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Nurses' Role in the Prevention of Pressure Ulcers in Critical Care Patients

A Scoping Review

Ezelobe Arinze Elochukwu

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Author: Ezelobe Arinze Elochukwu
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Supervisor(s): Nina Vesto

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Abstract

Pressure ulcers are a widespread phenomenon that has continuously gulped millions of funding per annum from health sectors across nations. Globally, with an incidence rate of 12-25%, critical care patients remain one of the highest risk groups. This study aims to provide an updated and comprehensive overview of effective nursing approaches and strategies aimed at preventing pressure ulcers in critical care patients and secondarily to improve the knowledge of nurses on effective prevention strategies for pressure ulcers.

This research employed a scoping review of peer-reviewed articles from a range of electronic databases, focusing on those published between 2014 and 2024. Dorothea Orem's Self-Care Deficit Theory provided the theoretical framework. Analysis of 11 selected studies identified key prevention strategies for pressure ulcers, including early risk and skin assessments, proper nutrition and hydration, routine repositioning of patients, and the preventive application of pressure redistribution materials.

Conclusively, the study shows that prevention of pressure ulcer in critical patients necessitates a multi-dimensional approach that entails early risk assessment and proper selection of medical devices, skin care, proper hydration and nutrition, timely patient repositioning, nursing education, interdisciplinary collaborations with other healthcare professionals and the use of new technologies. These strategies when combined effectively together can significantly reduce the incidence and risk of pressure ulcer among critical care patients.

Language:English Key words: Critical care, Pressure ulcer, Medical devices, Prevention,

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1 Introduction

Critical care units in hospitals are charged with the responsibility providing care to some of the sickest patients in the healthcare system. Even though there has been an overall increase with illness severity and complications in critically ill patients, the survival rate has greatly improved and this improvement is closely associated with technological advancements in medicine and improved expertise in the treatment of critical disease conditions.However, survival sometimes results in other unintended collateral outcomes such as the development of pressure ulcers (Cox & Schallom, 2021).

Pressure ulcers also known as decubitus ulcers, bedsores, pressure sores, or pressure injury rank as the third most expensive condition in terms of healthcare costs, following cancers and cardiovascular disease. Morse so, even with advancements in medical understanding and development of effective prevention and treatments, pressure ulcers remain prevalent. Their treatment expenses are significant, underscoring the financial burden they place on healthcare systems. Pressure ulcers contribute to approximately 2.5 million hospitalizations in the United States annually, with the healthcare system in the USA dedicating roughly $11 billion each year to their prevention and treatment. In the United Kingdom, £4 billion of total treatment costs are specifically set aside for the management and treatment of pressure ulcers, whereas in Finland, expenditures of pressure ulcer treatment gulps up to 500 million euros annually. (Afzali, Albatineh, Hasanpour & Ghanei, 2020; Payne, 2016; Aalto University, 2022). According to Cox & Schallom (2021), the intensive care unit of hospitals reports the highest prevalence of pressure ulcers in comparison to other hospital units at a rate varying between 12% -25% globally.

Pressure ulcers describe a skin and/or underlying tissue damage in areas of the body with protruding bony prominences such as the hip, elbow, shoulder blade, heels etc as a result of continuous pressure of shear or force. Many factors are known to contribute or exacerbate its development; however, the leading cause remains immobilization due to the patient's inability to readjust their position (Kim and Lee, 2019). Pressure ulcers are linked with pain, decreased patient independence, heightened chances of infection and sepsis, necessitating further surgeries, prolonged hospital stays, and heightened financial burdens on patients, families, and the healthcare systems. Apart from treatment expenses, there are costs related to bed occupancy during hospitalization and consequently a 50% increase in workload for nursing staff (Afzali *et.al.*,2020).

Most pressure ulcers are largely preventable and are usually referred to as avoidable adverse events and preventing pressure ulcers has been a longstanding focus for healthcare professionals due to their clinical and financial implications for both individuals and the healthcare system. The importance of its prevention has also been highlighted in a lot of policy documents and has also been adopted as a key quality indicator of nursing care by a lot of regulatory bodies and commissions (Källman *et.al*, 2022; Samuriwo, 2012). Given these statistics and my experience with a patient who suffered critical health deterioration due to the severity of his pressure ulcer, I decided to make this research, which is a synthesized evidenced-based knowledge from previous studies and bring to the fore new knowledge on various nursing approaches that could be taken to help prevent the development of pressure ulcers in critical care patients.

2 Background of the Research

This chapter aims to give an in-depth discussion on the chosen topic, the meaning and concept of pressure ulcers, stages of pressure ulcers, identification of risk groups, risk factors, treatment of pressure ulcers, and various nursing interventions that help minimize pre-identified risks.

2.1 Definition and Aetiology of Pressure Ulcers

Pressure ulcers, also known as decubitus ulcers, bedsores, or pressure sores describe a condition where localized damage occurs on the skin and in the underlying tissue due to sustained pressure and shear forces. These ulcers typically emerge in areas where bony prominences create pressure points such as the elbow, heel, hip, sacrum, and back. e.t.c (Kim and Lee, 2019). While a host of factors can contribute to the development of pressure ulcers, the key pathway that leads to ulceration is tissue ischemia. Tissues can tolerate pressure up to about 30-32 mm Hg on the arterial side for a short time. However, any increase in pressure beyond this capillary filling threshold leads to microcirculatory blockage, setting off a cascade toward ischemia, tissue death, and eventual ulceration (Bhattacharya & Mishra, 2015).

2.2 Risk Factors for Developing Pressure Ulcers

Several factors are responsible for the development of pressure ulcers in critical care patients. These risk factors and largely categorized into two major groups: intrinsic factors

and extrinsic factors (Al-khazali, 2023). The elderly, intensive or critical care patients and pediatric patients' groups are understood to be the highest risk group for pressure ulcer development (Kim & Lee, 2019).

2.2.1 Intrinsic Factors

A study by Kim & Lee (2019) considered age a risk factor as it revealed that the elderly amongst others (including critical care patients) are one of the highest risk groups for pressure ulcer development in comparison to the younger population due to age-related changes to the skin associated with a decrease in the number of subcutaneous and muscle cell tissues. These changes are visible as the skin seems to have lost its texture and elasticity, making the skin very fragile and easy to break. The prevalence of pressure ulcers as people age is further heightened by common comorbidities usually present in many elderly patients. More so, chronic illnesses, which account for 60% of global deaths, are particularly impactful. These conditions can affect how the elderly perceive sensation (sensory perception decline), their ability to move, and may lead to changes in blood flow, such as reduced oxygen levels, which are crucial for wound healing (do Egito Cavalcanti de Farias & Bezerra de Queiroz, 2022).

Nutrition is an important risk factor to consider when assessing patients with risk for pressure ulcers. Pressure ulcers are known to usually affect areas over bony prominences, and patients who are malnourished tend to have more bony prominences, exponentially increasing their risk of developing pressure ulcers (Cooper, 2013). Individuals with incontinence (both urinary and fecal) are also at an increased risk of developing pressure ulcers as moisture with a combination of compression and sheer forces can overload the skin surface causing it to tear (Jaul, Barron, Rosenzweig, Menczel, 2018).

Various chronic conditions can contribute to pressure ulcer development through reduced blood flow, tissue ischemia, and immobility. Cardiovascular diseases like advanced heart disease and atherosclerosis decrease perfusion, while diabetes mellitus leads to non-healing wounds and pressure ulcers due to neuropathy and vascular complications. Chronic pulmonary diseases (COPD) exacerbate pressure ulcer risk with decreased oxygenation and inflammation. Kidney disease, musculoskeletal disorders such as osteoporosis, and neurodegenerative disorders like dementia and Parkinson's disease also play roles in the development of pressure ulcers. Dementia can lead to an increased prevalence of pressure ulcers through cognitive impairment affecting self-care, loss of self-awareness, and inability

to express pain and consequent inability to reposition pressure areas from pain. Parkinson's disease eventually leads to immobility as age increases due to rigidity causing most patients to be bedridden thereby increasing their risk for pressure ulcers. (Jaul *et.al,* 2018).

2.2.2 Extrinsic Factors

Sustained pressure can cause the skin to become red and consequently tear leading to pressure ulcers. This pressure may result from immobility by either sitting or lying in the same position for too long. For example, in patients who have suffered a traumatic brain injury, the upright position is commonly used to reduce intracranial pressure. This interventional position may lead to increased pressure on the sacrum and subsequent development of pressure ulcers on the sacrum (Dehghani & Pourmontaseri, 2024). More so, in critically ill patients pressure ulcers could also result from the use of medical devices for diagnostic or treatment purposes. These devices may include nasal cannulas, nasogastric tubes, plaster bandages, splints, intubation tubes, masks, naso-tracheal tubes, neck braces, percutaneous pulse oximeter probes, electrocardiogram electrodes, and arteriovenous catheters. Various factors often influence these pressure ulcers: the device material being overly rigid, incorrect selection of the medical device, placement on areas with minimal fat tissue, improper fixation methods, incorrect use of adhesive tape, the use of multiple, prolonged use of a device on the same area, and the overall condition of the patient (Kim & Lee, 2019). Excessive moisture at the skin surface can cause the skin to become soggy, reducing its smoothness and increasing friction. Moist skin has a higher friction coefficient, making it more susceptible to damage from shear and friction forces thereby increasing the risk of pressure ulcers (Moore, Haynes & Callaghan, 2014).

2.3 Risk Assessment for Pressure Ulcers

A risk assessment is important in the prediction of pressure ulcers and in proactively developing individualized prevention strategies. Assessing the risk of pressure injuries is a multifaceted and systematic procedure. Skin assessment during pressure ulcer risk assessment typically involves using visual and tactile cues to identify signs of pressure damage, such as changes in skin colour from the person's normal tone, fragile tissue from previously healed pressure injury scars, and checking for the presence of medical devices or other objects that could cause pressure. It also encompasses evaluating any patient-specific characteristics, like comorbidities, that are recognized risk factors but may not be explicitly covered by risk assessment scales or tools (Delmore & Ayello, 2023). Some risk assessment

scales have been developed and used over time. However, it is should be emphasized that none of these scales are fully reliable if used alone.

2.3.1 Braden Scale

The Braden scale serves as a crucial tool in healthcare, especially for evaluating and predicting the risk of pressure ulcer formation. It is the most common scale in pressure sore risk assessment. This scale, developed by two nurses from America, Drs. Barbara Braden and Nancy Bergstrom, is a research-backed tool based on a conceptual framework. Initially introduced in 1987, the Braden Scale evaluates six key risk factors (subscales): sensory/perception, moisture, activity, mobility, nutrition, and friction/shear. It is widely used by healthcare professionals to assess the likelihood of pressure injuries and provides a comprehensive approach to understanding a patient's vulnerability to developing pressure ulcers (Delmore & Ayello, 2023).

The moisture subscale assesses the extent of skin exposure to moisture, a pivotal factor in pressure ulcer development. The activity subscale evaluates the level of physical activity, while the mobility subscale gauges the ability to independently change positions, both crucial in determining pressure ulcer risk. The nutrition subscale of the Braden scale assesses an individual's nutritional status, another key factor in pressure ulcer development and lastly, the friction and shear subscale evaluate a patient's exposure to these forces, which can damage the skin and contribute to pressure ulcer formation. In using the Braden scale, the 6 different subscale factors are evaluated individually and assigned values based on the assessment of specific criteria by the nurse. On five of the subscales; sensory/perception, moisture, activity, mobility and nutrition, patients may be assigned values ranging from 1-4 with 4 being the highest. In the last subscale, friction/shear, the patient can only be assigned a value of 1-3. The total value on the Braden scale can range from 6-23 with lower values indicating a high risk for the development of pressure ulcers (Braden & Maklebust, 2005). See appendix 1 for a detailed view on how the scale looks.

2.3.2 Norton Scale

The Norton scale was developed by Norton Doreen in 1962 to determine the risk of pressure sores in the elderly. Following discussions with her associates, she decided that the scale would focus on assessing the risk of pressure ulcers using 5 criteria risk factors namely, physical condition, mental condition, activity, mobility, and incontinence. The physical condition criterion of the scale assesses the individual's overall physical health and mobility,

including their ability to move and change positions, Mental condition tries to evaluate the patient's cognitive status, including their awareness of pain and ability to take corrective action. Activity assesses the individual's level of physical activity and their ability to independently change positions while mobility on the other hand assesses the individual's ability to move or reposition themselves with categories such as completely immobile and partially immobile. The incontinence factor evaluates the individual ability to control their bladder or bowel. All the factors on the scale are rated between 1 and 4 with 1 being the most impaired and 4 being the least impaired. The maximum achievable score on the Norton Scale is 20 points with lower scores indicating a greater risk of developing pressure ulcers (Šáteková, Žiaková & Žiaková, 2015). See appendix 2 for a picture of the Norton scale.

2.3.3 Water low Scale

The Water low scale was developed in 1985 for the assessment of the risk of pressure ulcer development amongst the elderly initially in the United Kingdom and Ireland. Recently it has also been used to identify the risk of pressure ulcers in critically ill and/or hospitalized patients. The scale assesses categories like weight/height (BMI), visual evaluation of skin in risk areas, gender/age, continence, mobility, appetite, and medications, and 4 other risk factors categorized as special risk factors. These factors include tissue malnutrition, neurological deficit, major surgery or trauma, and medication. The distinguishing factors from other scales like the BMI which tends to consider the patient's weight and height in the risk assessment. Weight is an important factor in pressure ulcer development with most underweight and overweight people being at a higher risk. It also considers age an important criterion and risk factor for the development the risk of pressure ulcers. In the use of this scale, values are assigned to each criterion and patients are categorized into 3 strata based on the total value or points they accumulated in the course of the assessment. The strata are as follows; patients at risk usually score about 10-15points, high-risk patients score between 15 to 19 points, and patients with very high risk of pressure ulcer development would typically score above 20 points (Šáteková, Žiaková & Žiaková, 2015). See appendix 3 for a clearer understanding of how the scale looks.

Other pressure risk assessments scales have also been developed and used to accommodate other specific risk groups such as neonates and children in critical and in-patient care. These scales have been developed through modifications of pre-existing scales. For example, the Neonatal Skin Risk Assessment Scale (NSRAS) was developed based on the Braden Scale to predict and help prevent skin breakdown in neonates. There is also the Braden Q scale

which is a modification of the original Braden scale used for adults but adds a 7th subscale tissue perfusion or oxygenation to reflect the unique developmental characteristics of the paediatric patient (Tayyib et.al, 2021).

2.4 **Classification and Staging of Pressure Ulcers**

Pressure ulcers are classified and described using staging systems. This staging system helps to provide descriptions of the level of tissue loss and the visual appearance of the injury resulting from pressure and/or shear. The staging system is also now being used as a basis for treatment, to compare outcomes, and in countries like the United States of America to offer reimbursements when necessary for patients who developed pressure ulcers because of their hospital stay. The staging system that has been adopted worldwide for the classification of pressure ulcers, is that which has been developed and modified by the National Pressure Ulcer Advisory Panel (NPUAP). The NPUAP staging system has undergone some evaluation and revision to align it with current scientific and clinical knowledge regarding the causes of pressure injuries. These changes aimed to enhance clarity, accuracy, and ease of use within the system. The NPUAP staging system classifies bedsores as follows.

STAGE 1: This is the first stage in the development of pressure ulcers. At this stage, the skin is still intact but with a localized area of non-blanchable erythema (redness) in light-skinned people and a blue or purple hue in dark-skinned individuals. The affected area of the skin may appear warmer or cooler in comparison to other areas of surrounding skin and the redness does not fade away or turn white upon removal of the pressure (Edsberg *et al.*, 2016).

STAGE 2: In this stage, there is a partial thickness skin loss, and the dermis is exposed. The wound bed is viable, pink or red, moist, and may also present as an intact or ruptured serum-filled blister. Adipose (fat) is and deeper tissue is not visible. Granulation tissue, slough, and eschar are also not present. These injuries commonly result from adverse microclimate and shear in the skin over the pelvis or in the heel (Edsberg *et al.*, 2016).

STAGE 3: In this stage, there is full-thickness skin loss in which fat tissues are visible in the ulceration and granulation tissues and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible as well. The depth of tissue damage varies by anatomical location; High-fat areas may develop deep wounds undermining and tunnelling may occur (Edsberg *et al.*, 2016).

STAGE 4: In this stage, there is full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining, and or tunnelling often occur. The injury depth varies by anatomical location. (Edsberg *et al.,* 2016).

DEEP TISSUE INJURY: This stage of pressure ulcer may be characterized by intact or non-intact skin with localized area of persistent non blanchable deep red, maroon, purple discoloration or epidermal separation revealing a dark wound bed or blood-filled blister. Pain and temperature changes often precede skin colour changes. This injury may result from prolonged pressure and shear forces at the bone-muscle interface (Edsberg *et al.,* 2016).

In addition to the already discussed stages of pressure ulcers (Stages I-IV) and deep tissue injury, there is an unstageable category in which there is a full-thickness skin and tissue loss to which the extent of tissue damage cannot be estimated or confirmed because it is obscured by slough or eschar (Edsberg *et al.,* 2016).

2.5 Prevention of Pressure Ulcers

Pressure ulcers are usually very slow to heal and have a high chance of recurrence, therefore it is important to develop robust prevention strategies to prevent their occurrence in the first place. The prevention of pressure ulcer entails numerous strategies aimed at reducing the risk factors specific to each patient, primarily by minimizing prolonged pressure through methods such as using suitable padding (protection) on pressure points, proper nutrition, frequent repositioning of the patient and regular skin assessment. Protection is one the best ways to prevent the development of pressure ulcers as patients who are at risk of developing pressure ulcers can be identified early enough and their skin inspected for early signs of redness and any source of pressure should be eliminated if possible or padded to reduce the pressure. The skin must also be kept clean and dry (Payne, 2016; Bhattacharya & Mishra, 2015).

Inadequate nutrition and insufficient dietary intake are primary factors that increase the risk of developing pressure ulcers, therefore proper nutrition plays a crucial role in the prevention of pressure ulcers. Underweight individuals have less tissue covering their bony areas, putting them at higher risk. While regular weighing can help identify this risk, it's not always feasible (especially in critically ill patients). However, the Malnutrition Universal Screening Tool score is a helpful tool for assessing risk, but direct observation and communication with the patient are equally valuable (Payne, 2016).

Support surfaces also play a critical role in the prevention and management of pressure ulcers by assisting in pressure redistribution. There are various types of support surfaces available today, but they are mainly divided into two categories: static (constant low pressure) and dynamic (alternating). Static surfaces redistribute pressure by increasing the contact area, while dynamic surfaces achieve pressure redistribution through timed inflation and deflation cycles. In addition, the effective prevention of pressure ulcers requires close collaboration among healthcare professionals, who must work together with a focus on addressing the patient's specific needs and priorities (Moore, Haynes & Callaghan, 2014).

3 Research Aim and Question

The goal of this research is to provide an updated and comprehensive overview of effective nursing approaches and strategies aimed at preventing pressure ulcers in critical care patients and secondarily to enhance the knowledge of nurses on effective prevention strategies for pressure ulcers.

This research aims to answer the question; What are the roles of nurses in preventing the development of pressure ulcers in critical care patients?

4 Theoretical Framework

A framework simply put is the main root of a research. Theoretical and conceptual frameworks are crucial in advancing research in science, as they make research findings both meaningful and generalizable. Theories help researchers organize observations and facts into a structured system, effectively combining accumulated data, even from isolated studies. This organized linkage of findings makes the evidence more accessible and useful (Polit and Beck, 2004 pp 119-120).

Additionally, the theoretical framework of every research helps the researcher in understanding both the 'what' of a natural phenomenon and the 'why' behind their occurrence. This understanding facilitates the prediction of phenomena, which is essential for their control. More so, theories and conceptual models drive research and expand knowledge by offering direction and motivation. Many nursing research (such as this) are specifically designed to explore aspects of a conceptual model, thus propelling knowledge advancement and evidence accumulation for practice (Polit and Beck, 2004 pp 119-120). This research will be using Dorothea Orem's theory of self-care deficit which would be discussed in detail subsequently.

4.1 Dorothea Orem's Self-Care Deficit Theory

Dorothea E. Orem created the Self-Care Deficit Theory as part of her efforts to improve nursing care in general hospitals in her state. The model links different concepts to provide a new and distinct way of understanding certain health phenomenon. While being relatively simple, the theory is flexible enough to be applied to a diverse patient population group. Nurses can also use it as a valuable framework to guide and improve their practice, but must ensure it aligns with other established theories, laws, and principles (Petiprin, 2023). The theory of self-care deficit is a combination of 3 other theories. These theories include the theory of nursing systems, the theory of self-care deficit and the theory of self-care (Alligood, 2017).

4.1.1 The Theory of Self-Care

The self-care theory which serves as the foundation to other component theories outlines the purpose, approach and results of caring for oneself. Self-care is a human regulatory function that individuals must intentionally carry out themselves or have others do for them to sustain life, health, development, and overall well-being (Alligood, 2017).

Orem’s theory of self-care places great emphasis on individual involvement in their own care process. She also acknowledges that a person’s development, health, sociocultural background, and environment are influenced by various factors. This theory can used as a framework by nurses to assess and support patient’s ability to care for themselves, work collaboratively with patients to identify their strength and weaknesses, equipping them with the necessary tools to develop and maintain self-care practices that are uniquely tailored to them, with the aim of improving and promoting independence, autonomy and overall wellbeing (Alligood, 2017).

4.1.2 The Theory of Self-Care Deficit

The second part of Orem’s theory known as the theory of self-care deficit talks about the need for nursing care or intervention and how patients may benefit from nursing, usually when patients are unable to either partially of fully take care of their own health or the health of their dependent(s). Self-care deficit as a term refers to the gap that exists between an individual's ability to perform self-care and their need for care assistance. This may happen when people do not know what kind of care is needed or when they are unable to perform the necessary tasks required to maintain their own or dependents' health and development (Alligood, 2017).

4.1.3 The Theory of Nursing Systems

This is the unifying theory that encompasses all the essential elements. The theory of nursing systems explains that nursing is a human action where nurses create care systems to help people with health-related self-care or dependent-care limitations. The basic nursing systems are categorized based on how the patient and nurse work together. These systems can be designed for individuals, dependent-care units, groups with similar self-care needs or limitations, and families or other multi-person groups (Alligood 2017).

Additionally, the theory of nursing systems also explains how a patient's self-care needs will be addressed by either the nurse, the patient, or a collaborative cooperation of both. Orem outlines three types of nursing systems aimed at fulfilling the patient’s self-care requirements: the wholly compensatory system, the partly compensatory system, and the supportive-educative system (Petiprin, 2023).

In practice, this theory model can be applied to the nursing process in 3 main parts. Firstly, the assessment, which gathers information that helps identify the problem and the need for

nursing care. The next part is the diagnosis and the development of an actual nursing care plan. The final part involves the implementation and the evaluation of the care plan to determine fine care goals were well implemented and met (Petiprin, 2023).

5 Research Methodology

Research methodology describes the approach that helps us to understand how research has been conducted scientifically. It serves as a roadmap, outlining the path researchers take to unravel complexities, test hypotheses, and find answers to their research question(s) while also describing the logic behind them, to amid the evaluation of the research results (i.e it is not enough to choose a technique and arrive at results, the researcher has to show why the chosen technique is best for the research purpose). Research methodology is multidimensional and encompasses the research method or technique, research design, research plan and implementation, and data collection techniques. It aims to provide a framework that guides the researcher to conduct the research in a well-organized, thorough, and impartial manner such that the research result is highly valid and reliable (Kothari, 2004, pg 25). Different techniques could be explored in research methodology and for this research, a scoping review was used. The scoping review approach was chosen for this study to obtain ample amount of data evidence from applicable studies after an extensive electronic database search.

5.1 Scoping Review as a Research method

Scoping literature review is a research method that has now gained popularity in the healthcare sector and across other sectors including technology in recent years since its first framework was developed in the year 2005 (Peters *et.al,* 2021).

A scoping review is a method of evidence synthesis that focuses on identifying and mapping relevant evidence on a specific topic, concept, or field. This method typically aims to provide a comprehensive overview of the research topic by incoprating diverse evidence from different sources including qualitative and non-qualitative sources. Scoping reviews are flexible, allowing adjustments to the research scope or inclusion criteria during the process. This adaptability makes scoping reviews well-suited for fields where literature is dispersed or heterogeneous(Verdejo *et.al,* 2021; Peters *et.al,* 2021). For this research, a comprehensive search of electronic databases was carried out. Articles meeting specific inclusion and

exclusion criteria were selected, then analyzed to uncover findings that describe the research phenomenon.

5.2 Data Collection

The data analysed and documented in this study was retrieved from electronic databases such as PubMed, GreenFile, CINAHL Complete, EBSCO, and Medline searches using keywords like, “pressure ulcers”, “bedsore”, “nursing intervention”, “critical care”, “critically ill”, “nursing approach”, “prevention”. The searched articles were limited to peer-reviewed articles written in English within the last ten (10) years (2014-2024).

5.3 Data Selection Criteria and Prisma Flowchart

This subsection contains information about the criteria used in the selection (inclusion and exclusion criteria) of articles for analysis in this research as detailed in table 1.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Articles published between the years 2014 to 2024	Articles published before year 2014
Articles written and published in English language	Articles published in Languages other than English Language
Articles that were peer reviewed	Articles that were not peer reviewed such as dissertations, seminars or commentaries.
Articles that were available in full text	Articles that were not available in full text

Table 1: Data selection criteria

5.3.1 Prisma Flowchart

A PRISMA flowchart, as shown in Figure 1 below, was utilized to visualize the data selection process. This included showing how the search was initiated and streamlined to the last stage that produced the final 11 articles for review and analysis in this research.

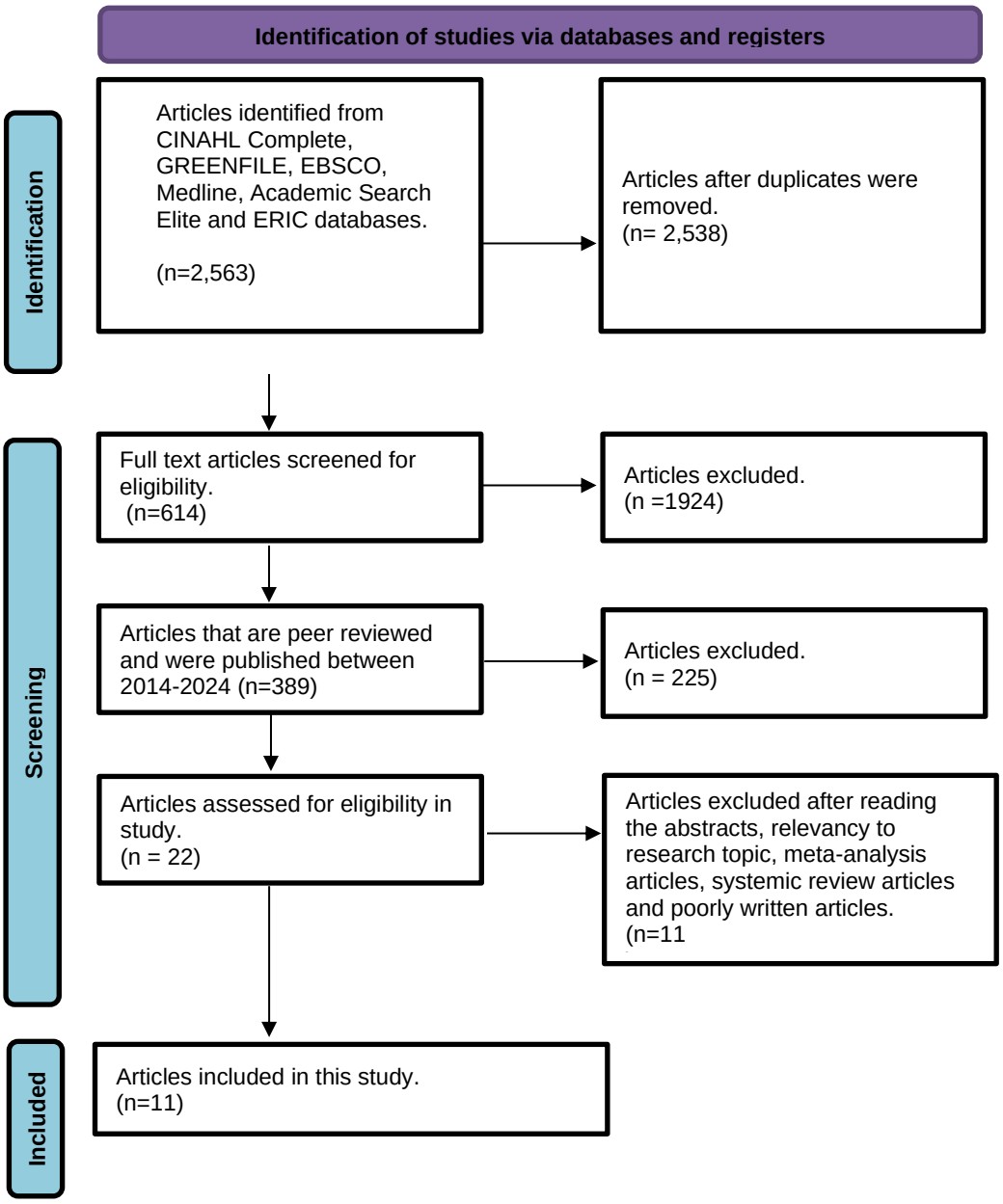

Figure 1: Prisma flowchart diagram

5.4 Data Analysis

The raw data collected from a research study do not answer the research question or provide meaningful information by themselves until they are systematically analysed so that patterns can be uncovered. Data analysis entails organizing and interpreting the information obtained from primary article sources used in the study to discover its hidden meaning (Polit & Beck, 2010, p. 392, p.463). The process of data analysis involves different steps starting with the discovery of patterns, themes and categories that highlight similarities or differences between subjects in the study (Polit & Beck, 2010 pp469-471).

In scoping reviews, after the analysis of the data information, in the presentation of results, the researcher should state the method they intend to use in the presentation of the results. This might for instance be the charting method, tabular form, a figure or in a descriptive format. However, the method used is ultimately dependent on the question the study aims to answer (Peters *et.al*, 2021). This study will use the descriptive method as this format is crucial in identifying and extensively describing the various nursing roles and strategies that prevent the development of pressure ulcers in critical care patients.

The 11 articles included in this study were carefully and systematically analysed to identify similarities and subsequently categorised into themes and sub-themes. The results found from this were then presented as shown in figure 2.

6 Ethical Considerations

This study was undertaken with strict compliance to the Novia University of Applied Science research guidelines in tandem with the Finnish National Board on Research Integrity, TENK. In Finland as in many other countries, ethics is very central to research to ensure that the integrity and value of the research are not in any way compromised. The body of TENK was appointed by the Ministry of Education and Culture to oversee research ethics and proactively develop research guidelines in Finland. The research integrity guidelines developed and published by TENK in cooperation with the Finnish research society (which includes universities, universities of applied sciences, and other relevant bodies) stipulates that research conducted in any member organization must adhere to the ethics and guidelines provided in the research integrity document. According to TENK (2023), 4 principles must be met by the researcher for research integrity to be assured, and a violation of any of these principles would result in violations of good research practice and ultimately research misconduct of varying severity. The first criterion is the reliability in ensuring the quality of

research encompasses various aspects of the research process, from its design and method to data analysis and the use of resources. Secondly, is honesty in the creation, execution, evaluation, documentation, and reporting of research in a clear, equitable, comprehensive, and impartial manner. The document also stipulates for respect of associate colleagues, research participants, natural ecosystems, cultural legacy, and the society at large throughout the research process and lastly taking accountability, by being responsible for the entire body of work from the development of the research idea to its publication, and its overall impact that may result from the application of its findings.

In Finland, there are 3 ways to categorize research misconduct namely, plagiarism which describes the unacknowledged use of another person's idea or work without permission, falsification which entails the manipulation of research results, and fabrication which deals with the presentation of fake research data, observation or result (TENK, 2023).

More so, bearing in mind these ethical frameworks, this study to avoid research misconduct ensured that the data used were only mined from reputable databases and academic sources with peer-reviewed journal articles of distinguished quality. This study also ensured that data falsification including deliberate omission was avoided. All original ideas and information extracted from previous researchers used in this study were duly acknowledged and properly cited throughout this study to avoid plagiarism.

7 Results

The result data gathered in this study was collected through an in-depth analysis of 11 peer-reviewed articles, during which main themes and other secondary themes relevant to the research question were revealed. The results were then organized into two main themes. The first theme, preventive and early detection measures extensively discussed measures of prevention with different subthemes including early risk assessment and appropriate medical device selection, skincare and skin assessment, nutrition and hydration, patient repositioning, and the prophylactic use of pressure redistribution materials. The second primary theme, educational intervention and technological engagement explores the areas such as educational advancement and trainings, interdisciplinary collaboration and documentation employing, and then employing new technologies in its subtheme. A visual presentation of the result can be seen as depicted in figure 2 below. See appendix 4 for breakdown articles analysed.

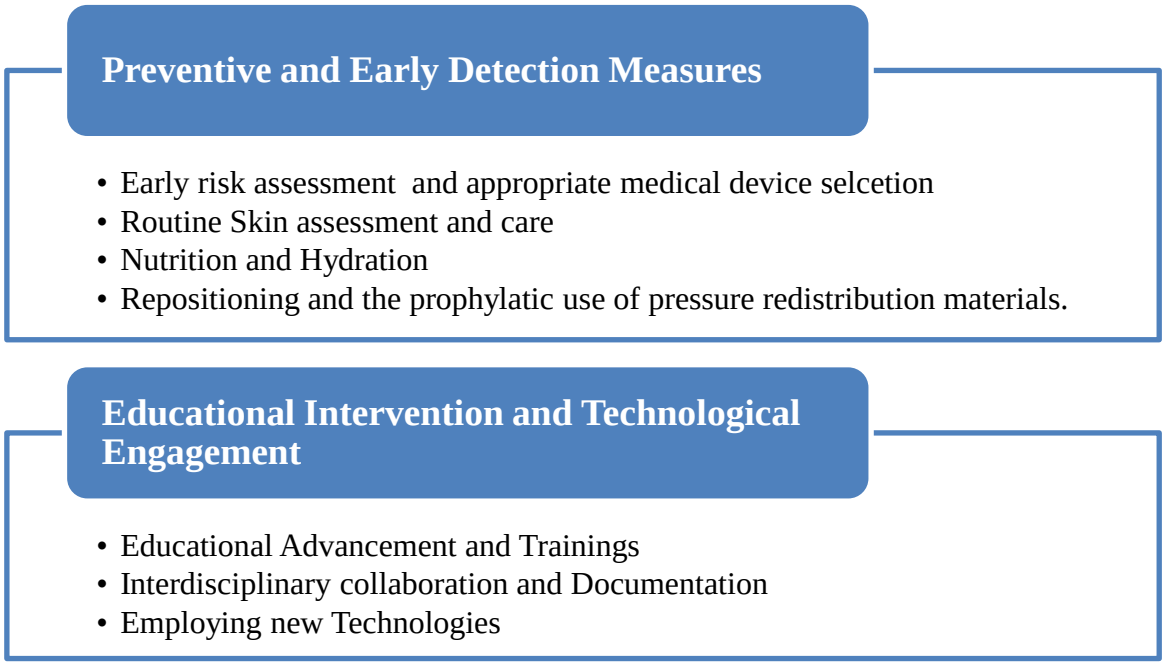

Figure 2: Pictorial Presentation of results (Themes and sub-themes)

7.1 Preventive and Early Detection Measures

The preventive and early detection measures for development of pressure ulcers in critical care patients are aimed at adopting strategies that delay, avoid and as much as possible reduce the incidence and risk of developing these painful wounds. These strategic interventions include early risk assessment and appropriate medical device selection, skincare and assessment, nutrition and hydration and the prophylactic use of pressure redistribution materials.

7.1.1 Early Risk Assessment and Appropriate Medical Device Selection

Patients admitted to critical care settings, such as the ICU, are over three times more likely to develop pressure ulcers compared to those in other hospital wards. This increased risk is due to factors like invasive treatments (for example mechanical ventilation) that make patient repositioning difficult, the use of medical devices that can cause medical device related pressure injuries (MDRPI). Most of the pressure injuries acquired at hospitals are preventable and prevention primarily begins with early risk assessment. Research evidence demonstrates that there is a robust relation relationship between the risk factor exposure duration and the development of pressure ulcers in critical care. The early risk assessment of patients admitted into critical care facilities is a proactive approach that is crucial to the prevention of the development of pressure injuries as it allows clinicians and nurses alike to

promptly identify risk factors and implement targeted interventions accordingly (Alderden, Kennerly, Cox & Yap, 2022).

> *"Hospital-acquired PrIs are considered mostly preventable. Prevention begins with risk assessment. Risk assessment allows clinicians to identify risk factors associated with HAPrI development and intervene accordingly" (Alderden, Kennerly, Cox & Yap, 2022).*

Pressure injuries are known to have both direct and indirect cost on the healthcare systems. The also impact the quality of life and care of the patient and therefore it is crucial that healthcare institutions and the relevant stakeholders invest in preventive and early detection of pressure ulcer risk factors. International guideline emphasizes the importance of conducting an immediate pressure injury risk assessment using a reliable tool upon patient admission into a healthcare facility at maximum within the first 8 hours of admission. This assessment should be re-evaluated whenever there is a change in the patient's condition to ensure ongoing evaluation of risk. However, it is also essential to pinpoint and acknowledge risk elements that could lead to occurrence these pressure injuries beyond the initial assessment. By focusing on these risks with specific interventions tailored to them, healthcare professionals can effectively reduce the risk of pressure ulcers leading to improved results, for patients (Tervo-Heikkinen *et.al*, 2023; Mitchell, 2018).

> *"The International Guideline recommends an immediate PI risk assessment with a reliable tool upon the patient's admission to the healthcare services. The risk assessment should also be repeated each time there is a change in the patient's condition (Tervo-Heikkinen et.al, 2023)".*
>
> " *Risk assessment should be carried out as soon as possible and within a maximum of 8 hours of the patient being either admitted to hospital or onto a community caseload; this should be repeated as often as required based on patient acuity" (Mitchell, 2018).*

The prolonged use of medical devices as is the case with many intensive care unit patients, is known to be a leading cause of pressure ulcer. The best prevention practice from research evidence suggest that device related pressure injuries can be prevented through the appropriate selection of best fitting medical devices a crucial first step because poorly fitting medical devices can apply too much pressure and dig into the skin causing pressure injuries. However, the selection of medical devices should only be based on empirical evidence gotten from risk assessment of developing pressure injuries from specific medical devices (Alderden, Kennerly, Cox & Yap, 2022).

> *" Best practice for DRPrI prevention includes carefully selecting and fitting medical devices" (Alderden, Kennerly, Cox & Yap, 2022).*

7.1.2 Routine Skin Assessment and care

Conducting routine skin assessment is imperative in preventing skin damage resulting from pressure ulcers, managing already existing pressure ulcers and preventing further skin damage. It is vital to identify the level of skin fragility with each risk assessment. To achieve this, nurses must identify and examine each of the vulnerable pressure points such as the sacral area, bony prominences or any part of the skin in continuous contact with medical devices. During the assessment of the skin, a finger pressure can be applied and any signs of redness (erythema) or discoloration can be evaluated to deduce if it is blanchable or not. It is also very important that the results of skin assessments are properly documented for any skin changes whether blanchable or not and immediate interventions started (Mitchell, 2018).

> *"Skin assessment is vital to prevent skin damage, manage existing PUs or prevent further breakdown, and skin fragility should be identified at each risk assessment" (Mitchell, 2018).*

All critical care patients require routine skin assessment and associated skincare. A comprehensive head-to-toe assessment of each patient which goes beyond just eye inspection should be performed regularly, as a simple change in skin texture or changes in temperature might be the first indicative signs of pressure ulceration especially in patients with darker skin tones where the early stages of pressure ulceration are difficult to spot.

Keeping the skin clean, moisturized, and protected from moisture is key to preventing these injuries. It's also essential to clean the skin promptly if it comes into contact with urine or faeces to proactively avoid skin irritation or breakdown (Alderden, Kennerly, Cox & Yap, 2022).

"Routine skin inspection and associated preventive skin care should be applied to all patients in the ICU. A head-to-toe skin assessment must be conducted regularly to identify potential problem areas requiring pressure offloading or skin care. (Alderden, Kennerly, Cox & Yap, 2022)."

In critically ill patients who are mostly bedbound, one of the daily primary nursing goals is to maintain skin integrity for as long possible to prevent pressure ulcers from developing. One of the ways to maintain skin integrity for bed bound patients is through the use different types of creams and ointments. These creams and ointments are beneficial in the reduction of the formation of pressure ulcers as they are designed to form a barrier around the skin area where it applied (usually at high pressure points) and between the pressure sources. This creams also work by keeping the skin moist and hydrated to reduce shear and friction through its antioxidant properties (Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019).

> *"Applying topical agents, like a cream or an ointment on skin, is one of the strategies to prevent PUs" (Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019).*

7.1.3 Nutrition and Hydration

It is an established fact according to research evidence that nutrition and hydration are highly essential in maintaining skin and tissue viability, and a patient's nutritional status plays a crucial role in wound healing process and the prevention of pressure ulceration. For example, the proteins that make up collagen are crucial for wound healing because they help produce important enzymes and connective tissue that support the growth of new cells. Other essential nutrients such as vitamin A, C, K , zinc and copper play vital roles in the bodies immune response, resistance to infection , formation of clotting factors , tissue reconstruction and cell growth. Malnutrition is quite common in critical patients as it usually results from reasons such as difficulty in swallowing, chewing, decreased food intake, age etc consequently resulting in unplanned weight loss which is a major risk factor for developing

pressure ulcer. Nurses as frontline caregivers should actively include malnutrition assessment in the care plans of patients identified to be at risk of developing pressure ulcers using a valid and reliable malnutrition tool, support patients during meal times to ensure adequate nutrition and the eventual referral to a registered dietician as per clinical recommendations for proper evaluation and an individualized nutritional supplementation plan if necessary (Tervo-Heikkinen *et.al,* 2023; Eglseer, Hödl &. Lohrmann, 2019; Saghaleini, *et al.,* 2018)

> *" ...recent literature shows that adequate nutritional interventions are effective in prevention and treatment of pressure injuries" (Eglseer, Hödl &. Lohrmann, 2019).*
>
> *"Nutritional deprivation and insufficient dietary intake are the key risk factors for the development of pressure ulcers and impaired wound healing (Saghaleini, et al., 2018)"*
>
> " *Malnutrition predisposes patients to PIs and slows their healing as well as recovery from other diseases due to the body's decreased ability to fight infections" (Tervo-Heikkinen et.al, 2023)*

For patients in critical care, it is important that they are properly hydrated to reduce the risk of pressure ulceration. Adequate hydration is crucial in the repair and maintenance of skin integrity. It is also crucial that critically ill receive adequate fluid intake, as it helps to promote blood flow to wounded tissue and consequently help wound heal faster. Dehydration on the other hand causes dryness and consequently ischemia due to reduced blood flow impeding wound healing and causing new or more ulcerative damages to tissues. Nurses in collaborative partnership with doctors can assess patient's fluid requirements for patients at risk of dehydration considering comorbidities of the patient. Fluid charts or fluid lists can be set up and used to measure patient's fluid intake to ensure proper hydration and the necessary follow up if needed (Saghaleini, et al., 2018; Mitchell, 2018).

> *"Hydration plays a vital role in the preservation and repair of skin integrity. Dehydration disturbs cell metabolism and wound healing. Adequate fluid*

intake is necessary to support the blood flow to wounded tissues and to prevent additional breakdown of the skin (Saghaleini, et al., 2018)"

7.1.4 Repositioning and the Prophylactic Use of Pressure Redistribution Materials.

Repositioning or postural change or body movement is an age long preventive interventional practice in nursing that has been used for many years to reduce the incidence of pressure ulcers particularly for patients who are in critical states, under sedation and are partially or completely dependent on a caregiver or nurse to move a change positions. Patient repositioning is usually performed to help redistribute the pressure between the skin of the patient and the support surface. Various methods can be employed to turn or change a patient's position ranging from a simple body rotation from side to side in lying position or a simple elevation of the bed angle which could either be done manually or mechanically. Some laying positions have been found to improve the flow of oxygen to tissues essentially preventing pressure ulcers or other conditions associated with immobility. Nurses should always ensure that patients are comfortable and that there are reminders in place either in patients care plan or form of frequency charts to ensure proper redistribution of pressure through repositioning. The frequency of patient repositioning which ranges between every 2 -6 hours and is usually dependent on the medical condition of the patient and the type of support surfaces (Cortes & Vasquez, 2024; Tervo-Heikkinen *et.al*, 2023; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019; Mitchell 2018).

" It has been found that the 90° lateralized supine position for more than 2 h decreases blood flow and leads to very low oxygen levels (close to anoxia levels); and positioning patients laterally with a 30° inclination improves transcutaneous oxygen levels, favoring the prevention of these ulcers on the skin and other complications associated with immobility" (Cortes & Vasquez, 2024).

" The need for repositioning is also influenced by the type of support surface used for each patient. Nevertheless, regular posture changes are important in PI prevention" (Tervo-Heikkinen et.al, 2023)

Repositioning alone would be inadequate to solve the problem of pressure ulcer development. Also, the use of support surfaces alone cannot negate the need for routine repositioning. Different articles have suggested that the choice of the support surface (mattresses) and the prophylactic use of dressings is also as important in relieving and distributing pressure in high-risk patients especially in critical care units where most patients are bedfast and use different medical devices that pushes against the skin. Different support surfaces have been designed to cushion and relieve pressure in vulnerable areas. This support surfaces can either be a total body support surface (in the form of mattresses) or a local body support surface (could either be a dressing, heel support etc) (Huang et.al 2023; McFee, Murdoch, Spitzer, 2023).

Similarly, the study by Huang et.al (2023), has also shown that certain types of mattresses called the static air mattress can prolong repositioning or turning times without increasing pressure ulceration. As effective as turning or patient repositioning is, frequent repositioning can be very uncomfortable, can interfere with the patient's resting state or therapeutic position and quite importantly increase the workload of nurses. The static air mattress has shown great promise in pressure redistribution and pressure ulcer prevention in comparison to convention mattress as it has a moderate softness to it and is recommended for use in critical facilities (Huang et.al 2023).

Additionally, to proactively combat medical device related pressure ulcer, in related studies by McFee et.al (2023) and Gasper et.al (2019), they have recommended the use of prophylactic dressings made from polyurethane foam as it was shown to significantly reduce the number of medical device related pressure injuries (MDRPIs) and hospital acquired pressure injuries (HAPIs). One of the major benefits polyurethane foams has over other types of prophylactic dressings, is its ability to mimic the skin's natural ability to exchange gases. Its elastic and sticky properties make it easy to apply to various parts of the body and help it withstand friction and shear forces, reducing the risk of skin damage (McFee, Murdoch, Spitzer, 2023; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019).

"The advantage of PF is its own system of gas exchange like the skin performance, which allows the diffusion of gases. Its elastic and adhesive characteristics permit it to be applied to different anatomical areas and allow resistance to friction and shear forces" (*Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019)*

7.2 Educational intervention and Technological Engagement

The knowledge and awareness of nurses and caregivers play a vital role in preventing pressure ulcers. Educating them about pressure ulcers, with an emphasis on prevention, can greatly reduce their incidence in critical care facilities.

7.2.1 Educational Advancement and Trainings

Education plays a crucial role in building and sustaining the competency required by the professional code of conduct for all healthcare workers. It arms practitioners with the required knowledge and skills necessary to make informed clinical decisions. It also facilitates a behavioural change in nurses and other healthcare professionals that drives and encourages preventive practices with the goal of decreasing the incidence of Pressure ulcer development. Studies by Huang et. al (2023) show that a lot of nurses are still lacking in knowledge about pressure ulcers. The continuous increase in the incidence of pressure ulcers can also be linked to the inadequate knowledge about pressure ulcer risk factors and their required preventive measures (Huang et.al 2023; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019)

In a study conducted in Finland by Parisod et.al (2021) to evaluate the level of nursing staff knowledge about evidence-based pressure ulcer prevention practices in both primary and specialised care, it was discovered that nurses working lower positions (nurses with vocational education) and registered nurses who rarely encounter or care for patients with pressure ulcers had limited knowledge about pressure ulcer prevention compared to their counterparts who have higher education and or care for pressure ulcer patients more frequently (wound care nurses) therefore highlighting the need for more educational attention to paid to this groups in order to successfully drive the implementation goals of pressure ulcer prevention.

> *" this study shows that further attention needs to be paid to nursing staff knowledge about evidence-based PU prevention practices with a special focus on those nurses working in positions that require lower levels of education and those who rarely take care of patients with PUs" (Parisod, Holopainen, Koivunen, Puukka, & Haavisto, 2021)*

Similarly, a study conducted on ICU nurses in Greece by Avegerinou et.al (2022) also echoed similar sentiments as it highlighted a direct relationship between the level of

education and working experience of nurses and their knowledge about pressure ulcer prevention. In the study participants with postgraduate education showed more knowledge about pressure ulcer prevention.

> *"...nurses with post graduate education pose a more positive attitude regarding prevention and better level of knowledge regarding pressure ulcer prevention, early assessment and management" (Avegerinou et.al 2022).*

7.2.2 Interdisciplinary Collaboration and Documentation

Although nurses remain the frontline caregivers, a lot is still left to be done in the prevention of pressure ulcers by other member involved in the care process including non-nursing staff, other medical staff, primary caregivers at the family level or community level and even the patient themselves due to the multifaceted nature of pressure ulcers. As a result, this requires a level of interdisciplinary collaboration to help reduce the incidence of pressure ulcers. It is also therefore important that everyone involved (nursing and medical staff alike) in the care process possess a degree of knowledge and training about risk assessment preventive measures (Huang et.al 2023; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019) to improve patient outcomes.

Gaspar *et. al* (2019) opines that gaps have been identified between recommended prevention practice protocols and the daily routine in healthcare facilities. Given how challenging it is to break routines and bring about change amongst healthcare staff, on-screen task reminders about routine activities like skin assessment, patient repositioning if documented properly in patients care plans have shown great promise in the reduction of the incidence of pressure ulcers.

Results of a study also conducted by Tervo-Heikkinen *et.al*, (2023), in Finland across the Finnish acute care system also shares a similar sentiment with Gaspar *et. al* (2019) showing a gap between the ward nurse managers' prevention implementation protocols and actual nursing practice which accounts for low implementation of prevention protocols in Finnish acute care units. In a country like Finland, where healthcare quality indicators such prevention of pressure ulcers are not nationally registered or reported proper systemic documentation of these quality indicators can help improve the quality of healthcare organisations and also help relevant stakeholders and public make informed decisions when choosing healthcare facilities.

" Systematic and transparent reporting of PI rates is needed for continuous quality improvement in health care organisations, and also for the population for making informed decisions" (Tervo-Heikkinen et.al, 2023).

7.2.3 Employing New Technologies

New technological advancements in the healthcare sector can also be employed in the proactive prevention of pressure ulcers. According to Alderden et.al, (2022),studies show that some new machine-learning methods when used and run together with electronic health records in the background (EHR) can help to correctly classify and promptly identify pressure ulcer risk patient in the ICU. This machine-learning models can identify the complex relationship between different variables that are not easily identified by the human brain. The technology is dynamic, as it is able to give up to date information about the patient's risk status with relation to the patient's current health status through information derived from the patient's electronic health record. This is important in the ICU because of the unstable status of patients admitted in the ICU. Another pro side to this technology is that it reduces the burden of entering data manually to assess patient risk from time to time as is the case with Braden scale and other risk assessment tools (Alderden, Kennerly, Cox & Yap, 2022).

"Studies conducted using EHR data from patients in the ICU show machine-learning methods can accurately classify patients in terms of HAPrI risk" (Alderden, Kennerly, Cox & Yap, 2022).

8 Discussion

This section explores the discussions of the findings in this study and the relationship between the results of this study and the theoretical framework used. It further emphasizes how these elements in the results collectively address the primary research aim and question, which focus on the role of nurses in the prevention and intervention strategies for managing pressure ulcers in critically ill patients.

8.1 Discussion of Results

The research question in this study which is “What are the roles of nurses in preventing the development of pressure ulcers in critical care patients?” has been answered with the interpretations of the results. These roles have been shown to be important in both promoting and improving patient health outcomes in critical care settings (See figure 2: pictorial presentation of results).

It is evident from this research that pressure ulcers continue to place financial, emotional and staffing burden on both the healthcare system and the patients themselves and therefore, preventing pressure ulcers requires a comprehensive approach that encompasses, early assessments, proactive interventional strategies, education and employing the latest technologies.

Early assessment of risk is key in the primary prevention of pressure ulcers in critical care patients. As a standard practice, nurses must promptly conduct thorough risk assessments and evaluation within a maximum of eight hours (8) upon patient admission into critical care facilities using reliable tools that considers individual risk factors. There is a direct relationship with exposure to risk factors and development of pressure ulcers. As a result, early risk assessments help nurses to identify patients and body areas at different levels of risk depending on their health conditions or treatment methods and to effectively design care plans with proactive interventions that prevents pressure ulcer from developing. Risk assessment must always be conducted again when there is a change in the condition of the patient (Alderden, Kennerly, Cox & Yap, 2022; Tervo-Heikkinen et.al, 2023). More so, as part of early detection strategies in the ICU, nurses must select medical devices correctly to ensure they are of the correct size, and that they are placed correctly. It is also important to alternate different medical devices to redistribute pressure. For example, we can alternate between an oxygen mask and high-flow nasal cannula (Alderden, Kennerly, Cox & Yap, 2022).

Routine skin assessment and skincare is fundamental in the prevention of pressure ulcers as the skin is usually the primary organ that is damaged when pressure ulcer develops. It is vital that nurses carry out routine comprehensive skin assessment (head-to-toe) and skincare daily in patients at risk of developing pressure ulcers (Alderden, Kennerly, Cox & Yap, 2022). This routine evaluation must include checking for signs of skin discoloration, changes in skin texture (particularly in areas of bony prominences), changes in skin temperature as this might be the first signs of skin ulceration and documenting these changes as well. Skincare

using appropriate lotions and barrier creams that help to maintain skin elasticity is also an important aspect of pressure injury prevention (Mitchell, 2018; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019).

The role of nutrition and hydration cannot be over emphasized as research shows that proper nutrition and hydration are essential for maintaining skin and tissue health, aiding in wound healing, and preventing pressure ulcers. Proper hydration is also essential for maintaining skin integrity and promoting blood flow, which accelerates wound healing in critically ill patients. Dehydration can lead to tissue damage and impede recovery, increasing the risk of pressure ulcers. Due to risk of malnutrition and dehydration in critical care patients, nurses are encouraged to collaborate with nutritionist and doctors to design meal plans and track fluid needs to ensure patients are optimally hydrated and nourished (Saghaleini, et al., 2018; Mitchell, 2018).

Patient repositioning and the use of pressure redistribution materials are also key strategies and interventions that can be employed to prevent pressure ulcers in critical care patients who are mostly bedfast. Routine repositioning after a few hours can help reduce and redistribute pressure in bedfast patients. In cases where repositioning is limited or not feasible due to the treatment method employed, nurses may prophylactically apply dressings to pressure points reduce shear force and prevent direct skin contact. Selecting the appropriate support surface is also very important as certain support surface are very effective in pressure redistribution thereby preventing pressure injuries (Huang et.al 2023; McFee, Murdoch, Spitzer, 2023; Gaspar, Peralta, Marques, Budri, & Gaspar de Matos, 2019).

More so, to efficiently reduce pressure ulcers nurses must continue to be knowledge-seeking through further education and trainings to equip themselves with up-to-date information and best evidence based standard practices about pressure ulcer prevention (Parisod, Holopainen, Koivunen, Puukka, & Haavisto, 2021; Avegerinou et.al 2022).

Interdisciplinary collaboration is essential in preventing pressure ulcers, as it requires the involvement of not only nurses but also non-nursing staff, medical personnel, and even patients and caregivers. Effective teamwork ensures that all parties are trained in risk assessment and preventive measures, improving patient outcomes. Proper and systematic documentation also helps in pressure ulcer prevention as it helps relevant stakeholders to make informed decisions from documented data, and also with nurses with helps for

continuation of care to ensure that no part of care required for pressure ulcer prevention is overlooked (Tervo-Heikkinen et.al, 2023).

Finally, employing the latest healthcare technologies is a good way to ease of a little of the burden particularly with risk assessment and patient repositioning. New technologies are available to help nurses with accurate risk assessment using data entered into the patient's electronic health record, saving time and ensuring prompt intervention. There are also several new technologies about new different types of support surfaces that distribute pressure and can help turn and reposition patients. These technologies can be employed and made more mainstream to help prevent pressure ulcers. (Alderden, Kennerly, Cox & Yap, 2022).

8.2 Discussion of The Research Method

The method employed in this study proved highly effective in achieving the research objectives and answering the central question. It ensured a structured and comprehensive analysis of existing evidence. By incorporating both qualitative and non-qualitatuve studies, it enabled a broad yet detailed exploration of diverse strategies, ensuring that the findings were not limited to a single perspective but reflected the multifaceted nature of the issue.

Scoping reviews are particularly valuable for synthesizing and summarizing available evidence, identifying gaps, and clarifying complex concepts and definitions (Verdejo et al., 2021). These features aligned seamlessly with the research aim of providing an updated and comprehensive overview of evidence-based nursing practices while also advancing the knowledge of nurses in this critical area. By examining the quantity and quality of existing evidence (Verdejo et al., 2021),this method also allowed the study to identify and describe key nursing roles and interventions that are both effective and applicable in various critical care settings.

8.3 Discussion of The Theoretical Framework

A crucial framework for understanding and preventing the development of pressure ulcers in critical care patients was provided by Dorothea Orem's theory model of self-care deficit. The theory brought to the fore the role nurses play in the risk identification of pressure ulcers, patient repositioning, skin care and assessment amongst other things as part of self-care activities nurses perform for critical care patients geared towards the prevention of pressure ulcers and promoting overall health.

In practice, nurses in critical care wards and facilities can use Orem's theory to identify aspects of patient self-care deficits through the assessment of their capabilities in performing self-care activities such as repositioning and maintaining good skin hygiene. These activities are usually difficult for most critical care patients because of significant limitations due to their condition, level of consciousness and mobility issues. The theory also helps nurses to identify risk factors including immobility, poor nutritional status, incontinence, and decreased sensory perception. By understanding these deficits, nurses can tailor interventions to meet individual patient needs.

More so, employing Orem's idea of nursing system, nurses in collaboration with the patients are able to create a comprehensive and individualized care plan that might be wholly compensatory (Petiprin, 2023); where the nurses take full responsibility of self-care activities such as repositioning , skin assessment amongst other things for patients who are unable to participate or a partially compensatory care plan for patients who are able to engage in certain aspects of their care which could include patient helping as much as they can in activities of repositioning or activities of skin care or hydration. Lastly, the care plan could be a supportive-educative for more alert and engaged patients so that nurses can provide education on self-care practices that prevent pressure ulcers, such as: How to identify pressure points and signs of skin breakdown, techniques for repositioning and the importance of maintaining mobility, and encouraging self-monitoring and reporting any skin changes to the nursing staff. Through these methods, patient and their families receive education about pressure ulcers and its prevention which helps to foster and increase patients' independence as necessary for prompt recovery (Petiprin, 2023).

8.4 Strength and Limitation of Study

The main strength of the study is that it was geared towards addressing an index of the quality of care (pressure ulcer); a major challenge that has consistently gulped millions of funding annually from the healthcare sector globally. Through a scoping review method, this study was able to identify and synthesize most of the available evidence-based practices aimed at the prevention of pressure ulcers with a focus on critical care patients and also enhance the knowledge of nurses about these prevention practices. The systematic search of different database sources to identify and screen the different studies included in the result of this study followed a strict adherence to the inclusion and exclusion criteria of the chosen method thereby significantly boosting the reliability of the results.

To acknowledge the study limitation as well, it is important to state that during this research, the study originally intended to use a systematic literature review method, but in the process of gathering data, the study had a significant challenge in finding enough quality articles for this review and due to this, the research method had to be changed to a scoping review instead. This review method does not strictly require the use of peer-reviewed articles, hence a risk for bias to be introduced into the study, potentially impacting the reliability and depth of the findings. Nonetheless, this study ensured that only peer-reviewed articles were included in this study.

9 Conclusion

The goal of this study was to provide an updated and comprehensive overview of effective nursing approaches and strategies aimed at preventing pressure ulcers in critical care patients and in the same vein improve the knowledge of nurses on key effective strategies. This research thesis has offered valuable insights by means of synthesizing available evidence-based practices and has also promoted improvement in health care procedures including patient assessment, nursing staff education and the use of new technologies to prevent pressure ulcer in critical care.

In the aspect on early risk assessment, emphasis was laid on how crucial it was for nurses to perform prompt and comprehensive assessment that includes skin integrity assessment, range of mobility, level of nutrition/malnutrition, age, underlying medical conditions of patients as soon as they are admitted into the wards. These assessments form the basis for tailored individualized care that includes selecting appropriate medical devices, support surfaces, help with motion or repositioning and routine reassessment to identify any changes in patient condition. Moreso, as covered in the aspect of early detection and preventive measures, it demonstrated the need for a multifaceted and interpersonal collaborative approach with other healthcare professionals in the prevention of pressure ulcers in critical care where and when needed particularly in the areas of hydration and nutrition management.

Additionally, this study demonstrates the need for nurses and wards managers to improve the attitude and knowledge of nurses on pressure ulcers as many researchers identified knowledge gaps amongst nurses in the aspect of pressure ulcer prevention. It further encourages nurses to seek knowledge by either furthering their education or ensuring policy makers and ward mangers create regular training sessions that are geared towards acquiring

new knowledge and various prevention strategies for preventing pressure ulcer in critical care settings.

As the world continues to become more digital, new technologies have emerged and more focus and resources can be put into employing new technologies that are time saving and more cost effective as some of these technologies have been to provide real time reports and patient risk level classification that enables healthcare providers to proactively prevent pressure ulcers from developing in critical care settings.

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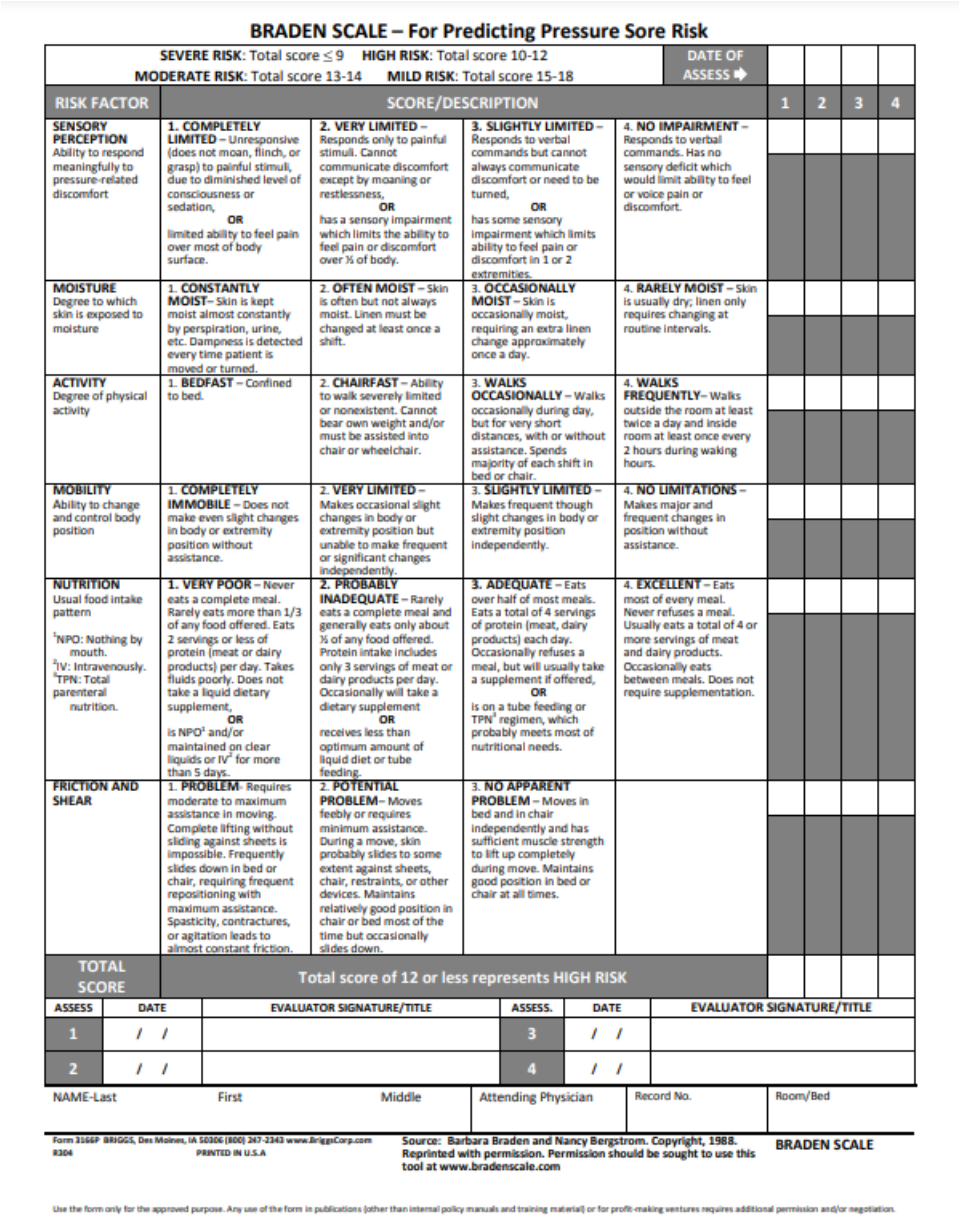
APPENDIX

APPENDIX 1: The Braden Scale for predicting Pressure Sore Risk



BRADEN SCALE – For Predicting Pressure Sore Risk

SEVERE RISK: Total score ≤ 9 **HIGH RISK**: Total score 10-12
MODERATE RISK: Total score 13-14 **MILD RISK**: Total score 15-18

DATE OF ASSESS ➡

RISK FACTOR	SCORE/DESCRIPTION				1	2	3	4
SENSORY PERCEPTION Ability to respond meaningfully to pressure-related discomfort	**1. COMPLETELY LIMITED** – Unresponsive (does not moan, flinch, or grasp) 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 of body.	**3. SLIGHTLY LIMITED** – Responds to verbal commands but cannot always communicate discomfort or need to be turned, **OR** has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	**4. NO IMPAIRMENT** – Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.				
MOISTURE Degree to which skin is exposed to moisture	**1. CONSTANTLY MOIST**– Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	**2. OFTEN MOIST** – Skin is often but not always moist. Linen must be changed at least once 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 only requires changing at routine intervals.				
ACTIVITY Degree of physical activity	**1. BEDFAST** – Confined to bed.	**2. CHAIRFAST** – Ability to walk severely limited or nonexistent. 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 or extremity position independently.	**4. NO LIMITATIONS** – Makes major and frequent changes in position without assistance.				
NUTRITION Usual food intake pattern [1]NPO: Nothing by mouth. [2]IV: Intravenously. [3]TPN: Total parenteral nutrition.	**1. VERY POOR** – Never eats a complete meal. Rarely eats more than 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement, **OR** is NPO[1] and/or maintained on clear liquids or IV[2] 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 refuses a meal, but will usually take a supplement if offered, **OR** is on a tube feeding or TPN[3] 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.					
TOTAL SCORE	Total score of 12 or less represents HIGH RISK							

ASSESS	DATE	EVALUATOR SIGNATURE/TITLE	ASSESS.	DATE	EVALUATOR SIGNATURE/TITLE
1	/ /		3	/ /	
2	/ /		4	/ /	

NAME-Last First Middle	Attending Physician	Record No.	Room/Bed

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BRADEN SCALE

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Appendix 2: The Norton Scale for Pressure Sore Risk Assessment

The Norton Pressure Sore
Risk-Assessment Scale Scoring System

The **Norton Scoring system**, shown below, and created in England in 1962, has been the first pressure sore risk evaluation scale to be created, back in 1962, and for this it is now criticized in the wake of the results of modern research. Its ease of use, however, makes it still widely used today.

To evaluate the Norton Rating for a certain patient look at the tables below and add up the values beside each parameter which apply to the patient. The total sum is the Norton Rating (NR) for that patient and may vary from 20 (minimum risk) to 5 (maximum risk).

(Indicatively, a Norton Rating below 9 means Very High Risk, 10 to 13 means High Risk, 14 to 17 medium risk and above 18 means low risk)

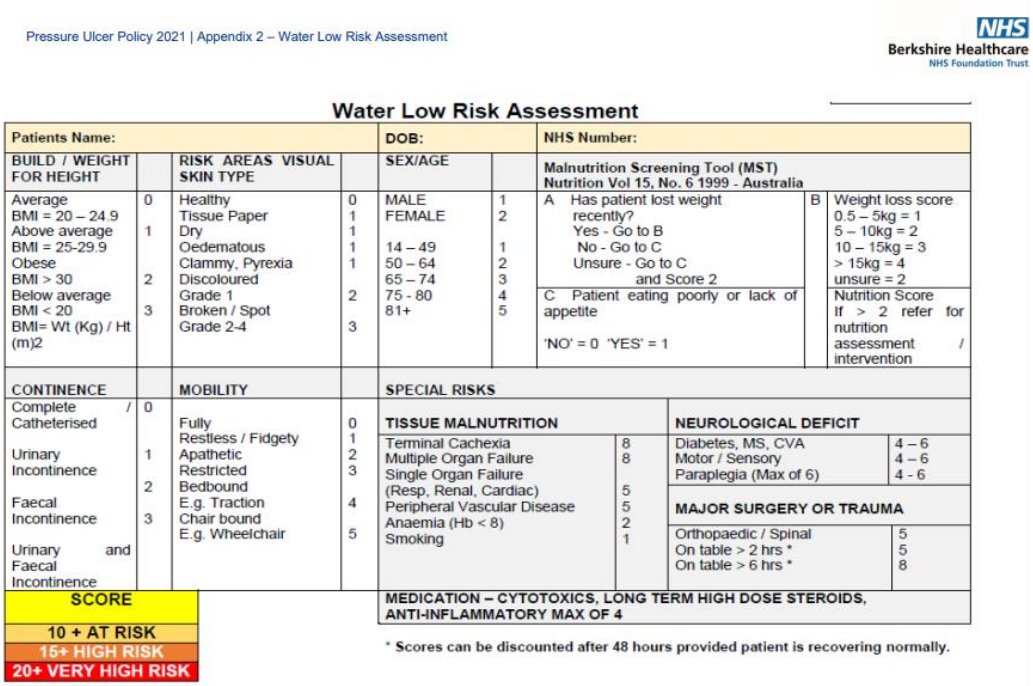
Physical Condition	Good	4
	Fair	3
	Poor	2
	Very Bad	1
Mental Condition	Alert	4
	Apathetic	3
	Confused	2
	Stuporous	1
Activity	Ambulant	4
	Walks with help	3
	Chairbound	2
	Bedfast	1
Mobility	Full	4
	Slightly Impaired	3
	Very Limited	2
	Immobile	1
Incontinence	None	4
	Occasional	3
	Usually Urinary	2
	Urinary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

Generally, the risk factor is coded this way:

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

Another rating system getting more and more popularity is the **Braden Scale**, created in the USA, more recent and precise than the Norton scale, which evaluates factors such as sensory perception, skin wetness, nutrition and such.

Appendix 3: The Water Low Scale for Pressure Sore Risk Assessment



Pressure Ulcer Policy 2021 | Appendix 2 – Water Low Risk Assessment

NHS Berkshire Healthcare NHS Foundation Trust

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 Above average BMI = 25-29.9 Obese BMI > 30 Below average BMI < 20 BMI= Wt (Kg) / Ht (m)2	0 1 2 3	Healthy Tissue Paper Dry Oedematous Clammy, Pyrexia Discoloured Grade 1 Broken / Spot Grade 2-4	0 1 1 1 1 2 3	MALE FEMALE 14 – 49 50 – 64 65 – 74 75 - 80 81+	1 2 1 2 3 4 5	A Has patient lost weight recently? Yes - Go to B No - Go to C Unsure - Go to C and Score 2 C Patient eating poorly or lack of appetite 'NO' = 0 'YES' = 1	B	Weight loss score 0.5 – 5kg = 1 5 – 10kg = 2 10 – 15kg = 3 > 15kg = 4 unsure = 2 Nutrition Score If > 2 refer for nutrition assessment / intervention
CONTINENCE		**MOBILITY**		**SPECIAL RISKS**				
Complete / Catheterised Urinary Incontinence Faecal Incontinence Urinary and Faecal Incontinence	0 1 2 3	Fully Restless / Fidgety Apathetic Restricted Bedbound E.g. Traction Chair bound E.g. Wheelchair	0 1 2 3 4 5	**TISSUE MALNUTRITION**		**NEUROLOGICAL DEFICIT**		
				Terminal Cachexia Multiple Organ Failure Single Organ Failure (Resp, Renal, Cardiac) Peripheral Vascular Disease Anaemia (Hb < 8) Smoking	8 8 5 5 2 1	Diabetes, MS, CVA Motor / Sensory Paraplegia (Max of 6)	4 – 6 4 – 6 4 - 6	
						MAJOR SURGERY OR TRAUMA		
						Orthopaedic / Spinal On table > 2 hrs * On table > 6 hrs *	5 5 8	
				MEDICATION – CYTOTOXICS, LONG TERM HIGH DOSE STEROIDS, ANTI-INFLAMMATORY MAX OF 4				

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

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

Appendix 4. Articles Summary Table

	Bibliographic data (Article Title, Author & Publication date)	**Aim**	**Method**	**Results**
1	Aby Mitchell (2018) . Adult pressure area care: preventing pressure ulcers.	To identify prevention strategies	Qualitative systematic review of article	The result revealed that effective use of risk assessments, repositioning techniques, and preventive care, alongside patient and family education, significantly reduces PU incidence and improves overall care.
2	Saghaleini, S. H., Dehghan, K., Shadvar, K., Sanaie, S., Mahmoodpoor, A., & Ostadi, Z. (2018). Pressure Ulcer and Nutrition.	To evaluate how nutritional support, especially nutrient-dense supplements, impacts the healing of pressure ulcers.	A systematic review of randomized controlled trials examining the effects of specific nutritional interventions on pressure ulcer healing rates.	The results indicated that targeted nutritional supplementation, especially with protein, positively impacted healing in patients, underscoring the value of nutrition in clinical wound
3	L Cortés, O., & M Vásquez, S. (2024). Patient Repositioning during Hospitalization and Prevention of Pressure Ulcers: a Narrative Review.	To examine the role of patient repositioning as a preventive strategy against pressure ulcers in hospitalized patients.	A narrative review of studies investigating repositioning techniques, frequency, and their effects on reducing pressure ulcer risk.	Findings suggest that consistent repositioning can significantly lower the likelihood of ulcer formation by relieving prolonged pressure on high-risk body areas, enhancing patient care outcomes.

4	Avgerinou, I., Kalemikerakis, I., Vasilopoulos, G., Kelesi, M., Maria, P., Petsios, K., & Dousis, E. (2022). Intensive Care Nurses' Knowledge, Practice and Attitudes Related to Pressure Ulcer Prevention: A Single Tertiary Center in Greece Case.	To investigate the attitudes and practices of Greek nurses toward pressure ulcer prevention and management.	This cross-sectional study used a survey distributed to nurses across various hospitals in Greece, gathering data on their knowledge, attitudes, and clinical practices in ulcer prevention.	The study found varying levels of knowledge and practice among nurses, highlighting a need for improved training and protocols in pressure ulcer prevention
5	Huang, L., Yan, Y., Huang, Y., Liao, Y., Li, W., Gu, C., Lu, X., Li, Y., & Li, C. (2023). Summary of best evidence for prevention and control of pressure ulcer on support surfaces	To summarize the best evidence for preventing and controlling pressure ulcers on support surfaces, including mattresses and cushions.	A systematic review of existing research and guidelines on the effectiveness of various support surfaces in preventing pressure ulcers.	Evidence supports that advanced support surfaces, such as specialized mattresses and cushions, significantly reduce pressure ulcer risk and promote healing.
6	Tervo-Heikkinen, T., Heikkilä, A., Koivunen, M., Kortteisto, T., Peltokoski, J., Salmela, S., Sankelo, M., Ylitörmänen, T., & Junttila, K. (2023). Nursing interventions in preventing pressure injuries in acute inpatient care: a cross-sectional national study	The study aimed to explore nursing interventions used in the prevention of pressure injuries within acute inpatient care settings, and to assess the frequency of these practices across a national sample of hospitals.	A cross-sectional study that involved a survey distributed to nurses working in acute care settings, to gather data on their practices, attitudes, and knowledge related to pressure injury prevention.	The study revealed that while most nurses used some form of pressure injury prevention, there were significant variations in the frequency and types of interventions applied across different hospitals. There was a noted need for standardized protocols and more consistent training on pressure injury prevention across the healthcare system.

7	Gaspar, S., Peralta, M., Marques, A., Budri, A., & Gaspar de Matos, M. (2019). Effectiveness on hospital-acquired pressure ulcers prevention: a systematic review.	To assess the effectiveness of various interventions in preventing hospital-acquired pressure ulcers.	A systematic literature review of studies analysing different preventive strategies, including repositioning, pressure-relieving devices, and nutritional support.	The review found that multi-faceted prevention strategies, including the use of specialized support surfaces and regular repositioning, were most effective in reducing the incidence of hospital-acquired pressure ulcers.
8	Alderden, J., Kennerly, S. M., Cox, J., & Yap, T. L. (2022). Pressure Injury Risk Assessment and Prevention in Patients With COVID-19 in the Intensive Care Unit.	To examine the importance of pressure injury risk assessment and prevention strategies in healthcare settings.	Systematic literature review.	The study emphasizes the need for early risk assessment and consistent preventive measures such as repositioning and using pressure-relieving devices.
9	Eglseer, D., Hödl, M., & Lohrmann, C. (2019). Nutritional management of older hospitalised patients with pressure injuries.	To evaluate the effectiveness of pressure ulcer prevention strategies in hospitalized patients.	Systematic literature review.	The results indicated that combining multiple preventive strategies significantly reduces the risk of pressure ulcers in hospital settings.
10	McFee, K., Murdoch, J. M., & Spitzer, M. (2023). Implementation of a Pressure Injury Prevention Protocol for Intensive Care Unit Patients Undergoing Prone Positioning.	To reduce hospital-acquired pressure injuries in COVID-19 ICU patients, especially those undergoing prone positioning.	Quantitative analysis	The incidence of pressure injuries decreased from 11.6% to 2.7%, a reduction of 76.7%, after pressure ulcer protocol implementation.
11	Parisod, H., Holopainen, A., Koivunen, M., Puukka, P., &	To evaluate the level of nursing	A correlational cross-sectional study	The results suggested that better education, experience,

	Haavisto, E. (2022). Factors determining nurses' knowledge of evidence-based pressure ulcer prevention practices in Finland: a correlational cross-sectional study.	staff knowledge and to identify factors influencing Finnish nurses' knowledge of evidence-based pressure ulcer prevention practices.		and attitudes towards evidence-based practices were positively correlated with greater knowledge of pressure ulcer prevention.