risk or manifestation of lesions induced by medical devices, assess existing lesions, determine the quality of wound healing, and monitor the progression or regression of skin quality following the

implementation of preventive measures. Consequently, individuals identified as considerable risk ought to undergo re-evaluation with increased regularity. (Almeida et al., 2020).

6.2.4 Optimizing Nutrition

Proper nutrition is integral to both the treatment and prevention of PUs (Edsberg et al., 2022). The significance of nutrition has been demonstrated as a crucial element in preventive care concerning PUs. Nutritional screening serves as a method of identifying patients requiring a comprehensive evaluation of their nutritional status, prompted by qualities that may predispose them to potential nutritional risk. Competent nursing professionals are authorised to conduct such screenings upon a patient's admission to the healthcare facility or during the initial outpatient consultation. (Almeida et al., 2020)

6.2.5 Application of Barrier Cream

To reduce the risk of damage, it is important to continuously maintain clean and dry skin using pH-balanced skin products. Suggestions were made to avoid massaging areas that are already reddened or hyperaemic especially for elderly patients. Patients with incontinence problems should have a specific care plan that includes immediate cleaning after each episode. Emollients can hydrate dry skin portions and prevent further damage. It is important to recognise that these creams should not be applied using massage techniques. (Almeida et al., 2020). Alderden et al. (2019) concurred, proposing that if faecal incontinence is not amenable to medical management, a protective cream or ointment that offers a moisture barrier might be a more advantageous alternative to a dressing that could potentially entrap faeces beneath it.

6.2.6 Use of Appropriate Dressings

In their research, Wang et al. (2021) proposed Mepilex, a self-adhesive, conventional foam dressing composed of soft silicone with potent absorption capabilities, as suitable in helping prevent the development of PUs. This dressing can function as a protective film on the skin's surface, decrease friction, lessen skin damage and bedsores, and even use moisture. Furthermore, the results of their study showed that the dressing group had a 5.56 percent lower incidence of skin complications compared to the control group, demonstrating that the Mepilex dressing effectively absorbs skin secretions, keeps the skin

dry, and maintains an ideal temperature, all of which contribute to the prevention and development of PU.

According to Chen et al. (2022), hydrocolloid dressings, which are made of elastic polymer hydrogels, synthetic rubbers, and viscous materials, can absorb exudate and retain moisture, which is crucial for preventing PUs in ICU patients suffering from liver failure. These dressings also have excellent airtightness, which helps to prevent microbial invasion. Alderden et al. (2019) in their study also found that the dressing that is applied over a cleansed stage 2 PU should ensure that the wound bed remains moist and due to their extended wear length, hydrocolloid dressings was suggested as an excellent choice for stage 2 PUs.

7 Discussion

This section explores the interpretation of the research findings, demonstrating the connection between the theoretical framework and the research conducted. It further demonstrates how these elements collectively engage with the study's objectives and research enquiries, which centre on the function of nurses in the prevention of PUs in critically ill patients within the ICU.

7.1.1 Discussion of Result

The study revealed the underlying factors contributing to PUs in critically ill patients within the ICU, as well as the nursing strategies that could be effectively employed to avert their occurrence.

The first theme highlighted the factors leading to PU development in critically ill patient. A significant amount of research indicates that systemic factors influencing the emergence of PUs in the ICU encompass tissue perfusion, age, malnutrition, immobility, or inactivity, diminished sensory perception attributable to sedative use, weight loss, hypotension, and incontinence. In contrast, local factors consist of pressure, shear, friction, and the extended duration of patient stays in the ICU. (Bai et al., 2020; Chen et al., 2022; Cox & Schallom, 2017; Edsberg et al., 2022; Lima Benevides et al., 2017; Wang et al., 2021).

As patients age, the likelihood of developing PUs increases, attributable to the reduction in skin elasticity, a slower healing process, and a decrease in capillary density (Wang et al., 2021). Furthermore, diminished oxygen levels that impair tissue perfusion heighten the probability of a critically ill patient experiencing PUs (Cox & Schallom, 2017). The study conducted by Chen et al. (2022) demonstrated that inadequate nutritional status results in the depletion of the skin's protective subcutaneous fat and muscle atrophy, thereby impairing the body's capacity to heal or withstand pressure. Immobility, a significant risk factor for PUs, is particularly prevalent among ICU patients. Prolonged inactivity hinders these individuals from relieving pressure points, thereby facilitating the development of PUs (Edsberg et al., 2022). Additional considerations, including diminished sensory perception resulting from sedative use, weight reduction, incontinence, and hypotension, were also incorporated into the systemic risk factors associated with critically ill patients.

In examining the local causative factors, it was determined that pressure serves as the most immediate cause of PUs. The phenomenon of shear, characterised by the sliding motion of a body against a surface, results in severe damage to deep tissues and disrupts blood circulation, potentially culminating in the formation of PUs. The presence of friction exacerbates the skin's susceptibility by eroding its protective layers, consequently leaving it exposed and facilitating the onset of PU (Bai et al., 2020; Wang et al., 2021). Ultimately, an extended duration in the ICU complicates the likelihood of PU formation. Prolonged bedrest subjects the critically ill patient to various local factors, consequently undermining circulation and diminishing the integrity of the skin (Bai et al., 2020).

The second theme laid out various strategies that may be employed to prevent the onset of PUs in critically ill patients. ICU nurses assume a vital responsibility in the prevention of PUs through the skilled application of a comprehensive strategy that integrates repositioning, pressure distribution surfaces, meticulous skin evaluations, nutritional assistance, the application of barrier creams, and appropriate dressings.

Repositioning emerged as the essential strategy for preventing PUs, as it effectively reduces pressure on specific areas of the body that are susceptible to injury, including the sacrum and heels. Edsberg et al. (2022) proposed that repositioning should occur every two hours, as their research indicated a 14% decrease in PUs following this intervention. Almeida et al. (2020) and Cox et al. (2022) concluded in their study that the duration and frequency of repositioning should be customised to meet the specific needs of each patient.

To alleviate pressure, it is essential to use surfaces that redistribute pressure, such as air-filled or silicone mattresses and cushions, to minimise shear and decrease friction. The findings of the study conducted by Bai et al. (2020) indicated a significant reduction of approximately 88% in the incidence of PUs with the utilisation of pressure redistributing foam mattresses. Chen et al. (2022) further proposed the use of silicon mattresses that conform to the body's contours and evenly distribute weight, thus reducing shear and frictional forces.

Cox et al. (2022) emphasise the necessity of conducting routine skin assessments with increased frequency, particularly in patients identified as elevated risk. Chen et al. (2022) advocated for a thorough examination of lesions, alterations in skin quality, and hyperaemia to implement essential measures aimed at preventing progression to PUs.

Given the critical role of proper nutrition in the context of PU, it is imperative for nurses to conduct regular nutritional screenings, particularly at the time of admission, to identify and address any potential deficiencies in the patient’s diet. (Almeida et al., 2020).

Alderden et al. (2019) advocated for the application of protective creams in instances of faecal incontinence, positing that they represent a superior alternative. Almeida et al. (2020) concurred that patients subjected to moisture due to incontinence, and thus at risk of maceration, should be treated with barrier creams to safeguard the skin against moisture-related damage.

Mepilex and hydrocolloid dressings establish a protective barrier that diminishes friction and sustains a moist wound environment, thereby facilitating the healing process. It also prevents infections and dryness of the skin. (Chen et al., 2022; Wang et al., 2021)

7.1.2 Discussion of the Theoretical Framework

Watson’s theory of transpersonal caring emphasises the significance of perceiving patients as complete entities. It presents ten carative factors that enable nurses to deliver compassionate, patient-centered care, facilitating healing, growth, and cultivating an environment that supports both individual and societal well-being.

A nurse's capacity to perceive a patient's emotional and spiritual well-being in addition to their physical health depends on her awareness of and connection to the power of

universal love and care, as well as her skill in entering the patient's physical space or phenomenal field. (Sitzman & Watson, 2018)

Intentionality and self-awareness on the part of the nurse in affirming the patient's subjective spiritual value while she strives to provide care in the face of danger and despair form the basis of the transpersonal caritas relationship. When a carer and care recipient share a bond characterised by mutual support, love, compassion, and trust, the result is a state of mental, physical, and spiritual balance. The definition of intentional presence is a selfless decision that arises from a place of moral excellence and disinterest. Respecting and making sense of the one-of-a-kind nature of each individual and the dynamic between nurse and patient is the overarching goal of this humanistic approach to nursing. A nurse saves a life when she reacts kindly to a patient's needs to lessen the severity of an actual or perceived danger to the patient's integrity. To address this, we must combine the scientific and humanistic perspectives, which are fundamental to compassion. Positive staff behaviour in critical care units can make an enormous difference in the mental health and recovery outcomes for patients and their families, as well as in their trust in the medical staff as a whole (Delgado Galeano et al., 2023). To apply this includes the implementation of pressure-relieving surfaces and the maintenance of a hazard-free environment to mitigate the risk of PUs. Additionally, the nurse fosters a setting devoid of anxiety and stress, both of which can hinder the healing process. The nurse also addresses essential human needs by managing pain, ensuring proper nutrition and hydration for optimal skin health, and tackling issues related to incontinence that may predispose a patient to the development of PUs.

In conclusion, Jean Watson’s theory of transpersonal care serves as an exemplary framework for this study, providing a structured approach for nurses to implement optimal practices, foster a secure environment, and engage both patients and their families in the prevention of PUs.

7.1.3 Discussion of the Methodology’s Strengths and Limitations

This study employed descriptive analysis, as it was considered appropriate for effectively addressing the research question and objectives. The prevention of PUs is crucial in mitigating the onset of additional health complications and in managing escalating

healthcare expenditures. It consequently possesses significant importance for evidence-based healthcare, improving patient care and influencing the trajectory of forthcoming research in this domain. The strength of this study lies in the meticulous methodology employed to identify, select, and evaluate pertinent studies, thereby minimising bias. Furthermore, through the synthesis of multiple studies, it yields valuable insights that foster an impartial assessment.

Nonetheless, the research does present certain constraints. The quality of a scoping review is inherently linked to the quality of the underlying studies used; thus, if the primary studies exhibit variability in quality, it decreases the credibility of the results and summaries gathered from the review. The limitation of the search to studies published in particular languages may foster the development of language bias. Furthermore, some studies may fail to disclose all pertinent data, thus creating obstacles for the reviewer.

8 Conclusion

This comprehensive review examines the entirety of nursing interventions recorded in the literature aimed at preventing PUs within critical care environments. The study provides insightful recommendations concerning the application of evidence-based strategies for the prevention of PUs, including regular repositioning, the use of barrier creams and suitable dressings, the implementation of pressure redistributing surfaces, the optimisation of nutrition, and comprehensive skin assessment and inspection. The execution of interventions aimed at preventing PUs led to a significant reduction in both the occurrence and intensity of PUs throughout all studies encompassed in this review. To improve the results for critically ill patients, it is essential to implement strategies for PU prevention that are grounded in evidence-based practices. Moreover, it is essential for nurses to undergo extensive education and clinical training to fully grasp their crucial responsibilities in the prevention of PU.

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Appendices

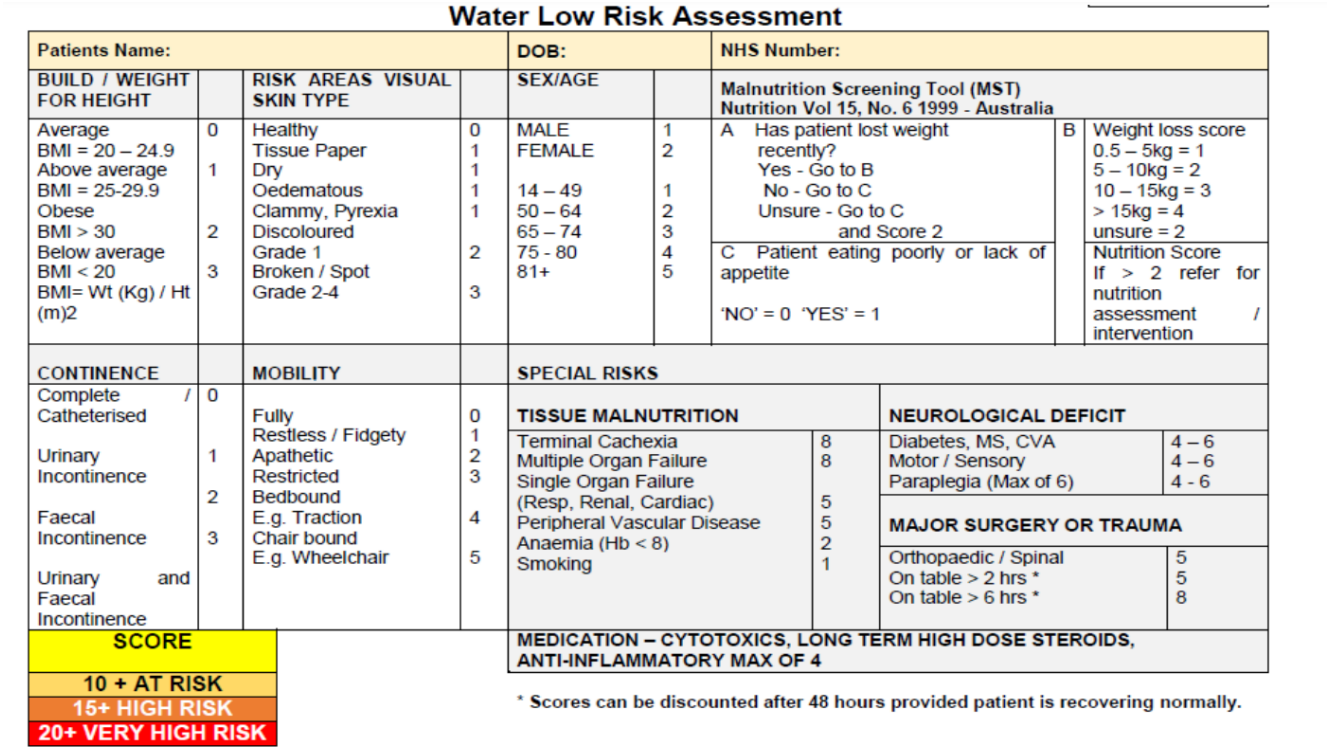
Appendix 1: Braden Scale

Braden Scale (Adult)

Sensory perception Ability to respond meaningfully to pressure-related discomfort	1. **Completely Limited**: Unresponsive (does not moan, flinch, or gasp) to painful stimuli due to diminished level of consciousness or sedation. Or Limited ability to feel pain over most of body surface.	2. **Very limited**: Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness. Or Has a sensory impairment which limits the ability to feel pain or discomfort over ½ the body.	3. **Slightly limited**: Responds to verbal commands but cannot always communicate discomfort or need to be turned. OR Has sensory impairment that limits ability to feel pain or discomfort in 1 or 2 extremities.	4. **No impairment**: Responds to verbal commands. Has no sensory deficit which will limit ability to feel or voice pain or discomfort.
Moisture Degree to which skin is exposed to moisture	1. **Consistently Moist**: Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	2. **Moist**: Skin is often but not always moist. Linen must be changed at least one a shift.	3. **Occasionally moist**: Skin is occasionally moist, requiring an extra linen change approximately once a day.	4. **Rarely moist**: Skin is usually dry, linen required changing only at routine intervals.
Activity Degree of physical activity	1. **Bedfast**: Confined to bed	2. **Chairfast**: Ability to walk is severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	3. **Walks occasionally**: Walks occasionally during day but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.	4. **Walks frequently**: Walks outside the room at least twice a day and inside room at least once every 2 hours during waking hours.
Mobility Ability to change and control body position	1. **Completely Immobile**: Does not make even slight changes in body or extremity position without assistance.	2. **Very limited**: Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	3. **Slightly limited**: Makes frequent though slight changes in body extremity position independently.	4. **No limitations**: Makes major and frequent changes in position without assistance.
Nutrition Usual food intake pattern	1. **Very Poor**: Never eats a complete meal. Rarely eats more than ⅓ of any food offered. Eats 2 servings or less protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement. Or Is NPO' and/or maintained on clear liquids or IV for more than 5 days.	2. **Probably inadequate**: Rarely eats a complete meal and generally eats only about ½ of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement. Or Receives less than optimum amount of liquid diet or tube feeding.	3. **Adequate**: Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products) each day. Occasionally will refuse a meal but will usually take a supplement if offered. Or Is on a tube feeding or TPN regimen, which probably meets most of nutritional needs.	4. **Excellent**: Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.
Friction and Shear	1. **Problem**: Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures, or agitation leads to almost constant friction.	2. **Potential problem**: Moves feebly or requires minimum assistance. During a move, skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	3. **No apparent problem**: Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times.	

Source: https://www.mghpcs.org/EED/SK/Assets/images/sk/resources/Braden-Scale-Adult.png

Appendix 2: Waterlow Scale



Water Low Risk Assessment

Patients Name:				DOB:		NHS Number:		
BUILD / WEIGHT FOR HEIGHT		**RISK AREAS VISUAL SKIN TYPE**		**SEX/AGE**		**Malnutrition Screening Tool (MST) Nutrition Vol 15, No. 6 1999 - Australia**		
Average BMI = 20 – 24.9	0	Healthy	0	MALE	1	A Has patient lost weight recently? Yes - Go to B No - Go to C Unsure - Go to C and Score 2	B	Weight loss score 0.5 – 5kg = 1 5 – 10kg = 2 10 – 15kg = 3 > 15kg = 4 unsure = 2
Above average BMI = 25-29.9	1	Tissue Paper Dry Oedematous	1 1 1	FEMALE	2			
Obese BMI > 30	2	Clammy, Pyrexia Discoloured	1 2	14 – 49 50 – 64	1 2			
Below average BMI < 20	3	Grade 1 Broken / Spot	2	65 – 74 75 - 80	3 4	C Patient eating poorly or lack of appetite		Nutrition Score If > 2 refer for nutrition assessment / intervention
BMI= Wt (Kg) / Ht (m)2		Grade 2-4	3	81+	5	'NO' = 0 'YES' = 1		

CONTINENCE		**MOBILITY**		**SPECIAL RISKS**			
Complete / Catheterised	0	Fully	0	**TISSUE MALNUTRITION**		**NEUROLOGICAL DEFICIT**	
Urinary Incontinence	1	Restless / Fidgety Apathetic	1 2	Terminal Cachexia	8	Diabetes, MS, CVA	4 – 6
	2	Restricted Bedbound	3	Multiple Organ Failure	8	Motor / Sensory	4 – 6
Faecal Incontinence	3	E.g. Traction	4	Single Organ Failure (Resp, Renal, Cardiac)	5	Paraplegia (Max of 6)	4 - 6
		Chair bound		Peripheral Vascular Disease	5	**MAJOR SURGERY OR TRAUMA**	
Urinary and Faecal Incontinence		E.g. Wheelchair	5	Anaemia (Hb < 8)	2	Orthopaedic / Spinal	5
				Smoking	1	On table > 2 hrs *	5
						On table > 6 hrs *	8

SCORE
10 + AT RISK
15+ HIGH RISK
20+ VERY HIGH RISK

MEDICATION – CYTOTOXICS, LONG TERM HIGH DOSE STEROIDS, ANTI-INFLAMMATORY MAX OF 4

*** Scores can be discounted after 48 hours provided patient is recovering normally.**

Source:
https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.berkshirehealthcare.nhs.uk%2Fmedia%2F109514503%2Fappendix-2-water-low-risk-assessment-pressure-ulcer-doc.pdf&psig=AOvVaw1BqdOezQGiar39Xjm3pr6M&ust=1730848586553000&source=images&cd=vfe&opi=89978449&ved=0CBQQjRxqFwoTCKi4o87nw4kDFQAAAAAdAAAAABAE

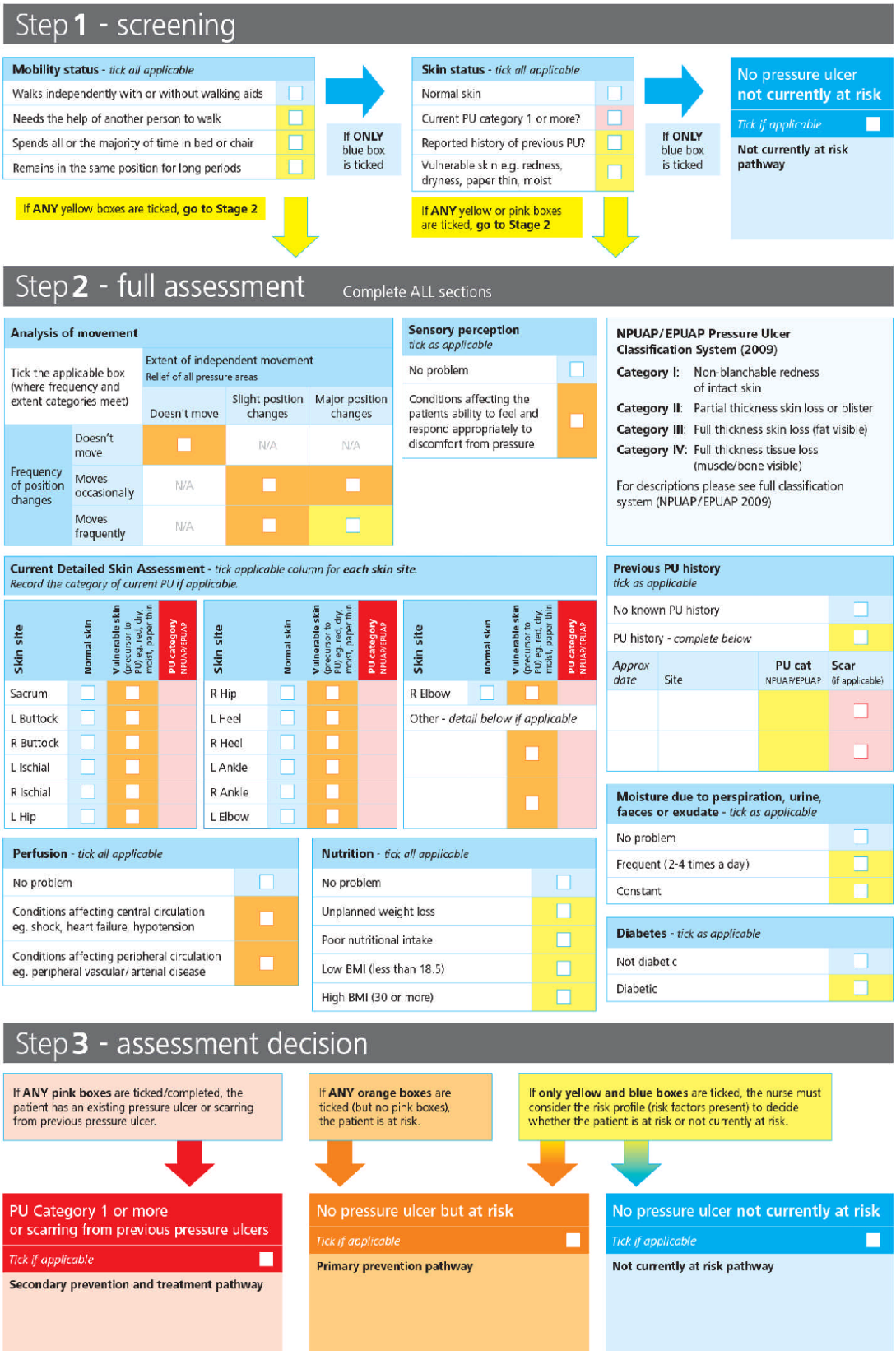
Appendix 3: Norton Scale

Physical Condition	Good	4
	Fair	3
	Poor	2
	Very Bad	1
Mental Condition	Alert	4
	Apathetic	3
	Confused	2
	Stuporous	1
Activity	Ambulant	4
	Walks with help	3
	Chairbound	2
	Bedfast	1
Mobility	Full	4
	Slightly Impaired	3
	Very Limited	2
	Immobile	1
Incontinence	None	4
	Occasional	3
	Usually Urinary	2
	Urinary and Fecal	1

Greater than 18	Low Risk
Between 18 and 14	Medium risk
Between 14 and 10	High Risk
Lesser than 10	Very High Risk

Source: https://www.researchgate.net/profile/Stanislaw-Stawicki/publication/36447782/figure/fig7/AS:309877827227652@1450892039165/Norton-scale-for-pressure-ulcer-risk-assessment-This-scale-was-created-in-England-in_W640.jpg

Appendix 4: PURPOSE-T Scale



Source: https://www.semanticscholar.org/paper/The-development-of-a-Pressure-Ulcer-Risk-Assessment-Coleman/7f74522d9fbaae5ff9fc1b337fe40730e5928c51/figure/40

Appendix 5

Author and Journal	Name of study	Aim	Method	Result
Alderden, J., et al. (2019)	Outcomes Associated with Stage 2 Pressure Injuries Among Surgical Critical Care Patients: A Retrospective Cohort Study	To examine outcomes of stage 2 hospital-acquired pressure injuries among critical care patients and identify factors associated with nonhealing stage 2 hospital-acquired pressure injuries.	Electronic health record data were used to identify surgical critical care patients with stage 2 hospital-acquired pressure injuries at a level I trauma center. Univariate Cox regressions were used to identify factors associated with healed stage 2 hospital-acquired pressure injuries.	Of 6376 surgical critical care patients, 298 (4.7%) developed stage 2 hospital-acquired pressure injuries; complete data were available for 253 patients. Of these 253 patients, 160 (63%) had unhealed pressure injuries at hospital discharge.
Bai, D., et al. (2020)	Relationship Between a Pressure Redistributing Foam Mattress and Pressure Injuries: An Observational Prospective Cohort Study	To examine the relationship between pressure redistributing foam mattress and development of pressure injuries	An observational prospective cohort study design was employed.	The overall incidence of pressure injuries was 5.9% with 1.6% for participants that used pressure redistributing foam mattress and 10.2% for participants that used non pressure redistributing foam mattress. The study concluded that the use of pressure redistributing foam mattress led to an 88% reduction in the risk of pressure ulcer development and postponed occurrence of pressure injuries by 4.2 days on average.

Chen, S., et al. (2022)	Effects of Silicone Mattress Combined with Hydrocolloid Dressing on Pressure Ulcers and Phlebitis in ICU Patients with Liver Failure	To clarify the application effect of silicone mattress combined with hydrocolloid dressing in ICU patients with liver failure	86 patients with liver failure admitted to the intensive care unit (ICU) of the Fifth Medical Center of Chinese PLA General Hospital from September 2018 to September 2020 were selected as the research subjects.	The incidence of pressure ulcers in group B (6.98%) was lower than that in group A (25.58%). The incidence of phlebitis in group B was lower than that in group A (20.93% vs. 53.49%). A higher nursing satisfaction was determined in group B compared with group A (93.02% vs. 76.74%).
Cox, J. et al. (2022)	Pressure Injuries in Critical Care Patients in US Hospitals	To examine pressure injury (PI) prevalence, PI risk factors, and prevention practices among adult critically ill patients in critical care units in the United States using the International Pressure Ulcer Prevalence™ (IPUP) Survey database from 2018 to 2019.	Overall critical care PI prevalence and hospital-acquired PI (HAPI) rates were obtained and analysed using the 2018/2019 IPUP survey database.	The overall PI prevalence for critical care patients was 14.3% (n = 5995) and the overall HAPI prevalence was 5.85% (n = 2451). In patients with severe HAPIs, the most common risk factors were diabetes mellitus (29.5%), mechanical ventilation (27.6%), and vasopressor agents (18.9%).
Cox, J. & Schallom, M. (2017)	Pressure Injuries in Critical Care: A Survey of Critical Care Nurses	To determine critical care nurses' attitudes toward prevention of pressure injury and the perceptions of frontline critical care nurses of specific risk factors	A descriptive cross-sectional survey design was used.	333 nurses responded, for a response rate of approximately 11%. Among the responders, 73% were employed as bedside critical care nurses. More than half (67%) thought that pressure injuries are avoid able, and 66% disagreed that

		associated with unavoidable pressure injuries.		pressure injury prevention was of less interest than other aspects of critical care.
Edsberg, L. et al, 2022	Implementation of Pressure Injury Prevention Strategies in Acute Care	To evaluate the implementation of pressure injury (PI) prevention strategies in adult acute care settings in the United States using the data from the 2018/2019 International Pressure Ulcer Prevalence (IPUP) Survey.	Observational, cohort study with cross-sectional data collection and retrospective data analysis.	Daily skin assessment was performed for 86% of patients with no HAPIs and 96.8% of patients with severe HAPIs. Pressure redistribution was used in 74.6% of all patients and in over 90% of patients with severe HAPIs; heel elevation was reported for over 60% of the patients with severe HAPIs while 31.9% did not receive heel elevation. Moisture management strategies were used in more than 71% of all patients and 89% for patients with severe HAPIs. Nutrition support was used for 55% to 82% of the patients and only documented as contraindicated in fewer than 2% of all groups.
Lima Benevides, J. et al. (2017)	Nursing Strategies for the Prevention of Pressure Ulcers in Intensive Therapy: An Integrative Review	To investigate the scientific evidence on the main nursing strategies for the prevention of pressure ulcers used in patients admitted to Intensive Care Units.	This is an integrative review	Six categories were identified: support surfaces; Programs and/or protocols for PU prevention; Preventive use of biological coverages; Change of position; Control of risk factors and computerized monitoring of skin pressure/support surface. C
Sales de Almeida et al. (2020)	Pressure Injury Prevention	To describe the constituent elements of nursing care	This is an integrative literature review.	The Braden scale was the most used scale among the analysed studies. The

	Scales in Intensive Care Units: An Integrative Review	present in the pressure injury risk assessment scales used in intensive care units.		constituent elements highlighted were structured risk assessment, skin and tissue assessment, preventive skin care, nutrition, repositioning in bed, support surfaces, and care with medical device.
Wang, F. et al. (2021)	Application of Self-Adhesive Soft Silicon Foam Dressing in Reducing Intraoperative Pressure Ulcers in Elderly ICU Patients	To report on the application of Mepilex for the prevention and treatment of PU in elderly ICU patients.	The 106 critically ill patients in the ICU admitted to the hospital from September 2018 to September 2020 were selected as the research objects and they were randomly divided into the dressing group (n =53) and the regular group (n =53).	The incidence of pressure sores in the dressing group was 3.77% lower than the 18.88% in the regular group. The skin complication rate of the dressing group was 5.56% lower than that of the regular group (22.64%).