INTENSIVE CARE UNIT NURSES' KNOWLEDGE OF PRESSURE INJURY PREVENTION AND MANAGEMENT

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DECLARATION

I, Ricki-Lee Serebro, declare that this research report is my own work. It is being submitted for the degree of Master of Science (in Nursing) at the University of the Witwatersrand, Johannesburg. It has not previously been submitted for any degree or examination at this or any other university.

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Signed at Johannesburg

On the 20th.....day of August....., 2021

Protocol Number M200364

DEDICATION

This study is dedicated to all the intensive care patients fighting for their lives.

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ABSTRACT

This study aimed to describe Intensive Care Unit (ICU) nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge. The intention was also to make recommendations for clinical practice and education of ICU nurses. The setting of the study was four adult ICUs at a university-affiliated public hospital in Johannesburg. Included were: multi-disciplinary ICU, trauma ICU, neurosurgical ICU and cardiothoracic ICU.

A non-experimental, descriptive, quantitative and cross-sectional survey design was used to describe the ICU nurses knowledge of pressure injury prevention and management. The final sample comprised 101 respondents for the study. Data were collected from ICU nurses using a validated questionnaire developed initially by Beeckman *et al.* (2010) and revised by Manderlier *et al.* (2017). Data was analysed using descriptive and inferential statistical tests using the Shapiro Wilk test, univariate and multivariate linear regression and Cronbach alpha coefficient tests. Testing was done on the 5% level of significance.

Of the 101 (n = 110) surveys distributed, the overall mean total score was 42.16% (SD 12.09). A score of 15/25 (60%) indicates an adequate knowledge of pressure injuries (Beeckman *et al.*, 2010). Furthermore, in this current study, only 6 (out of 110) respondents scored 60% and above. These findings suggest that ICU nurses cannot contribute effectively to the prevention of pressure injuries.

The lowest scores were found in Theme five (*prevention of pressure injuries*) and Theme two (*classification and observation*) with scores of 25.0% (M = 2, IQR = 11-3, 8 items) and 39.5% (M = 1.58; SD = 1.06, 4 items), respectively. The highest scores were found in Theme three (*risk assessment*) and Theme Four *(nutrition*) with scores of 100.0% (M = 2; IQ 1-2; 3 items) and 50.0% (M=1.51; SD = 0.84; 2 items). The fact that ICU nurses lack knowledge of prevention measures and classification and observation of stages may indicate that they may not be able to use risk assessment tools effectively in clinical practice.

Some factors were statistically significant to predict appropriate prevention of pressure injuries management, included a higher level of education (14.00; 95% CI 2.90-25.11; p = 0.014), seniority of ICU nurses position (15.58; 95% CI 2.92-28.24; p = 0.016) and years of experience (6.38; 95% CI 9.70-5.45; p = 0.039). Some studies have consistently shown that educational interventions have led to a statistically significant increase in pressure injury knowledge scores.

This study concludes that improving training and providing ICU nurses with adequate information about current strategies and evidence-based practices to prevent pressure injuries could strengthen their contribution to patient safety. Recommendations are made for the clinical practice and education of intensive care nurses.

Keywords: pressure injury, prevention and management, ICU nurses knowledge

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LIST OF ABBREVIATIONS

CEO	Chief Executive Officer
EPUAP	European Pressure Ulcer Advisory Panel
ICU	Intensive Care Unit
ICU Nurse	Intensive Care Unit Nurse
NPUAP	National Pressure Ulcer Advisory Panel
PUKAT	Pressure Ulcer Knowledge Assessment Tool
PUQ-199	Pressure Ulcer Questionnaire
PZ-PUKT	Pieper-Zulkowski Pressure Ulcer Knowledge Test

CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

An overview of the study and the research process is discussed in this chapter. This will include the background of the study, the problem statement, purpose and objectives of the study, significance of the study, definition of key terms and theoretical assumptions. A brief explanation of the research methods, ethical considerations, validity and reliability of the study, and the layout of the study will also be discussed.

1.2 BACKGROUND OF THE STUDY

The prevalence of pressure injuries within healthcare settings is considered an indicator of nursing care quality. Since nurses are responsible for continuous patient care, they should be equipped with the necessary knowledge and training based on scientific evidence to identify the patients at risk of developing pressure injuries. There is a high prevalence of pressure injury development among critically ill patients admitted in intensive care units (ICUs). Critically ill patients are immobile because they are often sedated and ventilated and therefore susceptible to developing pressure injuries. Pressure injuries increase the hospital stay of critically ill patients and cause many adverse effects such as infection. As this problem has become more prevalent, the focus has shifted onto strategies to prevent pressure injuries from occurring. ICU nurses' knowledge about pressure injuries is vital in preventing them.

The presence of pressure injuries increases among critically ill patients (Coyer *et al.*, 2017). Pressure injuries are considered "high cost" and are a substantial financial burden on health care systems (Satekova *et al.*, 2015). According to Graves *et al.* (2005), cited in Fulbrook and Anderson (2016), the cost of treatment for pressure injuries in Australia has been estimated at $285 million per annum. There are currently no studies available on the cost of pressure injuries in South Africa. The cost of pressure injuries includes nursing care time, resources and prolonged stay in hospital (Lospitao-Gomez *et al.*, 2017). The length of stay increases by more than four days for each pressure injury developed (Fulbrook & Anderson,

2016). Furthermore, nurses' time to care for patients with pressure injuries is more than the time needed to prevent pressure injuries from developing (Tonole & Brandao, 2018).

Pressure injuries increase morbidity and mortality, and the risk of developing pressure injuries increases as the length of stay in hospital increases (Fulbrook & Anderson, 2016). Pressure injuries also increase the rate of infection (Tayyib, Coyer & Lewis, 2016).

Critically ill patients are more likely to develop pressure injuries than patients in general wards (Nowicki *et al.,* 2018). Furthermore, patients in ICU are 3.8 times more likely to develop a pressure injury than non-intensive care patients (Coyer *et al.,* 2017). Fulbrook and Anderson (2016) concur that pressure injury development risk is more significant for patients in ICU than in other areas and delay recovery time and increase mortality. Severe illness, comorbidities, restricted movement and bed rest complications are the reasons why critically ill patients have a higher risk of developing pressure injuries. It is rare for a critically ill patient to not be at risk of developing pressure injuries (Fulbrook & Anderson, 2016).

The additional factors that place critically ill patients at risk of developing pressure injuries include vasopressors, sedation, altered level of consciousness, haemodynamic instability and mechanical ventilation (Lospitao-Gomez *et al.,* 2017). Age, specific treatments and medications, prolonged stay in ICU, bodyweight extremes such as obesity or underweight, inadequate nutrition, incontinence, oedema, pyrexia, anaemia, lymphopenia, decreased blood albumin levels, and history of smoking are further risk factors (de Almeida Medeiros *et al.,* 2018).

According to Lawrence *et al.* (2015) and Tigari *et al.* (2018), nurses are responsible for the maintenance of skin integrity and the prevention and treatment of pressure injuries. Pressure injuries are preventable. Improvement of strategies to prevent pressure injuries should be a priority (Fulbrook & Anderson, 2016). According to Pieper *et al.* (2014), knowledge of pressure injuries, including risk, prevention, staging, and treatment, is essential in preventing pressure injuries and their associated complications.

Knowledge is the basis of reasonable care. Nurses must use evidence-based practice to provide high-quality care (Beeckman *et al.*, 2010). Furthermore, Lawrence *et al.* (2015) concur with Beeckman *et al.* (2010) by stating that it is essential that nurses' knowledge is contemporary and up-to-date with guidelines, as these guidelines have progressed over time. Using evidence-based practice, nurses can improve the quality of care (Cardoso *et al.*, 2019).

1.3 PROBLEM STATEMENT

Pressure injuries continue to be prevalent among many critically ill patients admitted to the ICU. The problem persists worldwide, and the nurses' knowledge remains deficient despite the technical-scientific advances in health and guidelines with recommendations for pressure injury prevention. Literature on nurses' knowledge of pressure injury prevention and management demonstrates that knowledge levels are associated with individual and educational characteristics. To render holistic and quality care to critically ill patients, ICU nurses need scientific knowledge related to pressure injuries, as the practice is often not based on evidence but myths, traditions and one's own or colleagues' experiences.

The researcher attempted to answer the following research question:

- What is the intensive care unit nurses' knowledge of pressure injury prevention and management?

1.4 PURPOSE OF THE STUDY

This study aimed to describe ICU nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge to make recommendations for clinical practice, education, and training of nurses in ICU.

1.5 OBJECTIVES

The objectives of this study were:

- To describe the demographic characteristics of the ICU nurses.
- To describe ICU nurses' knowledge of pressure injury prevention and management

- To identify factors that predict appropriate prevention and management of pressure injuries.

1.6 SIGNIFICANCE OF THE STUDY

This study intended to describe ICU nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge. By conducting this study, the results could contribute to clinical practice in improving ICU nurses' knowledge of pressure injury prevention, thus reducing hospital costs and preventing prolonged hospital stays due to complications of pressure injuries. This study is significant as pressure injuries remain an immense problem in ICUs as critically ill patients are at high risk of developing pressure injuries due to the nature of their illness and immobility. Pressure injuries increase the risk of morbidity and mortality of critically ill patients already compromised physiologically by their illness severity.

1.7 RESEARCHERS' ASSUMPTIONS

According to Grove and Gray (2018), an assumption is a principle that is deemed truth, despite it not having been scientifically proven. A paradigm is an overall outlook on "the complexities of the real world" (Polit & Beck, 2018). Furthermore, there are two paradigms within which nursing research is conducted. This study made use of the Positivist paradigm and was based on the following assumptions:

1.6.1 Meta-theoretical Assumptions

According to Polit and Beck (2018), metatheory explores the theoretical foundations on which the study is based. The person, the environment, health and nursing are the four meta-theoretical assumptions in nursing.

- **The person**

The person in this study is the critically ill patient in the intensive care unit. A critically ill patient is a person who has actual or life-threatening health problems, requiring continuous

observation and interventions (Elliott, Aitken & Chaboyer, 2013). Patients have physiological, psychological, social and spiritual needs. Critically ill patients are susceptible to developing pressure injuries as they are often sedated and ventilated and often have additional risk factors.

- **The environment**

An environment is the physical surroundings (Masters, 2015). The environment in this study is the intensive care unit, a designated area in a hospital with specialized equipment and skilled personnel for critically ill patients (Oh, Bersten & Soni, 2008).

- **Nursing**

Intensive care nursing is a speciality that involves the care of critically ill patients (de Beer, Brysiewicz & Bhengu, 2011). Intensive care unit nurses require extensive knowledge and advanced decision-making skills (de Beer, Brysiewicz & Bhengu, 2011). According to Lawrence, Fulbrook and Miles (2015) and Tigari, Mirshekari and Forouzi, (2018), nurses are responsible for the maintenance of skin integrity and the prevention and treatment of pressure injuries.

- **Health and Wellness**

According to the World Health Organisation (1948), health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Pressure injuries increase morbidity and mortality, and therefore, knowledge on preventing and managing these promotes the health of critically ill patients.

1.6.2 Theoretical Assumptions

A theory is "an attempt to explain and predict a particular phenomenon" (de Vos *et al*., 2011). As stated previously, an assumption is a statement that is believed to be correct without being scientifically verified (Polit & Beck, 2018). Theoretical assumptions are theoretical notions used as a point of departure in a study (Polit & Beck, 2018). This includes the operational

definitions used in a study.

1.6.2.1 Operational definitions

Operational definitions define a variable by stipulating what actions are needed to measure it (de Vos *et al*., 2011). Definitions for the study were as follows:

- **Intensive Care Unit**

An Intensive Care Unit is a specifically designated area in the hospital with specialized equipment and skilled personnel to care for critically ill patients requiring immediate and continuous attention (Oh, Soni & Bersten, 2008). This study was conducted in the multidisciplinary, trauma, cardiothoracic and neurosurgical intensive care units at a university-affiliated public hospital in Johannesburg.

- **Critically ill patient**

Refers to a person who is characterized by the presence of actual or potential life-threatening health problems, which include the requirement for continuous observation and interventions in an intensive care unit to prevent complications and restore health where possible (Elliott, Aitken & Chaboyer, 2013).

- **Pressure injury**

This is an injury to a localized skin or soft tissue area due to pressure or pressure combined with shearing (NPUAP/EPUAP, 2014). This study intended to describe intensive care unit nurses' knowledge of pressure injuries.

- **Prevention**

Refers to the act of stopping something from happening or of stopping someone from doing something (Dictionary.cambridge.org, 2020). Knowledge of pressure injury prevention was examined in this study.

- **Management**

The control and organization of something (Dictionary.cambridge.org 2020). Knowledge of pressure injury management was investigated in this study.

- **Knowledge**

Knowledge is an understanding or information about a subject obtained through experience or study (Dictionary.cambridge.org, 2020). Intensive care unit nurses' knowledge of prevention and management of pressure injuries was researched in this study.

1.6.3 Methodological Assumptions

The methodological assumptions reveal the researcher's assumptions about the research process. The methodological assumptions of this study are in congruence with the scientific method of inquiry. A quantitative, descriptive and correlational design was chosen as the most suitable approach to obtain the information required in this study. This study was conducted to describe ICU nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge.

1.7 OVERVIEW OF THE RESEARCH METHODOLOGY

This study utilized a quantitative, descriptive, and correlational design to use a cross-sectional survey to collect the data. A revised version of the Pressure Ulcer Knowledge Assessment Tool (PUKAT) version 2.0 was used. The PUKAT 2.0 is a self-administered questionnaire developed initially by Beeckman *et al.* (2010) and updated by Manderlier *et al*. (2017).

Ethical clearance and permission to conduct the study were obtained from the university's research committee, the Gauteng Department of Health, the CEO of the hospital, the nursing service manager, and the four ICUs' unit managers.

This study was conducted in four ICUs at a university-affiliated public hospital in Johannesburg. These ICUs included multidisciplinary, trauma, neurosurgical and

cardiothoracic. The study period was September 2020 to December 2020. A preliminary audit taken in January 2020 from the unit allocation list indicated approximately 135 (N= 135) registered nurses practising in these units. A sample size of 100 (n=100) was decided upon consultation with a biomedical statistician, utilizing the convenience sampling method. Data was analyzed using descriptive statistics.

1.8 VALIDITY AND RELIABILITY OF THE STUDY

Validity was guaranteed by using large sample size and making use of an already validated questionnaire. Reliability was maintained by ensuring reliable and consistent data collection, which was accomplished by guaranteeing that the researcher was the solitary data collector and that the questionnaire was complied with.

1.9 ETHICAL CONSIDERATIONS

The following ethical issues were taken into consideration:

- Protocols were submitted for peer review to the Department of Nursing Education to assess the feasibility
- Protocols were submitted to the University Postgraduate Committee for permission to conduct the study, and ethics approval was obtained
- Permission from the Gauteng Department of Health and hospital management was obtained
- Permission to use the instrument from the developers was obtained
- All participants who completed the questionnaire were regarded as giving consent to take part in the study, as per the information letter issued to them
- Confidentiality and anonymity of participants was ensured by the use of code names or numbers
- Participants were informed that participation is voluntary, and they may withdraw from the study at any time, without penalty

1.10 LAYOUT OF THE STUDY

The proposed layout of the study was as follows:

Chapter One: Overview of the study

Chapter Two:	Literature review
Chapter Three:	Research design and methods
Chapter Four:	Results of the study
Chapter Five:	Discussion of findings, limitations and recommendations.

1.11 SUMMARY

In this chapter, the study outline was described, which included the background, research objectives, and purpose of the study and significance. The researcher's assumptions were described, and operational definitions were defined. The chapter briefly overviews the research methodology, which will be further discussed in Chapter Three.

The following chapter will focus on the literature review of the study in question.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents the discussion of the literature reviewed for the topic under study. A literature review summarises journal articles and books that portray current and previous information on the research topic. Furthermore, it illustrates a need for further investigation into the topic and how the study will contribute to the current literature (Creswell, 2012). When reviewing the literature, a researcher is equipped with background information on the research topic to understand the identified issue being researched. The literature review is crucial as it allows the researcher to know what is already known about the problem under investigation and aids the researcher to identify gaps in previous research and better research methods (de Vos *et al*., 2011).

An overview and definition of pressure injuries, classification, prevalence and incidence of pressure injuries, the role of intensive care unit nurse, prevention and management of pressure injuries will be presented in this chapter.

The search was conducted using electronic databases available in the University of Witwatersrand Health Sciences Library. The search engines used included CINAHL, EBSCO Host, MEDLINE, and Science Direct.

2.2 OVERVIEW AND DEFINITION OF PRESSURE INJURIES

The aetiology, prevention, and management of pressure injuries are complex. Pressure injuries have been well documented throughout history, since ancient times, with pressure injuries being found in human mummies. However, pressure injury prevention is relatively new and is still being investigated (Wound, Ostomy and Continence Nurses Society, 2017). Our insight into pressure injury development and aetiology has expanded recently. This has been possible through research, expertise, and international expert collaboration (Edsberg *et al*., 2016).

Pressure injuries are "localised injury to the skin and/or underlying tissue" caused by pressure and shear (NPUAP/EPUAP, 2014). Furthermore, pressure injuries were previously called pressure ulcers (Alderden *et al*., 2017). An ulcer is a "break-in skin or mucous membrane" with associated loss of tissue and epithelial tissue breakdown (Merriam-Webster Dictionary, n.d.; Edsberg *et al*., 2016). The National Pressure Ulcer Advisory Panel (NPUAP) implemented this name-change as it was decided that the term *ulcer* does not describe the physical appearance of all the stages accurately, for example, Stage I and Deep Tissue Injury (Edsberg *et al*., 2016).

2.3 CLASSIFICATION OF PRESSURE INJURIES

The National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance created the International NPUAP/EPUAP pressure ulcer classification system in 2014. This system aids in classifying pressure injuries into six stages.

Stage I refers to non-blanchable erythema. This occurs when the skin is discoloured, for example, red, in a localised area, typically over a bony prominence, and the area may differ from surrounding tissue with regards to Temperature and Pain. This stage is indicative of patients at risk of pressure injury development.

Partial-thickness loss of the dermis occurs in stage II and presents as a "shallow open ulcer without slough" or a blister filled with serum (NPUAP/EPUAP, 2014).

Stage III involves full-thickness tissue loss, and stage IV involves full-thickness tissue loss where the bone, tendon, or muscle is exposed (NPUAP/EPUAP, 2014).

The fifth stage is unstageable as the ulcer is covered in slough or eschar, and therefore the depth cannot be determined, and the sixth stage is a suspected deep tissue injury where a localised area of skin is intact but is purple or maroon, or a blood-filled blister is present. An overview of these stages is provided in **Table 2.1**.

Table 2.1: Pressure ulcer classification system

Stage	Definition	Description
Stage I	Non-blanchable erythema	Intact skin with redness which is non-blanchable
Stage II	Partial-thickness skin loss	Shallow, open ulcer without slough OR serum-filled blister
Stage III	Full-thickness skin loss	Subcutaneous fat visible; bone, tendon, muscle is not exposed
Stage IV	Full-thickness tissue loss	Exposed bone, tendon, or muscle
Unstageable	Full-thickness tissue loss-depth unknown	An ulcer is covered by slough or eschar- obstructing the view of the depth
Suspected deep tissue injury	Intact skin- purple/maroon	A localised area of discoloured skin OR blood-filled blister

Source: NPUAP/EPUAP (2014)

2.4 PREVALENCE AND INCIDENCE

Prevalence refers to "the proportion of the population that has the disease at a particular time", while incidence refers to "the occurrence of new cases of disease" during a period (Boston University School of Public Health, n.d.). Worldwide, hospital-acquired pressure injuries develop in 3% to 34% of patients (Alderden *et al*., 2017). According to Tayyib, Coyer and Lewis (2016), the prevalence of pressure injuries in Africa is 9.7% to 51.6%.

In a study conducted in Spain on the predictive validity and reliability of the Braden scale, it was found that of the pressure injuries developed during the study, the sacrum was the most affected area at 59.4%. Other less frequent locations included the occiput, spinous process, scapula, buttock, trochanter, heel, and internal malleolus (Lima-Serrano *et al*., 2018). Furthermore, in another study in Brazil, 58% of pressure injuries developed affected the coccyx/sacrum, followed by the gluteus, heel, inter-gluteal cleft, auricle, trochanter, occiput, and dorsum (Ranzani *et al*., 2016).

2.5 CRITICALLY ILL PATIENTS AND PRESSURE INJURIES

A critically ill patient is a person who suffers from a life-threatening health problem that may be actual or potential. They, therefore, require continuous observation and interventions to re-establish health and prevent complications (Elliot *et al*., 2013).

Critically ill patients are more likely to develop pressure injuries than patients in general wards (Nowicki *et al.,* 2018). Furthermore, patients in ICU are 3.8 times more likely to develop a pressure injury than non-intensive care patients (Coyer *et al.,* 2017). Fullbrook and Anderson (2016) concur that pressure injury development risk is more significant for patients in ICU than in other areas and delay recovery time and increase mortality. Severe illness, comorbidities, restricted movement, and bed rest complications are the reasons why critically ill patients have a higher risk of developing pressure injuries. It is rare for a critically ill patient to not be at risk of developing pressure injuries (Fulbrook & Anderson, 2016).

The additional factors that place critically ill patients at risk of developing pressure injuries include vasopressors, sedation, altered level of consciousness, haemodynamic instability, and mechanical ventilation (Lospitao-Gomez *et al.,* 2017). Age, specific treatments and medications, prolonged stay in ICU, bodyweight extremes such as obesity or underweight, inadequate nutrition, incontinence, oedema, pyrexia, anaemia, lymphopenia, decreased blood albumin levels, and history of smoking are further risk factors (de Almeida Medeiros *et al.*, 2018).

2.6 THE ROLE OF INTENSIVE CARE UNIT NURSES

The intensive care unit is "a specifically designated area in the hospital with specialised equipment and skilled personnel for the care of critically ill patients requiring immediate and continuous attention" (Oh, Soni & Bersten, 2008). Intensive care nurses require extensive knowledge and advanced decision-making skills (de Beer, Brysiewicz & Bhengu, 2011). As such it is an area of specialisation that involves the delicate care of critically ill patients.

2.6.1 Scope of Practice

As stated in the Scope of Practice for registered nurses (South African Nursing Council (SANC) Regulation 2598), the registered nurse must diagnose the health needs and provide a nursing regime to meet the patients' needs. This is achieved when the nurse can identify patients at risk of developing pressure injuries using a validated pressure injury risk assessment scale and provide their patients with intensive and appropriate nursing interventions. Furthermore, according to the South African Nursing Council, registered nurses are responsible for the "protection of the skin" and "the promotion of exercise", which includes mobility of the patient (South African Nursing Council, 1991).

In ICU, continuous nursing care is mandatory, and nurses are at the patient's bedside "24/7" (Marshall *et al*., 2017). Nurses are responsible for maintaining skin integrity and preventing and treating pressure injuries (Lawrence, Fulbrook & Miles, 2015; Tigari, Mirshekari, Forouzi, 2018).

2.6.2 Education

Ongoing education about pressure injury prevention is part of the pressure injury prevention protocol, which the National Pressure Ulcer Advisory Panel sanctions. It allows nurses to achieve and maintain up-to-date knowledge (Wound, Ostomy and Continence Nurses Society, 2017). Registered nurses must understand their responsibility to prevent pressure injuries, as outlined in the Scope of Practice. Therefore, they must receive frequent education to be confident in recognising, assessing, preventing, and managing pressure injuries (Wound, Ostomy and Continence Nurses Society, 2017).

2.6.3 Clinical judgement

Clinical judgment is an essential skill for nurses (Tanner, 2006). According to Tanner (2006), the clinical judgement refers to gathering information about a patient, such as the patient's needs or health-related issues, and drawing a conclusion from this information to make a decision. Clinical judgement is accomplished by four aspects, namely, *noticing, interpreting, responding, and reflecting*.

Noticing is the ability of the nurse to recognise the situation presented (Tanner, 2006). Regarding pressure injuries, this would mean that the nurse should recognise which patients are at risk of developing pressure injuries and recognising when a pressure injury develops.

Interpreting implies a sufficient understanding of the situation (Tanner, 2006). The nurse should identify the risk factors that make the patient susceptible to developing pressure injuries. The nurse should be able to stage the developed pressure injury accurately.

Responding refers to determining which intervention is appropriate (Tanner, 2006). Once the risk factors have been identified, the nurse must decide on the appropriate preventative measures. After a pressure injury is accurately staged, the nurse should choose which intervention and treatment are appropriate.

Reflecting identifies and recognises how the patient responds to the intervention/treatment (Tanner, 2006). This would mean the nurse should assess how the patient responds to the preventative measures and if these interventions are efficient regarding preventing pressure injuries. When treating a pressure injury, the nurse should assess whether the treatment is effective or not.

In a study by Balzer *et al*. (2014), the authors highlighted and underscored that nurses' clinical judgement is the primary basis for pressure injury risk assessment. Patients' characteristics are used by nurses when performing pressure injury risk assessments, as well as patients' "protective conditions" (Balzer *et al*., 2014). Clinical judgement is essential (NPUAP/EPUAP, 2014).

2.6.4 Knowledge of pressure injuries

Knowledge is the "understanding of or information about a subject that you get by experience or study" (Dictionary.cambridge.org, 2020). Knowledge is the basis of reasonable care. Nurses must use evidence-based practice to improve high-quality care (Beeckman *et al*., 2010). Furthermore, Lawrence, Fulbrook and Miles (2015) concur with Beeckman *et al*. (2010) by stating that it is essential that nurses' knowledge is contemporary and up to date with guidelines, as these guidelines have progressed over time. Using evidence-based practice, nurses can improve the quality of care (Cardoso *et al*., 2019).

Knowledge of pressure injuries, including risk, prevention, staging, and treatment, is essential in preventing pressure injuries and their associated complications (Pieper & Zulkowski, 2014). Nurses require updated knowledge to determine which patients need prevention, which preventative methods are most effective, and how best to apply these methods of prevention (Manderlier *et al*., 2017).

2.7 IMPLEMENTATION OF PRESSURE INJURY PREVENTION

Hospital-acquired pressure injuries remain a significant complication of hospitalisation, despite increased awareness and knowledge (Wong *et al*., 2018). Experts have identified many disparities in the prevention and management of pressure injuries. It is crucial to identify and address these barriers (Wound, Ostomy and Continence Nurses Society, 2017). Common barriers to implementing pressure injury prevention guidelines are knowledge deficit and a negative attitude towards preventing pressure injuries (Manderlier *et al*., 2017). As discussed, nurses' knowledge of pressure injuries is essential. Knowledge improves the quality of care and influences nurses' attitudes towards pressure injuries (Manderlier *et al*., 2017). Nurses' attitudes towards pressure injuries are significantly associated with implementing adequate pressure injury prevention strategies (Tan *et al*., 2020).

Other barriers faced in the prevention of pressure injuries are heavy patients who are difficult to reposition, lack of resources and time, and patients who do not participate in prevention interventions (Gunningberg *et al*., 2013). Furthermore, the lack of nursing staff has also been identified as a barrier. Therefore, Tonole and Brandao (2018) believe that adequate human resources are vital in preventing pressure injuries and other health-related incidents.

Identifying gaps in knowledge and evaluating nurses' attitudes and beliefs about the importance of preventing and managing pressure injuries is vital (Wound, Ostomy and Continence Nurses Society, 2017).

2.8 PREVENTION OF PRESSURE INJURIES

Pressure injuries are preventable. Hospitals are required to meet standards of care to prevent pressure in at-risk patients. Healthcare facilities need to prioritise implementing prevention and management programs, which should be evidence-based (Wound, Ostomy and

Continence Nurses Society, 2017). Improvement of strategies to prevent pressure injuries should be a priority (Fulbrook & Anderson, 2016). The need for implementation of a pressure injury prevention bundle is required. The elements included in the bundle are risk assessment, skin assessment, skincare, nutrition, repositioning, support surfaces, and medical device care (Tayyib, Coyer & Lewis, 2016).

- **Risk Assessment**

The development of pressure injuries is related to the patient's risk factors, and therefore the first step of preventing pressure injuries is risk assessment (Tonole & Brandao, 2018). A structured risk assessment should be performed when the patient is admitted when identifying risk or within eight hours of admission and should be repeated when or if there is a change in the patient's condition. However, Tayyib, Coyer and Lewis (2016) state that for an intensive care patient, the risk assessment should be done within 24 hours of admission and daily. A risk assessment should also be performed on individuals with existing pressure injuries as the existing pressure injury can progress/ worsen to another stage, and the patient may be at risk of developing further pressure injuries. Risk assessment is essential to identify patients at risk of developing pressure injuries. It is uncommon that an intensive care patient is identified as not at risk for pressure injuries (Fulbrook & Anderson, 2016). During the risk assessment, intrinsic and extrinsic factors, such as pressure, friction, shear, and maceration, are identified (Tonole & Brandao, 2018). These steps are followed to ensure an effective prevention plan and adequate resource usage (Tayyib, Mirshekari & Forouzi, 2016; Lima-Serrano *et al*., 2018).

Risk assessment scales are crucial in preventing pressure injuries, predicting which patients are at risk of pressure injury development by analysing patients' risk factors (Fulbrook & Anderson, 2016). Risk assessment scales are objective tools (Lospitao-Gomez *et al*., 2017) and allow early execution of preventative interventions for patients at risk of developing pressure injuries (Fulbrook & Anderson, 2016).

There are many risk assessment tools, but it is essential to choose a tool that has been tested for validity and reliability and is appropriate for the population under study. The Norton, Braden, and Waterlow scales are the most prevalent risk assessment scales (Wang *et al*., 2015). There are limited risk assessment scales created explicitly for intensive care patients

(Fulbrook & Anderson, 2016). Critical care risk factors are not included in many risk assessment scales (Nowicki *et al*., 2018). According to Lima-Serrano *et al*. (2018), there are only seven validated risk assessment scales for use in ICU. Lack of these creates barriers to correctly identifying patients at risk of developing pressure injuries (Nowicki *et al*., 2018). The most common scales will be discussed below.

"*The Waterlow Card*" was developed in 1985 and initially tested on medical, surgical, intensive care, orthopaedic, and elderly patients (Waterlow, 1998). It is a standardised and commonly used risk assessment scale despite its low validity (Satekova *et al*., 2015). It includes build, skin type, age, nutrition, continence, mobility, surgery, medication, and particular risk factors such as neurological deficit and tissue malnutrition (Waterlow, 1998).

"*The Braden Scale for Predicting Pressure Sore Risk*" was developed in 1986 (Bergstrom *et al*., 1987). It is one of the most common risk assessment scales as it has previously been established as valid and reliable (Satekova *et al*., 2015). However, this scale was developed for use in general wards (Satekova *et al*., 2015) and use in the elderly (Bergstrom *et al*., 1987). It includes sensory perception, mobility, moisture, nutrition, activity, and friction (Bergstrom *et al*., 1987). This scale has been reported as the most widely used risk assessment scale in ICU worldwide (Bergstrom *et al*., 1987).

"*The Norton Scale*" was developed in 1962. It was the first risk assessment scale and was developed using clinical experience (Satekova *et al*., 2015). It was created for use in elderly patients. Physical condition, mental state, continence, mobility, and activity are the five risk factors in this tool (Satekova *et al*., 2015).

"The *Cubbin-Jackson Scale*" was created explicitly for use in ICUs in 1991 (Kim *et al*., 2013). It includes ten factors: age, weight, skin condition, mobility, mental condition, respiration, nutrition, hygiene, continence, and hemodynamic condition (Seongsook, Ihnsook & Youngshee, 2004).

Table 2.2 shows an overview of the most common risk assessment scales.

Table 2.2: Overview of the risk factors in the pressure injury scales

Risk Factors	Waterlow Scale	Braden Scale	Norton Scale	Cubbin-Jackson Scale
Build/ weight	×			×
Skin condition	×			×
Age	×			×
Nutrition	×	×		×
Continence	×		×	×
Mobility	×	×	×	×
Surgery	×			
Medication	×			
Mental state	×		×	×
Tissue status	×			
Sensory perception		×		
Friction		×		
Moisture		×		
Physical condition			×	
Activity		×	×	
Respiration				×
Hygiene				×
Haemodynamic status				×

Source: Kim *et al*. (2013), Satekova *et al*. (2015) and Waterlow (1998)

However, the risk assessment tool should not be used on its own. Instead, it should be used in conjunction with clinical judgement. Clinical judgement and knowledge of risk factors should be utilised in any risk assessment (The Royal Children's Hospital Melbourne, 2019). Balzer *et al*. (2014) maintain that clinical judgement is imperative and is emphasised as the principal source of risk assessment. This may be because nurses use factors that are not included in the risk assessment tool. A risk assessment done by a nurse is "comprehensive and complex" (Balzer *et al*., 2014).

- **Skin Assessment**

A comprehensive skin assessment should be incorporated in every risk assessment to assess any changes in skin integrity as it is vital in preventing, classifying, diagnosing, and managing pressure injuries. A comprehensive skin assessment encompasses the identification of a localised area of heat, oedema, induration, as well as for blanching (The Royal Children's Hospital Melbourne, 2019). However, blanching and redness are often missed in individuals with dark skin as these are difficult to identify. The comprehensive skin assessment should be done within the first 4 hours of admission and then every 8 hours (Tayyib, Coyer & Lewis, 2016). However, how often a skin assessment should be done is based on the patient's condition and should be done more often if the patient's condition deteriorates (The Royal Children's Hospital Melbourne, 2019). According to these authors, the skin assessment should be done as a "head-to-toe" assessment, but attention should be given to high-risk areas which cover bony prominences such as the sacrum and heels.

Suppose a loss in skin integrity is identified. In that case, it should be classified according to the staging system by the NPUAP/EPUAP (2014), and the size and depth should be noted, as well as any exudates (Tayyib, Coyer & Lewis, 2016).

The skin assessment should involve examining the skin for erythema. If erythema is present, it should be assessed to establish whether it is blanchable or not. Pressing a finger on the area of redness for three seconds and assessing blanching when the pressure is released. Furthermore, oedema, heat, localised pain, and tissue consistency should be included in the skin assessment in individuals with dark skin, erythema may be challenging to observe, and so the skin should be assessed for oedema, heat, localised pain and tissue consistency. During the skin assessment, it is essential to check the skin around medical devices. This should be done twice a day, but more often if the patient is oedematous.

- **Preventive Skin Care**

The NPUAP/EPUAP (2014) outlines preventive skincare as follows:

- If possible, the patient should not be positioned on the area of erythema
- The skin should be kept clean and dry

- The skin should not be massaged or rubbed exuberantly as this causes friction
- The skin should be cleaned as soon as the possible post-incontinent episode
- Prevent moisture
- A skin moisturiser should be used to prevent dryness

Furthermore, Tayyib, Coyer and Lewis (2016) promote bathing patients with a pH-balanced soap once a day and protecting skin with a padded dressing. These prophylactic dressings alter the mechanical load on the skin. In a study by Clark *et al*. (2014), it was suggested that prophylactic dressings on the sacrum, heels, trochanter, and nose decreased pressure injury incidence. Thus, it is recommended that prophylactic dressings such as silicone dressings are applied to these areas and the buttocks and under medical devices (Wound, Ostomy and Continence Nurses Society, 2017).

- **Nutrition**

Nutritional screening should be done to identify patients at risk of nutritional deficit so that a comprehensive nutrition assessment can be performed. The screening should be done on admission if the patient's condition changes and when a pressure injury does not heal. Assessment of the patient's nutritional status on admission is included in the pressure injury prevention bundle (Tayyib, Coyer & Lewis, 2016).

A dietician should be included in the patient's management to ensure nutritional intake is optimal, and any weight loss should be investigated (Mallah, Nassar & Badr, 2015). When oral intake is insufficient or impossible, such as an intubated or unconscious patient, enteral or parenteral feeding should be used (NPUAP/EPUAP, 2014).

Adequate nutrition and hydration should be maintained. Nutritional support should be utilised to prevent or correct any deficits in nutrition. Protein, vitamin C, vitamin A and zinc have been identified as the primary nutrients in pressure injury prevention and treatment (The Royal Children's Hospital Melbourne, 2019).

- **Repositioning**

Repositioning is essential to relieve pressure on bony prominences (Mallah, Nassar & Badr, 2015). All at-risk patients should be repositioned as frequently as possible unless contraindicated (NPUAP/EPUAP, 2014). According to Tayyib, Coyer and Lewis (2016), patients should be repositioned every three hours, but Mallah, Nassar and Badr (2015) promote two-hourly turnings or more often as needed. The repositioning frequency should be determined by considering the patient's tissue tolerance, level of mobility, clinical condition, skin condition, comfort, and any pressure support surfaces such as pressure redistributing surfaces (Tonole & Brandao, 2018). If not contraindicated, the "30° tilted side-lying position" should be used. This incorporates repositioning the patient 30° by alternating on the ride side, the left side, and the back (NPUAP/EPUAP, 2014).

The head of the bed, hands, and heels should be elevated when lying in bed (Mallah, Nassar & Badr, 2015). The patient should reposition himself if he can (The Royal Children's Hospital Melbourne, 2019). A draw-sheet should be used when lifting or transferring patients who cannot reposition themselves, prevent friction, and patients should be mobilised every day to sit on a chair unless clinically contraindicated (Tayyib, Coyer & Lewis, 2016). When sitting in the chair, patients should be repositioned on the chair hourly (Mallah, Nassar & Badr, 2015). Patients should be mobilised as soon as possible (NPUAP/EPUAP, 2014).

- **Support Surfaces**

Support surfaces refer to specialised devices in redistributing pressure which transfers the pressure under the bony prominences (Tonole & Brandao, 2018). All intensive care patients should be nursed on an air mattress (Tayyib, Coyer & Lewis, 2016). Patients should still be repositioned despite the use of support surfaces (The Royal Children's Hospital Melbourne, 2019). Sheepskin, doughnut-shaped devices and gloves filled with water under the heels should not be used for pressure relief (The Royal Children's Hospital Melbourne, 2019).

- **Medical Device Care**

Medical devices can cause injury, which "mimics" the shape of the device. Medical device pressure injuries arise in adipose-free areas of the body. These progress into higher stages

quicker than non-medical device injuries. Patients with medical devices are at a higher risk of developing pressure injuries (Wound, Ostomy and Continence Nurses Society, 2017). These devices include cervical collars, orthotics, oxygen saturation probes, ECG cables, endotracheal tubes, non-invasive masks and nasal cannulas (The Royal Children's Hospital Melbourne, 2019). The skin around and under medical devices should be assessed 12 hourly but more often if patients are oedematous (Tayyib, Coyer & Lewis, 2016). Medical devices that are at risk of causing pressure injuries should be removed as soon as medically possible (NPUAP/EPUAP, 2014).

Nasogastric and endotracheal tubes should be repositioned and secured (Tayyib, Coyer & Lewis, 2016); however, ensure the endotracheal tube's depth is validated by repositioning it. Furthermore, it should be ensured that patients are not positioned on medical devices unintentionally (The Royal Children's Hospital Melbourne, 2019).

2.9 MANAGEMENT OF PRESSURE INJURIES

The pressure injuries classification system, as outlined previously, helps to describe the pressure injury, including the degree of skin and tissue damage ((NPUAP/EPUAP, 2014). Open wounds such as venous ulcers and incontinence-associated dermatitis may appear like a pressure injury. Therefore, it is essential to know the aetiology to treat the wound effectively. Also, the majority of South Africans have darkly pigmented skin. The current consensus is that pressure injuries or suspected deep tissue injuries may be difficult to detect in patients with darkly pigmented skin. Hence, assessing skin temperature, tissue consistency, and pain is also effective in the assessment (NPUAP/EPUAP, 2014).

- **Assessment of Pressure Injuries**

A comprehensive assessment of the patient and the pressure injury is required to manage the patient appropriately. The comprehensive assessment of the patient should include medical history; physical examination that includes factors that may affect healing, such as poor perfusion, as well as laboratory tests; nutritional status (NPUAP/EPUAP, 2014). According to Rosin *et al.* (2020), systematic assessment of the pressure site would include:

- staging the pressure injury classification system, as previously outlined;
- measurement of the wound, which includes the length, width, and depth;

- assessment of the wound edges, which may be attached, detached, or macerated;
- assessment of the wound bed which may be affected by slough, necrosis, eschar, or infection; and
- assessment of surrounding skin for intactness, denudation, maceration, or dermatitis.

Pressure injuries should show signs of healing within two weeks if there has been appropriate wound care, nutrition, and redistribution of pressure (i.e. regular turnings) (NPUAP/EPUAP, 2014). Pressure injuries should be assessed initially when the pressure injury is identified and then reassessed at least once a week (NPUAP/EPUAP, 2014). The physical characteristics of pressure injury should be assessed. These include location, stage; size; tissue type; colour; peri-wound condition, wound edges; sinus tracts; undermining; tunnelling; exudate, odour (Rosin *et al.*, 2020).

Assessment of the pressure injury for deterioration, such as an increase in wound dimensions and signs of infection and signs of healing, should be assessed with each dressing change. This allows the healthcare provider to decide if a change in treatment is required. As previously stated, clinical judgement is crucial. Clinical judgement is used to assess healing. Signs of healing include improvement in tissue, decreased dimensions of the wound, decreased amount of exudate. The health provider's clinical judgement is used in conjunction with validated and reliable pressure injury assessment tools and photographs (NPUAP/EPUAP, 2014).

- **Assessment and Treatment of Pressure Injury- related pain**

Pressure injuries are painful. The character, intensity, and duration of pain should be assessed if the patient is conscious and able to verbalise. However, if the patient cannot verbalise this, nonverbal cues and body language should be included in the assessment. Preventing pressure injury-related pain is a priority. Using a lift or transfer sheet to reposition the patient with a pressure injury will minimise friction and prevent pain. Furthermore, positioning the patient off the pressure injury will minimise the pain. Positions that increase pressure, such as Fowler's, should be avoided (NPUAP/EPUAP, 2014).

Pain management for pressure injuries begins with coordinating care with the administration of analgesia to reduce pain. Analgesia should be administered frequently. Pressure injury-related pain can also be reduced by keeping the pressure injury covered and moist. The dressing chosen should not require frequent changes, as this may lead to pain. The dressings most suitable for pressure injuries include hydrogels, alginates, foams, and silicone. Repositioning the patient may also reduce pain (NPUAP/EPUAP, 2014).

- **Wound Care: Cleansing and Debridement**

The pressure injury should be cleansed with each change in dressing, as well as the surrounding skin. The pressure injury should be cleansed with normal saline using an aseptic technique. However, if the pressure injury has debris or is infected, an antimicrobial cleansing solution should be used (NPUAP/EPUAP, 2014). In contrast, debridement involves foreign matter and necrotic tissue removal from a wound to promote its healing (Kamoltz & Wild, 2013). There are six types of debridement: surgical, conservative, autolytic, enzymatic, larval and mechanical. When there is extensive necrosis, cellulitis, or sepsis, surgical debridement is suggested using sterile instruments. Debridement should not be performed when there is not sufficient perfusion to the pressure injury, and therefore an assessment of perfusion must be conducted before the debridement to ensure that the pressure injury will heal (Rosin *et al.*, 2020; NPUAP/EPUAP, 2014).

- **Assessment and Treatment of Infection and Biofilms**

Intact skin provides primary defence against bacteria, which resides on all surfaces of skin. When the skin becomes damaged, namely in a pressure injury, bacteria can infect the wound. This may lead to infection. Patients with diabetes mellitus, protein malnutrition, poor perfusion, hypoxia, autoimmune disease, or immunosuppression are more prone to pressure injury infections (NPUAP/EPUAP, 2014). Signs of an infected pressure injury include erythema, induration; increased pain; increased heat, purulent drainage, increased dimensions of the wound, discolouration of the skin surrounding the wound. The patient may also have malaise, fever, and confusion. The first line of treatment is to ensure that the patient is in good health. This is done by ensuring that the patient is not nutritionally compromised, the patient's blood glucose is well controlled, and the patient is well perfused.

Further, contamination of the pressure injury by faeces should be prevented, and the pressure injury should be cleansed, as previously outlined. An antiseptic ointment may be used. Antibiotics may be used for systemic infections as evidenced by blood culture results, cellulitis and fasciitis, systemic inflammatory response syndrome, and sepsis (NPUAP/EPUAP, 2014).

- **Dressings for Treatment of Pressure Injuries**

There are many types of wound dressings for pressure injuries, and thus it is essential to select the most appropriate dressing. The dressing should be selected based on the size, depth, and location of the pressure injury and the amount and type of exudate present (NPUAP/EPUAP, 2014). Furthermore, the stage of pressure injury will determine the type of dressing chosen (Thomas & Compton, 2014). According to these, wet dressings are superior to dry dressings as they promote healing. Occlusive dressings, such as alginates, hydrogels, and hydrocolloids, support a moist environment by controlling the wound's vapour's movement to the external environment.

Also, hydrocolloid dressings should be used for clean stage II and III pressure injuries. It should not be used for fragile skin or profound exudate (Rosin *et al*., 2020). This type of dressing should be removed cautiously to prevent damage to the surrounding skin (NPUAP/EPUAP, 2014). Hydrocolloid dressings are also used for mild necrotic tissue autolytic debridement (Rosin *et al*., 2020).

Transparent dressings are used for autolytic debridement on non-immunocompromised patients. It should be removed with care to avoid trauma to the surrounding skin, as these types of dressings can cause maceration (Rosin *et al*., 2020). This type of dressing should not be used on pressure injuries with large amounts of exudate. Hydrogel dressings can be used on shallow pressure injuries which do not have much exudate and painful pressure injuries (NPUAP/EPUAP, 2014). They are also used for autolytic debridement of mild necrotic tissue and are often available with antimicrobial properties (Rosin *et al*., 2020).

For pressure injuries with large amounts of exudate or infected pressure injuries, alginate dressings are efficient. Foam dressings and honey-impregnated dressings can be used on stage II and III pressure injuries with large amounts of exudate. The dressing should be

changed if faeces contaminate it. Otherwise, the producer's recommendations for frequency of dressing change should be adhered to (NPUAP/EPUAP, 2014).

Topical Negative Pressure is vacuum-assisted wound closure (VAC). This type of dressing suctions excess fluid from wounds, allowing the wound to heal. Topical Negative Pressure is used to remove excess fluid and bacteria from the wound, reduce its size, and allow for granulation and growth of the epithelium (Thomas & Compton, 2014).

- **Surgery for Pressure Injuries**

Before surgery, factors that contribute to wound healing should be optimised, such as perfusion. Intraoperatively, the patient is at risk of developing pressure injuries as patients are immobile and lie on a hard surface. They can also feel pressure-related pain and relieve pressure by changing positions (NPUAP/EPUAP, 2014).

Postoperatively, patients should be nursed on a pressure redistributing mattress, as well as a surface that reduces shear and has microclimate control. Pressure, shear, and friction should be prevented to avoid damage to the blood supply flap. The wound should be observed for drainage, and signs of flap failure should be assessed, such as pallor, incision separation, oedema, and increased drainage from the incision (NPUAP/EPUAP, 2014).

2.10 THE PRESSURE ULCER KNOWLEDGE ASSESSMENT TOOL

There are many knowledge assessment tools for the prevention and management of pressure injuries. The oldest of these is the Pressure Ulcer Knowledge Test (PUKT) by Pieper and Mott (1995). This tool involves 47 items and incorporates true or false questions. The items are divided into three categories: 33 items regarding prevention/ risk, seven items regarding pressure injury staging, and seven items regarding wound description (Pieper & Mott, 1995). The PUKT has been used worldwide as it was developed using evidence-based literature and guidelines. However, the literature and guidelines have evolved, and therefore there was a need to update this tool. The Pieper- Zulkowski Pressure Ulcer Knowledge Test (PZ-PUKT) was consequently developed in 2014. This updated tool contains 72 true or false items, which are separated into three subscales: prevention/ risk (20 items), staging of pressure injuries

(25 items), and wound description (27 items). This tool can be used in research and the clinical environment (Pieper & Zulkowski, 2014).

Another of the older knowledge tests is the 1991 Pressure Ulcer Questionnaire (PUQ-1991). This test includes 27 items and asks participants to rate these items as "useful", "sometimes useful", "not useful", and "do not know" (Hulsenboom *et al*., 2007).

The 2003 Pressure Ulcer Questionnaire (PUQ-2003), based on the PUQ-1991, is an updated version and includes 28 items which participants are asked to evaluate if these items are helpful or not, as in the older version (Hulsenboom *et al*., 2007).

Before 2010, the validity and reliability of pressure injury knowledge assessment tools were not well established. Beeckman *et al*. (2010) noticed this and thus created the Pressure Ulcer Knowledge Assessment Tool (PUKAT). Beeckman *et al*. (2010) developed this self-administered knowledge assessment tool which became one of the most commonly used internationally as it was proven to be valid and reliable (Manderlier *et al.*, 2017). The tool has been used in research and practice to evaluate knowledge of pressure injuries (Beeckman *et* al., 2010). It consists of 26 multiple-choice questions sub-divided into six themes:

- Aetiology and development
- Classification and observation
- Nutrition
- Risk assessment
- Prevention: reduction of the magnitude of pressure and shearing
- Prevention: reduction of the duration of pressure and shearing

Even though the PUKAT is valid and reliable, it is not up to date as new guidelines for the management and prevention of pressure injuries have been developed since 2010, and this is why Manderlier *et al*. (2017) developed the Pressure Ulcer Knowledge Assessment Tool (PUKAT) version 2.0 which is an updated version as it includes the most recent guidelines on pressure injury prevention and management. The most advanced methods were used to develop this new version to ensure its validity and reliability, and it has shown good psychometric properties after it was thoroughly assessed. The new version consists of 25 multiple choice questions, divided into six themes:

- Aetiology
- Classification and observation
- Risk assessment
- Nutrition
- Prevention of pressure injuries
- Specific patient groups

Pictures and cases were added to assess practical knowledge, over and above the theoretical knowledge (Manderlier *et al*., 2017). The tool can be used in practice, education, and research as the themes are separated, and thus lack of knowledge on a specific theme can indicate the need for education on that particular theme. Furthermore, this tool can be used internationally and across different levels of education, such as nurses and nursing students (Manderlier *et al*., 2017).

2.11 SUMMARY

The literature reviewed about this topic was discussed in this chapter to provide further information about pressure injuries, prevention, and management.

This chapter presented the following: an overview of pressure injuries, classification, prevalence and incidence of pressure injuries; risk assessment scales, prevention, and management of pressure injuries, pressure injury prevention guidelines in ICU, and the role of intensive care nurses in using pressure injury guidelines, progress made with pressure injury guidelines implementation.

The next chapter will outline the research methods and design used in the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

The research design and methods utilised in this study is discussed in depth in this chapter. This includes the research design, study setting, research methods, data collection, pilot testing, data analysis, ethical considerations, validity, and reliability of the study.

3.2 AIM AND OBJECTIVES OF THE STUDY

The aim and objectives of the study are repeated to ensure consistency in the study.

This study aimed to describe ICU nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge to make recommendations for clinical practice, education, and training of nurses in ICU.

The objectives of this study were:

- To describe the demographic characteristics of the ICU nurses.
- To describe ICU nurses' knowledge of pressure injury prevention and management
- To identify factors that predict appropriate prevention and management of pressure injuries

3.3 RESEARCH DESIGN

A non-experimental, quantitative, descriptive and correlational design was employed in this study, using a cross-sectional survey to collect the data.

3.3.1 Non- experimental

According to Maree and Pietersen (2007), as cited in de Vos *et al*. (2011), there is no manipulation of variables and no control groups in non-experimental designs. These are

primarily used in descriptive research. A non-experimental design was used in this study as no variables needed to be manipulated.

3.3.2 Quantitative

Quantitative research involves investigating the relationship between variables to test objective theories (Creswell, 2009). In this study, statistics were used to investigate ICU nurses' knowledge of pressure injury prevention and management.

3.3.3 Descriptive

Descriptive research displays specific details of a subject to describe it accurately (de Vos *et al*., 2011). Descriptive research was used in this study to accurately describe the ICU nurses' knowledge of pressure injury prevention and management.

3.3.4 Correlational

According to Creswell (2012), correlational research designs involve correlational statistics to measure the strength of the relationship between two or more variables. Correlational statistics were used in this study.

3.3.5 Cross-sectional survey

A cross-sectional survey involves gathering data at one point in time to assess present attitudes or practice (Creswell, 2012). This study made use of a cross-sectional survey.

3.4 STUDY SETTING

This study was conducted in four ICUs at a university-affiliated public hospital in Johannesburg. These ICUs include multidisciplinary, trauma, neurosurgical and cardiothoracic ICU. These ICUs were selected because the severity of illness and length of stay of the critically ill patients are similar in these four units. A high level of specialised care for patients with more than one organ failure is provided in these ICUs.

Surgeons and intensivists manage these ICUs. Working with these consultants are surgery registrars and medical officers. Each ICU is managed by a unit manager or nurse in charge. This is a specialised nurse that ensures the smooth running of the ICU. The nursing staff is further made up of specialised nurses who have an extra qualification in intensive care nursing or trauma and professional nurses and enrolled nurses. The nurse to patient ratio is one nurse to one patient, and a bed capacity averages 8-12 beds (Schmollgruber, 2015).

On average, six to seven patients in the multidisciplinary and neurosurgical ICUs develop pressure injuries every month compared to two to four patients in the trauma and cardiothoracic ICUs. The operational managers of these ICUs supplied these statistics. Furthermore, the Waterlow scale is the risk assessment scale for pressure injuries used throughout the study setting.

3.5 RESEARCH METHODS

3.5.1 Population

A population is a group of people with specific characteristics (de Vos *et al.,* 2011). In this study, the study population consisted of registered nurses working in multidisciplinary, trauma, neurosurgical and cardiothoracic ICU. A preliminary audit taken in January 2020 from the unit allocation list indicated approximately 135 (N= 135) registered nurses practising in these units.

3.5.2 Sample and Sampling Methods

According to De Vos *et al.* (2011), a sample is a subset of the population that represents the population. A sample size of 100 (n = 100) was decided upon in consultation with a biomedical statistician. A confidence level of 95% (1.96), a margin of error of 5% and a prevalence of 80% was pre-set for the study. The sample size is a representative sample as the results can be generalised to the population. Convenience sampling was utilised to select participants who meet the inclusion criteria.

The inclusion criteria for prospective participants included:

- Registered nurses working in the multidisciplinary, trauma, neurosurgical and cardiothoracic ICU
- Registered with the South African Nursing Council (SANC)
- Working in ICU for six months

The exclusion included students, agency nurses as well as newly employed ICU nurses working in ICU at the study setting as they were not expected to have in-depth knowledge of pressure injury prevention and management in the intensive care unit and might not have enough time to become familiar with the unit's protocol.

3.6 DATA COLLECTION

Data collection is the gathering of pieces of information (Polit & Beck, 2018).

3.6.1 Instrument

A modified version of the Pressure Ulcer Knowledge Assessment Tool (PUKAT) version was used to achieve the study objectives. The PUKAT version 2.0 is a self-administered questionnaire developed initially by Beeckman *et al.* (2010) and revised by Manderlier *et al*. (2017).

The questionnaire consists of 25 multiple choice questions divided into six themes. The first section contains six (6) questions that collect biographic and workplace data about the respondents. In the second section, the themes include "aetiology", "classification and observation", "risk assessment", "nutrition", "prevention of pressure ulcers" and "specific patient groups". 1 point was allocated to each correct answer, and a score of 0 was allocated to each wrong and "I do not know" answers. Higher total scores signified more knowledge (Tigari, Mirshekari, Foriuzi, 2018).

3.6.2 Validity and Reliability of the Instrument

The original instrument (PUKAT) is a validated tool with a Cronbach alpha of 0.77 (Beeckman *et* al., 2010). The updated version (PUKAT 2.0) was used in this study. An expert panel, consisting of seven members of the European Pressure Injury Advisory Panel and

members from the National Pressure Advisory Panel, determined the face and content validity of the PUKAT version 2.0 (Manderlier *et al.*, 2017). Furthermore, the instrument was further tested on 228 nurses and 114 nursing students in 16 Belgian hospitals (De Meyer *et al.*, 2019).

The PUKAT 2.0 was developed in Europe, and therefore the language might not be understood in the same context, in the South African context. In order to verify that the instrument was applicable and easily understood, the questionnaire was subjected to face, and content validity by five experts recruited based on the following criteria:

- Operational managers who hold the critical care speciality and have more than ten years of experience in the field.
- Critical care lecturers at a university and members of the Critical Care Society of South Africa (CCSSA).

The instrument was modified based on feedback from the expert panel.

A few modifications were made to the questionnaire based on the feedback received from the experts as follows:

- Question 3 was changed from "what is the average percentage of patients with pressure injuries in European hospitals?" to "what is the average percentage of patients with pressure injuries in intensive care units generally?"
- In question 6, "ring cushion" was added to answer "d."
- The pressure injury risk assessment tool used in question 11 was changed from the Braden scale to the Waterlow scale as this is the risk assessment tool that is used in the study setting

3.6.3 Procedure

Permission to conduct the study was sought from the Gauteng Department of Health (**Appendix C**) and the CEO of the hospital (**Appendix D**), as well as the nursing service manager (**Appendix E**) and the unit managers of the four ICUs (**Appendix F**). Once this was obtained, a small pre-test procedure was conducted to improve the main study. After the pre-test was conducted, the main study commenced.

The researcher visited the four ICUs, and nurses with characteristics incorporated in the

inclusion criteria were chosen. The study was explained to the potential participants, and an information letter (**Appendix B**), which outlines the study and its procedures, was given to them. They were able to ask any questions or concerns about the study, which the researcher answered. The potential participants were assured that the study is voluntary and they must not feel obligated to participate. Furthermore, there will be no adverse effects or penalties should they choose not to participate. The nurses, once verbally consented, were given the survey (**Appendix A**), which was self-administered. The researcher remained in the vicinity while the survey was being completed to assist in any questions from the participants.

Data collection was collected from September 2020 to December 2020. The ICUs were visited two to three times a week. The questionnaires were handed out in the mornings and collected from the participants in the late afternoons for day shifts, and for night shifts, the surveys were handed out in the early evening around 20:00 and were collected the following day. However, more time was given to those who needed it. Once the surveys were collected, the researcher coded the questionnaires to maintain anonymity. The questionnaires were then put in a sealed box and kept under lock and key.

3.7 DATA ANALYSIS

Data was captured onto a spreadsheet in Microsoft Excel and then imported into a statistical software package. After data collection was completed, the questionnaire was divided into six themes, as follows:

- Theme One: Aetiology (Items 1 to 6)
- Theme Two: Classification and Observation (Items 7 to 10)
- Theme Three: Risk Assessment (Items 11 to 12)
- Theme Four: Nutrition (Items 13 to 15)
- Theme Five: Prevention of Pressure Injuries (Items 16 to 23)
- Theme Six: Specific Patient Groups (Items 24 to 25)

For the demographic characteristics, categorical variables were described as frequencies and percentages; continuous variables, such as years of experience, were assessed for normality using the Shapiro Wilk test. Normally distributed continuous variables were described as means and standard deviations (SD), and skewed variables were described as medians and interquartile ranges (IQR). A total score on knowledge of pressure injury prevention and

management was calculated by adding the number of correct responses of the 25 questions asked and calculating a percentage. For each of the themes in the questionnaire, a Cronbach alpha coefficient was calculated to measure the internal consistency of each of the items that make up each theme (Tavakol & Dennick, 2011). For each of the scores in each theme, a Shapiro Wilk test was used to determine the distribution of the scores. A Shapiro Wilk p-value of above 0.05 indicated that the scores were normally distributed; hence, the score's distribution was presented as a mean and standard deviation. A Shapiro Wilk p-value of less than 0.05 indicated that the scores were skewed; hence, the score's distribution was presented as a median and interquartile range.

A linear regression model was fitted to determine how each demographic factor predicted knowledge of pressure injury prevention and management independently. Multiple linear regression was then fitted to determine how the demographic factors (adjusted for each other) predicted pressure injury prevention and management knowledge.

All analyses were conducted at the 5% significance level. STATISTICA™ version 13.2 was the statistical software used to analyse the data. A biomedical statistician from the Faculty of Health Sciences verified the data analysis.

3.8 PRE-TESTING

A pre-test was done to improve the main study. The pilot test was a small-scale version of the main study, consisting of 5 participants from trauma ICU. The purpose of the pilot test was to gather the information used to improve the feasibility of the study. Spelling mistakes were found, but no other improvements were needed. No challenges were found, and other than the spelling mistakes, no changes needed to be made. The results of the pilot test were included in the main study.

3.9 ETHICAL CONSIDERATIONS

Data should be obtained without consequences to human beings (de Vos *et al.*, 2011). Ethics is a set of "moral principles" used to avoid participants' harm (de Vos *et al.*, 2011; Polit & Beck, 2018). The following ethical considerations will be discussed: informed consent, permission to conduct research, anonymity and confidentiality, data security and

management.

3.9.1 Informed Consent

An information letter (**Appendix B**) was given to all potential participants. This information letter included information about and contact details for the researcher and the supervisor. This letter also included the importance of the study, as well as the research procedure. The information letter emphasised that participation was voluntary and that withdrawing from the study without consequences is the participant's right. Furthermore, anonymity and confidentiality were highlighted in the information letter. There was no consent form needed as consent was implied by the completion and submission of the survey.

3.9.2 Permission to Conduct Research

Protocols were submitted to the University Postgraduate Committee for permission to conduct the study, and ethics approval was obtained. Permission from the Gauteng Department of Health (**Appendix C**), the hospital's CEO (**Appendix D**), the nursing services manager (**Appendix E**) and the operational managers of the ICUs (**Appendix F**) was obtained. Permission to use the instrument (**Appendix G**) from the developers was also obtained.

3.9.3 Anonymity and Confidentiality

Anonymity refers to the inability to identify any subject (de Vos *et al*., 2011). The use of code numbers ensured the anonymity of respondents. This ensured no identifiable information of the participant appeared on the questionnaire.

Confidentiality refers to restricting access to personal information to others (de Vos *et al*., 2011). Only the researcher and supervisor had access to the questionnaires. This ensured confidentiality was maintained.

Anonymity and confidentiality were further maintained by managing the data appropriately.

The data was viewed and managed solely by the researcher and supervisor. The completed questionnaires were kept under lock and key in a sealed box.

3.10 VALIDITY AND RELIABILITY OF THE STUDY

Validity was maintained by using the survey questionnaire used in the original study (Manderlier *et al*., 2017). Before the main study, a pre-test was carried out to ensure the questionnaire's phrases were precise and understood by participants in the South African context. To reduce the threats to internal validity, the data collected was analysed without any manipulation of variables.

Reliability was maintained by ensuring consistency with the data collection instrument using the same questionnaire provided by the researcher alone. The raw data was verified by the second round of data entry of data capturing for statistical analysis and accuracy. Statistical support ensured the accuracy and reliability of statistical tests.

3.11 SUMMARY

This chapter described the research design and methods. The research objectives, setting, population and sample were discussed, including the data collection procedure, data analysis and ethical considerations considered during the study.

The next chapter presents the results of the study.

CHAPTER FOUR

RESULTS OF THE STUDY

4.1 INTRODUCTION

This chapter describes the study results describing registered nurses knowledge of pressure injuries; this was achieved through a descriptive and correlational design. The population comprises registered nurses working in the adult intensive care units at a public sector hospital in Johannesburg. The population comprised 101 respondents (n=101), and convenience sampling was used to achieve the study sample. Data were collected utilising a data collection instrument (refer to **Appendix A**) and analysed using descriptive and inferential statistics. The descriptive tests were used to synthesise the respondent's demographic data and questionnaire schedule. Statistical tests included the Shapiro Wilk test, univariate and multivariate linear regression and Cronbach alpha coefficient tests. Testing was done on the 5% level of significance ($p<0.05$).

In this chapter, the results of the data analysis are presented. Firstly, the demographic aspects of the respondents are described, the responses to the data collection questionnaire are presented on item level in tables and graphical formats, and lastly significance of the relationships between respondent's knowledge of pressure injuries and demographic variables are examined.

4.2 RESULTS AND FINDINGS

4.2.1 Demographical Data

This section related to respondents demographic data, which comprises six (6) items. Items included were: gender, age, the highest level of education, intensive care experience, current position and type of ICU. Results of this process are summarised in **table 4.1**.

Table 4.1: Demographic characteristics of the respondents

Variable	Frequency	Percentage
Gender		
Male	11	10.89%
Female	90	**89.11%**
Age		
20 to 29yrs	15	14.85%
30 to 39yrs	27	**26.73%**
40 to 49yrs	26	25.74%
50 to 59yrs	26	25.74%
60 to 65yrs	7	6.93%
Highest level of education		
Undergraduate diploma/degree	45	44.55%
Postgraduate diploma/degree	52	**51.49%**
Master's degree	4	3.96%
Intensive care experience		
6 months to 1 year	17	16.83%
2 to 5 years	24	23.76%
6 to 10 years	32	**31.68%**
11 to 15 years	12	11.88%
16 to 20 years	9	8.91%
>20 years	7	6.93%
Current position		
Professional nurse	36	35.64%
Trauma trained/experienced	10	9.90%
ICU trained/experienced	52	**51.49%**
Unit manager	3	2.97%
Type of ICU		
Trauma	36	**35.64%**
Neurosurgery	14	13.86%
Cardio-thoracic	17	16.83%
Multidisciplinary	34	**33.66%**

Table 4.1 presented these results. Females accounted for 89.1% (n = 90) and males 10.9% (n = 11) of the total sample (n = 101). The largest group of respondents (26.73%; n = 27) were aged between 30 to 39 years, followed by 25.74% (n = 26) in the age categories 40 to 49 and 50 to 59 years, respectively. Most of the respondents (51.49%; n = 52) held a postgraduate level qualification and current position as ICU trained or experienced nurse, respectively. The largest group of respondents (31.68%; n = 32) had from 6 to 10 years of ICU experience, followed by 23.76% (n = 24) and 16.83% (n = 17) in the 2 to 5 years and 6 months to 1 years of experience, respectively. The largest group of respondents (35.64%; n = 36) worked in the Trauma ICU, followed closely by 33.66% (n = 34) in the multidisciplinary ICU.

4.2.2 Knowledge of Pressure Injury Prevention and Management Questionnaire

This section related to the nurse's responses to the questionnaire, which included 25 items separated into six themes (refer to **Appendix A**). Each of the items will be discussed individually.

4.2.2.1 Theme One: Aetiology

This section related to pressure injuries' aetiology, which included six items (Items 1 to 6). Each of the items will be discussed individually.

4.2.2.1.1 Question 1: Causal factors

Question 1 focused on causal factors in the development of pressure injuries. The respondents were presented with a statement, which stated: *"There are several causal factors in the development of pressure injuries",* where they had to select their responses from a list of five possible responses. **Figure 4.1** displays the results obtained.

- 52.5% (n = 53) of the respondents indicated that the correct response was a reduced level of activity (option D).

The remaining participants indicated the following incorrect responses:

- 5.9% (n = 6) selected diabetes (option A)

- 36.6% (n = 40) selected incontinence (option B)
- 2.0% (n = 2) selected fever (option C)

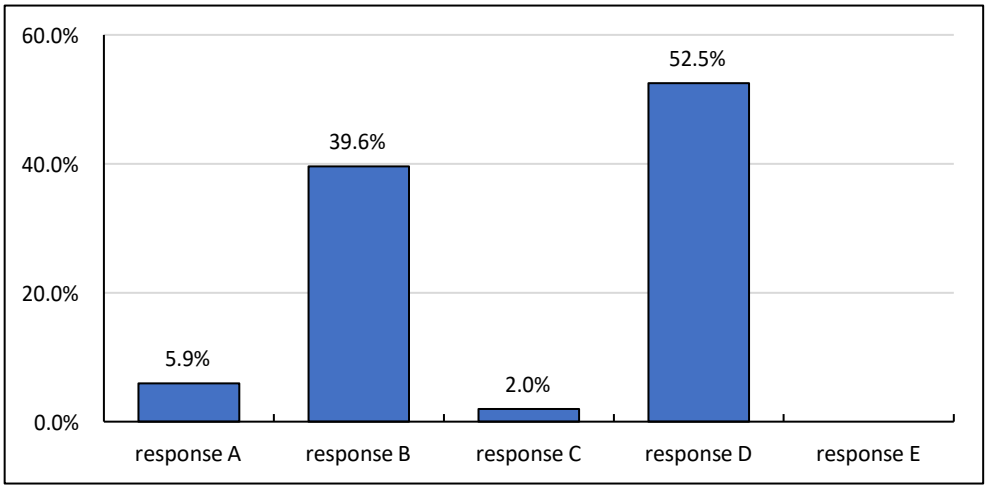

Figure 4.1: Responses obtained for question 1

4.2.2.1.2 Question 2: Position of the patient in bed

Question 2 focused on the patient's position in bed. The respondents were presented with the statement, which stated: *"A patient sits with the head of the bed elevated to 60 degrees. What happens when his skin sticks to the underlying surface when he slides down in bed?"* where they had to select their responses from five possible options. **Figure 4.2** displays the results obtained.

- 21.7% (n = 22) of the respondents indicated agreement with shear increases, which is the correct response (option C).

The remaining respondents indicated the following incorrect responses:

- 13.9% (n = 14) selected pressure increases (option A)
- 1.0% (n = 1) selected problems with microclimate occur temperature and relative humidity (option B)
- 58.7% (n = 59) selected friction/rubbing increases (option D)
- 5.0% (n = 5) selected I do not know (option E)

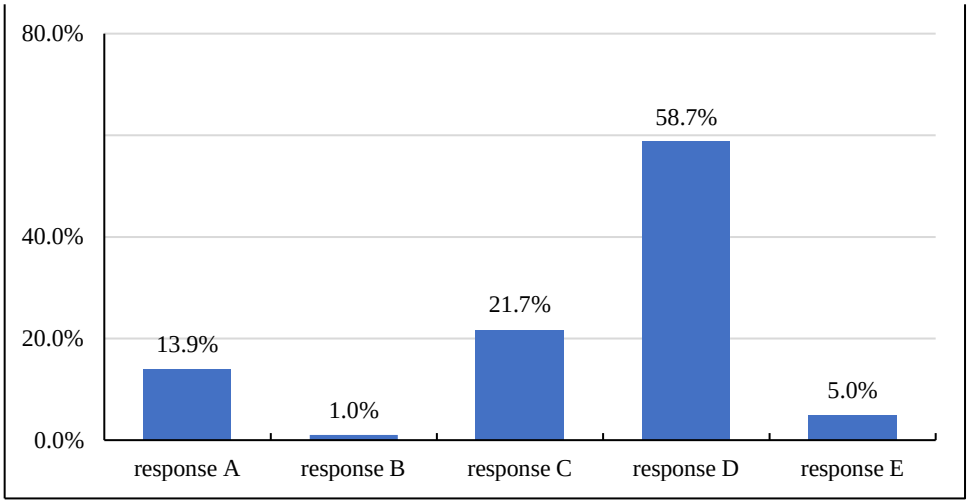

Figure 4.2: Responses obtained for question 2

4.2.2.1.3 Question 3: Average percentage of pressure injuries

Question 3 focused on the average percentage of pressure injuries. The respondents were presented with the statement, which stated: *"What is the average percentage of pressure injuries in the intensive care unit generally"* where they had to select their responses from five possible options. **Figure 4.3** displays the results obtained.

- 21.8% (n = 22) indicated agreement with 10 to 15% which is the correct response (option C)

The remaining responses indicated the following incorrect responses:

- 63.4% (n = 64) selected between 1 to 5% (option A)
- 3.0% (n = 3) selected between 5 to 10% (option B)
- 11.9% (n = 12) selected do not know (option E)
- No respondents selected between 15 to 20% (option D)

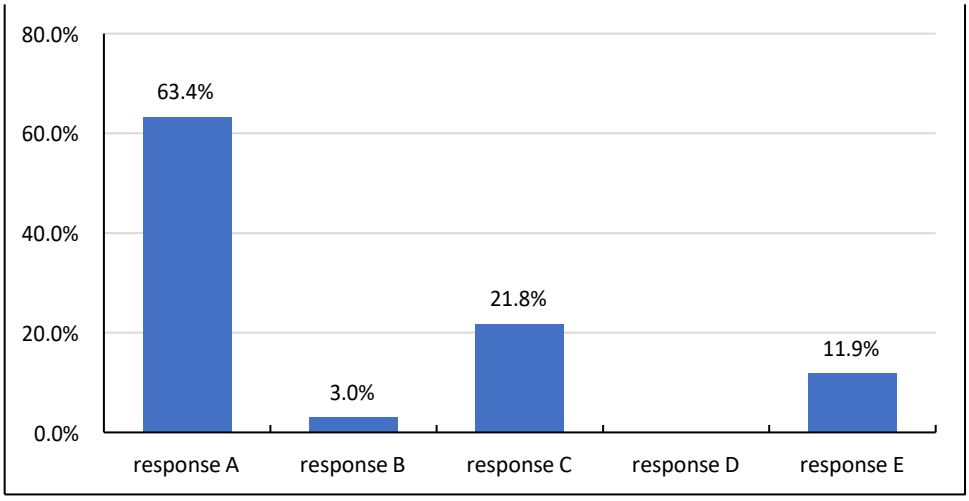

Figure 4.3: Responses obtained for question 3

4.2.2.1.4 Question 4: Clinical symptoms associated with pressure injuries

Question 4 focused on clinical symptoms associated with pressure injuries. The respondents were presented with the statement, which stated, *"Excessively moist skin (due to, e.g. incontinence or wound exudate) combined with pressure injury development"*, where they had to select their response from five possible options. **Figure 4.4** displays the results obtained.

- 79.2% (n = 80) of the respondents agreed that excessive skin moisture and raised temperature are risk factors for developing pressure injuries (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 12.9% (n = 13) selected yes, excessive skin moisture and raised temperature cause pressure injuries (option A)
- 5.9% (n = 6) selected no, wounds that occur in a moist and warm environment are always defined as incontinence-associated dermatitis (IAD) (option C)
- 1.0% (n = 1) selected no, increased temperature results in better blood flow and thus decreases the risk of pressure injuries (option D)
- 1.0% (n = 1) selected do not know (option E)

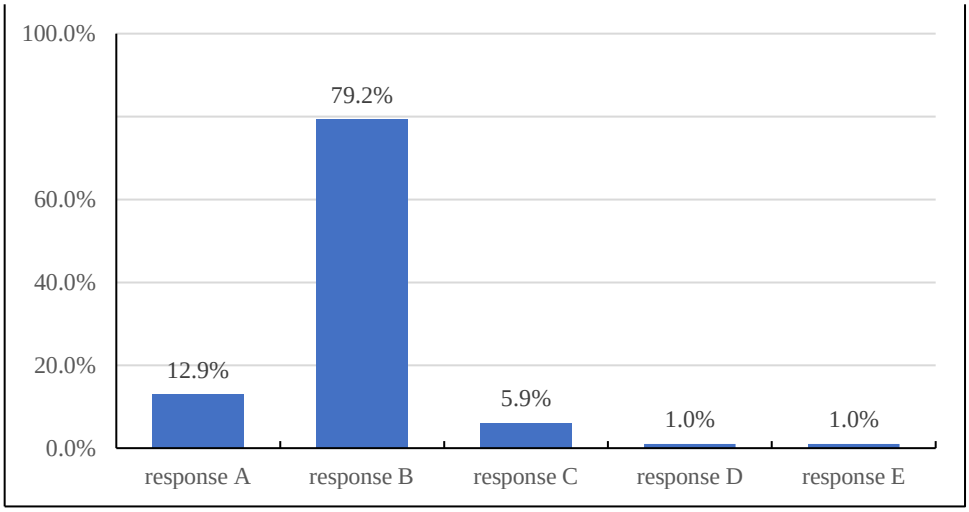

Figure 4.4: Responses obtained for question 4

4.2.2.1.5 Question 5: Highest risk for development of pressure injuries

Question 5 focused on the highest risk for the development of pressure injuries. The respondents were presented with the case which stated: *"A patient is sitting in a chair in the morning and in the afternoon, each time 2 hours. The rest of the day, he spends in bed. He cannot mobilise himself. When does this patient have the highest risk to develop a pressure injury (if no prevention is applied)?"* where they had to select their responses from five possible options. **Figure 4.5** displays the results obtained.

- 43.6% (n = 44) of the respondents agreed that the risk to develop a pressure injury is high in this specific case, both when seated and when lying in bed (option D), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 13.9% (n = 14) selected there is no higher risk to develop a pressure injury if a seated position in a chair is combined with a lying position in bed (option A)
- 6.9% (n = 7) selected the risk to develop a pressure injury is highest when he is seated in a chair because high pressure is applied during a short period (option B)
- 32.7% (n = 33) the risk to develop a pressure injury when he is lying in bed because lower pressure is applied during a longer period (option C)
- 3.0% (n = 3) selected no not know (option E)

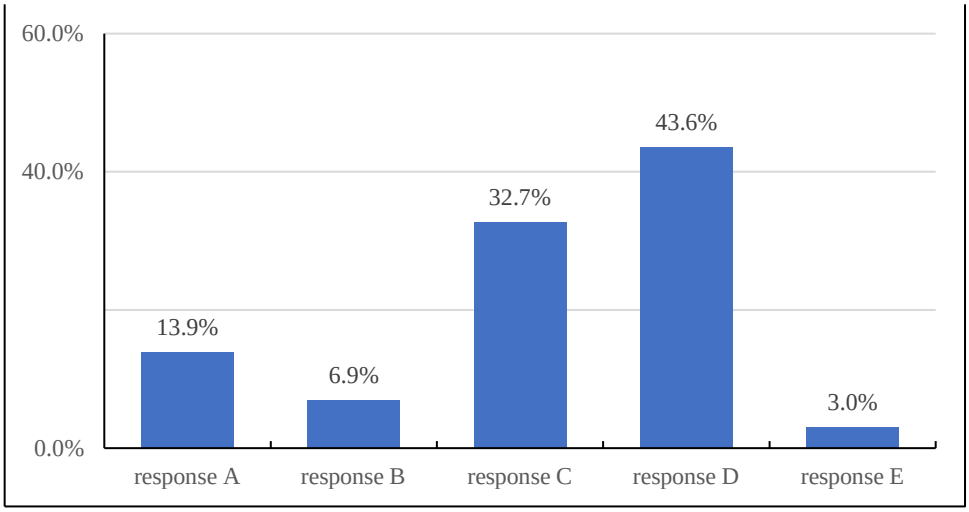

Figure 4.5: Responses obtained for question 5

4.2.2.1.6 Question 6: Interventions that increase or decrease pressure injuries risk

Question 6 focused on an intervention that increases or decrease pressure injuries risk. The respondents were presented with the statement, which stated: "*Which statement is correct?*" where they had to select their responses from five possible options. **Figure 4.6** displays the results obtained.

- 7.9% (n = 8) of the respondents agreed that water and soap could erode skin barrier, thereby increasing the risk of superficial skin damage (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 1.0% (n = 1) selected use of moisture-absorbing pads decreases the risk of pressure injuries (option A)
- 59.4% (n = 60) selected massaging the skin (during washing and drying) is effective to prevent pressure injuries (option C)
- 29.7% (n = 30) dressing the heels (with a bandage/ring cushion) will decrease the risk of heel pressure injury development (option D)
- 2.0% (n = 2) selected do not know (option E)

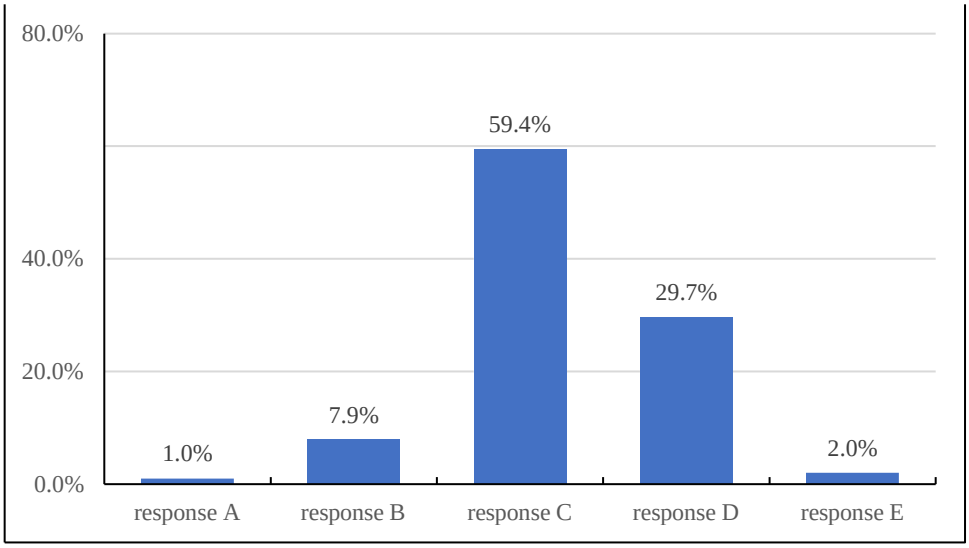

Figure 4.6: Responses obtained for question 6

4.2.2.2 Theme Two: Classification and Observation

This section related to the classification and observation of pressure injuries, including four items (Items 7 to 10). Each of the items will be discussed individually.

4.2.2.2.1 Question 7: Observation of pressure injury development

Question 7 focused on observation of pressure injury development. The respondents were presented with a statement, which stated: *"You observe a new blister on the heel of a patient who can position himself in bed. You take a look in the file, but your colleagues never reported non-blanchable erythema or a wound. Which statement is correct?"* where they had to select their responses from five possible options. **Figure 4.7** displays the results obtained.

- 12.9% (n = 13) of the respondents agreed that there was insufficient information to know if this is a pressure injury or not (option D), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 4.0% (n = 4) selected the blister as not a pressure injury (option A)
- 19..8% (n = 20) selected the blister as Stage II pressure injury (option B)

- 58.4% (n = 59) selected the blister as a Stage I pressure injury as long as it remains intact (option C)
- 5.0% (n = 5) selected do not know (option E)

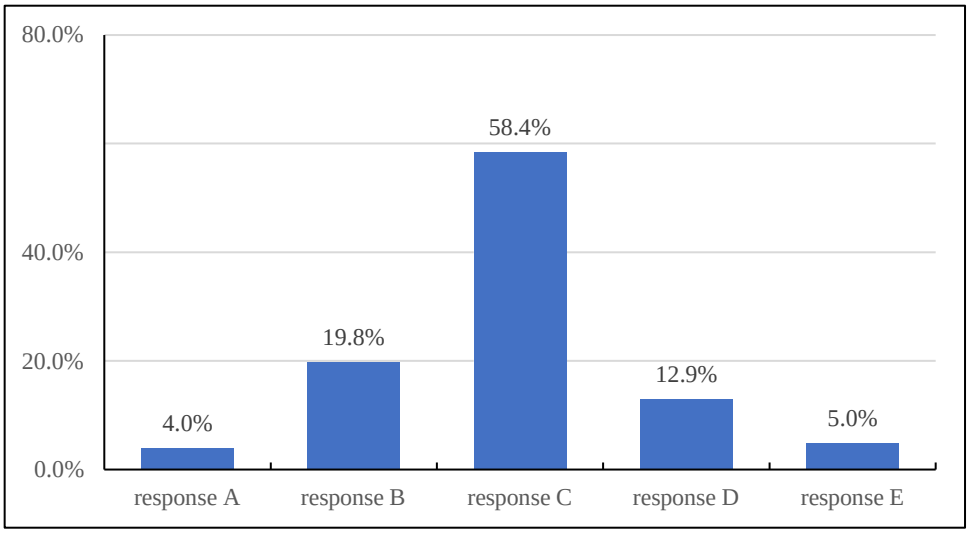

Figure 4.7: Responses obtained for question 7

4.2.2.2.2 Question 8: Classification of pressure injury

Question 8 focused on the classification of pressure injury. The respondents were presented with the statement: "*Which of these pictures is a pressure injury Stage 1*?" They had to select their responses from a list of five possible responses. **Figure 4.8** displays the results obtained.

- 45.5% (n = 46) agreed with non-blanchable erythema (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 5.9% (n = 6) selected blanchable erythema (option A)
- 36.6% (n = 37) selected intact blister (option C)
- 4.0% (n = 4) selected open blister (option D)
- 7.9% (n = 8) selected do not know (option E)

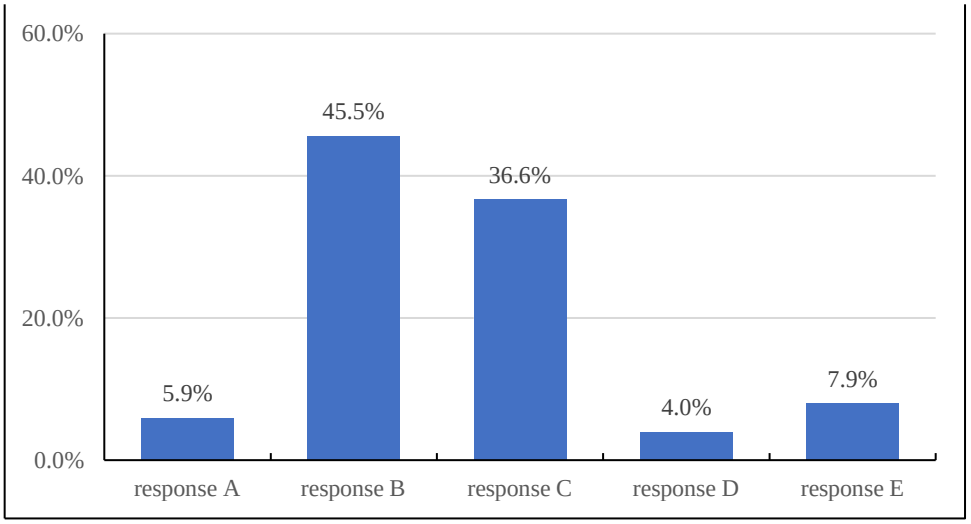

Figure 4.8: Responses obtained for question 8

4.2.2.2.3 Question 9: Stages of necrosis

Question 9 focused on stages of necrotic tissue. The respondents were presented with a statement, which stated: "*In which stages can necrotic tissue be present?"* where they had to select their responses from a list of five possible responses. **Figure 4.9** displays the results obtained.

- 48.5% (n = 49) of the respondents agreed that Stage III and Stage IV (option C) is the correct response.

The remaining respondents indicated the following incorrect responses:

- 6.9% (n = 7) selected Stage I, II, III and IV (option A)
- 7.9% (n = 8) selected Stage II, III and IV (option B)
- 29.7% (n = 30) selected Stage IV only (option D)
- 6.9% (n = 7) selected do not know (option E)

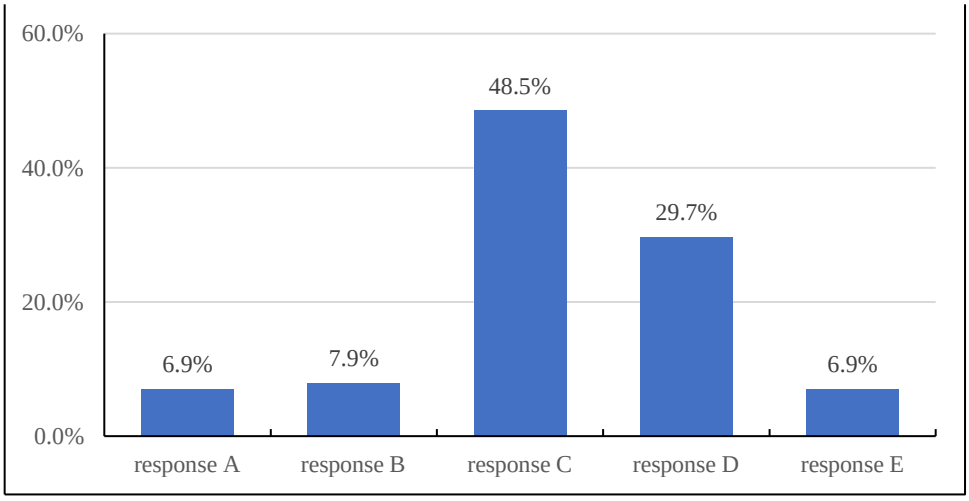

Figure 4.9: Responses obtained for question 9

4.2.2.2.4 Question 10: Pressure injury classification

Question 10 focused on the stage where pressure injury can be classified. The respondents were presented with a case, which stated: "*The nurse observes a bony structure in a wound. In which stage can you classify this pressure injury*?" where they had to select their responses from a list of five possible responses. **Figure 4.10** displays the results obtained.

- 50.5% (n = 51) of the respondents indicated agreement with stage IV (option A), which is the correct response

The remaining respondents indicated the following incorrect responses:

- 7.9% (n = 8) selected stage IV if there are signs of undermining of the adjacent tissue (option B)
- 16.8% (n = 8) selected stage IV if there is necrosis (option C)
- 14.9% (n = 15) selected stage IV if there are signs of a reduction of the supply of blood to the tissue (option D)
- 9.9% (n = 10) selected no not know (option E)

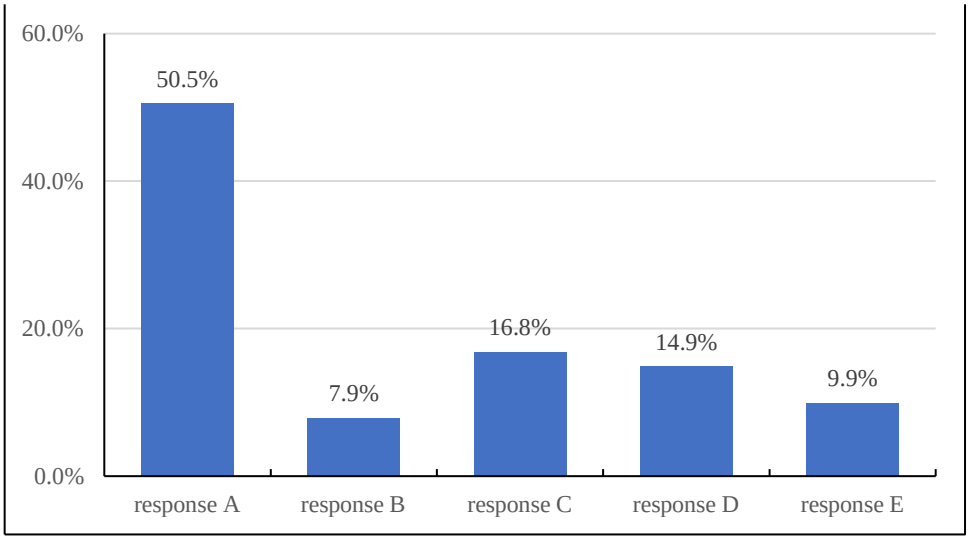

Figure 4.10: Responses obtained for question 10

4.2.2.3 Theme Three: Risk Assessment

This section related to the risk assessment of pressure injuries, including two items (Items 11 to 12). Each of the items will be discussed individually.

4.2.2.3.1 Question 11: Risk assessment score and clinical judgement

Question 11 focused on risk assessment score and clinical judgement. The respondents were presented with a case, which stated: "*A patient is recently admitted to your nursing unit. The patient has no signs of skin redness (blanchable/ non-blanchable) but is bedridden. When completing the Waterlow risk assessment tool, the scores indicate no risk for pressure injury development. No prevention is needed. However, you are very surprised because your clinical experience tells you that this patient is at risk. What are you going to do now?*" where they had to select their responses from a list of five possible responses. **Figure 4.11** displays the results obtained.

- 63.4% (n = 64) of the respondents agreed that preventive measures are taken because clinical judgment is as critical as the risk screening tool, which is the correct response (option C).

The remaining respondents indicated the following incorrect responses:

- 3.0% (n = 3) selected you do not implement a prevention plan because both the skin assessment and the scoring tool indicated there is no increased risk (option A)
- 1.0% (n = 1) selected you do not implement a prevention plan because risk assessment instruments are developed to replace clinical judgment (option B)
- 31.7% (n = 32) selected you to decide to reassess the patient daily (using the instrument) and to start prevention if the Waterlow risk assessment instrument indicates an increased risk to develop a pressure injury (option D)
- 1.0% (n = 1) selected do not know.

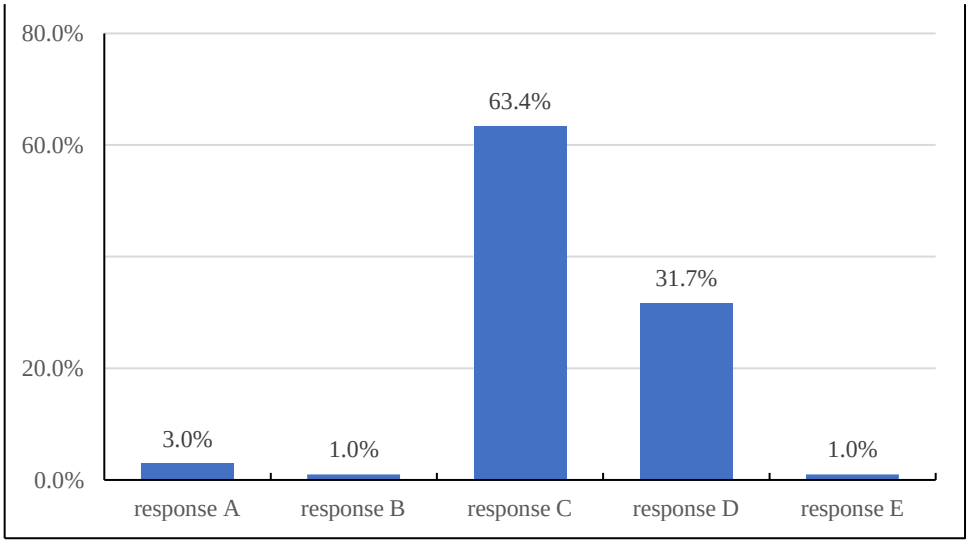

Figure 4.11: Responses obtained for question 11

4.2.2.3.2 Question 12: Skin assessment

Question 12 focused on skin assessment. The respondents were presented with a statement, which stated: *"Frequency of skin assessment on pressure points in hospital is correct?"* where they had to select from a list of five possible responses. **Figure 4.12** displays the results obtained.

- 92.1% (n = 93) of the respondents indicated agreement that the skin of all patients should be inspected at least daily (option D), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 1.0% (n = 1) selected the frequency of the skin assessment as a medical decision (made by a medical doctor) (option A)
- 3.0% (n = 3) selected skin areas with an increased risk for pressure injury development should be inspected at least once a week (option B).
- 3.0% (n = 3) selected the skin of patients should be inspected at least twice a week (option C)
- 1.0% (n = 1) selected do not know (option E)

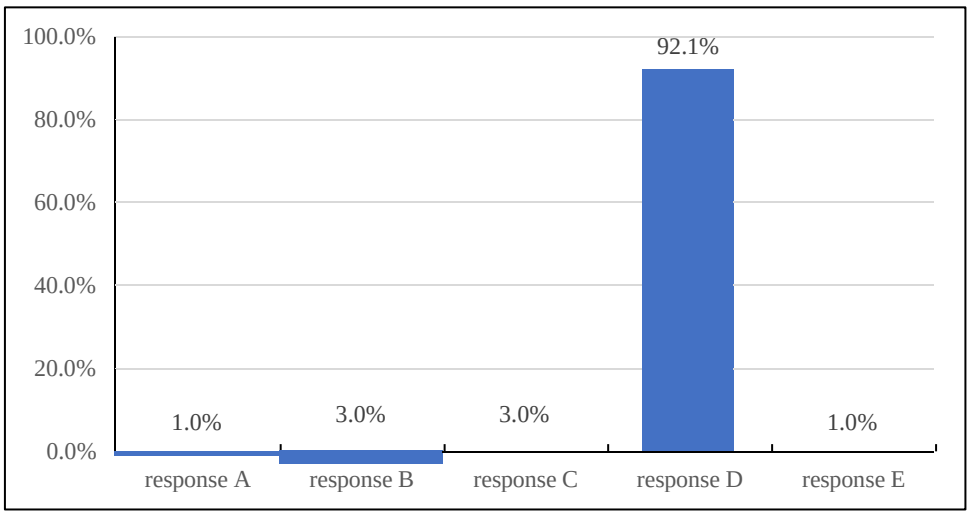

Figure 4.12: Responses obtained for question 12

4.2.2.4 Theme Four: Nutrition

This section related to the risk assessment of pressure injuries, which included three items (Items 13 to 15). Each of the items will be discussed individually.

4.2.2.4.1 Question 13: Nutritional supplementation

Question 13 focused on nutritional supplementation. The respondents were presented with a case which stated: "*A 23-year old previously healthy male was recently admitted to the hospital with a spinal cord injury (car accident). He is immobile and has no problems eating or drinking. Is nutritional supplementation needed to reduce the risk of pressure injuries?*" where they had to select their responses from a list of five possible responses. **Figure 4.13** displays the results obtained.

- 42.6% (n = 43) of the respondents indicated an agreement for no change in nutrition if nutritional intake is adequate (option D), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 13.9% (n = 14) selected yes, I provide nutritional supplementation (vitamin tablets) to prevent pressure injuries (option A)
- 30.7% (n = 31) selected yes, I provide nutritional supplementation (drinks enriched with amino acid arginine) to prevent pressure injuries (option B)
- 10.9% (n = 11) selected no, I will not change the nutrition of this patient as no signs of pressure injuries are observed (redness or skin breakdown) (option C)
- 2.0% (n = 2) selected do not know (option E).

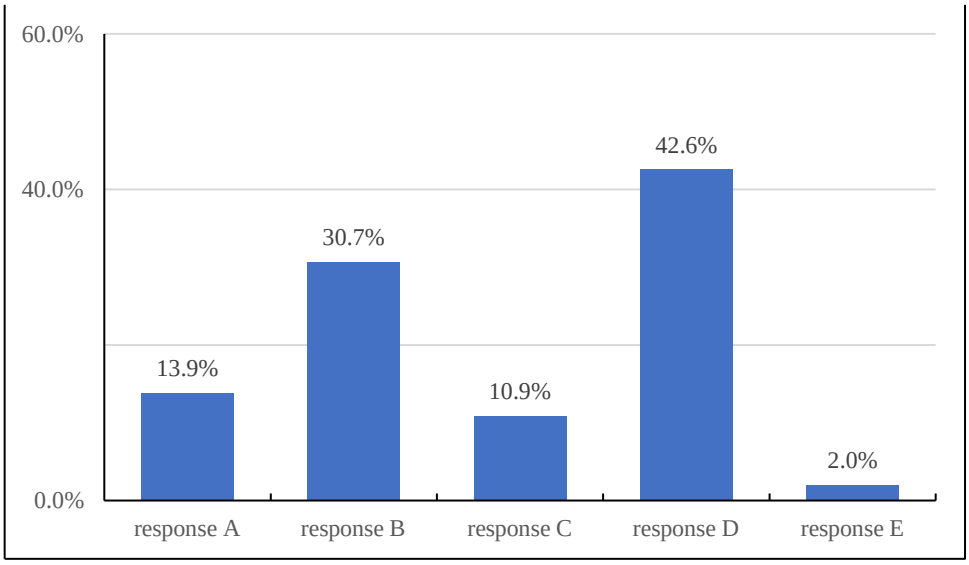

Figure 4.13: Responses obtained for question 13

4.2.2.4.2 Question 14: Nutritional elements

Question 14 focused on nutritional elements. The respondents were presented with a statement that stated: "Which nutritional are the most essential to prevent injuries?" They had to select their responses from a list of five responses. **Figure 4.14** displays the responses obtained.

- 37.6% (n = 38) of the respondents agreed to proteins and fluids (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 15.8% (n = 16) selected carbohydrates, fats and proteins (option A)
- 24.8% (n = 25) selected carbohydrates and proteins (option B)
- 17.8% (n = 18) selected fats, fluids and proteins (option D)
- 4.0% (n = 4) selected did not know (option E).

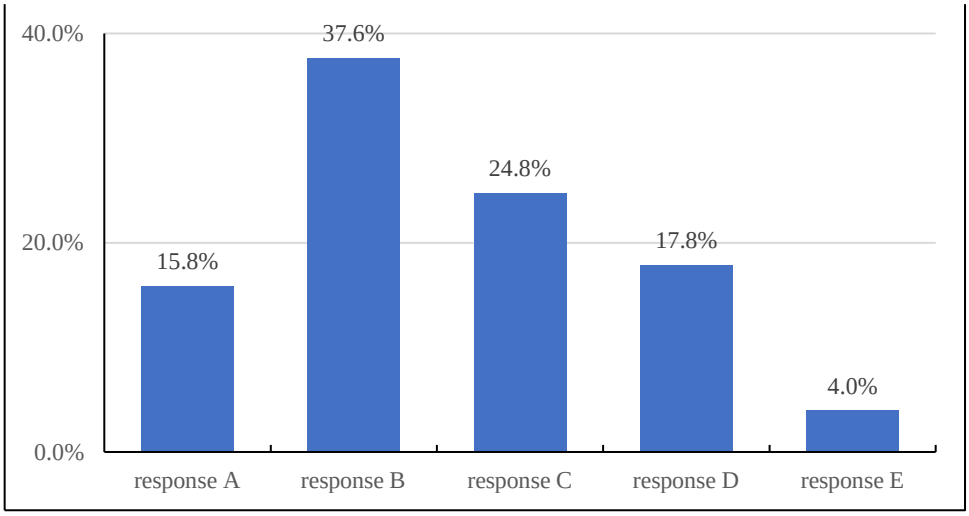

Figure 4.14: Responses obtained for question 14

4.2.2.4.3 Question 15: Type of patients at nutritional risk

Question 15 focused on types of patients at nutritional risk. The respondents were presented with a statement: "What type of patients (in terms of body weight) have an increased risk of developing *pressure injuries?"* where they had to select responses from a list of five possible responses.

- 37.6% (n = 38) of the respondents agreed that both fragile and obese patients are at increased risk (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 12.9% (n = 13) selected extremely thin patients (option A)
- 11.9% (n = 12) selected obese patients (option B)
- 1.0% (n = 1) selected body weight and BMI are not associated with pressure injury risk (option (option D)

- No respondents selected the option did not know (option E).

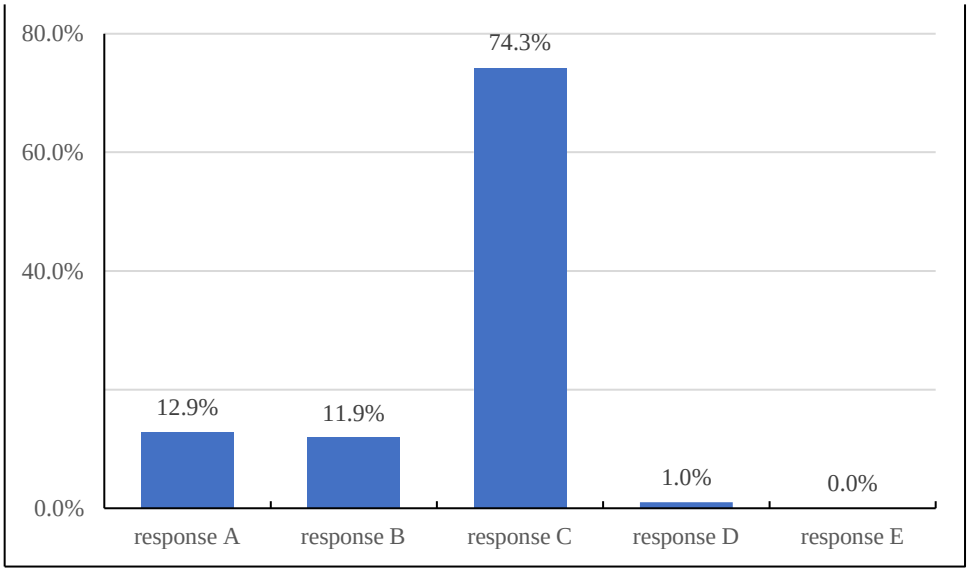

Figure 4.15: Responses obtained for question 15

4.2.2.5 Theme Five: Prevention of Pressure Injuries

This section related to the prevention of pressure injuries, including eight items (Items 16 to 23). Each of the items will be discussed individually.

4.2.2.5.1 Question 16: Prevention measures

Question 16 focused on adequate prevention measures. The respondents were presented with a statement, which stated: *"What is the prevention of patients with an increased risk to develop pressure injuries that receive adequate prevention in a chair and bed in hospital?"* where they had to select their responses from a list of five possible responses. **Figure 4.16** displays the results obtained.

- 24.8% (n = 25) of the respondents were in agreement that less than 20% (<20%) (option A), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 25.7% (n = 26) selected between 20% and 50% (option B)
- 12.9% (n = 13) selected between 50% and 70% (option C)

- 7.9% (n = 8) selected greater than 70% (>70%) (option D)
- 28.7% (n = 20) selected did not know (option E)

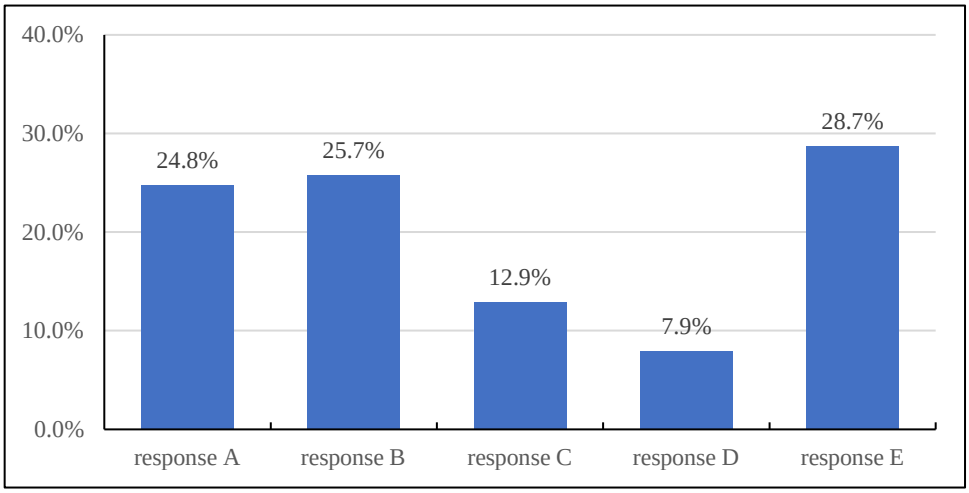

Figure 4.16: Responses to question 16

4.2.2.5.2 Question 17: Patient position

Question 17 focused on selected patient position. The respondents were presented with a case, which stated: *"Your colleague informs you that she positioned a patient in bed in a semi-fowler position. What does this mean?"* where they had to select their responses from a list of five possible responses. **Figure 4.17** displays the results obtained.

- 17.8% (n = 18) of the respondents agreed that the patient lies in a supine position with both head of the bed and upper legs elevated up to an angle of 30 degrees (option C), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 4.0% (n = 4) selected the patient lies on his side at an angle of 30 degrees (option A)
- 5.0% (n = 5) selected the patient lies on his side at an angle of 45 degrees (option B)
- 71.3% (n = 72) selected the patient lies in a supine position, with the head of the bed elevated up to an angle of 45 degrees (option D)
- 2.0% (n = 2) selected did not know (option E)

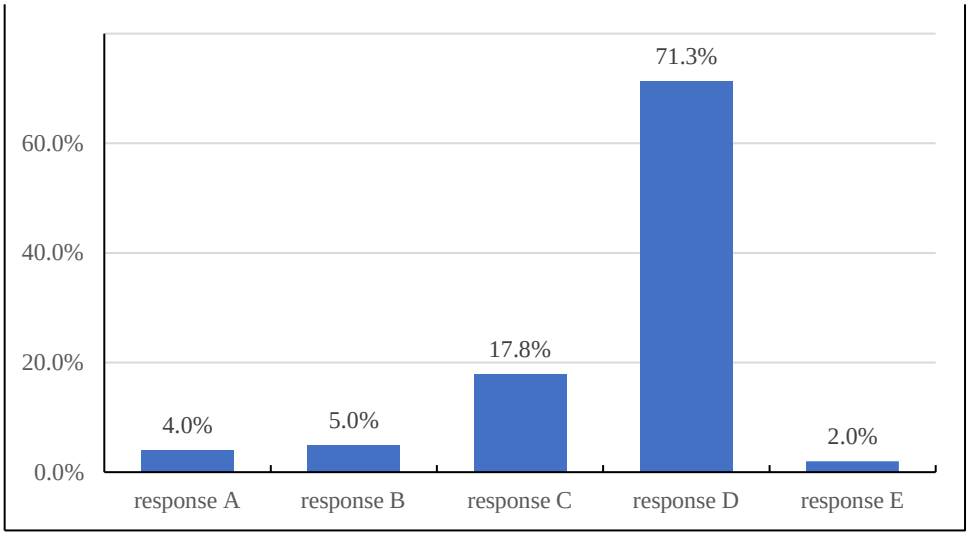

Figure 4.21 responses obtained for question 17

4.2.2.5.3 Question 18: Repositioning protocol

Question 18 focused on repositioning protocol. The respondents were presented with a statement, which stated: *"Which repositioning protocol is most effective to prevent pressure injuries? Starting with supine, then …"* where they had to select their responses from a list of five possible responses. **Figure 4.18** displays the results obtained.

- 45.5% (n = 46) of the respondents were in agreement lateral 30 degrees left-lateral-supine lateral 30 degrees right-supine-lateral 30 degrees left …,(option A), which is the correct response

The remaining respondents indicated the following incorrect responses:

- 2.0% (n = 2) selected lateral 90 degrees left-supine- lateral 90 degrees right- supine – lateral 90 degrees left … (option B)
- 18.8% (n = 19) selected lateral 30 degrees left –supine lateral 30 degrees right – supine-lateral 90 degrees right …(option C)
- 2.0% (n = 2) selected lateral 30 degrees left-lateral 90 degrees left- supine – lateral 30 degrees right – lateral 90 degrees right – supine …(options D)
- 31.7% (n = 32) selected did not know (option E).

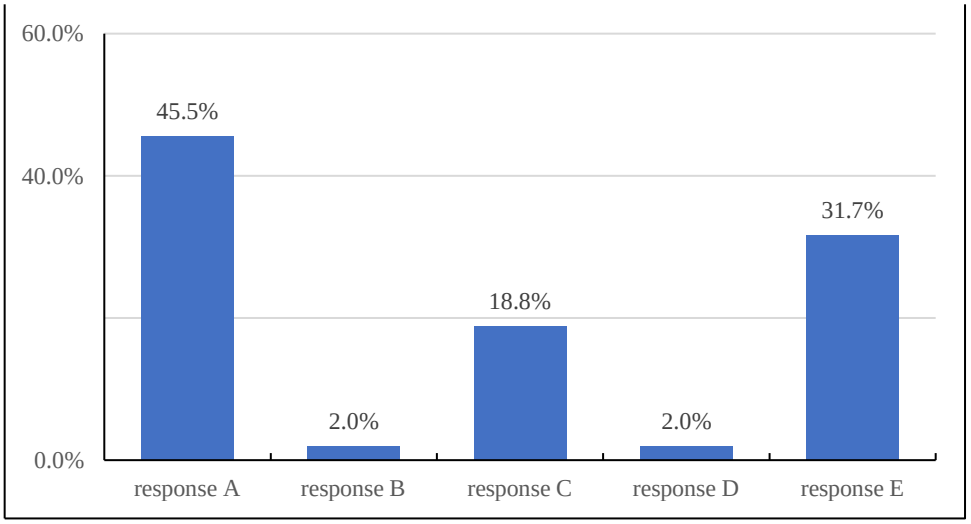

Figure 4.18: Responses obtained for question 18

4.2.2.5.4 Question 19: Prevention measures

Question 19 focused on effective prevention measures. The respondents were presented with a statement, which stated: *"the use of a ring cushion (doughnuts) is effective to prevent pressure injuries when patients are seated in a chair or wheelchair. Is this statement correct?"* where they had to select their responses from a list of five possible responses. **Figure 4.19** displays the results obtained.

- 16.8% (n = 17) of the respondents agreed that the statement was incorrect because the contact surface between the patient's skin and the surface is smaller (option C), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 47.5% (n = 48) selected yes because the pressure near the bony prominence is reduced (option A)
- 25.7% (n = 26) selected yes because it redistributes pressure near the bony prominence is reduced (option B)
- 5.0% (n = 5) selected no as it is only effective if a patient had a pressure injury in the past (option D)
- 5.0% (n = 5) selected did not know (option E)

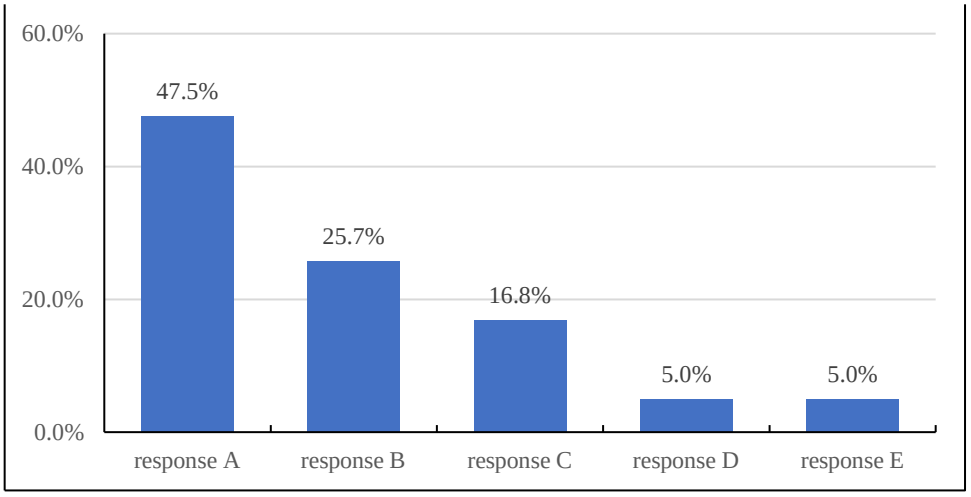

Figure 4.19 responses obtained from question 19

4.2.2.5.5 Question 20: Use of bed linen

Question 20 focused on the use of bed linen. The respondents were presented with a statement, which stated: *"how should bed linen be used to prevent pressure injuries?"* where they had to select their responses from a list of five possible responses. Figure 4.20 displays the results obtained.

- 4.0% (n = 4) of the respondents agreed not to secure the blanket under the mattress to move along with the patient (option B), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 5.0% (n = 5) selected do not secure the sheets under the mattress so they can move along with the patient (option A)
- 82.2% (n = 83) selected make sure the sheets are stretched tight (option C)
- 6.9% (n = 7) selected put moisture-absorbing pads under the patient (option D)
- 2.0% (n = 2) selected do not know (option E).

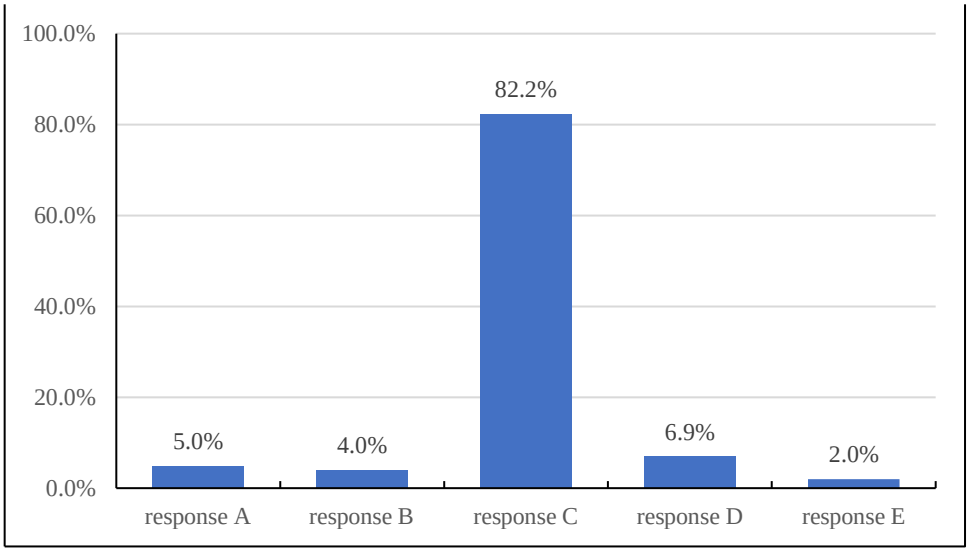

Figure 4.20 responses obtained from question 20

4.2.2.5.6 Question 21: Positioning technique

Question 21 focused on positioning technique. The respondents were presented with a statement, which stated: *"which is the most effective technique to position a patient when seated"*, where they had to select their responses from a list of five possible responses. **Figure 4.21** displays the results obtained.

- 23.8% (n = 24) of the respondents indicated agreement in a semi-reclined position with the legs being supported so that an angle of more than 90 degrees is created at the knees (option D), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 24.8% (n = 25) selected in an upright position with the knees at a 90-degree angle and the feet not touching the ground (option A)
- 25.7% (n = 26) selected in an upright position with the legs being supported so that an angle of more than 90 degrees is created at the knees (option B)
- 11.9% (n = 12) selected in a semi-reclined position with the knees in a 90-degree with the feet not touching the ground (option C)
- 13.9% (n = 14) selected did not know (option E).

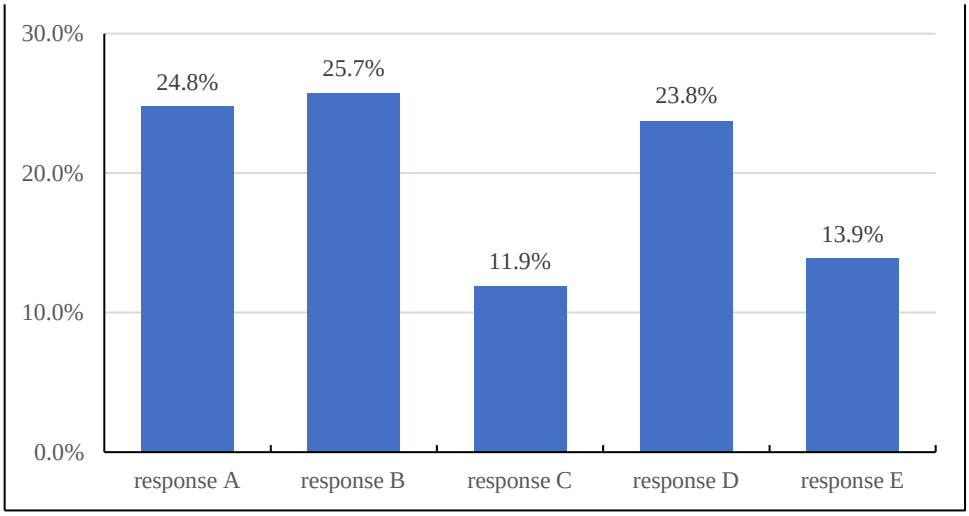

Figure 4.25 responses obtained from question 21

4.2.2.5.7 Question 22: Pressure redistribution

Question 22 focused on pressure redistribution. The respondents were presented with the case, which stated: *"Your patient is lying on a pressure redistribution foam mattress. Do you take other measures to prevent pressure injuries on the heels?"* where they had to select their responses from a list of five possible responses. **Figure 4.22** displays the results obtained.

- 31.7% (n = 32) of the respondents agreed with the option Yes I will place a pillow from the knee to the Achilles tendon to off-load the heels (option C), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 5.9% (n = 6) selected No, a pressure redistributing foam mattress is sufficient (option A)
- 13.9% (n = 14) selected No, a pressure redistributing foam mattress with repositioning is sufficient (option B)
- 47.5% (n = 48) selected Yes, I will place a pillow under the Achilles tendon to off-load the heels (option D)
- 1.0% (n = 1) selected did not know (option E).

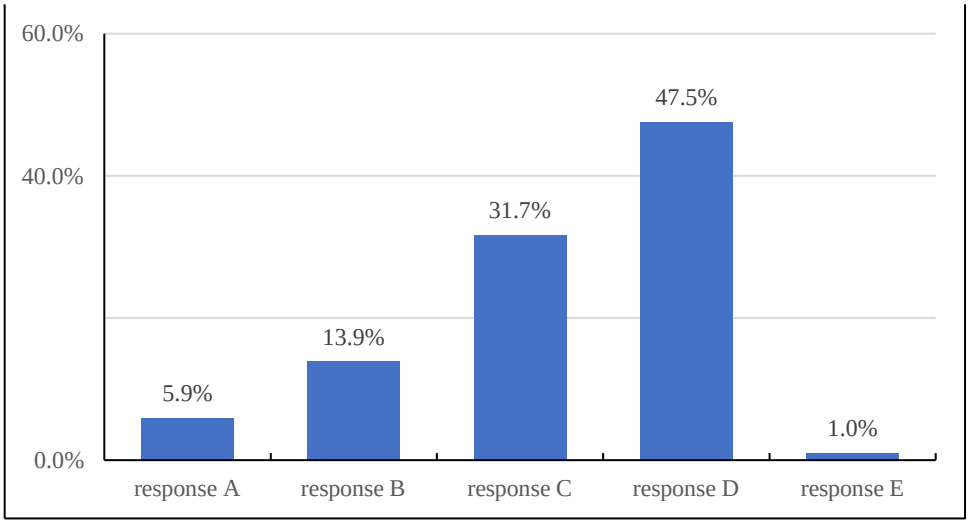

Figure 4.26 responses obtained from question 22

4.2.2.5.8 Question 23: Repositioning

Question 23 focused on repositioning. The respondents were presented with a statement, which stated: *"How does repositioning prevent pressure injuries?" w*here they had to select their responses from a list of five possible responses. **Figure 4.23** displays the results obtained.

- 28.7% (n = 29) of the respondents agreed that the duration of pressure and shear would be reduced (option C), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 5.9% (n = 6) selected the amount of pressure and shear will be reduced (option A)
- 48.5% (n = 49) selected the amount and duration of pressure and shear will be reduced (option B)
- 15.8% (n = 16) selected it reduces friction at the bony prominences (option D)
- 1.0% (n = 1) selected did not know (option E)

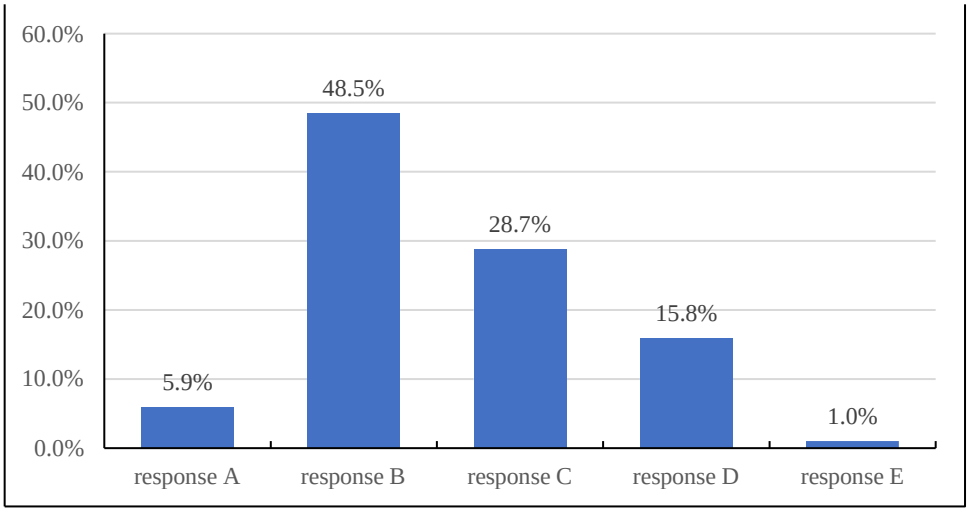

Figure 4.23: Responses obtained for question 23

4.2.2.6 Theme Six: Specific Patient Groups

This section related to specific patient groups, which included two items (Items 24 to 25). Each of the items will be discussed individually.

4.2.2.6.1 Question 24: Operating room

Question 24 focused on operating rooms. The respondents were presented with a statement, which stated: "*Which of these statements is correct about the development of pressure injuries in the operating room?"* where they had to select from a list of five responses. **Figure 4.24** displays the results obtained.

- 19.8% (n = 20) of the respondents agreed that when pressure injuries develop during surgery, the first visible signs appear a few days later, making people think they developed after surgery (option C), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 19.8% (n = 20) selected pressure injuries are not likely to occur during surgery. If redness is observed after surgery, it is most likely to be a burn wound (option A)
- 11.9% (n = 12) selected immobilisation after surgery causes pressure injuries to develop, not the immobilisation of surgery itself (option B)

- 44.6% (n = 45) selected a pressure injury appearing postoperatively is always the result of immobilisation during surgery (option D)
- 4.0% (n = 4) selected did not know (option E)

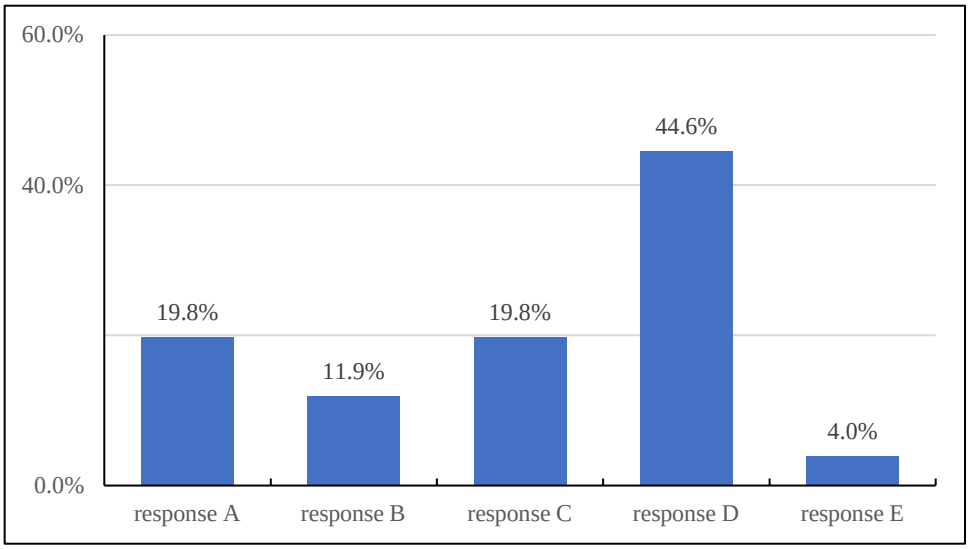

Figure 4.24: Responses obtained from question 24

4.2.2.6.2 Question 25: Babies risk

Question 25 focused on the babies risk for pressure injuries. The respondents were presented with a statement, which stated: "*Which is the location on the body where babies have the highest risk to develop a pressure injury?*" where they had to select their responses from a list of five possible responses. **Figure 4.25** displays the results obtained.

- 75.3% (n = 76) of the respondents agreed with the response occiput (option A), which is the correct response.

The remaining respondents indicated the following incorrect responses:

- 3.0% (n = 3) selected heels (options B)
- 1,0% (n = 1) selected shoulders (option C)
- 16.8% (n = 17) selected sacrum (option D)
- 4.0% (n = 2) selected did not know (option E)

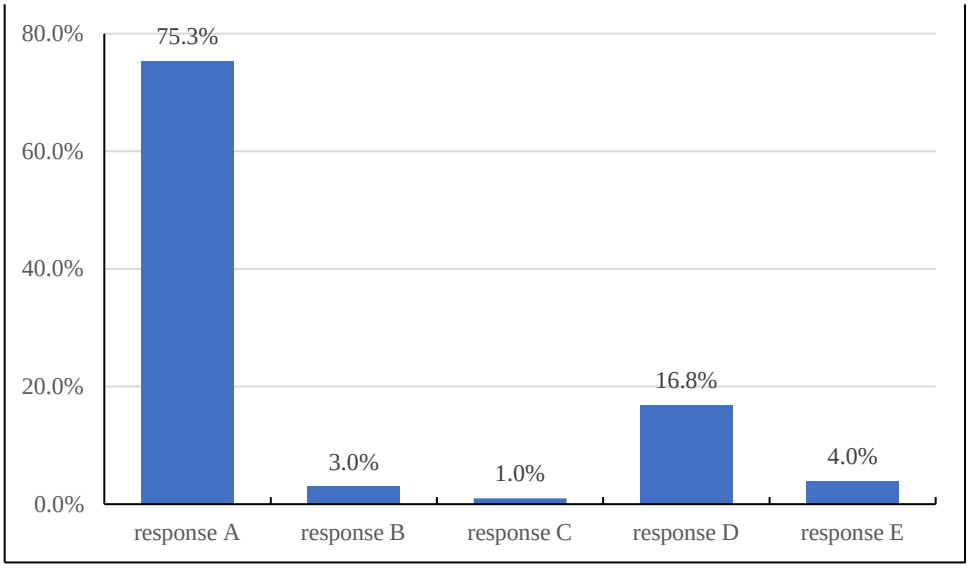

Figure 4.25 responses obtained from question 25

4.2.3 ICU Nurses' knowledge of Pressure Injury and Management

Table 4.2: ICU nurses' knowledge of pressure injury prevention and management

Variables	Mean	SD
Total score (%)	42.16	12.09
Themes		
Aetiology and development (items=6)	2.81	1.25
Classification and observation (items=4)	1.58	1.06
Nutrition (items=3)	1.51	0.84
Preventative measures to reduce the duration of pressure (items=2)	0.96	0.56
	Median	**IQR**
Risk assessment (items=2)	2	1-2
Preventative measures to reduce the amount of pressure (items=8)	2	11-3
	n	**%**
Equal to or more than 60%	6	5.94
Equal to or lower than 59%	95	94.06

Only 5.94% (n = 6) of the nurses enrolled in the study scored above the required score of 60%. The ICU nurses scored poorly on the PUKAT 2.0 questionnaire in all themes. **Table 4.2** presents these results.

4.2.4 Factors Associated with Knowledge of appropriate Prevention and Management

Table 4.3: Factors associated with knowledge of appropriate prevention and management of pressure injuries

	Coef (95% confidence interval)	p-value	Adjusted Coef (95% confidence interval)	p-value
Gender				
Male	7.39 (-0.16-14.95)	0.055	8.52 (1.80-15.26)	0.014*
Female	1	1	1	1
Age				
20-29	5.90 (-1.84-13.63)	0.133	9.69 (2.61-16.77)	0.008*
30-39	1	1	1	1
40-49	-1.34 (-7.94-5.25)	0.687	-1.42 (7.27-4.43)	0.630
50-59	2.04 (-4.56-8.64)	0.541	3.02 (-4.20-10.24)	0.407
60-65	0.68 (-9.51-10.86)	0.895	3.58 (-7.14-14.32)	0.508
Education				
Undergraduate diploma/degree	-5.41 (-10.08- -0.74)	0.024*	-2.40 (-8.03-3.24)	0.400
Postgraduate diploma/degree	1	1	1	1
Master's degree	11.92 (0.02-23.83)	0.050	14.00 (2.90-25.11)	0.014*
Doctorate	-	-	-	-

Experience				
6 months – 1 year	-9.18 (-15.90- -2.47)	0.008*	-10.71 (-18.53- -2.89)	0.008*
2-5 years	6.38 (0.33-12.41)	0.039*	2.89 (-3.41 – 9.18)	0.365
6-10 years	1	1	1	1
11-15 years	-2.13 (-9.70-5.45)	0.579	-1.85 (-9.25-5.54)	0.620
16-20 years	2.76 (-5.68-11.21)	0.517	-0.79 (-9.64-8.06)	0.860
≥20 years	0.73 (-8.61-10.07)	0.877	-0.97 (-10.65-8.71)	0.843
Position				
Professional nurse	-7.44 (-12.25- -2.64)	0.003*	-1.44 (-8.03-5.15)	0.665
Trauma trained/ experienced	3.20 (-4.45 -10.85)	0.409	1.76 (-6.62-10.13)	0.678
ICU trained/experienced	1	1	1	1
Unit manager	16 (2.84-29.16)	0.018*	15.58 (2.92-28.24)	0.016*
ICU discipline				
Trauma (1)	1	1	1	1
Neurosurgery (2)	-7.68 (-15.08- -2.88)	0.042*	-3.65 (-10.82-3.52)	0.315
Cardiothoracic (3)	0.07 (-6.84- 6.97)	0.985	0.44 (-6.52-7.40)	0.901
Multidisciplinary (4)	-5.70 (-11.31- -0.09)	0.047*	-2.82 (-8.71-3.07)	0.344

Key: * = statistical significance ($p<0.05$)

4.2.4.1 Unadjusted linear regression models

The linear regression models show that ICU nurses with an undergraduate degree/diploma were less likely to score higher on the PUKAT questionnaire (-5.41, 95% CI -10.08-0.74; p = 0.024) in comparison to ICU nurses with a postgraduate degree/diploma. The ICU nurses

aged between 20-29 years, with 6 months to 1 year experience in their field were less likely to score higher on the PUKAT questionnaire (-9.18, 95% CI 15.90-2.47; p = 0.008) in comparison to ICU nurses with 6-10 years of experience. The ICU nurses with 2-5 years of experience were more likely to score high on the PUKAT questionnaire (6.38, 95% CI 9.70 – 5.45; p = 0.039) in comparison to ICU nurses with 6-10 years of experience. Professional nurses were less likely to score higher on the PUKAT questionnaire (-7.44; 95% CI -12.25-2.64; p = 0.003) in comparison to ICU trained/experienced nurses.

4.2.4.2 Adjusted linear regression models

The adjusted multiple linear regression models show that adjusting for other factors, **male ICU nurses** were more likely to score higher in the PUKAT questionnaire (8.52, 95% CI 1.80-15.26; p = 0.014) in comparison to female ICU nurses. **ICU nurses aged 20-29 years** were more likely to score higher in the PUKAT questionnaire (9.69, 95% CI 2.61-16.77), in comparison to ICU nurses aged 30-39 years. **ICU nurses with a master's degree** were more likely to score higher on the PUKAT questionnaire (14.00, 95% CI 2.90-25.11; p = 0.014), in comparison to ICU nurses with a postgraduate degree/diploma. **Unit manager** were more likely to score higher on the PUKAT questionnaire (15.58, 95% CI 2.92-28.24; p = 0.016) in comparison to ICU trained/experienced nurses.

4.2.4.3 Cronbach alpha coefficients

Table 4.4: Internal consistency of the items in the PUKAT

Themes	Cronbach alpha coefficient
Theme One: Etiology and development	0.26
Theme Two: Classification and observation	0.31
Theme Three: Risk assessment	0.24
Theme Four: Nutrition	0.11
Theme Five: Preventative measures to reduce the amount of pressure	0.27
Theme Six: Specific patient groups	0.14

The Cronbach alpha coefficients show that there was very poor (Cronbach alpha coefficient <0.50) consistency in any of the themes in the PUKAT 2.0 questionnaire responses by the ICU nurses (Tavakol & Dennick, 2011).

4.4 SUMMARY

This chapter discussed descriptive and inferential statistical tests that were used to describe and analyse the data collected. The data and interpretations of findings supported by literature discussion were presented. The following chapter will discuss the limitations of the study, summary of the research findings, conclusions and recommendations.

CHAPTER FIVE

DISCUSSION OF FINDINGS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter provides a discussion of the study's findings and presents the justifications together with the limitations. The chapter ends with recommendations for nursing practice, education and future research and a conclusion for the study.

5.2 DISCUSSION OF FINDINGS

This study aimed to describe ICU nurses knowledge of pressure injury prevention and management to identify gaps in knowledge. The study intended to make recommendations for clinical practice and education of intensive care nurses.

5.2.1 Socio-demographic Characteristics of the Study Population

The *first objective* was to describe the demographic characteristics of the ICU nurses.

The distribution of the sample revealed that the majority (89.1%; n = 90) of the respondents were female and 10.9% (n = 11) were male. These findings are consistent with results of similar and more recent published studies (Bathiha, 2018; De Meyer *et al.*, 2019; Manderlier *et al.,* 2017), which have consistently demonstrated nursing as a predominantly female profession. Finding related to male distribution in this current study is lower than reported in one Turkish study by Kisacik and Sonmez (2020), where it was reported that 27.8% of the sample (n = 753) were male. Similar results were also reported in the Simonetti *et al.* (2015) and Gunningberg *et al.* (2013) studies.

Most 52.5% (n = 53) respondents were between the ages of 30 to 49 years, and 25.7% were in the category between 50 to 59 years of age. These results are comparable to the studies of Manderlier *et al.* (2017) and De Meyer *et al.* (2019), where the majority of respondents in both studies were between the ages of 35 to 50 years. Further, most of the studies conducted

overseas indicated a higher number in the category of bachelor's degree in their study samples (Batiha, 2018; De Meyer *et al.*, 2019; Manderlier *et al.*, 2017). This finding was contrasted in this current study, where most 51.2% (n = 52) of the respondents held a postgraduate degree or diploma. These findings are not unexpected; there has been an increase locally in the education and training of intensive care nurses.

In this current study, the largest 31.7% (n = 32) group of respondents had between 6 to 10 years of ICU experience. This finding is not comparable with one study by Batiha (2018) that reported that most of their Jordanian nurses had less than five years of experience in the ICU. No other studies were found that explicitly reported on nurses' experience in their study samples (Gunningberg *et al.*, 2013; De Meyer *et al.*, 2019; Usher *et al.*, 2018). Most 51.5% (n = 52) of the respondents in this current study were ICU trained or experienced and worked in either the trauma ICU or multidisciplinary ICU (35.6%, n = 52 and 33.6%, n =34), respectively. These findings are higher than 13.8% reported in the Australian study by Usher *et al*. (2018). Similar results were also reported in the Simonetti *et al.* (2015) and Batiha (2018) studies.

5.2.2 The ICU Nurses Knowledge of Pressure Injury Prevention and Management

The *second objective* was to describe ICU nurses' knowledge of pressure injury prevention and management by completing the PUKAT version 2.0 questionnaire.

The overall mean total score for ICU nurses knowledge of pressure injury prevention and management was 42.16% (SD 12.09). A score of 16 or higher, which equates to 60% or higher, indicates an adequate level of knowledge of pressure injuries (Dalvand *et al.*, 2018). While these scores are higher than 38.2% and 28.9%, respectively reported from studies using the PUKAT in Turkey (Kisacik & Sonmez, 2020) and Belgium (Demarre *et al.*, 2011), they are still unsatisfactory. One study conducted in Belgium (Beekman *et al.* 2010) reported a knowledge score of 49.6%, 49.3% for registered nurses, and third-year student nurses. Simultaneously, Simonetti *et al.* (2015) indicated 51.1% (13.3/26) in their Italian sample. Batiha (2018), De Meyer *et al.* (2019), and Gunningberg *et al.* (2013) also reported similar results in their study samples.

Findings in this current study also revealed only six (5.9%) out of 101 (n = 101) respondents achieved equal to or more than 60% (cut-off score), and none of the items were answered correctly by all the respondents. In their study in Turkey conducted on 150 nurses, Tulek *et al.* (2016) determined a success rate of 58% (15.36 ± 15, range 0-26), while Kim *et al.* (2013), in their study conducted with 282 nurses in Korea, and determined a success rate of 60.1%.

The total overall score in this current study is less than the scores reported in the studies by Manderlier *et al.* (2017), De Meyer *et al.* (2019) and Batiha (2018), where the respondents obtained scores of 52%, 50.7% and 54.9%, respectively.

In a recent systematic review and meta-analysis conducted with 4766 nurses, nursing students and assistant nurses, Dalvand *et al.* (2018) determined the mean score for the level of knowledge on the prevention of pressure injuries was 53.1% and emphasised the cut-off point of the scales used to be lower than 59%.

As previously stated, the PUKAT 2.0 questionnaire comprised of 25 items divided into six themes (aetiology and development, classification and observation, risk assessment, nutrition, prevention of pressure injuries and special patient groups).

For the first theme, *aetiology and development,* which comprised six items, respondents obtained a mean score of 2.81 (SD 1.25; 46.8%). The respondents attained a mean score of 1.58 (SD 1.06; 39.5%) for the second theme, *classification and observation*, which contained four items. The third theme, *risk assessment*, contained two items. The respondents attained a median score of two (IQR 1-2; 100%). *Nutrition* is the fourth theme and contained three items. The respondents mean score was 1.51 (SD 0.84; 50.0%). For the fifth theme, *prevention of pressure injuries*, the respondents obtained a median score of two (IQR 11-3; 25.0%). This theme contained eight items. *Specific patient groups*, which was the last theme, comprised of two items. The participants mean score was 0.96 (SD 0.56; 48.0%). These results are comparable with one Turkish study conducted on 471 nurses that reported similar results (Sengul & Karadag, 2020).

As seen above, the lowest scores were found in the following themes: "***classification and observation"*** with **scores of 39.5%** and "***prevention of pressure injuries"*** with **scores of**

25%. In this current study, the highest scores were found in "***risk assessment"*** **(100.0%)** and "***nutrition"*** **(50.0%).** These findings are similar to the study by De Meyer *et al.* (2019), where the highest scores were in the same themes: "*risk assessment"* and "*nutrition",* and the lowest score was in "*prevention of pressure injuries"*. These findings are similar to the scores in the study by Batiha (2018), where "*risk assessment*" (56.2%) and *"nutrition*" (63.9%) were some of the highest scores and "*prevention of pressure injuries"* (45.5%) were some of the lowest scores.

In this current study, when comparing the correct and incorrect responses on item scores (Figures 4.1 to 4.25), it was noted that four items scored lowest (<20%). Question 6, 7, 20 and 24 all fall under level 4 of Bloom's taxonomy, which is analysing. This is the second-highest form of knowledge. This was also found in the study of Kim *et al.* (2012) and Tiemeier *et al.* (2011). This highlights the need to increase the basic understanding of nurses related to pressure injuries since the ability to succeed at higher levels of Blooms Taxonomy is partially due to success at lower levels (De Meyer *et al.,* 2019). In contrast, in items with more general information, the number of correct answers tend to be higher (i.e. a*etiology and development*).

While preventing pressure injuries is one of the critical duties of nursing staff. Findings in this study also revealed low scores on remembering/recall (questions 17 and 19) which fall under level 1 of Blooms Taxonomy. Interestingly, the study was conducted in the adult intensive care units, yet most of the respondents correctly identified in the "*special patient category*" (theme 6) that babies risk pressure injuries yet could not recognise the operating room's risk. The PUKAT 2.0 questionnaire is the most up-to-date knowledge assessment tool on pressure injury prevention (Gunningberg *et al.,* 2013; Kisacik & Sonmez, 2020). All items of the tool were formulated according to the most recent evidence-based guidelines (Beeckman *et al.,* 2012). Also, cases and pictures were added to evaluate theoretical knowledge and practical knowledge (Mandelier *et al.,* 2017).

5.2.3 Factors that Predict Appropriate Prevention and Management of Pressure Injuries

The *third objective* was to identify factors that predict appropriate prevention and management of pressure injuries.

By analysing the relationship between the nurses' characteristics and knowledge, it was observed that the mean scores were likely to be influenced by postgraduate education and training and years of experience. The ICU nurses with an undergraduate degree/diploma were less likely to score higher on the PUKAT questionnaire (-5.41, 95% CI -10.08-0.74; p = 0.024) in comparison to ICU nurses with a **postgraduate degree/diploma**. Pancorbo-Hildago *et al.* (2007) analysed the influence of professional experience on nurses knowledge and found statistically significant differences between professional nurses with 2-5 and 5-10 years of experience compared to less experienced nurses, the latter having lower knowledge scores. A possible imbalance may explain this in between practical and theoretical knowledge.

Further, ICU nurses with **2-5 years** of experience were more likely to score high on the PUKAT questionnaire (6.38, 95% CI 9.70 – 5.45; p = 0.039) in comparison to ICU nurses with 6-10 years of experience. Based on Suva *et al*. (2018)'s literature review, the current evidence concerning clinical experience on nurses' knowledge about pressure injuries is unclear.

Further, the adjusted multiple linear regression models show **ICU nurses aged 20-29 years** were more likely to score higher in the PUKAT questionnaire (9.69, 95% CI 2.61-16.77) than ICU nurses aged 30-39 years. Significant higher mean scores for younger age group participants was also found in the study by Kaddourah *et al.* (2016). This may be explained by the short period between graduation and starting to work as a nurse.

Further, **ICU nurses with a master's degree** were more likely to score higher on the PUKAT questionnaire (14.00, 95% CI 2.90-25.11; p = 0.014) than ICU nurses with a postgraduate degree/diploma. Beeckman *et al.* (2010), Simonetti *et al.* (2015) and Pancorbo-Hildalgo *et al.* (2007) found a similar correlation between educational background and knowledge.

5.3 SUMMARY OF THE STUDY

The study intended to describe the ICU nurses' knowledge of pressure injury prevention and management to identify gaps in knowledge, in order to make recommendations for clinical practice, education and training of nurses in ICU. The main objectives were to describe the

demographic characteristics of ICU nurses to assess the knowledge of ICU nurses by completing a pressure injury prevention and management questionnaire and to identify the relationship between demographic characteristics of ICU nurses that predict appropriate pressure injury prevention and management.

The Adult Intensive Care Units at the public sector tertiary hospital in Johannesburg were used to conduct the study. The professional nurses were sampled using a sample of 101 (n = 101) ICU nurses affiliated to the selected study sites at the hospital. A self-administered questionnaire developed by Beeckman *et al.* (2010) and Manderlier *et al.* (2017) was used to collect the data.

To achieve the study objectives, a quantitative, descriptive, correlational and cross sectional research design was used. Data was collected from 101 respondents over a period of 12 weeks (3 months). One hundred and one surveys were available for data analysis. Results were discussed using descriptive and inferential statistics.

It was demonstrated that ICU nurses in this current study had poor knowledge of pressure injury prevention and management. The mean knowledge score for the sample was 42.16% (SD 12.09). Only six (5.9%) out of 101 respondents achieved equal to or more than 60% (cut-off score), and none of the items were answered correctly by all the respondents. The highest scores were found in the themes "*risk assessment"* (100.0%) and "*nutrition"* (50.0%). The lowest scores were found in the themes "*prevention of pressure injuries*" (25.0%), and "*classification and observation*" (39.5%). ICU trained nurses with a postgraduate qualification had higher scores than professional nurses. It was concluded that there is a knowledge deficit in pressure injury prevention and management among nursing staff in this academic-affiliated institution. A major educational drive needs to be undertaken both in the hospital setting and in nursing education.

5.4 LIMITATIONS

The researcher acknowledges the following limitations to the study.

- The findings from this study cannot be generalised to other populations as it was only conducted in one public hospital, in one province.

- A relatively small sample was used, and convenience sampling was the sampling method utilised.
- This study utilised a quantitative design. This limits the participant's response as it does not allow the participant to explain further.
- A structured questionnaire may isolate some participants as it creates an unnatural setting.
- Because the study only examined nurses' knowledge of pressure injury prevention and management, the nurses' perceptions and practices may not be representative of actual patient care.

In consideration of these limitations, this study's findings cannot be generalised unless it is replicated on a larger scale, involving other ICUs in other public hospitals and provinces.

5.5 RECOMMENDATIONS

The following recommendations are made based on the findings of this study. These include recommendations for clinical practice, education, and further research.

5.5.1 Clinical Practice

The implications for clinical nursing practice are based on the strategies that influence preventing and managing pressure injuries to bring about awareness of current evidence-based guidelines and protocols in preventing and managing at-risk patients. This may help nurses become more independent practitioners in managing and preventing pressure injuries in these high-risk, critically ill patients.

Consequently, the study findings promote the need to provide and develop South African evidence-based guidelines for preventing and managing pressure injuries that are specific to patients in all ICUs to improve practice, as a result, showed that only 6 (5.9%) out of 101 nurses achieved a knowledge level equal to 60% and none of the items were answered correctly by all the respondents.

Strengthening the multidisciplinary team approach to prevent and manage pressure injuries should be developed on evidence-based practice guidelines that allow nurses and doctors to seek best practice consultations with experts in this area, such as tissue viability or wound specialists, dieticians, and pharmacists.

The daily care plan for each patient must include risk assessment scales and tools or preventive measures appropriate for the population in context. Risk assessment scales without supporting intervention measures are inappropriate.

5.5.2 Nursing Education

Education programs about pressure injury prevention and management should be in place to keep the clinical practice up to date with the latest and current knowledge. The environment that supports learning by providing learning materials on the topic should be available for nurses at the bedside.

An education approach for optimal prevention and management of pressure injuries must include following the themes epidemiology, anatomy, pathophysiology, principles of patient care, wound management, management of infection, specialist interventions, systematic and psychosocial aspects of care. In-depth theoretical knowledge and pathophysiological insight are needed to understand which preventive measures should be applied.

Evidence-based training on pressure injury prevention and management at the institutional level should be mandatory at orientation and should inform continuous professional development every year.

5.5.3 Further Research

The development of more studies on the topic in South Africa is still in need for the country as not a lot is available in the literature to improve theoretical knowledge and clinical practice. This study involved nurses only. Perhaps an observational study or qualitative study involving patients or doctors might be more beneficial for future research.

5.6 CONCLUSION

In conclusion, this research report described ICU nurses knowledge of pressure injury prevention and management. It brings to light gaps in pressure injury prevention and management theoretical knowledge and practice knowledge. Also highlighted is the need for ICU nurses to acquire evidence-based knowledge related to clinical practice. Nurses play an essential role in preventing pressure injuries, risk identification, classification and management of pressure injuries. The results showed that nurses who participated in this study had poor knowledge of pressure injury prevention and management and, therefore not likely to protect patients under their care adequately. This study's findings emphasise a need for further education and training in the hospital setting and nursing education.

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APPENDIX A

INTESIVE CARE UNIT NURSES' KNOWLEDGE OF PRESSURE INJURY PREVENTION AND MANAGEMENT

DATA COLLECTION INSTRUMENT

Please fill in your personal information:

AGE:_____

GENDER: _____

NUMBER OF YEARS QUALIFIED AS A REGISTERED NURSE:_____

LEVEL OF EDUCATION:_____

NURSING GRADE (SPECIALISED, NON-SPECIALISED FOR E.G.):_____

Below are 25 multiple choice questions. Each question consists of 5 answers, only one being correct. PLEASE CIRCLE THE CORRECT ANSWER.

THEME: AETIOLOGY

1. **There are several causal factors in the development of pressure injuries. Which of the following factors is one of them?**
   a. Diabetes.
   b. Incontinence.
   c. Fever.
   d. Reduced level of activity.
   e. I do not know.

2. **A patient sits with the head of the bed elevated to 60 degrees. What happens when his skin sticks to the underlying surface when he slides down in bed?**
   a. The pressure increases.
   b. Problems with the microclimate occur (temperature and relative humidity).
   c. Shear increases.
   d. Friction/rubbing increases.
   e. I do not know.

3. **What is the average percentage of patients with pressure injuries in European hospitals?**

a. Between 1% and 5%.
b. Between 5% and 10%.
c. Between 10% and 15%.
d. Between 15% and 20%.
e. I do not know.

4. **Excessively moist skin (due to e.g. incontinence or wound exudate) combined with increased body temperature are associated with pressure injury development. Is this statement correct?**
   a. Yes, excessive skin moisture and raised temperature cause pressure injuries.
   b. Yes, excessive skin moisture and raised temperature are risk factors for the development of pressure injuries.
   c. No, wounds that occur in a moist and warm environment are always defined as incontinence-associated dermatitis (IAD).
   d. No, an increase temperature results in better blood flow and thus decreases the risk of pressure injuries.
   e. I do not know.

5. **CASE: A patient is sitting in a chair in the morning and in the afternoon, each time 2 hours. The rest of the day he spends in bed. He cannot mobilise himself. When does this patient have the highest risk to develop a pressure injury (if no prevention is applied)?**
   a. There is no higher risk to develop a pressure injury if a seated position in a chair is combined with a lying position in bed.
   b. The risk to develop a pressure injury is highest when he is seated in a chair because high pressure is applied during a short period of time.
   c. The risk to develop a pressure injury is highest when he is lying in bed because lower pressure is applied during a longer period of time.
   d. The risk to develop a pressure injury is high in this specific case, both when seated in a chair and lying in bed. A short-term high pressure can have the same effect as a long-term low pressure.
   e. I do not know.

6. **Which statement is correct?**
    a. The use of moisture-absorbing pads decreases the risk of pressure injuries.
    b. The use of water and soap can erode skin barrier, thereby increasing the risk of superficial skin damage.
    c. Massaging the skin (during washing and drying) is effective to prevent pressure injuries.
    d. Dressing the heels (with a bandage) will decrease the risk of heel pressure injury development.
    e. I do not know.

THEME: CLASSIFICATION AND OBSERVATION

7. **CASE: You observe a new blister on the heel of a patient who can reposition himself in bed. You take a look at his file, but your colleagues never reported a non-blanchable erythema or a wound. Which statement is correct?**
    a. The blister is not a pressure injury.
    b. The blister is a Stage II pressure injury.
    c. The blister is a Stage I pressure injury as long as it remains intact.
    d. There is insufficient information to know if this is a pressure injury or not.
    e. I do not know.

8. **Which of these pictures is a pressure injury Stage I?**

    a. Blanchable erythema

    b. Non-blanchable erythema

c. Intact blister

d. Open blister

e. I do not know.

9. In which of these stages can necrotic tissue be present?

a. Stage I, II, III and IV.
b. Stage II, III and IV.
c. Stage III and IV.
d. Stage IV only.
e. I do not know.

10. CASE: The nurse observes a bony structure in a wound. In which stage can you classify this pressure injury?

a. Stage IV.
b. Stage IV if there are signs of undermining of the adjacent tissue.
c. Stage IV if there is necrosis.
d. Stage IV if there are signs of a reduction of the supply of blood to the tissue.
e. I do not know.

THEME: RISK ASSESSMENT

11. CASE: A patient is recently admitted to your nursing unit. The patient has no signs of skin redness (blanchable/ non-blanchable) but is bedridden. When completing the Braden risk assessment tool, the scores indicates that there is no risk for pressure injury development. No prevention is needed. However, you are very surprised because your clinical experience tells you that this patient is at risk. What are you going to do now?

a. You do not implement a prevention plan because both the skin assessment and the scoring tool indicated that there is no increased risk.
b. You do not implement a prevention plan because risk assessment instruments are developed to replace clinical judgement.
c. You take preventive measures because your clinical judgement is as important as the result of the risk screening using the tool.
d. You decide to reassess the patient on a daily basis (using the instrument) and to start prevention if the Braden risk assessment instrument indicates an increased risk to develop a pressure injury.
e. I do not know.

12. Which of these statements about the frequency of skin assessment on pressure points in hospital is correct?

a. The frequency of skin assessment is a medical decision (made by a medical doctor).
b. Skin areas with an increased risk for pressure injury development should be inspected at least once a week.
c. The skin of patients at risk should be inspected at least twice a week.
d. The skin of all patients should be inspected at least daily.
e. I do not know.

THEME: NUTRITION

13. CASE: A 23-year-old previously healthy male was recently admitted to the hospital with a spinal cord injury (car accident). He is immobile and has no problems eating or drinking. Is nutritional supplementation needed to reduce the risk of pressure injuries?

a. Yes, I provide nutritional supplementations (vitamin tablets) to prevent pressure injuries.
b. Yes, I provide nutritional supplementation (drinks enriched with the amino acid arginine) to prevent pressure injuries.
c. No, I will not change the nutrition of this patient as long as no signs of pressure injuries are observed (redness or skin breakdown).
d. No, I will not change the nutrition of this patient as long as nutritional intake is adequate.

e. I do not know.

14. Which nutritional elements are the most essential to prevent pressure injuries?

a. Carbohydrates, fats and proteins.
b. Proteins and fluids.
c. Carbohydrates and proteins.
d. Fats, fluids and proteins.
e. I do not know.

15. What type pf patients (in term of body weight) have an increases risk to develop pressure injuries?

a. Extremely thin patients.
b. Obese patients.
c. Both extremely thin and obese patients.
d. Body weight and BMI are not associated with pressure injury risk.
e. I do not know.

THEME: PREVENTION OF PRESSURE INJURIES

16. What is the percentage of patients with an increased risk to develop pressure injuries that receive adequate prevention in a chair and in bed in hospitals?

a. <20%.
b. Between 20% and 50%.
c. Between 50% and 70%.
d. >70%.
e. I do not know.

17. CASE: Your colleague informs you that she positioned a patient in bed in a semi fowler position. What does this mean?

a. The patient lies on his side in an angle of 30 degrees.
b. The patient lies on his side in an angle of 45 degrees.
c. The patient lies in a supine position, with both head of bed and upper legs elevated up to an angle of 30 degrees.

d. The patient lies in a supine position, with the head of bed elevated up to an angle of 45 degrees.
e. I do not know.

18. Which repositioning protocol is most effective to prevent pressure injuries? Starting with supine, then…

a. Lateral 30 degrees left- supine- lateral 30 degrees right- supine- lateral 30 degrees left-…
b. Lateral 90 degrees left- supine- lateral 90 degrees right- supine- lateral 90 degrees left-….
c. Lateral 30 degrees left- supine- lateral 30 degrees right- supine-lateral 90 degrees left- supine- lateral 90 degrees right-…
d. Lateral 30 degrees left- lateral 90 degrees left- supine- lateral 30 degrees right- lateral 90 degrees right- supine-…
e. I do not know.

19. The use of a ring cushion (donuts) is effective to prevent pressure injuries when patients are seated in a chair or wheelchair. Is this statement correct?

a. Yes, because the pressure near the bony prominence is reduced.
b. Yes, because it redistributes pressure and shear effectively around the area at risk.
c. No, because the contact surface between the patient's skin and the surface is smaller.
d. No, as it is only effective if a patient had a pressure injury in the past.
e. I do not know.

20. How should bed linen be used to prevent pressure injuries?

a. Do not secure the sheets under the mattress, so they can move along with the patient.
b. Do not secure the blanket under the mattress, so it can move along with the patient.
c. Make sure the sheets are stretched tight.
d. Put moisture-absorbing pads under the patient.
e. I do not know.

21. Which is the most effective technique to position a patient when seated?

a. In an upright position with the knees in a 90-degree angle and the feet not touching the ground.
b. In an upright position with the legs being supported so that an angle of more than 90 degrees is created at the knees.
c. In a semi-reclined position with the knees in a 90-degree angle with the feet not touching the ground.
d. In a semi-reclined position with the legs being supported so that an angle of more than 90 degrees is created at the knees.
e. I do not know.

22. CASE: Your patient is lying on a pressure redistributing foam mattress. Do you take other measures to prevent pressure injuries on the heels?

a. No, a pressure redistributing foam mattress is sufficient.
b. No, a pressure redistributing foam mattress combined with repositioning is sufficient.
c. Yes, I will place a pillow from the knee to the Achilles tendon to off-load the heels.
d. Yes, I will place a pillow under the Achilles tendon to off-load the heels.
e. I do not know.

23. How does repositioning prevent pressure injuries?

a. The amount of pressure and shear will be reduced.
b. The amount and duration of pressure and shear will be reduced.
c. The duration of pressure and shear will be reduced.
d. It reduces friction at the bony prominences.
e. I do not know.

THEME: SPECIFIC PATIENT GROUPS

24. Which of these statements is correct about the development of pressure injuries in the operating room?

a. Pressure injuries are not likely occur during surgery. If redness is observed after surgery, it is most likely to be a burn wound.
b. Immobilisation after surgery causes pressure injuries to develop, not the immobilisation during the surgery itself.

c. When pressure injuries develop during surgery, the first visible signs appear a few days later; making people think they developed after surgery.
d. A pressure injury appearing postoperatively is always the result of immobilisation during surgery.
e. I do not know.

25. Which is the location on the body where babies have the highest risk to develop a pressure injury?

a. Occiput.
b. Heels.
c. Shoulders.
d. Sacrum.
e. I do not know.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

APPENDIX B

INTENSIVE CARE UNIT NURSES' KNOWLEDGE OF PREVENTION AND MANAGEMENT OF PRESSURE INJURIES
PARTICIPANTS' INFORMATION LETTER

Dear Sir/ Madam

My name is Ricki-Lee Serebro. I am currently studying my Master's degree in Intensive Care Nursing at the University of the Witwatersrand. I am conducting research on intensive care unit nurses' knowledge of prevention and management of pressure injuries. The prevalence of pressure injuries within healthcare settings is considered an indicator of nursing care quality. Since nurses are responsible for continuous patient care, they should be equipped with the necessary knowledge and training which is based on scientific evidence in order to identify the patients who are at risk of developing pressure injuries. Intensive care unit nurses' knowledge about pressure injuries is vital in preventing them. The aim of this study is to describe intensive care unit nurses' knowledge of pressure injury prevention and management in order to identify gaps in knowledge. Therefore, I would like to invite you to participate in this study in order to improve intensive care unit nurses' knowledge of pressure injury prevention and management.

Once you have agreed to participate, you will be given a survey to fill out. This survey consists of your demographics, as well as 25 multiple choice questions on the prevention and management of pressure injuries.

Participation in this study is voluntary and you may choose whether to participate in this study. You may also withdraw from this study at any time, without consequences. It will be ensured that anonymity and confidentiality is maintained throughout the study. This will be done by use of a code number.

This study has been approved by the research committee of the University of the Witwatersrand and Charlotte Maxeke Johannesburg Academic Hospital. Should you require any more information on this study, please feel free to contact e on 0849113344 or by email; 726329@students.wits.ac.za

Thank you for taking the time to read this letter.

_____

Ricki-Lee Serebro: MSc Intensive Care Nursing Student

Research Supervisor: Dr Ntombifikile Klaas email: fikile.klaas@wits.ac.za

APPENDIX C

Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Ms R-L Serebro

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200364

NAME: (Principal Investigator)	Ms R-L Serebro
DEPARTMENT:	School of Therapeutic Sciences Department of Nursing Education Medical School University
PROJECT TITLE:	Intensive Care Unit nurses' knowledge of pressure injury prevention and management
DATE CONSIDERED:	2020/03/27
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr N Klaas
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/08/14

This clearance certificate is valid for 5 years from the date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **March** and will therefore reports and re-certification will be due early in the month of **March** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

APPENDIX C

Hospital Permission to Conduct Research

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Office of the Nursing Director
Enquiries: Mr. Moses Tshabuse
Tel: (011) 488-4558
Email: Moses.Tshabuse@gauteng.gov.za
26 June 2020

GP_202005_029

Dear Miss Ricki-Lee Serebro

STUDY TITLE: Intensive Care Unit Nurses' Knowledge of Pressure Injury Prevention and Management

Permission is granted for you to conduct the above-mentioned study as described in your request provided:

1. Charlotte Maxeke Johannesburg Academic Hospital will not anyway incur or inherit costs as result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the HOD and Unit Manager or sister in charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Supported / not supported

Ms. M Pule
Nursing Director
DATE: 26/06/2020

Approved/not approved

Ms. G.M Bogoshi
Chief Executive Officer
Date: 06.07.2020

APPENDIX D

Postgraduate approval of title

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

06 January 2021
Person No: 726329
PAG

Ms R-L Serebro
Po Box 133
Wendywood
2144
South Africa

Dear Ms Ricki - Lee Serebro

Master of Science in Nursing: Approval of Title

We have pleasure in advising that your proposal entitled *Intensive care unit nurses' knowledge of pressure injury prevention and management* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

APPENDIX F

Permission to use instrument

Dear Fikile
Many thanks for your kind e-mail. Please find attached the instrument. I also would like to inform you that we published an updated version in 2017 (see attachment). I am pleased to provide permission to apply the instrument for the study/research that you described.
Please keep me informed about the outcome of your work.
All the best.
Met vriendelijke groeten
Kind regards
Dimitri Beeckman

PROF. DR. DIMITRI BEECKMAN, RN, PhD
Professor of Skin Integrity and Clinical Nursing
Department of Public Health and Primary Care
University Centre for Nursing and Midwifery, Skin Integrity Research Group (SKINT)
Van: Fikile Klaas <fikile.klaas@wits.ac.za> **Verzonden:** woensdag 22 januari 2020 21:32 **Aan:** Dimitri Beeckman <Dimitri.Beeckman@UGent.be> **Onderwerp:** Request for permission to use an instrument

Dear Professor Beeckman,

I am currently supervising a student who is wanting to conduct a study on Intensive Care nurses' knowledge on pressure injuries. We would like to know if you would be willing to give us permission to use the instrument that you used in your study entitled: Pressure ulcer prevention: Development and psychometric validation of a knowledge assessment instrument (Beeckman *et al.* 2010) published in the International Journal of Nursing Studies.

If you are in agreement can I please ask you **to send us a copy of the instrument** with a short note stating that **you give us permission to use the instrument**. An email approval will also be adequate. Our university requires the student to include a copy of permission for instruments used from the authors for ethical clearance and a copy in the research report. The student is doing her MSc study by course work and we anticipate that she will complete the study by the end of this year. As part of the degree requirement, she is required to prepare a manuscript for publication.
Looking forward to your response
Kind regards,