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CONSENSUS ON NURSE-SENSITIVE INDICATORS FOR ADULT INTENSIVE CARE UNITS IN SOUTH AFRICA

by

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DECLARATION

I, Rose Okello, Student Number: 13293444 declare that ***Consensus on nurse-sensitive indicators for adult intensive care units in South Africa*** is my own work, and that all the sources used or quoted have been indicated and acknowledged by means of complete references. Furthermore, this work has not been submitted for any other degree at any other institution.

Rose Okello 29th May 2023

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Signature **Date**

ABSTRACT

CONSENSUS ON NURSE-SENSITIVE INDICATORS FOR ADULT INTENSIVE CARE UNITS IN SOUTH AFRICA

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Background: Nurse-sensitive indicators (NSI) are tools specifically related to nursing care that can be used to measure nurses' contribution to patients' outcomes. NSI are important for demonstrating and evaluating quality of nursing care to ensure that patients receive efficient, effective, and safe care. In South Africa, where critical care faces challenges of resource scarcity and increased demand for Intensive Care Unit (ICU) services, there is a need to implement the use of nurse-sensitive indicators to monitor the quality of care critically ill patients receive. However, there are no published sets of nurse-sensitive indicators for adult ICUs in the country.

Objective: The study aimed to develop and reach consensus on nurse-sensitive indicators for adult ICUs in South Africa.

Methods: The study used a scoping literature review and two rounds of eDelphi technique among registered nurse specialists in critical care.

Results: Thirty-four nurse-sensitive indicators were identified from 29 studies in the scoping review. In the first eDelphi round, a panel of 32 ICU nursing experts reduced the 34 indicators

to 29 and added 3 others to obtain a set of 32 indicators which were grouped into 12 categories of systems or areas of use. These were then presented to a second panel of ICU experts in the second eDelphi round. All the 32 indicators obtained agreement of at least 85% in the second eDelphi round and were finalized for possible implementation in ICU in South Africa. The 12 categories included the respiratory, cardiovascular, neurological, gastrointestinal, integumentary, and urinary tract systems. Others were infection control, patient safety, nursing processes, workload, training and experience, and institution related.

Conclusion: The study established consensus on a set of 32 nurse-sensitive indicators grouped into 12 categories suitable for use in adult ICUs in South Africa. However, there is need to establish validity, reliability, and burden of data collection by conducting pilot studies in actual ICU settings.

Keywords: Nurse-sensitive indicators; consensus; Delphi technique; intensive care unit; South Africa

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ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Providing the best quality of care to patients, users of health care services, and their families to meet the needs and expectations of both family and health care users is the overarching goal of healthcare institutions. Improving the quality of care provided remains one of the most crucial roles of health care institutions in South Africa (National Department of Health 2011:2). In this context, the last two decades have seen an increased interest in quality management in healthcare in general, and more specifically in the intensive care units (Flaatten 2016:202). Caring for critically ill patients is complex and resource intensive. Monitoring patient care and safety is essential to optimise outcomes for patients and the health system (Chrusch & Martin 2016:1).

Accordingly, Chrusch and Martin (2016) identified six domains of ICU function and developed 22 quality indicators for ICUs to assess their performance, identify gaps and strengths, and prioritise improvement efforts. Quality indicators (QIs) play an important role in evaluating the standard of care patients receive and therefore enable identification of shortfalls in care paths and allow improvement strategies (Evangelou, Lambrinou, Kouta & Middleton 2018:28). Medical quality indicators are important practical tools to evaluate healthcare quality and their development requires specific evidence-based methods, particularly in the ICU with its complex processes (Kumpf, Nothacker, Braun & Muhl 2020:1). Nursing care is a critical factor of patient care therefore the assessment of quality indicators that specifically reflect nurses' contribution is vital (Evangelou, Lambrinou, Kouta & Middleton 2018:28).

Intensive care units have become an integral part of most health care systems for the purpose of providing enhanced specialized medical and nursing care to critically ill patients, and to provide physiologic organ support to sustain life during a period of life-threatening organ system insufficiency. Critically ill patients admitted in the ICU require continuous 24-hour

monitoring (Marshall, Bosco, Adhikari, Connolly et al 2017:270). The ICU is one of the most significant units in a hospital, that provides multifaceted life-saving care for a wide variety of complicated conditions in patients who require continuous 24-hour monitoring, such that nurses can care for only a limited number of patients at a time and there is a high need for nursing capacity provided by trained critical care nurses (Hoogendorn, Margadant, Brinkman, Haringman et al 2019:2). Critically ill patients experience a high burden of disease and providing safe quality care to them is often complex and requires a combined effort from a specially qualified interdisciplinary and interprofessional team of healthcare providers complementing trained critical care nurses (Chrusch & Martin 2016:1).

1.2 BACKGROUND TO THE STUDY

In the ICU where adverse events and human error may contribute to a high rate of morbidity and mortality, monitoring quality of care plays an important role in quality improvement strategies. In order to measure and improve the quality of health care provided to critically ill patients by multi-disciplinary professionals in ICUs, it is important to know, evaluate, and clarify each discipline's daily processes (Conolly & Wright 2017:603). Nursing staff who provide continuous care from admission to discharge make a significant contribution to patient care in the ICU (Marshall, Bosco, Adhikari, Connolly et al 2017:271). Therefore, it is essential to use objective strategies to evaluate nursing activities in order to optimize utilization of ICU resources and to demonstrate a comprehensive and accurate picture of the value of nursing and the benefits of services they provide according to standard of care (Lachance, Douville, Dallaire, Padilha & Gallani 2015:148). Evaluating the quality of care provided by nurses is also an important part of assessing the overall quality of care provided due to the significant contribution they make to patient care (Yang, Huang, Zhao, Xing et al 2019:48).

Nurse-sensitive indicators are tools specifically related to nursing care that can be used to measure nurses' contribution to patients' outcomes (Sutton & Jarden 2017:339; Burston, Chaboyer & Gillespie 2014:1785). Since 2009, Australia, Austria, Germany, India, New Zealand, Spain, the UK, and several other countries have published lists of nationally recognised intensive care indicators aimed at optimizing resource utilization in ICUs (Bilotta, Nato, Falegnami & Pugliese 2019:1027). These indicators were general and either did not specifically assess the nursing aspect of care or were described differently therefore making it difficult to generalize and replicate in a different ICU environment (Evangelou, Lambrinou,

Kouta & Middleton 2018:28). In South Africa, where patients with a high burden of complicated communicable or non-communicable illnesses are admitted to ICU for life support, it is critical to identify and use nurse-sensitive indicators to monitor and improve patient outcomes, and to reduce adverse events (Gqaleni & Bhengu 2018:2; Joynt, Gopalan, Argent, Chetty, Wise, Lai et al 2019:36).

1.3 PROBLEM STATEMENT

Nursing care is a critical factor of patient care because of the central role nurses play in the care of critically ill patients in the ICUs (Evangelou, Lambrinou, Kouta & Middleton 2018:28). The use of quality indicators that objectively evaluate nurse-specific activities in ICUs offers an opportunity to demonstrate specific contributions that nurses make to patient outcomes, reduction of errors and incidents, and enhancing patient satisfaction (Gathara, Zosi, Serem, Nzinga, Murphy, Jackson, Brownie & English 2020:1). The use of nurse-sensitive indicators also offers an assurance that patients have been provided with and received adequate and necessary care (Yang, Huang, Zhao et al 2019:48). Hence without nurse-sensitive quality indicators (QIs) it is not possible to assess the quality of nursing care provided to patients. However, quality indicators specific to nursing care in ICUs are generally not available (Evangelou, Lambrinou, Kouta & Middleton 2018:28). Appropriate nurse-sensitive indicators should be identified and be integrated with routine nursing care to measure nurses' contribution to patient outcomes for quality improvement purposes in ICUs (Evangelou, Lambrinou, Kouta & Middleton 2018:28).

The identification of nurse-sensitive indicators from the literature would enable the development of QIs that could be adopted in practice in the context of auditing performance and monitoring quality of care in day-to-day routine nursing care in ICU in a South African context. The researcher found no literature on nurse-sensitive indicators for ICUs in South Africa. Therefore, identifying and developing a set of evidence-based nurse-sensitive indicators for ICUs in South Africa should enhance the quality of nursing care provided and allow for comparison of improvement efforts across different ICUs countrywide. This motivated the researcher to explore and identify nurse-sensitive indicators from the literature, develop them into a set of QIs for ICU, and present them to a panel of experts to agree on their definitions, how to use them, and their usefulness in a South African setting.

1.4 SIGNIFICANCE OF THE STUDY

A research study should be significant to the nursing profession and contribute to the body of knowledge (Brink, van der Walt & van Rensburg 2012:61). The results of the study should benefit nurses, patients, hospital management and policy makers.

Nurse-sensitive indicators would provide evidence of the quality of nursing care that patients receive and identify areas in need of improvement (Evangelou, Lambrinou, Kouta & Middleton 2018:28). Using nurse-sensitive indicators should enhance patient outcomes thereby providing job satisfaction to nurses. Nurse-sensitive indicators could be used to reduce length of stay, hospital costs, morbidity, and mortality. This, in turn, would improve patient satisfaction and confidence in the healthcare system, which would benefit policy makers in deciding and implementing policy. Nurse-sensitive indicators should be included in the critical care nursing curriculum.

1.5 CONTEXT OF THE STUDY

The study was conducted in selected intensive care units in South Africa. The intensive care service in South Africa is framed within the district, provincial and national levels of the health service and graded from level I to level IV. Level I units are in the public sector tertiary referral hospitals with sophisticated equipment. They follow a closed system and have a 1:1 or 1:2 patient/nurse ratio and other specialised staff such as intensivists caring for a variety of critical illnesses (De Beer, Brysiewicz & Bhengu 2011:7). Level II to IV units is found in the private sector. Level II units are specialised units catering for neurological or coronary care, level III units are the critical care units found in community hospitals, which can provide limited invasive monitoring, and level IV units are high-dependency units with a 1:1 patient/nurse ratio (De Beer, Brysiewicz & Bhengu 2011:8). According to the 2009 national audit of ICU resources in South Africa, there were 4,719 ICU and high-care beds in the private and public sectors to cater for a population of 57 million people of which 75% (3,533) were in the private sector and 25% (1,186) were in the public sector (Naidoo & Naidoo 2021:2). Most ICU beds in the public sector were in Gauteng (49%, 2,312 beds), KwaZulu-Natal (14%, 672 beds) and the Western Cape (15%, 719 beds) provinces (Naidoo & Naidoo 2021:2). The mortality rate for patients in ICU in South Africa is 31.5% with the most common contributing factors being a shortage of

critical care facilities, shortage of skilled experienced staff, increased workloads, and faulty equipment (Gqaleni & Bhengu 2018.2).

1.6 AIM AND OBJECTIVES OF THE STUDY

The aim of the study was to reach consensus on nurse-sensitive indicators suitable for adult ICUs in a South African context. In order to achieve the aim, the objectives were to

- Identify nurse-sensitive indicators for adult ICUs already in use in ICUs worldwide.
- Reach consensus on nurse-sensitive indicators for adult ICUs which can be used in South Africa.

1.7 RESEARCH QUESTION

The study wished to answer the following question:

> Which nurse-sensitive indicators identified from the literature review are suitable for adult intensive care units in the South African setting?

1.8 ASSUMPTIONS

Assumptions are basic principles that are accepted on faith or taken for granted, or assumed to be true without proof or verification (Brink, van der Walt **& van Rensburg** 2018:22). Polit and Beck (2017:720) refer to assumptions as principles that are accepted as true based on logic or reason, without proof, that determine the nature of concepts, definitions, purposes, and relationships. In this study, the researcher made two assumptions. The first assumption was that nurse-sensitive indicators identified from the literature review would enable evaluating nurses' contribution to patient care; measure nursing-related tasks; help ensure high quality nursing care, and drive quality improvement initiatives. Secondly, the use of a formal consensus group method in decision-making has the advantage of a wider range of knowledge and experience; debating among the panel may challenge ideas and stimulate new ones, and group consensus is more credible than decisions made by a single person (Humphrey-Murto, Varpio, Gonsalves & Wood 2017:15).

1.9 DELINEATION

The study focused on reaching consensus on nurse-sensitive indicators for developing a set of feasible and relevant nurse-sensitive indicators (NSIs) for reporting nursing outcomes in adult ICUs in South Africa. The study concentrated on adult patients admitted in ICU and quality indicators in the literature review specific to nursing activities and outcomes.

1.10 RESEARCH DESIGN

A research design is a set of logical steps taken by the researcher to answer the research questions (Brink, van der Walt **& van Rensburg** 2018:187). A research design is the plan for addressing a research question, including the specifications for enhancing the integrity of the study (Polit & Beck 2017:164). In this study, the researcher selected a systematic review design in phase 1 to obtain nurse-sensitive indicators from the literature review and a Delphi technique in phase 2 to reach consensus on a set of indicators feasible and applicable in adult ICUs in South Africa.

1.11 RESEARCH METHODOLOGY

Research methodology is the plan for conducting the specific steps of a study. Research methods are the techniques or tools researchers use to collect, structure, and analyse data systematically (Polit & Beck 2012:741). The research methodology includes the population, sample and sampling, data collection, analysis and interpretation, and ethical considerations.

In this study the researcher conducted the study in two phases to reach consensus on a set of nurse-sensitive indicators for adult ICUs in South Africa. In phase 1, the researcher conducted a systematic literature review on electronic databases available in the library at the University of Pretoria in order to select and develop nurse-sensitive indicators for inclusion. In phase 2, a population of ICU-trained nurses from selected ICUs in South Africa evaluated and reached consensus on nurse-sensitive indicators for South African adult ICUs.

Table 1.1 Summary of research methodology and methods

Description	Application
Phase 1 Systematic literature review	**Unit of analysis** • Search the electronic databases in University of Pretoria library for relevant sources • Develop a list of nurse-sensitive indicators for adult ICUs published in the literature review since 2014
Phase 2 Reach consensus on nurse-sensitive indicators for adult ICUs in the South African context, using two Delphi rounds	**Population** • ICU-trained nurses and ICU nurse managers or educators with at least 5 years' experience in ICU practice • Participate in two Delphi rounds to reach consensus on nurse-sensitive indicators that are feasible and acceptable in the South African context

1.12 RIGOUR

Rigour minimizes bias and ensures control over variables under study (Polit & Beck 2017:558). Rigour requires a researcher to ensure a systematic approach to the research design and an awareness of the importance of interpretation rather than reliance on assumptions or perceptions (Brink, van der Walt & van Rensburg 2018:82). Rigour is a way by which reliability or trustworthiness is assured in any research finding. In phase 1, the researcher used the preferred reporting items in systematic review and meta-analyses (PRISMA) guidelines to ensure rigour (Shamseer, Moher, Clarke, Ghersi, Liberati, Petticrew, Shekelle & Stewart 2015:1). The researcher applied Humphrey-Murto, Varpio, Gonsalves and Wood's (2017:16) recommendations to add credibility to the research process and results (see chapter 3 for full discussion).

Researchers achieve rigour in qualitative studies by ensuring trustworthiness of the data collected (Polit & Beck 2017:558). Trustworthiness is "the degree of confidence that qualitative researchers have in their data, using the strategies of credibility, dependability, confirmability, transferability and authenticity" (Polit & Beck 2017:558). In this study, the researcher applied the strategies of credibility, dependability, transferability, and confirmability to ensure trustworthiness (see chapter 3).

1.13 DEFINITION OF KEY TERMS

In this study, the following key terms were used as defined below:

- **Consensus**

Longman Dictionary of Contemporary English for Advanced Learners (2009:356) defines *consensus* as “an opinion that everyone in a group agrees with or accepts.”

According to Diamond, Grant, Feldman, Pencharz, Ling, Moore, and Wales (2014:401), the most common definition for consensus was percent agreement, with 75% being the median threshold to define consensus.

In this study, consensus referred to at least 85% of the participants agreeing to a given nurse-sensitive indicator for inclusion in the set of nurse-sensitive QIs for adult ICUs in South Africa.

- **Critical care nurse**

According to the *Nursing Act, 33 of 2005* (South Africa 2005:1), the term “nurse” refers to a Registered Nurse, Enrolled Nurse, Enrolled Nurse Assistant, or Student Nurse as a person registered by the South African Nursing Council (SANC) to practise as a nurse and administer medication either independently or under direct supervision according to their rank. A professional nurse (PN) is a person who is qualified and competent to independently practise comprehensive nursing in the manner and to the level prescribed and who can assume responsibility and accountability for such practice (South Africa 2005:6).

The South African Nursing Council (SANC) (2014:1) defines a critical care nurse as a nurse in possession of knowledge, skill, and competencies to provide comprehensive care to the clinically unstable patient in collaboration with other healthcare professionals.

In this study, a critical care nurse referred to a registered nurse who had been trained and found competent in all the skills of a post-basic qualification in critical care according to the competencies for critical care nurse specialist (adult) (SANC 2014:1).

- **Intensive care unit (adult)**

An intensive care unit (ICU) is an organized system within a medical facility for the provision of care to critically ill patients that provides intensive and specialized medical and nursing care, and possesses an enhanced capacity for monitoring multiple modalities of physiologic organ support to sustain life during a period of life-threatening illness (Marshall, Bosco, Adhikari, Connolly et al 2017:270).

In this study, an ICU for adults referred to an area within a medical facility equipped with advanced technology, such as ventilators, and personnel trained to provide continuous intensive, advanced life-supportive care to critically ill patients older than 18 years.

- **Nurse-sensitive indicators**

Nurse-sensitive indicators are tools relating specifically to nursing care that can be used to measure nurses' contribution to patients' outcomes that are affected or influenced by nurses (Kieft, Stalpers, Jansen, Francke & Delnoij 2018:755).

In this study, nurse-sensitive indicators referred to tools to measure health outcomes for patients that are influenced by nursing care in ICU.

- **Quality health care**

Allen-Duck, Robinson, and Stewart (2017:382) define quality healthcare as "the provision of effective and safe care reflected in a culture of excellence, resulting in the attainment of optimal or desired outcomes".

In this study, quality care referred to care that is effective, efficient, safe, patient-centred, and acceptable.

1.14 ETHICAL CONSIDERATIONS

Ethics deals with matters of right and wrong. When humans are used as study participants, care must be taken to ensure that their wellbeing and rights are protected (Polit & Beck 2017:138). The *Belmont Report, 1979* states there are three broad principles of ethical conduct in research, namely respect for persons or human dignity, beneficence, and justice (Polit & Beck 2017:137). Accordingly, the researcher obtained permission to conduct the study, and observed the ethical principles of beneficence, respect for human dignity, and justice (Polit & Beck 2017:139).

- **Permission**

  The researcher obtained written ethical approval and permission to conduct the study from the Faculty of Health Sciences, Research Ethics Committee of the University Pretoria (ethics approval number: 185/2021 of 13 May 2021) (see Annexure A1).

- **Beneficence**

  The principle of beneficence includes treating people in an ethical manner, respecting their decisions, causing them no harm and maximising benefits. It involves the right of the participants to freedom from harm and discomfort and protection from exploitation (Polit & Beck 2017:139). The study was non-experimental and the researcher assured the participants of anonymity and confidentiality during the Delphi method.

- **Respect for human dignity**

  This principle includes the right to self-determination and the right to full disclosure (Polit & Beck 2017:211). The researcher treated the participants as autonomous individuals; informed them of the purpose of the study, that participation was voluntary, and that they were free to withdraw from the study at any time should they wish to do so. The researcher described her responsibilities and the benefits of the study, allowed the participants to ask questions, and informed them that all information would be treated confidentially (Polit & Beck 2017:141). The participants signed informed consent before taking part in the Delphi rounds (see Annexure A2).

- **Justice**

  Justice includes the participants' right to fair treatment and to privacy. The participants were selected fairly based on their qualification as critical care nurses with experience in ICUs in South Africa. They were attached to either a tertiary hospital or a training institution. The researcher always respected and took the participants' opinions into consideration (Polit & Beck 2017:141).

  The participants' confidentiality was protected by ensuring that no identifying information was included in the questionnaires, and the consent forms were kept separate from the questionnaires. The electronic research records were protected by a password available only to the researcher and the supervisor. The research records were available to authorized people only. No data or information could be attributed to any participant. Consequently, any report, publications and/or presentations resulting from the study will be able to identify any individual participants.

1.15 LAYOUT OF THE DISSERTATION

The dissertation consists of five chapters. Table 1.2 presents the layout of the chapters.

Table 1.2 Layout of the chapters

CHAPTER	TITLE	DESCRIPTION
1	Orientation to the study	Describes the problem, purpose, research design and methodology of the study, defines key terms, and describes the ethical considerations of the study.
2	Literature review	Discusses the literature review conducted for the study.
3	Research design and methodology	Describes the research design and methodology of the study.
4	Journal article	Draft article for publication in a critical care journal. Article not yet submitted
5	Findings, limitations and recommendations.	Briefly presents the conclusions based on the findings and makes recommendations for nurse-sensitive indicators for use in adult ICUs in South Africa. **This chapter also recommends further testing of the nurse-sensitive indicators developed in this study to evaluate their suitability in ICU practice in South Africa.**

1.16 DISSEMINATION OF RESULTS

The results will be disseminated at staff meetings, workshops, and seminars, and in an article in an approved professional journal. **The findings of this study will also be presented and discussed in Critical Care Society of Southern Africa congress and other nursing scientific meetings.**

1.17 CONCLUSION

This chapter outlined the aim, problem, research design and methodology of the study and defined key terms.

Chapter 2 discusses the literature review conducted for the study on nurse-sensitive indicators for adult ICUs.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided an overview of the study. This chapter discusses the literature review conducted for the study. A literature review is an organised, written presentation of what has been published on a topic and involves researching, reading, and understanding literature relevant to a study (Burns, Grove & Gray 2017:120). The purpose of a literature review is to convey what is currently known regarding the topic of interest and to assist researchers to comprehend and extend their knowledge of the phenomenon under study (Polit & Beck 2017:99).

The literature review covered provision of quality health care and nurse-sensitive indicators (NSIs) as a means of achieving quality health care; the history, development, implementation, and role of NSIs; examples of specific NSIs suitable for use in adult ICUs; how specific NSIs are used to facilitate quality improvement in adult ICUs to enhance the quality of health care and improve patient outcomes, and the role of NSIs in ICU nurses' job satisfaction. The researcher conducted the literature review on electronic databases available in the University of Pretoria library.

2.2 HEALTHCARE QUALITY

Worsening quality indicators of health care shake public trust. In 1988, Donabedian proposed a structure, process, and outcomes model which laid the groundwork for an emerging body of consensus measures and tools for assessing the delivery of care (Allen-Duck, Robinson & Stewart 2017:377). Quality healthcare has been defined.

2.2.1 Definition

Allen-Duck, Robinson and Stewart (2017:377) examined the concept of healthcare quality and identified four defining attributes, namely effective, safe, culture of excellence, and desired outcomes. Based on these attributes, Allen-Duck, Robinson and Stewart (2017:377) defined healthcare quality as "the assessment and provision of effective and safe care, reflected in a culture of excellence, resulting in the attainment of optimal or desired outcomes". Rhodes, Moreno, Azoulay, Capuzzo, Chiche et al (2012:599) describe quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes consistent with current professional knowledge".

2.2.2 Attributes

The four attributes of health care quality are effective, safe, culture of excellence, and desired outcomes. Effective refers to proper treatment of patients, including accurate assessment, interventions, and response that is equitable, consistent, and timely. For example, was the care provided sufficient and able to improve the patient's health and outcome? One feature of effectiveness is making sure that things are not missed or omitted (Burhans & Alligood, 2010 cited in Allen-Duck, Robinson & Stewart 2017:379). Safe and safety refer to the prevention of errors and adverse effects to patients associated with health care (World Health Organization, 2021). Safety elements include infection control practices, accurate medication administration, and commitment to protocols that prevent any procedural-related complications. Providing safe care also means reducing harm caused in the process of delivering care. Rhodes, Moreno, Azoulay, Capuzzo et al (2012:599) state that patient safety is an integral part of

quality as it is difficult to provide quality care where safety is compromised. Moreover, safety means the absence of clinical error, either by commission (doing the wrong thing unintentionally) or omission (failing to do the right thing unintentionally). Clinical error is failing to complete a planned action as intended or using a wrong plan to achieve an aim (Institute of Medicine [IOM], 1999**.** According to the South African Nursing Council (SANC, 2005), as professionals, nursing practitioners are personally accountable for their actions and omissions while carrying out their responsibilities in their profession. Examples of acts and omissions that are regarded as professional misconduct are failure to give the required treatment to a patient; failure to keep accurate and complete records of all nursing care provided to a patient, and giving confidential information about a patient to unauthorised person.

A culture of excellence encompasses collaboration and communication among the professionals, compassion, competence, advocacy, respect, responsibility, and trustworthiness. Desired outcomes are characterized by goal achievement, the best possible results, shared decision making, patient-centred care, and patient satisfaction (Allen-Duck, Robinson & Stewart 2017:382). Shared decision-making involves identifying patients' needs, preferences, and abilities, and engaging patients to make decisions about their health and take responsibility for the same (Allen-Duck, Robinson & Stewart 2017:383). Attributes of health care are measurable.

2.2.3 Measures of health care quality

Quality indicators (QIs), also called performance indicators, were first introduced in the United States of America (USA) to assess performance. In medicine, QIs are standardized tools that can be used with readily available hospital inpatient administrative data to measure and track clinical performance and outcome (Bilotta, Nato, Falegnami & Pugliese 2019:1027). QIs address: prevention, intended to evaluate hospital admissions that might have been avoided; inpatient treatment, including mortality indicators, utilisation indicators, and volume indicators; and patient safety, to identify potentially avoidable patient safety events. Bilotta, Nato, Falegnami and Pugliese (2019:1027) add that in critical care, QI selection is more complex due to the substantial role of caseload (selection of patients admitted), structural features (technology and staffing), and the role of each individual professional (quality and commitment). Quality nursing care is significant because it is a means through which excellence of care is measured in nursing

2.3 NURSE-SENSITIVE QUALITY INDICATORS FOR ICUS

Nurse-sensitive indicators are an important measure currently used to ensure quality. Quality nursing care is important because it is linked to patient safety, patient satisfaction, and health outcomes.

Nurse-sensitive quality indicators refer to measuring tools used to assess the quality of nursing care, and provide a means of quality control for activities specific to nursing staff (Chen, Huang, Xing, Feng, Shao & Shao 2017:503).

Some patient outcomes are influenced by the quality of nursing care. In their systematic literature review, Myers, Pugh and Twigg (2018:447) examined the impact of nurse staffing and nurse skill variations on patient outcomes in high acuity areas. Patient outcomes influenced by the quality of nursing care included central nervous system complications, prophylaxis of deep vein thrombosis and pulmonary embolism, prevention of pressure ulcers, gastrointestinal bleeding, pneumonia, sepsis, shock, cardiac arrest, rate of urinary tract infection, failure to rescue, physiologic/metabolic derangement, pulmonary failure, wound infections, mortality, and length of stay in hospital (Myers, Pugh & Twigg 2018:448). Another outcome commonly mentioned is hospital mortality which is an important patient outcome that has been associated with nursing performance. In a study in 137 National Health Service (NHS) trust hospitals in England, Griffiths, Ball, Murrells, Jones, and Rafferty (2016:4) found that a higher nurse staffing level was associated with lower mortality. Connolly and Wright (2017:603) state that the extent to which nurse-to-patient ratio, sickness and absences, registered nurse education level and experience, hospital-acquired infection, pressure ulcers, falls and medication administration affect nursing quality is not clear.

In the Netherlands, Stalpers, de Vos, van der Linden, Kaljouw and Schuurmans (2017:151) found that nurses in three Dutch ICUs identified pressure ulcers and patient satisfaction as nurse-sensitive indicators and nurses' full responsibility. Less than 50% of the participant nurses considered mortality, urinary tract infections (UTI), delirium, sepsis and multidrug-resistant (MDR) infections nurse-sensitive indicators. The main barriers to nurse-sensitive outcomes in ICUs were lack of time (behaviour), unfamiliarity with mandatory indicators

(knowledge) and the work environment or clinical autonomy (attitude) (Stalpers, de Vos, van der Linden et al 2017:154).

2.3.1 History of nurse-sensitive indicators

Nurses are the first in the line of duty in providing care to patients in hospital because they are the only health professionals at the patient's bedside 24 hours a day. Traditionally, nurses are known to care for and nurture patients based on nursing skills, but there has been little focus on measuring the effects of a nurse's care on patient outcomes. Florence Nightingale was the first to acknowledge the importance of effective collection of medical statistics and its relation to the improvement of health care outcomes (Ellis 2008:404). Florence Nightingale recognised the role of quality nursing in health care and began measuring patient outcomes to produce reports that linked patient outcomes to environmental conditions. She represented her analysis in graphical form – such as pie charts and the Nightingale rose diagram, which was the equivalent to modern circular histograms – to make it easier to draw conclusions and actions from data. Her philosophy and teachings emphasise that nurses must use their brains, hearts, and hands to create healing environments to care for patients' bodies, minds, and spirits (Ellis 2008:405).

Measuring the quality of nursing's contribution to patient outcomes is critical because nurses are major stakeholders and key personnel who play significant roles in the discussion on patient safety and health care quality (Eglseer, Osmancevic, Hoedl, Lohrmann & Bauer 2021:187).

In 1996, researchers at the University of Iowa College of Nursing developed a comprehensive classification of nursing-sensitive patient outcomes (Maas, Johnson & Moorhead 1996:295). The Nursing-Sensitive Outcomes Classification (NOC) completed the nursing process elements of the Nursing Minimum Data Set (NMDS). The NOC provided standardized patient outcomes for determining the effectiveness of nursing interventions and enabled inclusion of these data in datasets for healthcare effectiveness research (Maas, Johnson & Moorhead 1996:302). Many countries have since developed measurement programmes and databases to measure the quality of nursing care.

In 1998, the American Nurses Association (ANA) established the National Database of Nursing Quality Indicators (NDNQI) to continue the process of collecting and building on data established in previous studies and further expand and refine nursing's body of knowledge associated with factors which affect the quality of nursing care (Montalvo 2007:1). The NDNQI nurse-sensitive indicators use the Donabedian method of structure, process, and outcome to measure nursing performance (Flaatten 2016:202; Connolly & Wright 2017:604). Structure refers to conditions under which care is provided, such as supply of nursing staff, skill level, education level, or availability of adverse reporting system; process are the methods by which health care are provided, e.g., nursing process: patient assessment, diagnoses, treatment, and prevention of adverse events – often given as a percentage; patient outcomes are real changes in health status that can be attributed to the health care (Flaatten 2016:202). There are specific nursing-sensitive indicators for use in a critical care unit.

2.3.2 Quality indicators for intensive or critical care

Critical care has evolved from treatment of poliomyelitis victims with respiratory failure in an ICU to the treatment of severely ill patients irrespective of location or specific technology. In 2003, Pronovost Berenholtz, Ngo, McDowell et al (2003:145) developed and tested a set of valid and reliable yet practical quality indicators for intensive care. Since 2009, Australia, Canada, Denmark, Germany, the Netherlands, India, New Zealand, Spain, the United Kingdom (UK) and several other countries have published lists of nationally recognised critical care quality indicators in order to optimize the use of resources in ICUs (Bilotta, Nato, Falegnami & Pugliese 2019:1027).

In Europe, various organizations took action to raise health care professionals' and public awareness of patient safety in the ICU. In 2009, the European Society of Intensive Care Medicine (ESICM) took an initiative in which it highlighted the problem of patient safety in ICUs across Europe (Rhodes, Moreno, Azoulay, Capuzzo et al 2012:599). The outcome of this initiative was a directive to identify a set of indicators that could be used to measure the quality of care provided in any ICU in any European country which could also act as a baseline for improvement strategies (Rhodes, Moreno, Azoulay, Capuzzo et al 2012:599).

Populations in the developed world suggest that the global burden of critical illness is higher than generally appreciated and will increase as the population ages. Although intensive care capacity is scarce in the developing world, efforts to improve the care of the critically ill in these settings is emerging (Adhikari, Fowler, Bhagwanjee & Rubenfeld 2010:1339). Unlimited expansion of intensive care to meet the needs of an ageing population and handle the consequences of natural disasters, conflict, inadequate primary care, and high-risk treatments for very sick patients, will be challenged by high costs at a time of economic constraint. To meet this challenge, the specialty of intensive care will need to measure better the global burden of critical illness and develop both preventive and therapeutic interventions for the sickest patients. Interventions need to be scalable across health care systems at all the world's latitudes (Adhikari, Fowler, Bhagwanjee & Rubenfeld 2010:1346).

Timely and appropriate care is the key to achieving good outcomes in acutely ill patients, but the effectivess of critical care may be limited in resource-limited settings. Vukoja, Riviello, Gavrilovic, Adhikari, Kashyap et al (2014:337) conducted a survey on critical care resources and practices in thirteen ICUs in low- and middle-income countries in Eastern Europe, Asia, Latin America and Africa. The study found that only two ICUs used any kind of checklists for acute resuscitation, and ten ICUs listed lack of trained staff as the most important barrier to improving the care and outcomes of critically ill patients (Vukoja, Riviello, Gavrilovic, Adhikari, Kashyap et al 2010:342).

Sakr, Moreira, Rhodes, Ferguson, Kleinpell, Pickkers, Kuiper, Lipman and Vincent (2015:520) examined the the impact of hospital and ICU organisational factors on patient outcomes in a large cohort of ICUs in North America, Latin America, Western Europe, Asia and Oceania. The study found that hospital and ICU characteristics varied worldwide. A high nurse:patient ratio was independently associated with a lower risk of in-hospital death (Sakr, Moreira, Rhodes, Ferguson et al 2015:526).

Brazil is an emerging country and the largest country in South America. Many challenges affect the healthcare sector, such as economic inequalities and an ageing population (Salluh & Lisboa, 2016). There are approximately 36,000 ICU beds but distribution ranges widely between and in regions and states. There is a need to provide universal and timely access to critical care, especially in order to care for sepsis, trauma, respiratory failure and other threats, as well as adequate staffing to improve specialist availability for rural areas (Salluh & Lisboa 2016:189).

A retrospective cohort study to investigate the impact of organisational factors on outcomes and resource use in 78 Brazilian ICUs found that most frequent protocols focused on sepsis management and prevention of healthcare-associated infections (Soares, Bozza, Angus, Japiassú, Viana, Costa, Brauer, Mazza, Corrêa, Nunes & Lisboa 2015:2150). Soares, Bozza, Angus, Japiassú et al (2015:2159) concluded that in emerging countries such as Brazil, organisational factors, including the implementation of protocols, could improve patient outcomes and efficient resource use in ICUs, and assist in policies and interventions to bridge the quality gap in critical care delivery.

A randomized clinical trial in 118 ICUs in Brazil examined whether a multifaceted quality improvement intervention reduced the mortality of critically ill patients. Cavalcanti, Bozza, Machado, Salluh, Campagnucci, Vendramim, Guimaraes, Normilio-Silva, Damiani, Romano, and Carrara (2016:1480) found that the implementation of checklists, daily goal assessments, and clinical prompts as a quality improvement initiative in ICU did not reduce 14 outcomes including ICU mortality, central line-associated bloodstream infections, ventilator-associated pneumonia, urinary tract infection, mean ventilator-free days, mean ICU length of stay, mean hospital length of stay, bed elevation to ≥ 30°, venous thromboembolism prophylaxis, diet administration, job satisfaction, stress reduction, perception of management, and perception of working conditions. However, other outcomes, namely use of low tidal volumes, avoidance of heavy sedation, use of central venous catheters, use of urinary catheters, perception of team work, and perception of patient safety climate, were significantly improved (Cavalcanti, Bozza, Machado et al 2016:1480).

In India, Kartik, Gopal and Amte (2017:187) found that most ICUs follow available protocols and routinely monitor infection control with measures such as hand hygiene, monitoring of ICU-acquired infections, and monitoring of quality and policy measures. Kashyap, Vashistha, Saini, Dutt, Raman, Bansal, Singh, Bhandari, Ramakrishnan, Seth, and Sharma (2020:32) found that ICUs use protocols regularly for activities such as sepsis care, ventilator-associated pneumonia, nutrition, deep vein thrombosis prophylaxis, stress ulcer prophylaxis, and glycaemic controls. However, quality measures are not optimum as gaps exist and improvement is still needed in end-of-life care pathways, ICU staffing patterns, discharge planning, standardized mortality rate monitoring and conducting of multidisciplinary ICU rounds (Kartik, Gopal & Amte 2017:189)

Intensive care nursing (ICN) in South Africa is not typical of that in the rest of the world because most patients are males, most admissions are for and trauma, and HIV/AIDS has a profound impact on intensive care in South Africa. Various challenges face intensive care nursing in South Africa. South Africa's health care system consists of private and public sectors, with the emphasis of service delivery having shifted from a curative, hospital-based service to a comprehensive primary health care approach. Intensive care, coronary care, cardiothoracic care, and emergency care are all sub-specialty areas of critical care (CC) having the common element that patients admitted to these areas are in a health crisis that requires the collaborative care of a multidisciplinary team (de Beer, Brysiewicz & Bhengu 2011:6). Despite South Africa having a sophisticated health structure in some areas, the disease profile reflects that of a less developed country (de Beer, Brysiewicz & Bhengu 2011:7). Moreover, de Beer, Brysiewicz and Bhengu (2011:8) point out that not much research has been done in this domain in South Africa as only a limited number of nurses have presented their research at congresses, or published their results (de Beer, Brysiewicz & Bhengu 2011:8).

Critically ill patients admitted to critical care units (CCUs) might have life-threatening or potentially life-threatening problems. Adverse events (AEs) occur frequently in CCUs, resulting in compromised quality of patient care. In their study in five CCUs in KwaZulu-Natal, Gqaleni and Bhengu (2018:1) explored the experiences of CCNs in relation to how the reported AEs were analysed and handled in CCUs. The findings demonstrated that there were major gaps that affected the maximum utilisation of the reporting system. In addition, not all institutions utilised the system, thus affecting quality patient care. The study recommended that a non-punitive and non-confrontational system should be promoted and an organisational culture should be encouraged where support structures are formed within institutions. The support structures should include a legal framework, patient and family involvement, effective AE feedback, and education and training for staff (Gqaleni & Bhengu 2018:14).

ICU nursing in South Africa is especially in need of published nurse-sensitive indicators since it faces a high burden of very ill patients suffering from infectious diseases and traumatic injuries. Monitoring tools are urgently needed because due to an acute shortage of specialized ICU nurses, several ICUs are forced to use untrained general registered nurses or enrolled nurses with poor skills in managing ICU patients (de Beer, Brysiewicz & Bhengu 2011:9).

Intensive care in South Africa is faced with the challenge of resource scarcity as well as an increasing demand for ICU services (Joynt, Gopalan, Argent, Chetty, Wise, Lai et al 2019:36). ICU services are expensive, and practitioners in low- to middle-income countries experience daily the consequences of limited resources. Critically limited resources necessitate that rationing and triage (prioritisation) decisions are frequently necessary in South Africa, particularly in the publicly funded health sector. Fair and efficient triage is important to ensure the ongoing provision of high-quality care to adult patients referred for intensive care (Joynt, Gopalan, Argent, Chetty, Wise, Lai et al 2019:39). Therefore, there is need to develop tools for measuring quality of nursing care in South Africa.

2.3.3 Development of nurse-sensitive indicators

Extensive work has been focused on developing and analysing different performance and quality measures in health services. The study found that staff perceptions of quality and performance were often based on different logics to the notions of performance and quality embedded in current policy. Quality in everyday practice relies on staff values, motivations and behaviours and how staff interact with patients, putting both explicit and tacit knowledge into specific action. Management models need to account for the relational and experiential aspects of care quality to support the prioritisation of patients' needs (Farr & Cressey 2015:131). In China, the development and implementation of nurse-sensitive indicators contributed to the standardisation of care; improved the quality and performance of nursing care at all levels, and enhanced patient safety in neonatal ICUs (Chen, Huang, Xing, Feng, Shao & Shao 2016:503).

Different approaches have been used to develop and implement nurse-sensitive indicators in the ICU. The predominant approach has been first to collect relevant data, then reach a consensus using different groups of experts. Data sources relied upon varied from pre-existing patient data to literature review data. Some researchers included piloting indicator sets to assess their usability and acceptance in the healthcare environment. Several projects undertaken to develop nurse-sensitive indicators for adult ICU are discussed next.

In 2003, Pronovost, Berenholtz, Ngo, McDowell, Holzmueller, Haraden, Resar, Rainey, Nolan, and Dorman (2003:145) developed a set of valid, reliable, and practical ICU quality measures

which could be used to estimate the potential opportunity for quality improvement, based on the prevailing performance of a particular unit. They conducted the process in 5 stages (Pronovost, Berenholtz, Ngo et al 2003:146):

- Reviewed the existing literature and summarized the evidence regarding the structure and process of care associated with improved outcomes.
- Selected specific outcomes to evaluate, mortality, morbidity, and cost of care; which individual providers and hospitals performed the measures according to their settings. they had to be able to demonstrate the effects of these measures.
- Selected pilot indicators based on the strength of evidence that the specific process improved the outcome, and that data collection was feasible.
- Wrote the design specifications for the measure, including who would collect the measure, what would be measured, where the measure be done, at what point in the process the measure would be done, and how the measurement would be taken.
- Evaluated the validity and reliability of the measure. Validity meant that the providers believed that the measure evaluated an important aspect of care, and reliability meant that steps would be taken to reduce the difference in how different providers used the measure by explaining the process of data collection in detail. A standard data collection tool was created.
- Finally, the measure was pilot tested to find out how it performed in the ICU

After establishing the validity and reliability of the quality measures, Pronovost et al (2003:146) piloted the resulting quality measures in two additional phases. In the first phase, they selected two ICUs and allowed the staff to use the indicators for two weeks after which they were interviewed regarding how clear the data-collection tools and abstraction guide were, the burden of data collection, how useful each of the measures were, and suggestions for modifications of the measures. They then modified the tools and the guides based on the staff responses. In the second phase, they distributed the modified tools in 13 adult ICUs, with either a nurse or physician to lead data collection. The staff were then trained and asked to collect data for four weeks. Data was assessed by an independent person after which feedback was given to the participating ICUs. The results of the pilot project suggested that it was practical to design and implement measures of quality of care in several ICUs using primary data collection with minimal burden of data collection in addition to providing a good opportunity to improve care (Pronovost, Berenholtz, Ngo et al 2003:153).

In 2016, Chrusch and Martin (2016:1) developed and implemented quality indicators to compare ICU characteristics and performance within and between ICUs in different regions in Canada. There were no standardised national performance measures of critical care services. The premise was that a national ICU database with consistent definitions and naming of terms would provide a mechanism for comparing characteristics and performance between different units and regions over time (Chrusch & Martin 2016:2). Experts (including nurses) representing 18 adult ICU units from fourteen hospitals from five Canadian provinces assembled to discuss and reach consensus on the domains and principals for indicator selection including the development of a score card.

Quality indicators were then selected using a structured method for generating and narrowing down the list. Detailed operational definitions were developed for each indicator, including the domain represented, how it is reported, the reporting period, significance of the indicator, derivation, details of data collection, considerations in its measurement or derivation, data display, benchmark or goal, revision notes and references (Chrusch & Martin 2016:2). Chrusch and Martin (2016) developed twenty-two indicators representing six domains of ICU function: safe, timely, efficient, effective, patient and family centred, and staff work life (see Table 2.1).

Table 2.1 Quality indicators and their domains

Domain	Indicators
Safe	Unplanned extubation
	Readmission to intensive care unit
	Incidence of ventilator-associated pneumonia
	Incidence of central line-related blood stream infections
	Incidence of intensive care unit acquired *methicillin*-resistant *Staphylococcus aureus*
	Prevalence of intensive care unit acquired *methicillin*-resistant *Staphylococcus aureus*
Timely	Occupancy
	Intensive care discharges at night
Efficient	Avoidable days in the intensive care unit
	Patient flow
	Ventilated patient flow
	Ventilator utilization ratio
	Interfacility patient transfer
Effective	Intensive care unit length of stay
	Extubation failure rate
	Intensive care unit mortality
	Hospital mortality
	Consent rate for organ donation
Patient/family satisfaction	Patient/family satisfaction
Staff work-life	Staff turnover
	Overtime
	Absenteeism

Adapted from Chrusch & Martin (2016:3)

The participating institutions collected patient data using the indicators. The indicators were refined by reviewing and refining the data. Then end-user satisfaction surveys were conducted on 5 components: content, accuracy, format, ease of use, and timeliness. The results supported the use of control charts to display the data and indicated that staff education was needed for end-users to obtain maximum value from the use of indicators, as well as the need for measures and methodology that would allow for comparison with others (Chrusch & Martin 2016:3). The pilot phase collected data for testing the validity of the indicators in clinical use (Chrusch & Martin 2016:5). Chrusch and Martin defined the indicators and described the

numerator and denominators to measure outcomes expressing the indicators as rates or percentages (see Table 2.2).

Table 2.2 Examples of operational definitions of nurse-sensitive indicators

Indicator	**:**	Unplanned extubation
Domain	**:**	Safe
Reported as	**:**	Number of unplanned extubations per 1000 invasive mechanical ventilation days
Reporting period	**:**	Quarterly
Definition	**:**	Unplanned extubation is the unscheduled removal of an artificial airway (endotracheal or tracheostomy tube) due to accidental dislodgement or patient self-extubation. The patient need not be ventilated at the exact time of the event (e.g., on t-piece or tracheal mask)
Significance	**:**	Unplanned extubation may result in patient harm and prolonged length of stay due to loss of the airway and the risk associated with recapture. Putative factors in unplanned extubation include inadequate/inappropriate: a) Positioning, length, or fastening of artificial airways b) Management of analgesia, sedation, and delirium c) Vigilance, nurse to patient ratio, and use of physical restraints. A significant and/or sustained increase in unplanned extubations should lead to the review of these factors.
Derivation	**:**	Numerator Number of extubations in the reporting period Denominator Sum of invasive mechanical ventilator days in the reporting period Calculation = (number of unplanned extubations ÷ sum of invasive mechanical ventilator days) x 1000

Data collection	**:**	Unplanned extubations could be captured from nursing or respiratory therapist flow sheets or from review patient incident/hazard/safety reports. Each institution is responsible for maintaining a process for recognizing and documenting all unplanned extubations. Invasive ventilation days may be captured by counting the number of mechanically ventilated patients in the ICU at approximately the same time every day and assigning one day of mechanical ventilation to each of these patients (like the VAP measure)
Considerations and assumptions	**:**	The number of days when a patient has artificial airway but is not on invasive mechanical ventilation is not readily available and is not included. While this will lead to an overestimate of the rate of unplanned extubations, the magnitude is expected to be small.
Data display	**:**	XmR statistical process control run chart with 3 sigma limits
Benchmark/goal	**:**	Best reported rates in the literature are <5%
Revision notes	**:**	Current version in May 2012. Previous versions were in June 2011. No key changes and organizational and text edits.

Adapted from Chrusch and Martin (2016:9-10)

In their integrative literature review, Evangelou, Lambrinou, Kouta and Middleton (2018:29) identified validated quality indicators specific to nursing care in the adult intensive care units. An integrative review summarizes empirical or theoretical literature to provide a more comprehensive understanding of a particular phenomenon or healthcare problem, with a potential to build nursing science by informing research, practice, and policy initiatives (Whittemore & Knafl 2005:546). Evangelou, Lambrinou, Kouta and Middleton (2018:29) assessed the quality of the identified indicators as well as the quantity of the nursing care the indicators were able to measure. Evangelou, Lambrinou, Kouta and Middleton (2018:30) extracted 45 indicators from 13 articles that met the appraisal requirements. The indicators were then scored, with the highest score assigned to items that had already been tested in daily practice and were evidence-based, and a lower score assigned to those that were developed only by stakeholder involvement. Like Chrusch and Martin (2016:1), Evangelou, Lambrinou, Kouta and Middleton (2018:30) included studies in their review that provided full descriptions of terminology, rationality or justification, source of data and type of the parameter being evaluated.

After identifying the nurse-sensitive indicators, Evangelou, Middleton, Kyprianou, Kouta, Merkouris, Raftopoulos, Palazis and Lambrinou (2021:234) organised them into a set of potential quality indicators capable of quantifying nursing care provided to critically ill patients in ICU through a consensus method. The team selected 15 out of the 45 potential nurse-sensitive indicators that reflected safety dimension of quality for review by a panel of experts to achieve consensus. The development was conducted in three phases. Phase one was conducted among 139 registered nurses from 13 European countries who had worked in the ICU for at least two years. Using a questionnaire, they were required to rate each of the potential indicators according to three pre-determined criteria, namely feasibility (defined as the extent to which the QI can be applied and assessed in ICU), representativeness (defined as the degree to which the ICU nurse is responsible for or affects the outcome), and importance (defined as the degree to which the QI is important for patient's clinical outcome in ICU). Fifteen QIs satisfied the pre-determined 60% consensus in this phase.

In phase 2, Evangelou Middleton, Kyprianou, Kouta et al (2020:237) presented the questionnaire to a panel of 7 experts from Cyprus comprising academic nurses and medical doctor specialists in adult ICU and healthcare quality assessment, and experts in epidemiology and biostatistics. The panel individually graded the nurse-sensitive QIs based on the criteria of feasibility, representativeness, and importance. In phase 3, the panel discussed the nurse-sensitive indicators and calculated the content validity index (CVI) for each item. The CVI is an index of inter-rater agreement. The panel included fifteen indicators that achieved a CVI of at least 0.70 in the final list (see Table 2.3).

Table 2.3 Participants' response

	Nurse-sensitive indicators for adult ICU	Content Validity Index (CVI)		
		Representativeness	**Feasibility**	**Importance**
1	Pressure ulcer	1	1	0.86
2	Falls	0.86	0.86	1
3	Ventilator-associated pneumonia	0.86	0.86	0.86
4	Urinary tract infections	0.86	1	0.86
5	Surgical wound infection	0.71	1	0.86
6	Unplanned extubations	1	0.86	1
7	Central line bloodstream infections	0.86	0.86	0.86

8	Multi drug resistant bacteria infection rate	0.86	1	0.86
9	Removal of nasogastric tube occasioned by occlusion	0.86	0.86	0.86
10	Accidental removal of intravascular catheters	0.86	0.86	0.71
11	Physical restraints prevalence	0.86	1	0.86
12	Ventilator days	1	1	1
13	Length of stay	1	1	1
14	Readmission rate	1	1	1
15	Mortality (standardized mortality rates)	1	1	1

Adapted from Evangelou, Middleton, Kyprianou, Kouta, Merkouris et al (2021:238)

In China, Yang, Huang, Zhao, Xing, Shao, Zhang et al (2019:49) identified 50 relevant articles in their literature review and 38 nurse-sensitive source indicators from the selected articles. The 38 indicators were then presented to a panel of 11 experts comprising ICU nurse managers and nurse specialists from different hospitals in China. The panel experts discussed and analysed the 38 evidence-based source indicators relative to the quality of care in the ICU, compiled them into a questionnaire and presented it to a Delphi panel of experts to reach consensus on which indicators were most suitable. The Delphi team consisted of 44 ICU experts comprising ICU managers or nurse specialists, and ICU physicians with more than 5 years' experience. After two Delphi rounds, the original 38 indicators were reduced to 20 (grouped into three domains of structure, process, and outcome) which were considered relevant to the specific critical care practice in Chinese ICUs (see Table 2.4). Yang et al (2019:59) recommend that data should still be collected in clinical practice to determine their reliability and validity, in addition to future verifications and revisions.

Although Pronovost, Berenholtz, Ngo et al (2003:153) and Evangelou, Middleton, Kyprianou, Kouta, Merkouris et al (2021:238) identified the NSIs from a literature review in the initial phase of their developmental process, the former piloted the indicators in several ICUs whereas the latter used consensus by experts in ICU and health care quality evaluation to obtain the final set of indicators. In their project, Chrusch and Martin (2016:5) used data obtained from different ICUs to compare ICU characteristics and performance within and between ICUs and

regions over time. A group of experts agreed on the indicators to be selected, defined, and categorized them, and then tested them in different ICUs in Canada. Both methods are useful in developing nurse-sensitive indicators.

Table 2.4 Overview of intensive care unit (ICU) nursing quality indicators. Adapted from Yang *et al*. (2019:54)

INDICATOR	DIMENSION	SIGNIFICANCE	METHOD OF COLLECTION
1. Nurse-to -bed ratio	Structure	Nurse-to-patient ratio affects patient safety. A higher ration may significantly reduce patient mortality and can prevent the occurrence of other adverse events.	Clinical data
2. Percentage of nurses who have worked in the ICU for more than 3 years	Structure	Longer duration of work may be associated with clinical experience and professional competence required to manage the patients safely	Personnel data
3. Ratio of ICU staff who had completed advanced cardiac life support training	Structure	Advanced life support training enables nurses to deal with the rescue process more confidently, arrange the rescue more effectively, and thereby increase patient survival.	Personnel data
4. Ratio of reaching the standard in the management of the blood glucose level	Process	Monitoring blood glucose in a critically ill patient is critical because either hyperglycaemia or hypoglycaemias may adversely affect a patient's recovery	Clinical data
INDICATOR	**DIMENSION**	**SIGNIFICANCE**	**METHOD OF COLLECTION**
5. Implement rate of placing ICU patients in a semi-recumbent position (30 − 45°)	Process	Unless there is a contraindication, placing a patient in a semi-recumbent position (30–45°), during mechanical ventilation can prevent and reduce the incidence	Clinical data

		of ventilator associated pneumonia (VAP).	
6. Ratio of evaluation for sedation	Process	Excessive sedation may prolong the duration of mechanical ventilation and the length of hospital stay	Clinical data
7. Ratio of evaluation for pain	Process	Untreated pain may prolong the duration of mechanical ventilation and the length of hospital stay, and affect patient experience and recovery.	Clinical data
8. Ratio of evaluation for delirium	Process	Untreated delirium may prolong the duration of mechanical ventilation and the length of hospital stay, and increase morbidity and mortality.	Clinical data
9. Ratio of patients with serious infection or septic shock who were treated with broad spectrum antibiotics within 1 h of definite diagnosis	Process	Early and appropriate broad spectrum antibiotic therapy can improve the prognosis of patients with severe infection/sepsis.	Clinical data
10. Rate of reaching the standard in enteral nutrition bundle care safety management	Process	Compared to parenteral nutrition, enteral nutrition results in significantly lower mortality, infection rate, and length of hospital stay. However, care must be taken with EN to avoid adverse events (e.g., administration into a wrong tube, tube dislocation and displacement, metabolic disorders, aspiration, and reaction between the drug and nutrition fluid) occurring during formulating, operating, and monitoring the tube feeding	Clinical data
INDICATOR	**DIMENSION**	**SIGNIFICANCE**	**METHOD OF COLLECTION**

11. Ratio of implementation of hand hygiene	Process	The hand is an important route for transmission of hospital acquired infections. Improving compliance with hand hygiene can significantly reduce nosocomial infections and decrease inappropriate use of resources.	Infection control data
12. Ratio of using restraints	Process	Restraints are generally not recommended. The use of restraints can be reduced by raising the consciousness level and physiological function of the patient.	Clinical data
13. Ratio of preventing deep vein thrombosis	Process	limited physical activity causes a high risk of deep vein thrombosis	Clinical data
14. Incidence of intravascular catheter-related infection	Outcome	Central venous catheterization plays an important role in the treatment of critically ill patients; however, it may also cause infection.	Clinical data
15. Incidence of urinary catheter-associated urinary tract infection	Outcome	CAUTI caused by an indwelling catheter is one of the most common nosocomial infections in the ICU	Clinical data
16. Incidence of ventilator-associated pneumonia	Outcome	VAP is a frequent iatrogenic complication of mechanical ventilation. VAP is diagnosed a patient who used the ventilator within the previous 48 hours has symptoms of systemic and respiratory tract infections, and positive chest X-ray and laboratory findings.	Clinical data
17. Incidence of pressure ulcers	Outcome	Most of these are preventable	Clinical data
18. Incidence of incontinence-associated dermatitis	Outcome	Most of these are preventable	Clinical data

INDICATOR	DIMENSION	SIGNIFICANCE	METHOD OF COLLECTION
19. Incidence of unplanned extubation following endotracheal intubation in the ICU	Outcome	Most of these are preventable	Clinical data
20. Incidence of outgoing transport-related accidents	Outcome	Most of these are preventable	Clinical data

2.3.4 Implementation of nurse-sensitive indicators (NSIs)

Diverse tools for measuring nurse-specific performance exist in the nursing and medical literature. However, it is challenging to apply them in a clinical setting. Reaching consensus on a uniform conceptual and operational definition of each nurse-sensitive indicator is strongly recommended to facilitate implementation and use in a clinical setting (Danielis, Palese, Terzoni & Destrebecq 2020:13).

Many nurse-sensitive indicators related to the critical care environment have been developed that can be easily adapted and implemented in different set-ups. Chrusch and Martin (2016:1) note that although mechanisms for measuring and improving the implementation of best practice in specific diseases such as sepsis exist in most systems, a more universal description and accepted evaluation of critical care performance remains to be developed, in order to understand how practice can be improved in this setting. Sound management decisions can only be made once the stakeholders understand the past performance, the current need, and future expectations. Chrusch and Martin (2016) developed a national ICU database with consistent definitions and designation to provide a way of measuring and comparing the standards in different ICUs in Canada.

2.3.5 Role of nurse-sensitive indicators

Nurses practise in different roles and healthcare settings, often working with a variety of other professionals to deliver health care to patients. Patients in the ICU are routinely cared for by

a multidisciplinary team of health professionals such as nurses, doctors, respiratory therapists, dieticians, infection control specialists, radiologists, and laboratory staff (Marshall, Bosco, Adhikari, Connolly et al, 2017). Nevertheless, increasing evidence demonstrates that nursing care has the greatest influence on patient outcome (Aiken & Fagin 2018:469; Needleman 2017:525).

Nurses are the primary care providers in hospitals as they are the only health care professionals to be found at the patient's bedside 24 hours a day (Stalpers, de Vos, van der Linden, Kaljouw & Schuurmans 2017:149). Nursing care is provided continuously round the clock by the nurses, and the ratio of nurse to patient is higher in ICU than in the other wards (Marshall, Bosco, Adhikari, Connolly et al 2017:273). This implies that a large component of the care that patients receive is provided by the nurses, thus making nursing care critical to the overall quality of care provided to a patient. Examining the impact that nurses have on patient outcomes is crucial in measuring the extent to which nursing personnel in ICU contribute to the quality of the healthcare in general.

The complexity of the role nurses plays in addition to lack of reliable tools make accurately measuring and evaluating nurses' contributions to patient outcomes more challenging (Danielis, Palese, Terzoni & Destrebecq 2020:2; Koch, Kutz, Conca, Wenke, Schuetz & Mueller 2020:3484). However, quantifying the contribution of nursing care toward patient outcomes provides a suitable background for measuring the effect of any changes to nurse variables, such as nurse staffing levels, nurse skill mix, or nurses' work environment, on patient outcomes (Myers, Pugh & Twigg 2018:448).

Despite the large number of nursing staff in the healthcare setting and the critical role they play in influencing patient outcomes, measuring the nurses' performance remains a challenge (Stalpers, de Vos, van der Linden et al 2017:149; Sim, Crookes, Walsh & Halcomb 2018: e369). To date, there is no universal agreement on how the quality of nursing care should be measured or on a set of indicators or performance measures that comprehensively capture their unique contribution to patient outcomes (Sim et al 2018: e369).

Nevertheless, measuring the overall quality of care provided by nursing staff in ICU is possible using nurse-sensitive indicators (Stalpers, Kieft, van der Linden et al 2016:149). Nurse-

sensitive indicators relate particularly to nursing care and are valid and reliable in supporting quality and performance of nursing care (Sutton & Jarden 2017:339). NSIs act as enablers for achieving the best possible care for patients and their families, and provide a foundation for quality improvement initiatives that are contextually driven (Yang, Huang, Zhao et al 2019:53). In addition to their usefulness in effective evaluation of the quality of care and driving quality improvement initiatives, objective evidence-based NSIs can also assist in the training and mentoring of nurses for continuous professional development (Chen, Huang, Ming et al 2016:503).

Even though several quality indicators for intensive care exist in the public domain, it is not clear which ones can be easily adopted for use in different settings, due to lack of strong evidence on selection criteria and successful implementation in clinical practice (Valiani, Rigal, Stelfox, Muscedere et al 2017: e488).

2.3.6 Commonly used nurse-sensitive indicators in ICU

In Canada, Chrusch and Martin (2016:3) developed and defined 22 indicators covering 6 domains of ICU function, namely safe; timely; efficiency; effective; patient/family satisfaction, and staff work-life, which facilitate implementation and use (see Tables 2.1 and 2.2). In Cypress, Evangelou, Lambrinou, Kouta and Middleton (2018:28) identified 45 indicators related to patient safety, with negative performance indicators such as adverse events, infections, and complications encountered more frequently. ICU length of stay, mortality, bloodstream infections, and skin breakdown were the most reported indicators occurring (Evangelou, Lambrinou, Kouta &Middleton et al 2018:35).

In their systematic literature review of studies between 2000 and 2016, Myers, Pugh and Twigg (2018:449) found a significant relationship between the outcome and staffing variables. Myers, Pugh and Twigg identified suitable indicators for measuring the effect of nurse staffing and nurse skill mix differences on patient outcomes in stand-alone high acuity areas. The review examined which nurse-sensitive patient outcomes were associated with nurse skill mix in adult patients and which nurse-sensitive patient outcomes were associated with nurse staffing levels. Myers, Pugh and Twigg (2018:451) identified 8 indicators from 44 eligible research articles: mortality, length of stay, central line-associated bloodstream infection,

ventilator-associated pneumonia, sepsis, patient falls with injury, reintubation, and medication administration errors. Some studies reported a significant association with nurse staffing levels while some reported no association. These results concur with Evangelou, Lambrinou, Kouta and Middleton's (2018:35) findings of ICU length of stay, mortality, and bloodstream infections.

In China, Yang, Huang, Zhao, Xing et al (2019:53) identified 20 indicators covering structure, process, and outcome. Yang, Huang, Zhao, Xing et al (2019:53) included indicators which measured elements from the structural domain such as nurse-to-bed ratio, and patient-centred outcomes such as evaluation of pain (see Table 2.4).

Mortality and adverse events (e.g., pressure ulcers, ventilator-associated pneumonia, physiologic parameter changes) were considered outcomes sensitive to nursing practice in ICU (Chrusch & Martin 2016:3; Evangelou, Lambrinou, Kouta & Middleton 2018:35, Myers, Pugh, JD & Twigg 2018:451; Danielis, Palese, Terzoni & Destrebecq 2020:2). In their scoping review, Danielis, Palese, Terzoni and Destrebecg (2020:4) noted that a large heterogeneity of outcomes influenced by nursing care emerged. At the same time, other outcomes of nursing care in the intensive care units, especially those associated with physical dimensions (e.g., bowel status), and personal experiences of being admitted to intensive care (e.g., family involvement in care) were not considered in many studies (Danielis et al 2020:3).

According to Munn, Peters, Stern, Tufanaru, McArthur and Aromataris (2018:145), a scoping review is a perfect tool to establish the scope or coverage of a body of literature on a given topic and give clear indication of the volume of literature and studies available, in addition to providing an overview of its focus. A scoping review is used to map concepts that support a research area and the main sources and types of evidence available (Munn, Peters, Stern et al 2018:145). The general purpose for conducting a scoping review was to identify and map the available evidence on nurse-sensitive indicators in ICU without the limits applied by a systematic review (Danielis et al, 2020:2). This review provided relevant data capable of offering a complete view of studies conducted in the field, revealing nurse-sensitive outcomes which were accompanied by a clear summary of evidence (Danielis et al 2020:3). Danielis, Palese, Terzoni and Destrebecg (2020) asked two questions in their scoping review: (1) what is the state-of-the art science in research in the field of nurse-sensitive outcomes in the ICU?

(2) What nurse-sensitive outcomes have been conceptualized, used, and studied up to now in ICU setting?

Danielis, Palese, Terzoni and Destrebecq (2020:5) identified 233 nurse-sensitive outcomes which were extracted from 112 studies, of which only 4 were published before the year 2000. The most studied outcomes were pressure ulcers, ventilator-associated pneumonia, physiologic parameters, and delirium. The least studied nurse-sensitive outcomes were quality of life, secretion clearance, patient-ventilator synchrony, and post-extubation dysphagia, each reported from one study respectively. A variety of systems were used to measure the outcomes, including validated instruments or tools, direct clinical measures, administrative data, and patients' account, except in 22 studies that did not report on the measurement system used (Danielis et al 2020:5). The outcomes were further categorized into 4 domains, namely safety, clinical, functional, and perceptive (see Table 2.5).

Table 2.5 Overview of identified nurse-sensitive outcomes in ICU

Outcome domain	Outcome sub-domain (n.)	Reported outcomes from publication (n.)
Safety (77)	Critical incidents (39)	Pressure ulcers (20)
		Falls (6)
		Unplanned extubations (4)
		Adverse events (4)
		Incontinence-associated dermatitis (3)
	Healthcare-associated infections	Ventilator-associated pneumonia (19)
		Central line-associated bloodstream infection (19)
		Catheter-associated urinary tract infection (12)
Clinical (72)	General health (39)	Mortality (11)
		ICU length of stay (9)
		Length of mechanical ventilation (8)
		Hospital length of stay (7)
		ICU readmissions (3)
		Quality of life (1)
	Goal assessment and monitoring (33)	Physiologic parameters (14)
		Pain (9)

		Glycaemic levels (5)
		Deep vein thrombosis (2)
		Patient-ventilator desynchrony (1)
		Post-extubation dysphagia (1)
		Secretion clearance (1)
Functional (70)	Psychosocial dimension (40)	Delirium (13)
		Anxiety (11)
		Psychological status (11)
		Cognitive status (5)
	Physical dimension (30)	Sleep quality (11)
		Functional status (5)
		Nutritional status (4)
		Oral health status (4)
		Bowel status (2)
		Eye health status (2)
		Hygiene status (2)
Perceptual (14)	Experience of being in intensive care	Patient satisfaction (7)
		Comfort (5)
		Family participation (2)

Adapted from Danielis, Palese, Terzoni & Destrebecq (2020:11)

Danielis, Palese, Terzoni and Destrebecq (2020:5) found that several studies documented outcomes which negatively influenced patient safety, including critical incidents and healthcare-associated infections. Within the critical incident sub-domain, the most reported outcomes were pressure ulcers, falls and unplanned extubation rates. Adverse events outcomes were reported in different ways in most studies. Incontinence-associated dermatitis was reported in only 3 studies. Among healthcare associated infections, ventilator-associated pneumonia incidence, central line-associated bloodstream infections and catheter-associated urinary tract infection were the most frequently reported outcomes. Nurse-sensitive outcomes in the safety domain were measured predominantly with prevalence/incidence, reporting the number of cases as documented in the clinical records or databases (Danielis et al 2020:5).

Outcomes related to symptoms and disease control, such as goal assessment and monitoring and general health were documented by 72 out of 112 studies. Within these outcomes, physiological parameter alteration was the most reported outcome (see table 2.4). Pain was documented in nine studies. Other indicators documented were glycaemic levels, deep vein

thrombosis, and patient-ventilator desynchrony, post-extubation dysphagia, and secretion clearance, respectively. The most reported outcomes were mortality, but reported in different ways such as ICU, in-hospital, and 30-day mortality; ICU length of stay; length of mechanical ventilation; hospital length of stay; ICU readmissions, and quality of life (see Table 2.4) (Danielis et al 2020:10).

In addition to the commonly reported nurse-sensitive outcomes, Danielis, Palese, Terzoni and Destrebecq (2020:10) reported indicators in the less commonly addressed areas, namely functional domain, and perceptive domain. Nurse-sensitive outcomes in the functional domain which were divided into psychosocial dimension (delirium, anxiety, psychological status, cognitive status) and physical dimension (sleep quality, functional status, nutritional status, oral health status, bowel status). In the perceptive domain, some studies evaluated the experience of being in ICU and considered patient satisfaction, comfort, and family participation (Danielis et al 2020:11).

2.3.7 Characteristics of nurse-sensitive indicators for ICU

The goal of applying nurse-sensitive indicators in ICU is to promote quality in everyday care. The increased use of nurse-sensitive indicators shows that the requirements for characteristics such as being relevant to the problem, understandable, measurable with good validity and reliability, behaviourable (open to change), acceptable and feasible, according to the RUMBA rule are met (Kumpf, Braun, Brinkmann, Bause, Bellgardt, Bloos, Dubb, Greim, Kaltwasser, Marx & Riessen 2017:1). RUMBA (Kumpf, Nothacker, Braun & Muhl 2020:4) stands for:

- **R**elevant – Relevance to the problem
- **U**nderstandable – The definition is clear, and the application is also clear to the end-users
- **M**easurable – with high dependability and validity. Barriers to implementation has been considered and completeness of the datasets can be checked.
- **B**ehaviourable– changeable through behaviour of assessed service providers
- **A**chievable –and feasible. Can be comprehended and interpreted for patients and the interested public.

In Canada, Chrusch and Martin (2016:2) confirmed the following characteristics of nurse-sensitive indicators for ICU:

- Should be directly intended for use in the ICU
- Their use should result in quality improvement
- An indicator should
    a) Be chosen based on its usefulness, feasibility, and reliability
    b) Be action enabling
    c) Represent the three different classes of process, outcomes, and structure
    d) Be able to assess the present performance
    e) Be based on available evidence or benchmarks
    f) As far as possible have been previously validated with precise definitions

2.3.8 Challenges to implementing nurse-sensitive indicators in ICU

Assessment of the quality of nursing care in ICU is crucial as it gives assurance that patients have been provided with adequate care. However, there are challenges to implementing quality indicators in ICU. Challenges to implementation may be associated with factors such as:

- Differences in culture and custom of both patients and service providers in an environment
- Variation in the measurement methods
- Non-adherence to standards of care
- Methods of data collection
- Variation in case definition
- Interpretation of the data

2.3.8.1 Differences in culture and customs

Indicators should take into consideration relevant country-specific practices, incidence of events to be measured, level of health care delivery and practice, and other environment specific conditions (Yang, Huang, Zhao, Xing et al 2019:53; Evangelou, Middleton, Kyprianou, Kouta, Merkouris et al 2021:241). For instance, in China, Yang, Huang, Zhao, Xing et al (2019:53) did not did not select falls as an important indicator because Chinese ICU beds have side-rails that are put up and patients are usually very old and sick so that the number

of falls from bed is very low. Some QIs are also not commonly used in several countries due to their low observed rates because of the variation in relevancy and the given priority (Evangelou, Middleton, Kyprianou, Kouta, Merkouris et al 2021:242).

In order to persuade the nurses to use the NSIs, health organizations should emphasize how monitoring of the NSIs relates to the regular duties and responsibilities, and that monitoring is not an unnecessary time-consuming activity but part of their job. One way of achieving this is by determining how useful an indicator is in a unit, depending on how frequently specific problems are encountered by patients in the unit, so that nurses can dedicate more time to monitoring the specific indicator which is most relevant (Stalpers, de Vos, van der Linden et al 2017:153).

2.3.8.2 Difficulty and variation in measurement methods and data collection

A very important requirement is that an indicator should be clearly defined, with a numerator and denominator, and how data will be collected. Some indicators have different names that examine the same numerators and denominators, such as *decubitus* ulcers and skin breakdown. There are also instances where different numerators and denominators have been used for seemingly identical indicators, and similar indicators that may been considered part of a more general quality indicator, such as device-related catheter-associated urinary tract infection and urinary tract infection (Evangelou, Lambrinou, Kouta & Middleton 2018:30). The lack of a uniform way of defining and describing indicators makes it difficult to measure and collect data accurately.

Sutton and Jarden (2017:339) emphasise that barriers to the success of implementing initiatives for NSIs in ICU include communication delays, poor reporting, and difficulty of measuring the impact. In the Netherlands, Stalpers, de Vos, van der Linden et al (2017:152) examined barriers and facilitators of implementing NSIs. The study found that of the participant nurses, 42% responded that nurse-sensitive outcomes took too much time to measure; 20% were not familiar with the mandatory set of NSIs determined by their organization, and 15% did not agree that monitoring leads to reliable benchmark data. However, the fact that 92% (n=105) of the participants nurses agreed that they needed further education on nurse-

sensitive indicators before using them was an effective facilitating factor (Stalpers, de Vos, van der Linden et al 2017:152).

2.3.8.3 Non-adherence to standard of care

Some commonly used nurse-sensitive indicators in ICU, such as central line-associated bloodstream infection (CLABSI), catheter-associated urinary tract infection (CAUTI), and ventilator-associated pneumonia (VAP), need specific investigation requirements to be diagnosed. Therefore, CLABSI and CAUTI are unlikely to be reported since blood or urine cultures are not strictly performed according to standard procedures. Similarly, if an X ray of the chest is not taken, VAP will not be diagnosed.

Adverse events such as medicine administration errors and falls are often underestimated because of under-reporting by nurses due to fear of disciplinary action (Evangelou, Middleton, Kyprianou, Kouta, Merkouris et al 2021:6). In their study, Stalpers, de Vos, van der Linden et al (2017:152) found that 80% of the participant nurses agreed that clear rules and policies on nurse-sensitive indicators in their unit were important facilitators while 35% were of the view that social pressure from the hospital management was ineffective as a facilitating factor.

2.4 CONCLUSION

This chapter discussed the literature review conducted for the study. The literature defined and explained nurse-sensitive indicators, outlined the history and development, characteristics, classification and their advantages or importance in the ICU.

Chapter 3 describes the research design and methodology of the study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 2 discussed the literature review conducted for the study. This chapter describes the research design and methodology of the study.

3.2 AIM AND OBJECTIVES OF THE STUDY

The aim of the study was to reach consensus on nurse-sensitive indicators suitable for adult ICUs in a South African context. In order to achieve the aim, the objectives were to

- Identify nurse-sensitive indicators for adult ICUs already in use in ICUs worldwide.
- Reach consensus on nurse-sensitive indicators for adult ICUs which can be used in South Africa.

Accordingly, the study wished to answer the following question:

Which nurse-sensitive indicators identified from the published literature are suitable for adult intensive care units in the South African setting?

3.3 RESEARCH DESIGN

A research design is an overall plan for finding answers to the research questions, how data will be collected, types of comparisons to be made and where the study will take place (Polit & Beck 2017:164). The researcher chooses the research design to achieve the purpose of the study and answer the research questions (Brink, van der Walt & van Rensburg 2018:184). Research designs help researchers minimize bias and guide the whole process of answering the research questions in order to obtain accurate and interpretable evidence (Polit & Beck

2017:58; Brink, van der Walt & van Rensburg 2018:184). Therefore, the best design for a study is the one most appropriate to the research problem and purpose.

In this study, the researcher selected a two-phase qualitative research design. The researcher conducted a scoping literature review in phase 1 and a Delphi consensus method in phase 2. The researcher considered a two-phase method appropriate to develop a credible and useful set of evidence-based nurse-sensitive indicators feasible and applicable for adult ICUs in South Africa.

3.3.1 Scoping literature review

The researcher conducted a scoping literature review. The purpose of a scoping review is "to deliver a meticulous summary of all the available primary research in response to a research question" (Munn, Peters, Stern, Tufanaru, McArthur & Aromataris 2018:144). A scoping review allowed the researcher to explore and identify validated nurse-sensitive indicators found in the literature worldwide.

Brink, van der Walt and van Rensburg (2018:17) maintain that scoping reviews are needed whenever there is a significant healthcare-related question or several primary studies with diverse findings and uncertainty. Although many studies have developed nurse-sensitive indicators worldwide, they have been conducted in specific contexts and the indicators might not be readily applicable in a different setting. Furthermore, no nationally recognised set of nurse-sensitive indicators for use in adult ICU has yet been published in South Africa. The scoping review enabled the researcher to identify a set of evidence-based nurse-sensitive indicators from the literature, which have already been tested in other settings, and present them to a panel of South African ICU experts to obtain consensus on their feasibility and acceptability in adult ICUs in South Africa (Polit & Beck 2017:647).

3.3.2 Delphi method

Consensus group methods, such as the Delphi method and nominal group technique, are used to synthesise expert opinions when evidence is lacking. The Delphi method is a structured communication technique originally developed as a systematic, interactive forecasting method, which relies on a panel of experts to achieve an accurate and reliable assessment (Humphrey-Murto, Varpio, Wood, Gonsalves, Ufholz, Mascioli, Wang & Foth 2017:1491). Humphrey-Murto, Varpio, Wood et al (2017:1491) add that consensus methods

are particularly useful when empirical evidence is lacking, limited, or contradictory. The Delphi method uses multiple rounds of questionnaires sent to a panel of experts to work towards a mutual agreement or consensus opinion.

The Delphi technique is a method for gathering data from participants within their domain of expertise with an aim of achieving comparable opinion on specific real-world issues to validate and further refine the statements presented to them. In their study, Masaki, Kawai, Matsumoto, Kuwata, Yoshioka, Nishiyama et al (2017:3) used the Delphi method to develop and build consensus on quality indicators specifically for nursing in the cultural and traditional context of Japan.
The researcher therefore considered a consensus method relevant in this study to develop feasible and acceptable adult ICU nurse-sensitive indicators as South Africa lacks a published nationally accepted set of nurse-sensitive indicators for adult ICUs.

The Delphi technique allows a group of experts to evaluate the information presented and weigh differences in views until a pre-determined level of consensus is reached. The Delphi method involves six steps: (1) identifying a research problem, (2) completing a literature search, (3) developing a questionnaire of statements, (4) conducting anonymous iterative mail or e-mail questionnaire rounds, (5) providing individual and/or group feedback between rounds, and (6) summarizing the findings (see Table 3.1).

Table 3.1 Steps in reaching consensus in the Delphi method

Step 1: Identify a research problem.
Step 2: Complete a literature search.
Step 3: Develop a questionnaire of statements.
Step 4: Conduct anonymous iterative mail or e-mail questionnaire rounds.
Step 5: Provide individual and/or group feedback between rounds.
Step 6: Summarize the findings.

Source: Humphrey-Murto, Varpio, Wood, Gonsalves et al (2017:1492)

The process is repeated until the best possible level of consensus is reached or a predetermined number of rounds are completed. The Delphi method has the following advantages: the participants never meet or interact directly; it has the capacity to include many participants who are geographically dispersed; it has relatively minimal support structure needs (thus making it relatively inexpensive), and the avoidance of undue dominance by

particular individuals through anonymity (Humphrey-Murto, Varpio, Wood, Gonsalves et al 2017:1493).

3.4 RESEARCH METHODOLOGY

Research methodology is the plan for conducting the specific steps of a study. Research methods are the techniques, steps or procedures researchers use to collect, structure, and analyse data systematically (Polit & Beck 2017:741). The research methodology includes the population, sample and sampling, and data collection, analysis, and interpretation. The methods used in each phase of the study are described next.

3.4.1 Phase 1: Scoping literature review to develop index NSIs

In phase 1, the researcher undertook a scoping literature review to develop a set of evidence-based nurse-sensitive indicators for adult ICUs. The researcher conducted a scoping literature review to identify, evaluate and summarise evidence-based nurse-sensitive indicators from the selected studies. The scoping review was conducted and recorded according to the PRISMA 2020 flow diagram (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan & Chou 2021:5) and data collected according to the procedures outlined in Figure 3.1.

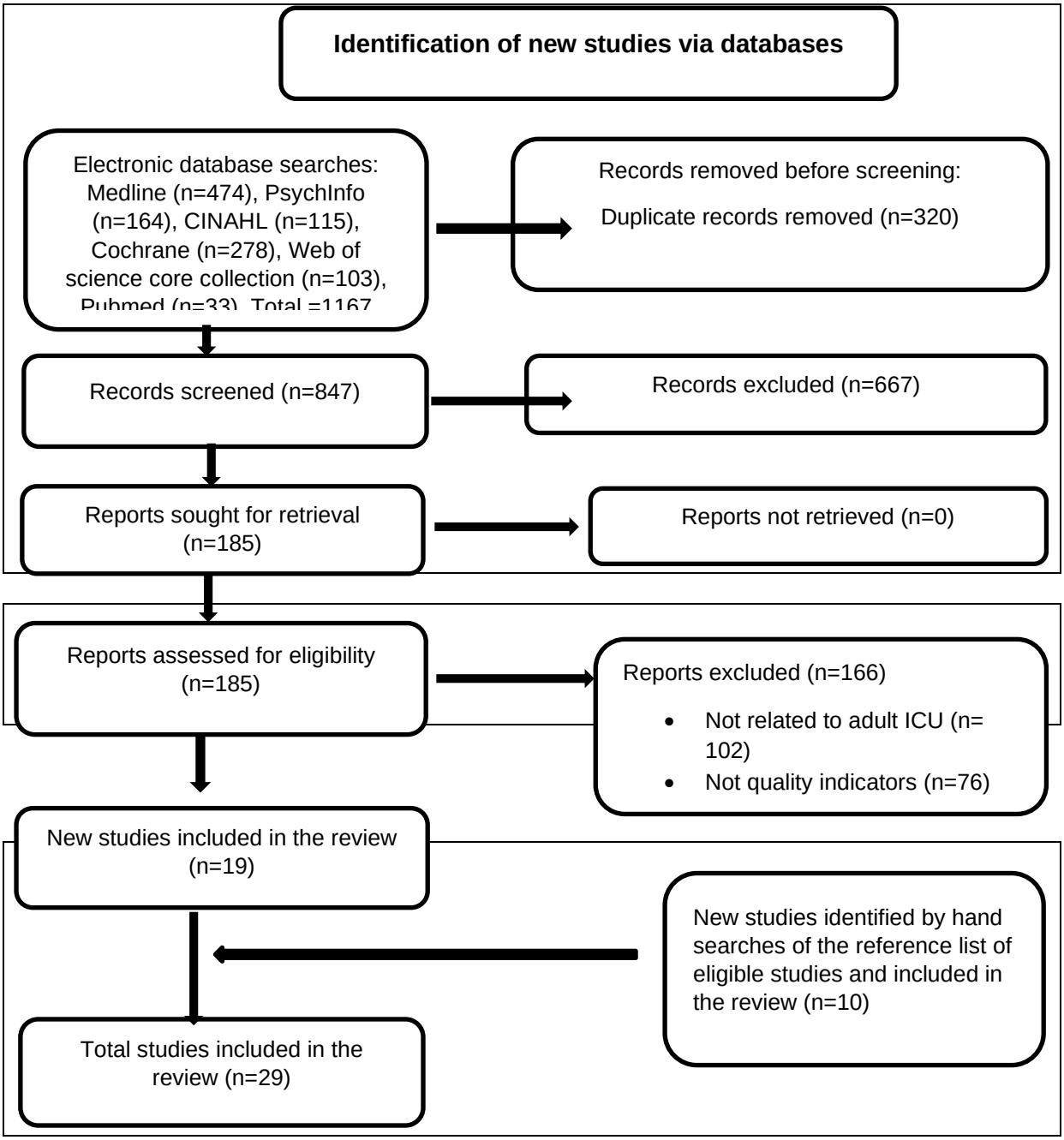

Figure 3.1 PRISMA 2020 flow diagram for scoping reviews

Source: Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow et al (2021:93)

3.4.1.1 Unit of analysis

A unit of analysis is the basic unit or focus of a researcher's analysis (Polit & Beck 2017:747). The unit of analysis in this study was the published literature from electronic databases available in the University of Pretoria library. The selected studies were able to answer the

review question (see Table 3.2). The review question is expressed in terms of the population covered (P), interventions or observations conducted (I), comparator (C), outcomes (O), timing (T), and the setting and study design (S) [PICOTS] (Polit & Beck 2017:733). The population considered were adult patients of 18 years and above, admitted to ICU in a hospital. The outcomes considered were those that were well described and related to activities performed mainly by nurses.

Table 3.2 PICOTS question

PICOTS question: Which nurse-sensitive indicators for adult ICU have been reported in the literature?
Population: Adult patients of 18 years and above, admitted to ICU in a hospital
I**ntervention**: Activities conducted specifically by nurses in ICU
Comparator: Absent involvement of the specific activity
Outcomes: Quantitative or qualitative metrics related to patient or nursing staff outcomes
Timing: From ICU admission to discharge or death
Setting: Inpatient setting in the intensive care unit

3.4.1.2 Sampling

Sampling is the process of choosing appropriate objects from which the actual information needs to be drawn (Brink, van der Walt & van Rensburg 2018:130). The following electronic databases available in the University of Pretoria library were searched: Medline, PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Psych Info, Cochrane library, and Web of Science core collection. Table 3.3 lists the inclusion and exclusion criteria. All the full-text articles that met the selection criteria were included for analysis

Table 3.3 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Papers published since 2014 • Papers that were accessible • Publications in English • Studies where the setting was adult ICU • Studies investigating the association between nursing and setting variables • Studies that evaluated quality indicators • Studies analysing secondary data related to nurse-specific outcomes • Adult ICU-specific hospital guidelines • Review studies analysing nurse-specific quality indicators or outcomes • Experimental studies (RCT, non-RCT, observational studies, case-controlled studies, case series, descriptive studies)	• Publications outside the timeframe; i.e., earlier than 2014 • Setting in any place other than adult ICU • Publications in any language other than English

3.4.1.3 Data collection

Studies were identified by performing the searches in the databases using the search terms: nurse-sensitive outcomes OR nurse-sensitive quality indicators OR nurse-sensitive indicators OR nurse-sensitive patient outcomes AND intensive care OR intensive care unit OR critical care. Articles with at least one search term were identified and sent to the EndNote X9 reference manager. The particulars of the author, year of publication, title and an abstract or a short preview were captured in reference manager. Duplicate articles were removed. The identified articles were then screened by reading the titles and abstracts and determining their relevance to the review question.

Titles and/or abstracts that were deemed not relevant to the PICOTS question were not selected. Articles that appeared to satisfy the PICOTS question were selected and full-text articles in PDF format downloaded onto the EndNote X9 for a detailed evaluation. The selected full-text articles were evaluated against the eligibility criteria with respect to study question, population, exposure or intervention, outcomes, and the type of study. articles that did not meet the eligibility criteria were not selected for the next step. Full-text articles that met the inclusion criteria were then selected for data extraction. The reference list of the articles that met the inclusion criteria were searched by hand and relevant articles which had not been

picked up by the electronic searches but met the inclusion criteria were also added for data extraction (see Figure 3.1).

3.4.1.4 Data extraction

The following information was extracted from each of the studies:

- Author(s), publication date, country
- Aim(s) of the study
- Methods including study design, tools used, population and duration
- Quality indicators and formula or definitions identified
- Description of participants
- Results or outcomes

The information was captured in a customized table (see Annexure 3.1 – Characteristics of articles found).

3.4.1.5 Data synthesis

Index indicators identified were tabulated against each article from which they were reported (see Annexure 3.2 – Nurse-sensitive indicators identified in included articles). For each nurse-sensitive indicator for adult ICU, the operational definition including the numerator and the denominator were recorded (see Annexure 3.3 – Nurse-sensitive indicators identified with definitions and/or numerator and denominator).

3.4.1.6 Potential NSI data set (Data-collection tool)

Potential nurse-sensitive indicators identified in the scoping literature review were organized according to the organ system or domain in which they fell and incorporated into a questionnaire. The self-administered questionnaire had two sections. The first section explained the purpose of the study and background, the completion requirements of the questionnaire and the expected return date (see Annexure 3.4 – Questionnaire for Delphi round 1). The first section included the participants' demographic profile, including age, gender, position at work, and number of years of experience in ICU. The second part comprised the nurse-sensitive indicators, the description and its application in ICU, and agreement with a statement about the importance of each item (relevant, feasible, implementable). The extent of agreement with the nurse-sensitive indicator was based on a

4-point Likert scale grading (4 = strongly agree; 3 = agree; 2 = disagree, and 1 = strongly disagree).

3.4.1.7 Rigour

Rigour minimizes bias and ensures control over variables under study (Polit & Beck 2017:558). Rigour requires a researcher to ensure a systematic approach to the research design and an awareness of the importance of interpretation rather than reliance on assumptions or perceptions (Brink, van der Walt & van Rensburg 2018:82). Rigour is a way by which reliability or trustworthiness is assured in any research finding. In phase 1, the researcher used the updated Preferred Reporting Items in Systematic Review and Meta-analyses (PRISMA) guidelines to ensure rigour (Shamseer, Moher, Clarke, Ghersi, Liberati, Petticrew, Shekelle & Stewart 2015:349; Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan, and Chou, 2021:105906). The researcher applied Humphrey-Murto, Varpio, Gonsalves and Wood's (2017:16) recommendations to add credibility to the research process and results. Rigour is the degree to which conclusions made in a study are accurate and true (Polit & Beck 2017:310). Rigour ensures that reliability or trustworthiness is maintained. The rigour and trustworthiness of a scoping review is mainly based on a methodological approach and planning process usually explained in a protocol document (Moher, Shamseer, Clarke, Ghersi et al 2015:1).

A protocol ensures that a scoping review is carefully planned and that what is planned is clearly documented before the review starts, as such promotes consistent conduct by the researcher, accountability, research integrity, and transparency of the eventual completed review (Shamseer, Moher, Clarke, Ghersi, Liberati, Petticrew, Shekelle & Stewart 2015:349).To ensure that a scoping review is transparent, a researcher should provide complete, and accurate account of why the review is done, what is being done (such as how studies were identified and selected) and what was found, such as characteristics of contributing studies and results (Page, McKenzie, Bossuyt, Boutron et al 2021:89).

The researcher ensured rigour in the conduct of the scoping review by having designed a protocol on how each step of the review was done prior to start of the study. The proposal adopted a checklist of items considered essential and minimum components of a scoping

review (Moher, Shamseer, Clarke, Ghersi et al 2015:1). Table 3.4 lists the checklist of items considered.

Table 3.4 Scoping review checklist

Section and topic	Checklist item	Yes	Where found
Title	Identify as a scoping review	☒	3.3.1
Rationale	Describe rationale for review in context of what is already known	☒	3.3.1
Objectives	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	☒	3.4.1.1
Eligibility criteria	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	☒	3.4.1.2
Information sources	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or grey literature sources) with planned date of coverage	☒	3.4.1.2
Search strategy	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	☒	3.4.1.3
Data management	Describe the mechanism that will be used to manage records and data throughout the review	☒	3.4.1.3
Selection process	State the process that will be used for selecting studies through each phase of review (that is, screening, eligibility)	☒	3.4.1.3
Data collection process	Describe planned method of extracting data from reports	☒	3.4.1.3
Data items	List and define all variables for which data will be sought (such as PICO items) and pre-planned data assumptions and simplifications	☒	3.4.1.2
Outcome and prioritization	List and define outcomes for which data will be sought, including prioritization of main and additional outcomes with rationale	☒	3.4.1.4
Risk of bias in individual studies	Describe the anticipated methods in assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	☒	3.4.2.3
Data synthesis	Describe criteria under which study data will be quantitatively synthesised	N/A	
Data synthesis	If quantitative synthesis is not appropriate, describe the type of summary planned	☒	3.4.1.6

Source: Moher, Shamseer, Clark, Ghersi et al (2015:3)

3.4.2 Phase 2: Delphi process for consensus on NSI

Two Delphi rounds were performed to obtain consensus on nurse-sensitive indicators for adult ICUs in South Africa.

3.4.2.1 Population

A population is the entire set of individuals or objects having some common characteristics that is of interest to the researcher (Polit & Beck 2017:797). The study population from which the Delphi team was selected comprised registered nurses with post-basic ICU training and experience in ICU practice in South Africa; registered nurses who were managers in specialized or general ICU in government or private hospitals, and critical care nurse educators in the provincial training centres and tertiary academic institutions in South Africa.

The participants in the Delphi process were selected from ICU-trained nurses and ICU nurse managers or educators with at least 5 years' experience in ICU practice.

3.4.2.2 Sampling

Sampling is the process of selecting a portion of the population to represent the entire population to permit inferences about the population (Polit & Beck 2017:802). In this study, the researcher used purposive or non-probability sampling to select participants based on her personal knowledge of the population and judgement about which ones would be most informative (Polit & Beck 201:799). The participants in the Delphi process were selected purposively to obtain information-rich data as they were considered knowledgeable about the nursing activities and outcomes in ICU.

The panel consisted of 32 participants. Table 3.5 presents the Delphi panel's demographic profile.

Table 3.5 Delphi panel's demographic profile

Characteristics	Number (N=32)	Percentage (100%)
Age (years)		
18 – 29	0	0
30 – 39	5	15.6
40 – 49	6	18.8
≥ 50	21	65.6
Gender		
Female	28	87.5
Male	4	12.5
Position at work		
Registered nurse (ICU trained)	20	62.5
Registered nurse (ICU experienced)	0	0
Nurse manager	5	15.6
Nurse educator	7	21.9
Number of years worked in ICU		
5 – 10	4	12.5
10 – 15	11	34.4
> 15	17	53.1

The participants were trained critical care nurses, nurse educators, and nurse managers with experience of working in or managing intensive care units.

To be included in the study, the participants had to

- Be registered with the South African Nursing Council in the category Critical Care Nursing – General.
- Have worked in the ICU for at least 5 years.
- Be interested in participating in the study.
- Agree to complete two rounds of questionnaires during the study.

3.4.2.3 Data collection

Prospective participants in the Delphi process were approached via email or telephone and requested to participate in the study. The researcher asked those who agreed for permission to send them an electronic informed consent via email to confirm their agreement to participate in the study (see Annexure 3.5 - Consent form). Those who agreed to participate and returned the consent form were enrolled in the study. Data was collected by means of a self-administered questionnaire (see Annexure 3.4 Questionnaire for Delphi round 1). The participants were requested to complete the questionnaire without consulting each other. The electronic questionnaire included an explanation of the purpose of the study, instructions on how to complete it, and the index nurse-sensitive indicators graded on a 4-point Likert scale. The participants were requested to complete the questionnaire and return their responses in round 1 of the Delphi processes within two weeks. Email and SMS reminders were sent to the participants if the questionnaire was not returned within one week.

The responses from Delphi round 1 were collected, analysed, and a second-round questionnaire containing the quality indicators that met consensus criteria was prepared and sent to the participants (see Annexure 3.6 - Questionnaire for Delphi round 2). Index indicators that did not meet the consensus threshold were not included in the second Delphi round. Table 3.6 summarises the Delphi process.

Table 3.6 Steps in reaching consensus

Step 1:	Prepare questions for round 1
Step 2:	Select participants based on clearly defined criteria
Step 3:	Invite participants for the Delphi, send out the questions and collect the responses for round 1
Step 4:	Analyse the responses and provide feedback to the participants
Step 5:	Prepare and send out questionnaire for round 2
Step 6:	Analyse the responses

3.4.2.4 Data analysis

Data analysis is the systematic organization and synthesis of research data with the purpose of establishing patterns of relationships (Polit & Beck 2021:783). After collecting the responses from the first round, the outcome was analysed and discussed with the supervisor. The items

that met the exclusion criteria according to the pre-determined consensus threshold were deleted (see Table 3.7).

Table 3.7 Consensus threshold

Consensus thresholds	
Inclusion	More than 85% of respondents provide a positive result (3 or 4) on the Likert scale for the item
Exclusion	More than 85% of respondents provide a negative result (1 or 2) on the Likert scale for the item
Non-consensus	When the item has met neither the inclusion nor the exclusion consensus threshold

Items that met the inclusion criteria were carried forward to the second Delphi round.

A questionnaire was prepared and sent out for the second Delphi round (see Annexure 3.6 Questionnaire for Delphi round 2). The consensus threshold for the second Delphi round was 85% of experts providing a positive result (3 or 4) on the Likert scale. Items that provided negative result (1 and 2) were discarded and those that met the consensus threshold were finalized and adopted as a set of evidence-based nurse-sensitive quality indicators for adult ICU (see Annexure 3.7- Final set of nurse-sensitive indicators for adult ICUs in South Africa).

Descriptive statistics obtained from the analysis of the participants' demographic characteristics and responses to the nurse-sensitive indicators were summarized and presented in tables. To score the Likert scale, score responses of each item of nurse-sensitive indicator from each respondent were counted. The frequency of scores of 3 and 4 for each item were added together and expressed as frequency of the total responses in percentages (Polit & Beck 2017:285).

3.4.2.5 Rigour

Rigour is the degree to which conclusions drawn from a study are accurate and true (Polit & Beck 2017:310). The researcher applied Humphrey-Murto, Varpio, Gonsalves and Wood's (2017:17-19) recommendations to ensure the credibility and validity of the findings (see Table 3.8).

Table 3.8 Methods of achieving rigour in the study

Recommendations for achieving rigour	How rigour was achieved in the study
Provide a clear purpose for the study	The purpose of the study was stated clearly: To reach consensus on nurse-sensitive indicators for adult ICUs in South Africa.
Describe each step of the process. If changes were made, provide a rationale for the changes.	Each step of the scoping review and the Delphi process was described in detail.
Describe the selection and preparation of the scientific evidence for the respondents.	The nurse-sensitive indicators selected from the scoping review were described and clearly stated and presented to the respondents to review.
Describe how items were selected for inclusion and exclusion in the first part of the questionnaire.	Steps followed in the extraction from the literature review of nurse-sensitive indicators included in the first Delphi round questionnaire were fully described.
Describe how the participants were selected.	A detailed description was given of the selection process for the participants including eligibility criteria.
The number of Delphi rounds and the criteria for the termination of the Delphi process.	Two rounds of the Delphi process were pre-planned together with the threshold for consensus.
Definition of consensus	Consensus was defined as 85% of participants selecting Likert option 3 or 4 (‘strongly agree’ or ‘agree’) to retain an item, and 85% of participants selecting item 2 or 1 (‘disagree’ or ‘strongly disagree’) to discard an item.
Report response rates and results after each round.	The response rates and results after each round were made known to the participants.
Describe the feedback provided after each round.	Feedback was provided on the extent to which participants agreed with each issue and with each other.
Describe how anonymity will be maintained.	Each participant was contacted by phone or email individually and requested not to discuss with the others.
Address potential methodological issues	The researcher discussed issues that may have impacted on the results openly

Humphrey-Murto, Varpio, Gonsalves & Wood (2017:17-19)

3.5 CONCLUSION

This chapter described the research design and methodology. The study was conducted in two phases, namely a scoping literature review (phase 1) and Delphi method (phase 2). The researcher developed a set of potential nurse-sensitive indicators for adult ICUs from the literature review. A panel of ICU nurse specialists then reached consensus on the indicators in two Delphi rounds (see Annexure 3.7). The researcher then compiled the final set of indicators that are feasible, acceptable, and applicable in South Africa.

Chapter 4 presents the data analysis and interpretation, and findings in an article format.

CHAPTER 4

ARTICLE

CONSENSUS ON NURSE-SENSITIVE INDICATORS FOR ADULT INTENSIVE CARE UNITS IN SOUTH AFRICA

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ABSTRACT

Background: Nurse-sensitive indicators (NSI) are tools specifically related to nursing care that can be used to measure nurses' contribution to patients' outcomes. NSI is important for implementing and evaluating the quality of nursing care. Thus, ensuring patients receive, efficient, effective, and safe nursing care. In South Africa, critical care faces challenges such as resource scarcity and increased demand for intensive care units as well as qualified intensive care nurses. There is a need to implement the use of nurse-sensitive indicators to monitor the quality of care critically ill patients receive. However, there are no published nurse-sensitive indicators for adult intensive care in the South Africa.

Objective: This study aimed to develop and reach consensus on nurse-sensitive indicators for adult intensive care units in South Africa.

Methods: The study used a scoping literature review and eDelphi technique among trained intensive care nurses, with a minimum of five years' experience.

Results: Thirty-four nurse-sensitive indicators were identified from 29 global studies. In eDelphi round one, a panel of 32 intensive care nursing experts reduced the indicators to 29 and added 3 others to obtain a set of 32 indicators grouped into 12 categories of systems or areas of use. All the 32 indicators obtained agreement of at least 85% each in the second eDelphi round. and were finalized for possible implementation in ICU in South Africa. The 12

categories included the respiratory, cardiovascular, neurological, gastrointestinal, integumentary, and urinary tract systems. Others were infection control, patient safety, nursing processes, workload, training and experience, and institution related.

Conclusion: This study established consensus on a set of 32 nurse-sensitive indicators grouped into 12 categories suitable for adult intensive care units in South Africa.

Keywords: Consensus, eDelphi technique, Nurse-sensitive quality indicators; consensus; intensive care unit, intensive care nurse.

INTRODUCTION AND BACKGROUND

Providing the best quality of care to patients, their families, and other users of health care services to meet their needs and expectations is the overarching goal of many healthcare institutions. Improving the quality of care delivered remains one of the central objectives of healthcare institutions in South Africa (National Department of Health, 2011:2). The last two decades have seen an increased interest in quality management in healthcare in general and specifically in the ICU (Flaaten, 2016:202). ICUs are an integral part of most health care systems for the purpose of providing enhanced specialized medical and nursing care incorporating physiologic organ support to sustain life during a period of life-threatening organ system insufficiency (Marshall, Bosco, Adhikari, Connolly, Diaz, Dormanetal, 2017:270).

In the ICU where adverse events and human errors may contribute to a high rate of morbidity and mortality, monitoring quality of care plays a vital role in quality improvement strategies. Monitoring patient safety measures may enable the development of a common definition of quality of care and establish tools and benchmarks against which ICUs can assess their performance, identify gaps and strengths, and establish databases against which comparison can be made between different units in a region (Chrusch and Martin, 2016:1).

Critically ill patients experience high burden of disease and providing safe quality care to them is often complex and requires a combined effort from a specially qualified interdisciplinary team of healthcare providers complementing trained critical care nurses (Chrusch and Martin, 2016:1). In order to measure and improve the quality of health care provided to a critically ill patient by professionals from diverse disciplines such as that found in the ICU, it is important for one to know, evaluate, and make transparent each discipline's daily processes (Conolly and Wright, 2017: 603).

A significant contribution of patient care in the ICU is made by the nursing staff who provides continuous care from admission to discharge (Marshall et al., 2017:271). Therefore, the use of objective strategies to evaluate nursing activities is essential, not only to demonstrate a comprehensive and accurate picture of the value of nursing and the benefits of services that nurses provide according to standard of care, but also to optimize the utilization of scarce ICU resources (Lachance, Douville, Dallaire, Padilha, and Gallani, 2015: 148).

Nurse-sensitive indicators (NSI) are tools relating specifically to nursing care that can be used to measure nurse's contribution to patients' outcome (Sutton and Jarden, 2017:339; Burston, Chaboyer and Gillespie, 2014:1785). The use of quality indicators that objectively evaluate nurse-specific activities in ICU offers an opportunity to demonstrate specific contributions that nurses make towards patient outcomes such as reducing errors and incidents, and enhancing

patient satisfaction (Gathara, Zosi, Serem, Nzinga and Murphy 2020:1). However, quality indicators specific to nursing care in the ICU are generally not available (Evangelou et al 2018:28).

In the last 10 years, 13 countries (mostly in Europe, Australia/New Zealand, and India) have published lists of nationally recognised intensive care indicators aimed at optimizing resource utilization (Bilotta, Nato, Falegnami and Pugliese, 2019:1). These indicators were however general and either did not specifically assess the nursing aspect of care, or they were described differently by different authors making it difficult to generalize and replicate in a different setting (Evangelou et al., 2018:28). Appropriate NSI should be identified and be integrated with routine nursing care to measure nurses' contribution to patient outcomes for quality improvement purposes in ICUs (Evangelou et al., 2018:28).

In South Africa where patients with high burden of complicated communicable or non-communicable illnesses are admitted to ICU for life support, it is critical to identify and use NSI to monitor and improve patient outcomes and to reduce adverse events (Gqaleni and Bhengu 2018:2: Joynt, Gopalan, Argent, Chetty, Wise, Lai, et al.,2019:36). However, there is scarcity of published NSI for adult ICU in South Africa. Therefore, there is an urgent need to develop a set of NSI that could be easily implemented in practice for auditing performance and monitoring quality of day-to-day routine nursing care in an adult ICU in a South African setting.

The aim of this study was to develop NSI suitable for adult ICUs in South Africa. It intended to answer the question "Which NSI identified from the published literature are suitable for adult ICUs in the South African setting? This study was approved by the University Pretoria Faculty of Health Sciences Research Ethics Committee with ethics approval number: 185/2021 of 13 May 2021.

METHODS

Study design

The study was conducted in two phases. Phase one consisted of a scoping literature review to identify a set of NSI for adult ICU already in use in other settings. The literature review was conducted according to the updated Preferred Reporting Items for Systematic Reviews and Meta-analysis [PRISMA] 2020 guidelines (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan, and Chou, 2021:5). Phase two involved a process of Delphi technique among an expert panel of ICU specialised registered nurses to obtain consensus on the identified NSI. The complete process and outcome of the searches are described in Figure 1. The review question expressed in terms of the population covered

(P), interventions or observations conducted (I), comparator (C), outcomes (O), timing (T), setting and study design (S) [PICOTS] (Polit & Beck, 2017:33) is shown in Box 1.

Box 1 PICOTS question

PICOTS question: Which nurse-sensitive indicators for adult ICU have been reported in the literature?
Population: Adult patients of 18 years and above, admitted to ICU in a hospital
I**ntervention**: Activities conducted specifically by nurses in ICU
Comparator: Absent involvement of the specific activity
Outcomes: Quantitative or qualitative metrics related to patient or nursing staff outcomes
Timing: From ICU admission to discharge or death
Setting: Inpatient setting in the ICU

Sampling

We accessed the following electronic databases to identify relevant publications: Medline, PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Psych Info, Cochrane library, and Web of Science Core Collection. We used the following terms: [(nurse-sensitive outcomes) OR (nurse-sensitive quality indicators) OR (nurse-sensitive indicators) OR (nurse-sensitive patient outcomes)] AND [(Intensive care) OR (intensive care unit) OR (critical care) OR (critical care unit)]. Search process and results are shown in **Figure 1**. Records with at least one search word were downloaded onto the EndNote X9 software for a detailed evaluation. The particulars of the author, year of publication, title and an abstract or a short preview are captured in the reference manager. Duplicate records were then removed. The remaining records were screened by reading the titles and abstracts and determining their relevance to the review question. Titles and/or abstracts that were deemed not relevant to the PICOTS question were not selected. The inclusion and exclusion criteria are described in **Table 1**. Full-text articles of the records that met the inclusion criteria were downloaded for detailed evaluation. Articles that satisfied PICOTS and eligibility criteria were selected for data extraction. Additionally, reference lists of the eligible articles were hand-searched and relevant articles not been picked up by the electronic searches but meet eligibility criteria were added to the selected articles. Full-text of the selected articles in PDF format were downloaded for data extraction.

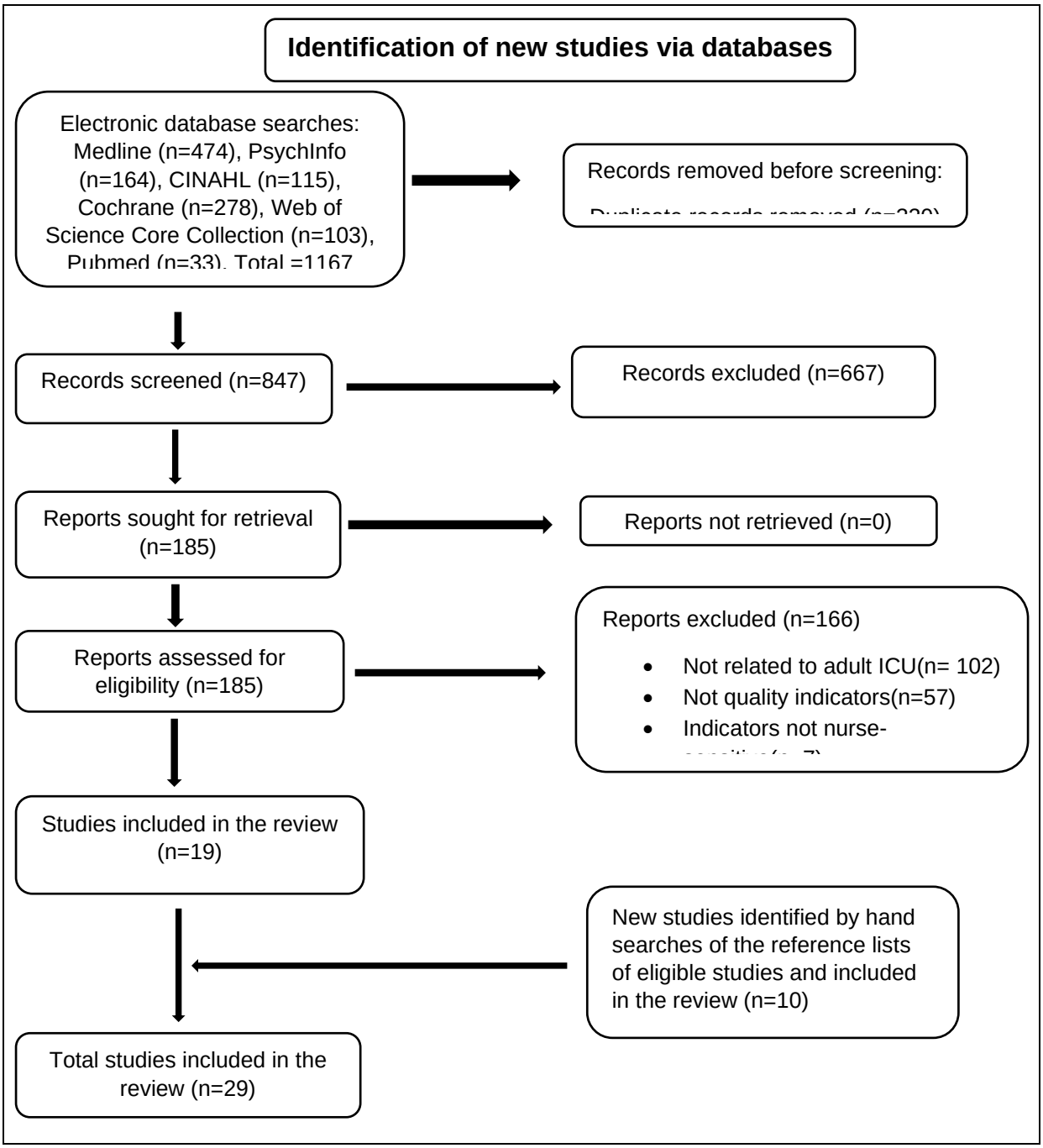

Figure 1 PRISMA 2020 flow diagram for Systematic scoping literature Review (Page et al., 2021:5)

Data extraction and Synthesis

The following information was extracted from each of the selected studies: author(s) name, publication date, country; aim(s) of the study; methods including study design, tools used, population and duration; quality indicators and formula or definitions identified; description of participants; and results or outcomes (**Appendix A**).

Table 1 Inclusion and exclusion criteria of records

Inclusion criteria	Exclusion criteria
✓ Papers published since 2014 ✓ Papers that are accessible ✓ Publications in English language ✓ Studies where the setting is adult ICU ✓ Studies investigating the association between nursing and setting variables ✓ Studies that evaluated quality indicators ✓ Studies analysing secondary data related to nurse-specific outcomes ✓ Adult ICU specific hospital guidelines ✓ Review studies analysing nurse-specific quality indicators or outcomes ✓ Experimental studies (RCT, non-RCT, observational studies, case-controlled studies, case series, descriptive studies)	✓ Publications outside the timeframe i.e., earlier than 2014 ✓ Publication in any language other than English ✓ Setting in any place other than adult ICU

Index indicators identified were tabulated against each article from which it was reported **(Appendix B).** For each nurse-sensitive indicator, the operational definition including the numerator and the denominator were recorded (Table 2). The identified indicators were then organized according to the organ system or domain in which they fall and developed into a self-administered questionnaire for the Delphi enquiry.

The self-administered questionnaire has two sections. In the first section information regarding the purpose of the research and background, demographic profile of the participant including age, gender, position at work, experience in ICU, and the completion requirements are explained. The second part contains the main text of questionnaire comprising of the NSI, description and application, and agreement with a statement about the importance of each item in terms of its relevance, feasibility, and ease of implementation.

The degree of agreement is based on a 4-point Likert scale grading method (4 points = “strongly agree”, 3 points = “agree”, 2 points = “disagree” and 1 point = “strongly disagree”).

Table 2 Nurse-sensitive indicators with definitions and formula

INDICATOR	FORMULA FOR CALCULATION	INDEX	METHOD OF COLLECTION
Respiratory system			
Ventilator associated pneumonia	(Number of patients who had ventilator-related pneumonia ÷ Total days of patients using the ventilator) x 100	%	Patient chart
Length of mechanical ventilation	Number of ventilator days		Patient chart
Unplanned endotracheal tube extubation	(Number of cases of unplanned extubation following endotracheal intubation ÷Total duration of endotracheal intubation [Days]) ×1000	Per 1000	Patient chart
Re-intubation	Endotracheal tubes repositioned and retied every 12 hours		Patient chart
Cardiovascular system			
Central line associated blood stream infections (CLABSI)	(Number of CLABSI ÷ Number of central line days) x 1000	Per 1000	Patient chart
Accidental removal of IV catheters			Patient chart
Implementation rate of DVT prevention	(Number of patients who received DVT prevention ÷Number of patients in the ICU) ×100	%	Patient chart
Neurological system			
Evaluation of delirium	(Number of patients who underwent evaluation for delirium ÷ Number of patients in the ICU) ×100	%	Patient chart
Evaluation of the level of sedation	(Number of patients who underwent evaluation for sedation ÷ Number of ICU patients who took sedative drugs) × 100	%	Patient chart
Evaluation of analgesia	(Number of patients responding very satisfied ÷ Number of patients in the ICU) ×100	%	Patient chart
Use of restraints	(Number of days using restraints ÷ Number of ICU patients' total hospitalization days) ×100	%	Patient chart
Prescription/consent for restraints use			Patient chart
Gastrointestinal system			
Upper GI bleeding			
Implementation of enteral nutrition	(Number of eligible patients who receive enteral nutrition within 24 hours of admission ÷ Total number of patients who received enteral nutrition at the same period) × 100		Patient chart
Nasogastric tube removal due to obstruction and re-positioned			Patient chart
Management of blood glucose level	(Total number of time with blood glucose level reaching 8–10 mmol/L ÷ Total number of blood glucose measurements performed for critically ill patients) × 100	%	Patient chart

INDICATOR	FORMULA FOR CALCULATION	INDEX	METHOD OF COLLECTION
Integumentary system			
Pressure ulcers	(Number of patients who had pressure ulcer during the period under consideration ÷ Number of ICU patients' total hospitalization days) x 100	%	Patient chart
Incontinence associated dermatitis	(Number of patients who had incontinence-associated dermatitis ÷ Number of ICU patients' total days of hospitalization) ×1000	Per 1000	Patient chart
Infection control			
Implementation of early appropriate broad-spectrum antibiotic	(Number of patients who had a serious infection or septic shock treated with broad spectrum antibiotics within 1 hr after definite diagnosis ÷ Number of patients who had a serious infection or septic shock) × 100%	%	Patient chart
Implementation of hand hygiene	(Frequency of implementation of qualified hand hygiene during the observation period ÷ Frequency of hand hygiene implementation at the same period) × 100	%	Unit report
Use of personal protective equipment			Unit report
Urinary system			
Catheter related urinary tract infection	(Number of patients who experienced an infection related to a catheter ÷ Number of catheter days) x 1000	Per 1000	Patient chart
Use of urinary tract bundles	Most frequently used urinary tract bundle		Patient chart
Patient safety			
Potentially inappropriate medications	PIM is a medication having potential risks that outweigh its potential benefits		Adverse events report
Medication administration errors	(Number of reported medication errors within the statistical period÷ number of dispensed doses during the statistical period) x 1000 patient days	Per 1000	Adverse events report
Outgoing transport related accidents	(Number of cases with outgoing transport-related accidents ÷Number of transported patients) ×1000	Per 1000	Unit report
Patient falls	(Number of patients who experience an unplanned descent to the floor ÷Number of patient days) x 1000	Per 1000	Patient chart
Inappropriate turn-off of alarms			
Nursing processes			
Implementation of discharge planning process			Patient chart
Failure to rescue	(Number of deaths ÷ Number of deaths resulting from complications of care such as pneumonia, deep vein thrombosis/pulmonary embolism, sepsis, acute renal failure, shock/cardiac arrest, or gastrointestinal haemorrhage/acute ulcer)		Adverse events report
Work-load			
Nursing staff turnover rate			Personnel data

Number of continuous hours worked	Nursing care hours per patient day		Unit report
Professional nurse per ICU bed	(Number of ICU nurses registered during the period of research ÷ ICU beds at the same period) ×100	%	Unit report
INDICATOR	**FORMULA FOR CALCULATION**	**INDEX**	**METHOD OF COLLECTION**
Training and experience			
ICU nursing staff with ACLS	(Number of ICU staff who had completed the advanced cardiac life support training ÷ Number of registered ICU nurses at the same period) × 100	%	Personnel data
Nurses who worked in ICU for < 3 years	(Number of nurses who had worked in the ICU for more than 3 years ÷ Number of registered ICU nurses at the same period) ×100	%	Personnel data
Composition of care teams			
Falls/ falls with injury			
Institution related			
Length of stay	mean ICU length of stay (days)		Unit report
ICU readmission	Number of patients readmitted to the ICU within 30 days		Unit report
Cost of treatment	Hospital cost per patient		Hospital data
ICU mortality	30-day mortality		Monthly report
Do not resuscitate/ end of life care			

The eligibility criteria for the Delphi expert panel were: registration with the South Africa Nursing Council in the category Critical Care Nursing (General); minimum experience of 5 years in ICU; and available to participate in two Delphi rounds. The participants were purposively selected and the questionnaire sent by email. Responses from Delphi round 1 were collected and analysed. A second questionnaire with the indicators that met 85% consensus level (Table 4) in round 1 was prepared for Delphi round 2 and sent out to the participants. Eighty-five percent consensus threshold was required for Delphi round 2.

Table 4 Consensus levels

Consensus thresholds	
Inclusion	More than 85% of respondents provide a positive result (Three or four) on the Likert scale for the item
Exclusion	More than 15% of respondents provide a negative result (one or two) on the Likert scale for the item

Data analysis

Descriptive statistics obtained from the analysis of the participants' demographic characteristics and responses regarding the NSI are summarized in **Table 5 and 6**. To score the Likert scale, the frequency of score responses of each item were counted. Scores of 3 and 4 were considered for selection of an item while 1 and 2 for rejection. Total scores for each

item were added together and expressed as frequency of the total responses in percentages (Polit & Beck, 2021:285).

Quality appraisal

Literature search was performed according to a pre-approved protocol based on PRISMA guidelines which adopted a checklist of items considered essential and minimum component of a systematic review (Shamseer et al., 2015:1; Page et al., 2021:5). Additionally, the recommendation by Humphrey-Murto *et al*. (2017:17-19) in the use of consensus groups was adopted in this study to ensure credibility of the research process and validity of the findings.

RESULTS

Scoping literature review

Overview of the studies

Database searches yielded 1167 records. After applying exclusion criteria 19 studies were suitable for review. Additional 10 studies meeting eligibility criteria were identified from the reference lists of the studies already obtained resulting in 29 studies that were included in the review (**Figure** 1). The included studies originated from North America (n=10: United States of America 9; Canada 1), Australia and New Zealand (n=7), Europe (n=6), Asia (n=3), and one each from South America (Brazil), the Middle East (Lebanon), and a multi-national collaboration of USA and Australia. There was no study from Africa. Majority of the included studies used observational design. These were prospective (n=12), retrospective (n=4), consensus (n=5), survey (n=1), and literature review (n=9). A few of the studies used combination of designs. All studies were published between 2014 and 2021.

Nurse-sensitive indicators

Thirty-four nurse-sensitive indicators for adult ICU were identified from the 29 studies (Table 2). The most frequently studied indicator was pressure ulcers (n=13), followed by catheter-associated urinary tract infections [CAUTI] (n=10), ventilator associated pneumonia [VAP] (n=9), central line associated blood stream infections [CLABSI] (n=9), and patient falls (n=9). Others were potentially inappropriate medications [PIM] (n=7), length of stay (n=7), and mortality (n=6). Use of restraints, use of urinary tract bundles to reduce the rate of CAUTI, and ICU readmission rates were reported in five studies each. The rest of the indicators were reported in 4 articles or less (**Appendix B**).

Several studies documented indicators reporting negative patient outcomes (22 NSI). In the critical incidents, the most reported indicator was pressure ulcers, falls, mortality, and

unplanned extubation. The most frequently reported healthcare associated infections were CAUTI, followed by VAP and CLABSI. Adverse events such Potentially Inappropriate Medication (PIM) and medication errors (n=7 and n=5, respectively) were also frequently reported. NSI in the safety domain were predominantly expressed as prevalence or incident rates expressed per 1000 or as percentages (**Table 2**). Data for the number of cases were obtained from patients' clinical records.

Consensus

The Delphi expert panel was composed of 32 registered nurses (**Table** 5).

Table 5 Demographic profile of Delphi panel of experts

CHARACTERISTIC	**NUMBER (n=32)**	**PERCENTAGE (100%)**
Age (years)		
18 – 29	0	0
30 - 39	5	15.6
40 - 49	6	18.8
≥ 50	21	65.6
Gender		
Female	28	87.5
Male	4	12.5
Position at work		
Registered nurse (ICU trained)	20	62.5
Registered nurse (ICU experienced)	0	0
Nurse manager in ICU	5	15.6
Nurse educator in critical care	7	21.9
Number of years worked in ICU		
5 – 10	4	12.5
10 – 15	11	34.4
> 15	17	53.1

In round one, 29 indicators attained more than 85% of agreement by the experts. Consensus was not reached in 5 indicators (delirium, nurses with ICU experience less than 3 years, patient falls, ICU readmission rates, and use of restraints, attaining 81.3%, 81.3%, 78.1%, 75%, and 71.9% agreement of the experts respectively) which were then deleted. Three other indicators (use of personal protective equipment [PPE], urine test, and Do Not Resuscitate/End of Life care) were added by the experts in round 1. All the 32 indicators from round 1 attained more than 85% of agreement by the experts in round 2 (**Table** 6).

Table 6 Final set of NSI for adult ICU in South Africa after consensus

Respiratory system				
INDICATOR	**SIGNIFICANCE**	**FORMULA FOR CALCULATION**	**INDEX**	**SOURCE OF DATA**
Ventilator associated pneumonia (VAP)	VAP is a frequent iatrogenic complication of mechanical ventilation that increases mortality	(Number of patients who had ventilator-related pneumonia ÷ Total days of patients using the ventilator) x 100	%	Patient chart
Length of mechanical ventilation	Number of days a patient is on a mechanical ventilator affects recovery	Number of ventilator days		Patient chart
Unplanned endotracheal tube extubation (removal)	Accidental extubations (removal) include accidental slippage or removal of an endotracheal tube by nonmedical practices	(Number of cases of unplanned extubation following endotracheal intubation ÷Total duration of endotracheal intubation [Days]) ×1000	Per 1000	Patient chart
Re-intubation	Re-intubation done properly in a timely manner can prevent respiratory complications	Endotracheal tubes repositioned and retied every 12 hours	Per 1000	Patient chart
Cardiovascular system				
Central line associated blood stream infections	Central line catheterization plays an important role in the treatment of critically ill patients, but can increase the risk of infection	(Number of CLABSI ÷ Number of central line days) x 1000	Per 1000	Patient chart

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Accidental removal of IV catheters	Risk of complications and complete device failure are increased when dislodgement occurs			Patient chart
Implementation of DVT prevention	ICU patients are with limited physical activity are at a high risk of deep vein thrombosis	(Number of patients who received DVT prevention ÷Number of patients in the ICU) ×100	%	Patient chart
Neurological system				
Evaluation rate of level of sedation	Excessive sedation may prolong the duration of mechanical ventilation and increase the LOS resulting in increased hospital costs and increased rate of morbidity and mortality.	(Number of patients who underwent evaluation for sedation ÷ Number of ICU patients who took sedative drugs) × 100	%	Patient chart
Evaluation of analgesia	Untreated pain can do great harm to the patient and result in a high metabolic state, cardiopulmonary dysfunction, or arrhythmias, and ultimately, complications and poor recovery	(Number of patients responding very satisfied ÷ Number of patients in the ICU) ×100	%	Patient chart

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Gastrointestinal system				
Implementation of enteral nutrition	Compared to those on parenteral nutrition, patients on enteral nutrition have better prognoses and may have a significantly lower mortality, infection rates, and length of stay	(Number of eligible patients who receive enteral nutrition within 24 hours of admission ÷ Total number of patients who received enteral nutrition at the same period) × 100		Patient chart
Management of blood glucose level	Close monitoring of blood glucose in a critically ill patients is needed because hyperglycaemia and hypoglycaemia may affect the rate of recovery	(Total number of time with blood glucose level reaching 8–10 mmol/L ÷ Total number of blood glucose measurements performed for critically ill patients) × 100	%	Patient chart
Integumentary system				
Pressure ulcers	Prolonged contact between the skin and devices used in patient care can result in pressure ulcers	(Number of patients who had pressure ulcer during the period under consideration ÷ Number of ICU patients' total hospitalization days) x 100	%	Patient chart

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Incontinence associated dermatitis	Promotion of skin integrity is a fundamental nursing intervention and a patient outcome associated with nursing quality, hospital costs, and liability	(Number of patients who had incontinence-associated dermatitis ÷ Number of ICU patients' total days of hospitalization) ×1000	Per 1000	Patient chart
Infection control				
Implementation of early appropriate broad-spectrum antibiotic	Early and appropriate broad-spectrum antibiotic therapy within 1-hour of diagnosis can improve the prognosis of patients with severe infection or sepsis.	(Number of patients who had a serious infection or septic shock treated with broad spectrum antibiotics within 1 hr after definite diagnosis ÷ Number of patients who had a serious infection or septic shock) × 100%	%	Patient chart
Implementation of hand hygiene	The hand is an important route for transmission of microbes	(Frequency of implementation of qualified hand hygiene during the observation period ÷ Frequency of hand hygiene implementation at the same period) × 100	%	Unit report

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Use of Personal Protective Equipment	Personal protective equipment (PPE) is key to protecting healthcare workers from COVID-19 infection and other communicable diseases			
Urinary tract system				
Catheter related urinary tract infection	Urinary tract infection caused by an indwelling catheter is one of the most common nosocomial infections	(Number of patients who experienced an infection related to a catheter ÷ Number of catheter days) x 1000	Per 1000	Patient chart
Urine test	Dipstick analysis, the microscopic exam, and other information gathered from a urine test enable decision-making for a variety of diagnostic, therapeutic, and disposition issues			

Patient safety				
INDICATOR	**SIGNIFICANCE**	**FORMULA FOR CALCULATION**	**INDEX**	**SOURCE OF DATA**
Potentially inappropriate medications (PIM)	A PIM is a medication having potential risks that outweigh its potential benefits, use of which may result in adverse drug reactions, and is related to increased health-related expenditures	PIM is a medication having potential risks that outweigh its potential benefits		Adverse events report
Medication administration errors	Giving a patient the wrong drug, wrong dose, wrong concentration, wrong way, at the wrong time or even to the wrong patient can seriously harm or cause death of the patient	(Number of reported medication errors within the statistical period÷ number of dispensed doses during the statistical period) x 1000 patient days	Per 1000	Adverse events report
Outgoing transport related accidents	Transferring an unstable patient out of ICU can have serious harm to the patient's outcome	(Number of cases with outgoing transport-related accidents ÷Number of transported patients) ×1000	Per 1000	Unit report

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Inappropriate turn-off of alarms	ICU depends on the stable functioning of technical equipment, failure of which may lead to events that compromise patient safety, with some deaths attributable to the failure of a device			
Nursing processes				
Discharge planning	Discharge planning focuses on the patient's problem, including prevention, rehabilitation and nursing care that provides the patient and their family with an understanding of the disease and any caring interventions			Patient chart

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Failure to rescue	Nurses spend most of the time at the patient's bedside, and are in the best position to recognize signs of deterioration in a patient's condition, record and report these changes, and intervene with treatments.	(Number of deaths ÷ Number of deaths resulting from complications of care such as pneumonia, deep vein thrombosis/pulmonary embolism, sepsis, acute renal failure, shock/cardiac arrest, or gastrointestinal haemorrhage/acute ulcer)		Adverse events report
Work-load				
Nursing staff turnover rate	Adverse outcomes have been attributed to a series of deficiencies including high nursing staff turnover			
Number of continuous hours worked	Associations have been found between extended work shifts and the risk of occurrence of adverse events	Nursing care hours per patient day		Unit report
Professional nurse per ICU bed	Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible,	(Number of ICU nurses registered during the period of research ÷ ICU beds at the same period) ×100	%	Unit report

	whether directly or indirectly related to patient care			
INDICATOR	**SIGNIFICANCE**	**FORMULA FOR CALCULATION**	**INDEX**	**SOURCE OF DATA**
Training and experience				
ICU nursing staff with ACLS	Advanced life support training enables nurses to deal with patient's resuscitation process more effectively and with confidence, thereby increasing the chances of patient's survival.	(Number of ICU staff who had completed the advanced cardiac life support training ÷ Number of registered ICU nurses at the same period) × 100	%	Personnel data
Institution related				
Length of stay (LOS)	Decreased LOS has been associated with decreased risks of opportunistic infections and side effects of medication, improvements in treatment outcome and lower mortality rates.	Mean ICU length of stay (days)		Unit report
Cost of treatment	Treating a patient in ICU involves the use of expensive equipment's, investigations, and expensive medicine	Number of patients readmitted to the ICU within 30 days		Unit report
ICU mortality	The number of deaths in ICU within a 30-day period	Hospital cost per patient		Hospital data

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Do Not Resuscitate /End of Life Care	Support given to families during transition from active treatment to end of life care is related to the interaction between patient, family, and the nurses			

DISCUSSION

There is scanty information in the literature regarding the development and use of nurse-sensitive indicators for adult ICU in the developing world despite the rapidly evolving critical care services in these countries (Adhikari, Fowler, Bhagwanjee, and Rubenfeld, 2010: 1339; Vukoja, Riviello, Gavrilovic, Adhikari, Kashyap, Bhagwanjee, Gajic, Kilickaya, et al. 2014:341). This is supported by findings of the current study in which only 17.2% of the studies arising from the review were conducted in developing countries (Asia, Brazil, and Lebanon) with the vast majority comprising 82.8% originating from the developed world (North America, Australia and New Zealand, and Europe). No publication fulfilling the inclusion criteria was found from any study conducted in the African continent or in South Africa. De Beer, Brysiewicz and Bhengu (2011:8) point out that not much research has been done in this domain in South Africa as only a limited number of nurses have presented their research at congresses, or published their results.

Studies reveal significant differences in critical care practice between developed and developing countries depending on the different epidemiology, available financial and human resources, and cultural practices (Sakr, Moreira, Rhodes, Ferguson, Kleinpell, Pickkers, Kuiper, Lipman, and Vincent, 2015: 520). High income countries in North America, Europe, Australia, and New Zealand have established national databases of nursing sensitive quality indicators that can be used to measure the quality of care provided, or as a baseline for quality improvement strategies in any ICU in these regions (Montalvo, 2007:1; Rhodes et al, 2012: 599). Among the developing countries, only India and Brazil have published lists of nationally recognised critical care quality indicators to optimize patient outcomes in ICU (Flaaten, 2016:202; Bilotta et al, 2019: 1; Salluh, and Lisboa, 2016: 189; Kashyap, Vashistha, Saini, Dutt, Raman, Bansal, Singh, Bhandari, Ramakrishnan, Seth, and Sharma, 2020:32; Kartik, Gopal, and Amte, 2017: 187).

No publication was found from the literature search that reported on nationally recognised critical care nursing-sensitive indicators from South Africa. One of the few published research projects evaluating adverse event reporting system in selected ICUs in Kwa Zulu Natal province found that adverse event reporting system were only available in some ICUs where they were not being used maximally by the nursing staff (Gqaleni and Bhengu, 2018:12). Although professional organizations such as the Critical Care Society of South Africa (CCSSA) support intensive care nursing by developing guidelines for ICU, the emerging guidelines so far are for general issues such as triage system and bed use and are not suitable for

monitoring quality of patient care by nurses in ICU (Joynt, Gopalan, Argent, Chetty, Wise, Lai, Hodgson, Lee, Joubert, Mokgokong, and Tshukutsoane, 2019:1).

In the current study, 32 nurse-sensitive indicators that are commonly used in ICU were identified from the literature. Each indicator was extracted together with its formula for calculation, index or unit of measurement, method of collecting the relevant data, and its significance in the adult ICU. Each of these indicators achieved significant consensus of at least 85% agreement from a panel of experienced ICU trained South African nurses and critical care nurse-educators as to its relevance and feasibility of implementation in ICU. The indicators, already in use in other settings to monitor or measure a variety of applications such as patient safety, critical incidents, and healthcare associated infections were finalized for possible implementation in ICU in South Africa. The indicators were grouped into 12 categories of systems or domains of use including the respiratory, cardiovascular, neurological, gastrointestinal, integumentary, and urinary tract systems. Others were infection control, patient safety, nursing processes, workload, training and experience, and institution - related such as ICU mortality rates

A significant finding among the indicators in which consensus was reached was the use of Personal Protective Equipment (PPE) to protect the nursing staff from communicable diseases, for example Covid-19, Human Immunodeficiency Virus Infection and hospital acquired gram negative- bacterial infections. Another important new nurse sensitive indicator was the implementation of Do-Not-Resuscitate (DNR) and End-of-life (EoL) care. Monitoring and reporting the use of PPE is critical in South Africa where ICU nursing faces many challenges such as a high burden of very ill patients suffering from infectious diseases. Implementation of DNR/EoL is vital in the care of families during transition from active treatment to end of life care as it relates to the interaction between patient, family, and the nurses with a possibility to create satisfaction and confidence of the family towards the nursing care provided to their critically ill relative.

Nevertheless, ICU nursing in South Africa is especially in need of published NSI to monitor the care provided to patients in the intensive care unit. Monitoring tools are urgently needed because among other issues acute shortage of specialized ICU nurses has made several institutions to use untrained general registered nurses or enrolled nurses with poor skills in managing ICU patients whose output should be monitored (De Beer, et al.2011: 9).

IMPLICATIONS FOR ICU PRACTICE IN SOUTH AFRICA

From a wide variety of NSI used in ICUs worldwide, this study has identified and established consensus on a set of 32 indicators that could be used to evaluate nurses' contribution to high quality care in ICU in South Africa. These indicators will provide a basis for nursing management and the monitoring of quality.

Benefit to patients

NSI can be used to provide evidence of the quality of nursing care that patients receive (Evangelou et al., 2018:28). When nurses caring for patients in ICU adhere to the use of NSI, it becomes possible to track clinical performance and outcome of patients. For example, a higher nursing activity score, an indicator which serves to assess the nursing workload and the percentage of time spent on nursing interventions in an ICU patient (LaChance et al 2015:149) is closely related to a higher family satisfaction (Gerasimou-Angelidi, Myrianthefs, Chovas, Baltopoulos, and Komnos, 2014:156). Patients are also less likely to experience adverse event in units which implement the use of NSI (Driscoll 2018:21).

Benefit for nurses

Choosing indicators that are nursing-specific is an important mechanism of nursing care. For example, nurses in ICU may care for only a limited number of patients per shift to avoid burn-out. High workload is associated with increased complications in ICU (Hoogendoorn et al 2019:1). Therefore, the use of an indicator that can quantify the need for nursing time as accurately as possible is critical for planning nursing staff requirements and directing the actions of nurses so they can attend to patients' health care needs with knowledge, skill, competence, and safety (Kakushi, and Évora, 2014:156). Studies have revealed a significant positive association between objectively measured quality of care using NSI and subjectively measured quality of care from the nurses' point of view, thereby affirming the value of NSI as a measure of quality of nursing care (Stalpers et al, 2016:5).

The availability and use of NSI highlight the critical role nurses play to promote and improve health system and reveals this fact openly in their eyes and that of other professionals, thus increasing nurses' motivation (Barchielli, Rafferty, and Vainieri, 2022:8) when their effort and contribution is acknowledged and appreciated. It should be noted that NSI not only cover the activities for which nurses are responsible, but all processes in which they participate, thereby demonstrating their contribution to the health system. Additionally, it clearly demonstrates how

nurse's contribution is integrated with that of other professionals, thereby strengthening the position of the need for multi-professionality in ICU (Barchielli et al, 2022:8).

Benefits for policy makers

Globally there is concern about need for quality health care provision. The management of health facilities and policy makers should be able to evaluate various aspects of quality of services they provide from care delivered to the patient and family satisfaction (Bilota et al 2019). Therefore, healthcare managers need to know, evaluate, and make transparent their current situation to improve quality of care. This can be done by implementing the use of quality indicators. NSI are criteria that can serve to address and whenever possible improve the quality of service delivered to improve patient satisfaction and confidence in the healthcare system.

For nursing education

Knowledge of NSI should be included in the curriculum of critical care nurses as it will enable the critical care nurse to acquire knowledge of NSI early in their training. The implementation and use of NSI should also play an important role in the accreditation of learning institutions, particularly where practical training is taking place. Apart from improving quality of care of patients in the unit, it also enables the critical care nurses and the permanent staff to stay updated and compliant with knowledge and practical skills supported by evidence-based education and evidence-based practice.

RECOMMENDATIONS

The indicators developed in this study need to be tested further and verified in clinical practice, then revised to practically suit the context in which they are to be used. The indicators should be piloted in different levels of ICU in South Africa and data collected to determine their reliability and validity in clinical practice. Future verification and revisions for continuous quality improvement will also be needed and a database established to compare the results from different ICUs in South Africa.

LIMITATIONS

Even though a comprehensive search strategy and an inclusive approach were employed, there is no guarantee that all eligible studies were identified. Moreover, other potentially relevant publications could have been missed because searches were (a) limited to specific databases, with (b) publications written in English language, and (c) publications since 2014 which may also have excluded indicators reported in earlier publications.

CONCLUSION

This study sets the stage for new initiatives aiming at filling the current gaps in the use of standardized national NSI for ICUs in South Africa. The 32 NSI identified can be used in clinical practice to (a) detect clinically recognizable outcomes among critically ill patients in an ICU environment, (b) achieve clinical meaningfulness by monitoring all dimensions of health status influenced by nursing care, (c) provide evidence of the critical care nurses' contribution to patients' outcomes, and (d) act as a base-line for establishing quality improvement measures in ICU in South Africa. A set of NSI specific for the adult ICU may influence clinical nursing practice, guide improvements of the care delivered and contribute to the transformation and improvement of the health care system (Evangelou 2018) in South Africa.

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CHAPTER 5
FINDINGS, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

Chapter 4 reported this study entitled CONSENSUS ON NURSE-SENSITIVE INDICATORS FOR ADULT INTENSIVE CARE UNITS IN SOUTH AFRICA, in a journal article format. Chapter 5 summarises the findings, discusses the significance and limitations of the study, and makes recommendations for further research. The researcher concludes with a personal reflection of the research experience and lessons learnt.

5.2 AIM AND OBJECTIVES

The aim of the study was to reach consensus on nurse-sensitive indicators suitable for adult ICUs in a South African context. In order to achieve the aim, the objectives were to:

- Identify nurse-sensitive indicators for adult ICUs already in use in ICUs worldwide.
- Reach consensus on nurse-sensitive indicators for adult ICUs which can be used in South Africa.

Accordingly, the study wished to answer the following question:

> Which evidence-based nurse-sensitive indicators identified from the published literature are suitable for adult intensive care units in the South African setting?

5.3 SCOPING LITERATURE REVIEW

The researcher conducted a scoping literature review to identify, screen and select articles on nurse-sensitive indicators for adult ICUs. Articles that were not set in adult ICUs, did not report on health quality indicators, and/or did not examine nurse-sensitive indicators were excluded. Nineteen articles met the eligibility criteria and were included in the final analysis. An additional ten studies that met the eligibility criteria were identified from the reference lists of the 19 eligible articles and included. Twenty-nine studies that met the eligibility criteria were thus included for data extraction (see chapter 3, Figure 3.1 – PRISMA 2020 flow diagram for systematic reviews).

5.3.1 Origin of selected studies

The selected studies originated from the United States of America (USA), Canada, Australia and New Zealand, Europe, Asia, South America (Brazil), the Middle East (Lebanon), and a multi-national collaboration between the USA and Australia. No studies from Africa were included (see Figure 5.1).

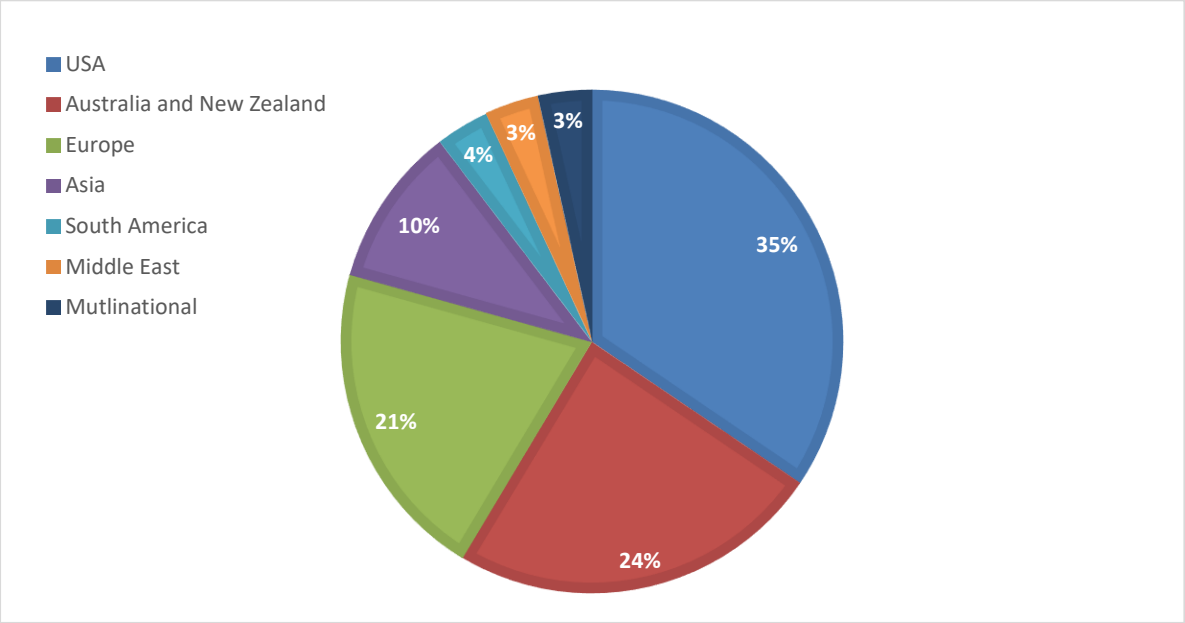

Figure 5.1 Origin of selected studies

5.3.2 Study designs

The researcher selected studies published between 2014 and 2021 and the research designs included prospective, retrospective, consensus, survey, mixed methods, and literature reviews (see Figure 5.2). No controlled randomized studies were identified within the review period.

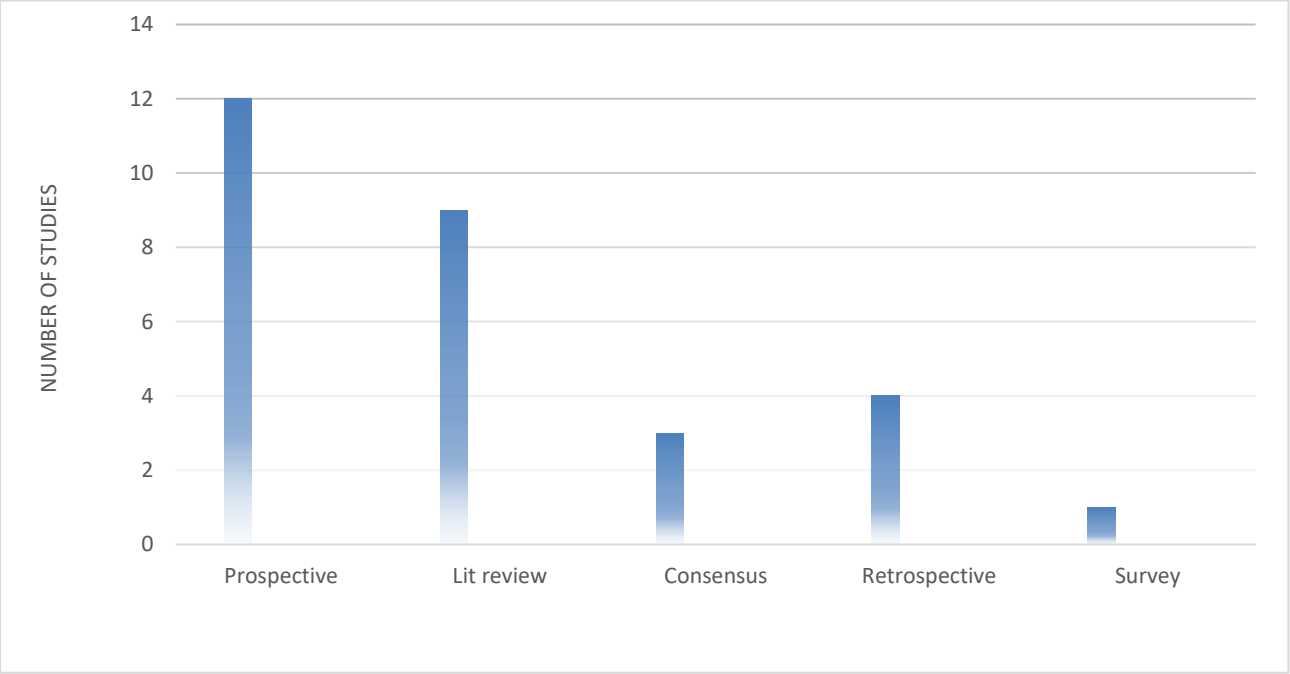

Figure 5.2 Research designs of selected studies

5.3.3 Nurse-sensitive indicators identified

The researcher identified 34 nurse-sensitive indicators (NSIs) for adult ICUs from the 29 studies (see Annexure 3.3 – Nurse-sensitive indicators identified in selected studies). The most frequently studied indicators were pressure ulcers; catheter-associated urinary tract infections; ventilator-associated pneumonia (VAP); central line-associated bloodstream infections (CLABSI), and patient falls. Others were potentially inappropriate medications [PIM], length of stay (LOS), and mortality. Use of restraints, use of urinary tract bundles to reduce the rate of catheter-associated urinary tract infection (CAUTI), and ICU readmission rates were reported as indicators in five studies each. The rest of the indicators were reported in 4 articles or less.

Several studies documented indicators that measured negative influences on patient safety (22 nurse-sensitive indicators). Among those measuring critical incidents, the most reported indicators were pressure ulcers, patient falls, mortality, and unplanned extubation. The most frequently reported healthcare-associated infections were CAUTI, followed by VAP and CLABSI. Measurements for adverse events, such as potentially inappropriate medications and medication errors, were also frequently reported.

Nurse-sensitive indicators in the safety domain were mainly expressed as prevalence or incident rates expressed per 1000 or as percentages (see Annexure 3.3 - Nurse-sensitive indicators identified with definitions and formula). Data for the number of cases were obtained from reports in patients' clinical records or databases.

The researcher grouped the indicators according to the body systems and other shared characteristics, such as use in infection control, patient safety, nursing processes, workload, training, and experience, and institutional-related use. Each indicator was extracted together with its formula for calculation, index or unit of measurement, method of collecting the relevant data, and its significance in the adult ICU (see Annexure 3.3 - Nurse-sensitive indicators in adult ICU with definitions and formula). The selected indicators were then used to develop a 4-point Likert scale questionnaire administered to a panel of experts in ICU nursing (see Annexure 3.4 - Questionnaire for Delphi round 1).

5.4 REACHING CONSENSUS ON THE NURSE-SENSITIVE INDICATORS

The 4-point Likert scale questionnaire was administered to a 32-member panel of South African nursing experts comprising 20 critical care registered nurses with at least 5 years' ICU experience, 7 nurse educators, and 5 nurse managers of ICU (see chapter 3, Table 3.1 Delphi panel's demographic profile).

The pre-selected level of consensus was at least 85% of the experts agreeing on an indicator. Twenty-nine (29) indicators out of 34 emerging from the literature review were selected, and

attained agreement from at least 85% of the experts. Five indicators were discarded as they attained less than 85% agreement. These were delirium, nurses with less than 3 years' ICU experience (81.3% each), patient falls (78.1%), ICU readmission rates (75%), and use of restraints (71.9%). Moreover, three new indicators, namely use of personal protective equipment (PPE), urine test, and Do-Not-Resuscitate/End-of-Life care were added by the experts in round 1. All 32 indicators emerging from round 1 attained a minimum of 85% agreement and were retained after Delphi round 2 (see Table 5.1).

Table 5.1 ICU nurse-sensitive indicators before and after Delphi rounds

INDICATOR	DECISION AFTER DELPHI ROUND 1	DECISION AFTER DELPHI ROUND 2
Respiratory system		
Ventilator-associated pneumonia (VAP)	Retained	Retained
Length of mechanical ventilation	Retained	Retained
Unplanned endotracheal tube extubation	Retained	Retained
Re-intubation	Retained	Retained
Cardiovascular system		
Central line-associated bloodstream infections	Retained	Retained
Accidental removal of IV catheters	Retained	Retained
Implementation of DVT prevention	Retained	Retained
Neurological system		
Delirium	Deleted	
Evaluation rate of level of sedation	Retained	Retained
Evaluation of analgesia	Retained	Retained
Use of restraints	Deleted	
Gastrointestinal system		
Implementation of enteral nutrition	Retained	Retained
Management of blood glucose level	Retained	Retained
Integumentary system		
Pressure ulcers	Retained	Retained
Incontinence-associated dermatitis	Retained	Retained
Infection control		
Implementation of early appropriate broad-spectrum antibiotic	Retained	Retained
Implementation of hand hygiene	Retained	Retained
Use of Personal Protective Equipment	Added	Retained
Urinary tract system		
Catheter-related urinary tract infection	Retained	Retained
Urine test	Added	Retained
Patient safety		
Potentially inappropriate medications	Retained	Retained

INDICATOR	DECISION AFTER DELPHI ROUND 1	DECISION AFTER DELPHI ROUND 2
Medication administration errors	Retained	Retained
Outgoing transport-related accidents	Retained	Retained
Patient falls	Deleted	
Inappropriate turn-off of alarms	Retained	Retained
Nursing processes		
Discharge planning	Retained	Retained
Failure to rescue	Retained	Retained
Workload		
Nursing staff turnover rate	Retained	Retained
Number of continuous hours worked	Retained	Retained
Professional nurse per ICU bed	Retained	Retained
Training and experience		
ICU nursing staff with ACLS	Retained	Retained
Nurses who worked in ICU for < 3 years	Deleted	
Institution related		
Length of stay (LOS)	Retained	Retained
ICU readmission rates	Deleted	
Cost of treatment	Retained	Retained
ICU mortality	Retained	Retained
Do-Not-Resuscitate/End-of-Life Care	Added	Retained

5.4.1 Respiratory system

Three of the four indicators in this category, namely ventilator-associated pneumonia (VAP), length of mechanical ventilation, and rate of re-intubation obtained more than 90% consensus. Unplanned endotracheal tube extubation was selected by 87.5% of the panel. VAP is a frequent cause of iatrogenic infection especially where the length of mechanical ventilation is prolonged (Yang, Huang, Zhao et al 2019:55). The number of days a patient is on a ventilator after recovery, that is, length of mechanical ventilation, should be as short as possible. Insertion of an endotracheal tube (ET) is necessary for mechanical ventilation. The ET should be placed accurately and secured properly to avoid unplanned extubation because of slippage

or accidental removal of ET by non-medical practice which can increase the risk of mortality in a patient (Chrusch & Martin 2016:10). Following an unplanned extubation, re-intubation should be done in a timely manner to prevent respiratory complications.

5.4.2 Cardiovascular system

Implementation of deep vein thrombosis (DVT) prevention was selected by 100% of the panel members. Critically ill patients in ICU have very limited physical activity, which places them at a high risk of DVT (Driscoll, Grant, Carroll, Dalton et al 2018:20). Prophylactic anticoagulants and monitoring of DVT are therefore critical to prevent complications in a patient with limited physical activity.

Central line catheterization plays an important role in the treatment of critically ill patients for administration of medicines and nutrients and resuscitation (Yang, Huang, Zhao et al 2019:54). However, central line catheters may increase the risk of bloodstream infection. Central line-associated bloodstream infection (CLABSI) is a serious complication in ICU patients, and leads to prolonged length of stay, increased hospital costs, and mortality. Close monitoring and care of the central lines, prevention and early detection of infection are a critical patient safety measure in ICU (Berenholtz, Lubomski, Weeks, Goeschel, Marsteller, Pham et al 2014:59). In addition, close monitoring and care will prevent accidental removal of intravenous catheters to avoid the increased risk of additional complications and complete device failure when dislodgement occurs and unnecessary reinsertion of the central line.

5.4.3 Neurological system

Sedation is an integral part of ICU treatment. However, excessive sedation may prolong the duration of mechanical ventilation and increase the length of ICU stay thus resulting in increased hospital costs and increased rate of morbidity and mortality (Sutton & Jarden 2017:340). Evaluating the level of consciousness and sedation vacation in ICU patients will alert the nurse to when it is necessary to reduce or increase sedation. Closely linked to sedation is the amount of analgesia a patient receives (Yang, Huang, Zhao et al 2019:54). Pain control in ICU promotes healing while untreated pain can be detrimental to the patient,

resulting in increased metabolic state, cardiopulmonary dysfunction, or arrhythmias, and ultimately, systems complications and poor recovery (Yang, Huang, Zhao et al 2019:54).

5.4.4 Gastrointestinal system

All the panel members (100%) agreed that management of blood glucose level in ICU patients is an important patient safety measure that ensures early detection of hypo-/hyperglycaemia and treatment thereof, and that adequate nutrition is required for a patient's quick recovery. Close monitoring of blood glucose in a critically ill patient is necessary because hyper- and hypoglycaemia may affect the rate of recovery, resulting in increased length of stay or high mortality (Sutton & Jarden 2019:340). Compared to parenteral nutrition, patients with enteral nutrition have better prognoses and may have significantly lower mortality, infection rates, and length of stay (Yang, Huang, Zhao et al, 2019). However, enteral nutrition must be carefully formulated and accurately administered and monitored to produce the desired effect and prevent adverse events. Therefore, meticulous assessment of patients is required to determine all the patients who qualify for enteral nutrition within the first 24 hours after admission. Patients who require parenteral nutrition must also receive it within the 24-hour period.

5.4.5 Integumentary system

The promotion of skin integrity is a fundamental nursing intervention and a patient outcome associated with nursing quality, hospital costs, and liability (Nowicki, Mullany, Spooner, Nowicki, Mckay, Corley, Fulbrook & Fraser 2018:259). Prolonged contact between the skin and devices used in patient care can result in pressure ulcers. When the barrier provided by the skin is broken, infection, sepsis, prolonged hospitalisation, or even mortality can result therefore pressure ulcer prevention is very important. All the panel (100%) agreed that prevention and monitoring of pressure ulcers and incontinence associated dermatitis is necessary.

5.4.6 Infection control

The hands are an important route for transmission of microbes. Improving compliance with hand hygiene and washing hands before and after contact with patients reduces the number

of microbes in the hands, thereby reducing incidents of nosocomial infections (Yang, Huang, Zhao et al 2019:55).

Implementation of early appropriate broad-spectrum antibiotics is critical for a patient with suspected sepsis in ICU. Early and appropriate broad-spectrum antibiotic therapy within 1 hour of diagnosis can improve the prognosis of patients with severe infections or sepsis (Sutton & Jarden 2017:345).

In 2019, the COVID-19 pandemic resulted in a surge of ICU admissions. Since ICU healthcare workers were exposed to aerosol-generating procedures and infection, it was essential to ensure optimal personal protective equipment (PPE). Rajamani, Subramaniam, Shekar, Haji et al (2021:135) evaluated PPE preparedness in ICUs in six Asia-Pacific countries and found that standardised PPE guidelines are vital to minimize transmission of infections. PPE is key to protecting healthcare workers from COVID-19 infection and other communicable diseases (Rajamani, Subramaniam, Shekar, Haji, Luo, Bihari, Wong et al 2021:139).

5.4.7 Urinary tract system

Catheter-associated urinary tract infection (CAUTI) caused by an indwelling catheter is one of the most common nosocomial infections (Duszyńska, Rosenthal, Szczęsny, Woźnica, Ulfik, Ostrowska, Litwin & Kübler 2016:1). The use of urinary tract bundles is an effective way of monitoring measures to prevent and reduce the rate of CAUTI (Sampathkumar, Barth, Johnson, Marosek et al 2016:258; Mullin, Kovacs, Fatica, Einloth, Neuner, Guzman et al 2017:188).

5.4.8 Patient safety

Safety is one of the four defining attributes of quality healthcare. Providing safe care also means reducing harm caused during delivery of care. Errors of medication administration refer to abnormal events associated with the administration process, such as giving a patient the wrong drug, dose, concentration, or route and at the wrong time, or even to the wrong patient.

Therefore, medication administration errors can harm the patient and compromise safety. Monitoring medication administration errors is one way of measuring the safety of patients in ICU. Administering potentially inappropriate medications (PIM) of which potential risks outweigh their potential benefits, may result in adverse drug reactions, and is related to increased health-related expenditure (Floroff, Slattum, Harpe, Taylor & Brophy 2014:526).

Another threat to patient safety is inappropriate turning off the alarms. Intensive care depends on the stable functioning of technical equipment. Technical failures frequently lead to events that compromise patient safety, with some deaths attributable to the failure of a device. The rate of inappropriate turn-off of alarms is a measure that can be used to assess patient safety (Evangelou, Lambrinou, Kouta & Middleton 2018:33).

The rate of outgoing transport-related accidents is another measure of patient safety. Transferring an unstable patient out of ICU can cause serious harm to the patient's outcome thus compromising safety. Recording outgoing transport-related accidents is another way of assessing patient safety in the ICU.

5.4.9 Nursing processes

Nursing processes such as rescue, support and discharge planning are performed exclusively by the ICU nurse and are a good indication of the nurses' output. Nurses spend most of the time at the patient's bedside and are in the best position to recognize deterioration in patient conditions, record and report these changes, intervene with treatments, and hence save the patient.

Discharge planning focuses on the patient's problem, including prevention, rehabilitation and nursing care that provides the patient and the family with an understanding of the disease and any caring interventions that must be done after discharge from ICU, in addition to explaining the patient's needs and ensuring that they know what to do in case further treatment is needed (Forster, Bihari, Tiruvoipati, Bailey & Pilcher 2020:1401). In their study in Australia, Forster, Bihari, Tiruvoipati, Bailey and Pilcher (2020:1405) found that increasing discharge delay in ICUs was associated with reduced likelihood of mortality and ICU readmission in high-risk patients.

Despite the strong urge to provide the best care to cure the patient, this is not always achievable and the best an ICU nurse can do is honour a Do-Not-Resuscitate (DNR) directive or provide end-of-life (EOL) care. Support given to families during transition from active treatment to end-of-life care is related to the interaction between patient, family, and the nurses (Coombs, Parker, Ranse, Endacott & Bloomer 2017:39). Coombs, Parker, Ranse, Endacott, and Bloomer (2017:50) found that nurses equipped families for EOL care by information and communication, by managing withdrawal of life-sustaining treatments to meet family need, and continued care to build memories. How well this is done is an indication of quality care provided to the patient and their family.

5.4.10 Workload

Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care (Altafin, Grion, Tanita, Festti, Cardoso, Veiga, Kamiji et al 2014:292). These activities can change depending on the patient's degree of dependency, the complexity of the disease, the characteristics of the institution, work processes, the physical layout, and the nature of the professional team (Altalfin, Grion, Tanita, Festti et al 2014:293). Nursing workload has significant implications for the quality of patient care (Driscoll, Grant, Carroll, Dalton et al 2018:21). Associations have been found between extended work shifts and the risk of occurrence of adverse events (Driscoll, Grant, Carroll, Dalton et al 2018:21). Adverse outcomes have also been attributed to a series of deficiencies, including high nursing staff turnover. Monitoring the number of professional nurses per ICU bed, the number of continuous hours worked, and nursing staff turnover rate is used to determine nurse workload in an ICU (Hoogendoorn, Margadant, Brinkman, Haringman, Spijkstra & de Keizer 2019:1).

5.4.11 Training and experience

The proportion of ICU nursing staff with Advanced Cardiac and Life Support (ACLS) skills as an indicator for professional competency attained 93.8% consensus. Advanced life support training enables nurses to deal with the patient resuscitation process more confidently and effectively, thereby increasing the chances of patient survival.

Regarding the length of experience working in ICU, Yang, Huang, Zhao et al (2018:54) found that nurses with more than five years' ICU experience promoted decision-making ability. However, the expert panel did not reach consensus on this indicator.

5.4.12 Institution related

Treating a patient in the ICU involves the use of expensive equipment, investigations, and expensive medicine. Cost of treatment is an important setting-related indicator that needs to be optimized to ensure that cost-effective care is given to patients without compromising treatment outcomes. Closely related to the cost of treatment is the length of stay (LOS). LOS is an indicator used to assess the efficiency of hospital management, patient quality of care, and functional evaluation. Decreased LOS has been associated with decreased risks of opportunistic infections and side effects of medication, and with improvements in treatment outcome and lower mortality rates.

Despite the best care provided, some patients lose their life due to the seriousness of the illness and/or irreversible damage to vital organ system. Therefore, consideration must also be given to eventual patient mortality in ICU as a measure of quality care

5.5 SIGNIFICANCE

A research study should be significant to the nursing profession and contribute to the body of knowledge (Brink, van der Walt & van Rensburg 2018:61). From a wide variety of nurse-sensitive indicators used in ICUs worldwide, the study identified and reached consensus on a set of 32 indicators that could be used to evaluate nurses' contribution to quality care in adult ICUs in South Africa. These provide a basis for nursing management and monitoring of nursing quality. The findings of this study should be of significance for policy makers, nurses, patients, and nursing education.

5.5.1 Policy makers

The Department of Health and the South African Nursing Council (SANC) should introduce and implement NSIs to evaluate nurses' contribution to quality care in adult ICUs in South Africa. The use of quality indicators would facilitate the management and monitoring of patient care thereby improving patient and family satisfaction and confidence in the healthcare system (Bilotta, Nato, Falegnami & Pugliese, 2019).

5.5.2 Patients

The use of nurse-sensitive indicators provides evidence of the quality of nursing care and facilitates tracking clinical performance and patient outcomes. For example, a higher nursing activity score, an indicator which assesses the nursing workload and the time spent on nursing interventions in ICU patients is related to greater family satisfaction (Evangelou, Lambrinou, Kouta & Middleton, 2018; Lachance, Douville, Dallaire, Padilha et al, 2015). Moreover, patients are less likely to experience adverse events in ICUs which implement NSIs.

5.5.3 Nurses

Choosing indicators that are nursing-specific is a vital mechanism of nursing care. The use of an indicator that can quantify the need for nursing time as accurately as possible is critical for planning nursing staff requirements and directing the actions of nurses so they can attend to patients' health care needs with knowledge, skill, competence, and safety (Kakushi & Évora, 2014). Stalpers, Kieft, van der Linden, Kaljouw & Schuurmans (2016:125) found a significant positive association between objectively measured quality of care using NSIs and the subjectively measured quality of care from nurses' perspectives, thereby affirming the value of NSI as a measure of quality of nursing care. The use of nurse-sensitive indicators highlights the critical role of nurses in promoting and improving health systems, demonstrates how their contribution is integrated with that of the multi-professional team, and increases their motivation (Barchielli, Rafferty & Vainieri 2022:8).

5.5.4 Nursing education

Nurse-sensitive indicators should be included in the curriculum of critical care nurses. This would enable student nurses to acquire knowledge of NSIs in their training. The implementation and use of nurse-sensitive indicators should be included in the accreditation of learning institutions, particularly where practical training is given. Besides improving the quality of ICU patient care, it enables student nurses and permanent staff to stay current and compliant with knowledge and practical skills supported by evidence-based education and practice.

5.6 LIMITATIONS

The literature review was limited to studies published since 2014 and written in English. Indicators reported in earlier publications, or in other languages, which could have been relevant, were thus excluded.

5.7 RECOMMENDATIONS FOR FURTHER RESEARCH

The indicators developed in this study need to be tested further and verified in clinical practice, then revised to practically suit the context in which they are used. Based on the findings, the researcher recommends that further research be conducted on the following topics:

- An investigation into the reliability and validity of the use of nurse-sensitive quality indicators in adult ICUs in South Africa
- The effect of NQIs on nursing practice in adult ICUs in a public and a private hospital in Limpopo province.
- ICU nurses' perspectives on the implementation and outcomes of NQIs/NSIs in adult ICUs in South Africa
- Challenges to the implementation of NSIs/NQIs in adult ICUs in public hospitals in South Africa

5.8 PERSONAL REFLECTION

When my supervisor asked me to conduct a systematic review on nurse-sensitive indicators for ICU, I was not sure what it entailed. To start with my initial topic was something to do with nurses' resilience, so when the two supervisors changed my topic to nurse-sensitive quality indicators for ICU, at first, I asked myself, "what's this"? I had no idea what the topic meant. Then my co-supervisor told me to search Google Scholar, download and read systematic and scoping review articles on this subject. When I started reading, I realized that the term "nurse-sensitive" meant nursing-related activities and that "indicators" had something to do with quality of care that nurses provide to patients on a day-to-day basis.

Initially it appeared to me that nursing indicators was a totally new subject. However, as I continued reading, I thought that indicators were an indication of something. Further reading revealed that nursing indicators were, in fact, a measure of quality of health care provided by nurses. I then realized that I was unknowingly already practising the use of quality indicators at my work in ICU. For example, measuring cuff pressure to ensure that it is within acceptable limits helps prevent aspiration in a sedated patient thereby preventing ventilator-associated pneumonia (VAP), and that ensuring that central line is free from potential infections is part of maintaining quality by preventing hospital-acquired infections.

As I continued the literature search, downloading articles on nurse-sensitive indicators for ICU and reading them, I realized that nursing-sensitive indicators are very much related to what I do in ICU on a day-to-day basis. I came to learn that these indicators are used for monitoring quality in relation to what nurses do in ICU. I learnt that quality indicators will enable nurses to provide optimal nursing care safely, in addition to ensuring patient safety, improving patient outcomes, preventing avoidable loss of life, and providing patient and family satisfaction with care received. The use of indicators has other advantages such as being the basis for quality improvement initiatives, optimal use of resources, providing nurses' job satisfaction, and preventing errors that may lead to medico-legal hazards and litigation from malpractice.

The acquired knowledge has changed my perception of nurse-sensitive indicators and their application in ICU. Now that I have an insight into what they are, I will ensure my patients receive quality nursing care by careful use thereof to reveal my role in patient care in ICU and

to improve the quality of care provided. I will also attempt to impart this knowledge to my colleagues in ICU, those with or without Critical Care specialty, to ensure they understand the relationship between use of quality indicators and the quality of care provided to patients. In my own professional development, I will maintain the standard of care using nurse-sensitive indicators in my day-to-day activities to enhance what I have read, thus translating theory to practice.

5.9 CONCLUSION

This study sets the stage for new initiatives aimed at filling the current gaps in the use of standardized national nurse-sensitive indicators for ICUs in South Africa. The NSIs identified can be used in clinical practice to detect clinically recognizable outcomes among critically ill patients in an ICU environment; achieve clinical meaningfulness by monitoring all dimensions of health status influenced by nursing care; provide evidence of critical care nurses' contribution to patients' outcomes, and act as a baseline for establishing quality improvement measures in ICUs in South Africa. The use of these nurse-sensitive indicators specific for the ICU should influence clinical nursing practice, guide improvements in the care delivered, and contribute to the transformation and improvement of the health care system in South Africa.

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ANNEXURE A

ETHICS APPROVAL:
UNIVERSITY OF PRETORIA

ANNEXURE B 1

CONSENT FORM

Annexure B 1 Consent form

CONSENT FORM

Title: Consensus on nurse-sensitive quality indicators for adult ICU in South Africa

Principal Investigator: Rose A. Okello

Supervisor: Prof IM Coetzee

My name is Rose Okello, a master of nursing science student at the Department of Nursing Science, University of Pretoria, and principal investigator in this study. I would like to invite you, because you are either a professional nurse in ICU, or a nurse manager, or a nurse educator, to participate in this research project. The aim of the study is to reach a consensus on nurse sensitive-quality indicators that can be used to monitor and the evaluate care that adult patients receive in ICUs in South Africa. Nurse-sensitive quality indicators consists of principles, programmes, or objective assessment scales that measure nursing related tasks and help to ensure high quality

nursing care a patient receives. A significant contribution of patient care in the intensive care unit is made by the nursing staff who provides continuous care every day. Evaluating the quality of nursing care is therefore an important part of evaluating the overall quality of care provided to the patient.

Your participation in this study is very important and will help to develop a set of nurse-sensitive quality indicators suitable for use in adult ICU in South Africa in future. Please note that this study will be used for dissertation for my master's degree qualification, and we would like to publish the result in accredited professional journals.

There are no recognised risks to participate in this study. While there will not be individual benefit of participating in this study, it will be an opportunity to contribute to quality patient care. On a professional level, the unique knowledge gathered from this study will enhance quality patient care efforts, by specifying indicators that are useful and effective in monitoring and evaluating the nursing care we provide to our patients in ICU.

Any information that you provide is confidential. For example, your name will not appear on any of the questionnaire and there will be no means to identify your specific answers. Your response will be in your personal capacity and will not reflect the views of your employer or institution. The data will be kept in the researcher's and the supervisor's persona; computers that is password protected and will be destroyed after the study in accordance with the University of Pretoria research ethics guidelines. All measures will be taken to make sure that your response is not viewed by unauthorised persons. Your participation is entirely voluntary and you are free to decline to participate. If you decline, this will not affect you negatively in any way. You are also free to withdraw from the study at any point and that includes completing the questionnaire after you have started, even if you did agree to take part, initially.

I would be grateful if you would complete the full survey. If you choose to participate, it will take you about 30 minutes to answer the questions.

Should you have any questions regarding the research study, please feel free to email me or my supervisor at the following addresses:

Rose Okello (Principal Investigator) arokellof@yahoo.co.uk
Prof IM Coetzee (Supervisor) (Isabel.coetzee@up.ac.za

I have read and understood the information provided in this study and, I agree to participate by completing this survey.

☐Yes

☐No

ANNEXURE B 2

CHARACTERISTICS OF ARTICLES FOUND

Annexure B 2 Characteristics of articles found

Authors, publication date, country	Research aim (s)	Methods: study design, population, tools used, study duration	QIs and formula or definition identified	Description of participants	Results
Altafin *et al*., (2014) Brazil	To evaluate the nursing workload in an adult ICU of a university hospital using the NAS instrument and to analyse the effects that demographic and clinical characteristics have on their workload.	A longitudinal, prospective study involving patients admitted to the adult ICU between March 10, 2008 and December 31, 2008. Therapeutic Intervention Score System (TISS 28) and Nursing Activity Score (NAS) were used to measure and characterize the nursing workload in the ICU, in addition to the Acute Physiology and Chronic Health Evaluation (APACHE II) severity score and Sequential Organ Failure Assessment (SOFA) organ dysfunction score to	• Professional nurse per ICU bed. • NAS score: percentage of time spent by the nursing staff caring for critically ill patients i.e., it represents how much of a staff member's working time was required by a patient over the last 24 hours. A score of 100 points indicates that a patient required 100% of the nurse's time in the past 24 hours. Each point in the NAS is equivalent to providing 14.4 minutes of nursing care.	Patients admitted consecutively to the ICU during the study period	• A total of 437 patients were evaluated. The type of admission, length of stay in the ICU and condition at discharge from the ICU and hospital were the variables associated with differences in nursing workload. • the mean NAS-Admission with the APACHE II, mean SOFA-Admission and mean TISS-28-Admission were significant ($p<0.001$ • The high mean NAS observed in the study reflects that each patient required more than half of the nursing workload, thus suggesting an ideal proportion of one nurse professional per ICU bed.

		characterize patient severity			
Berenholtz *et al*., (2014) USA	To evaluate the impact of the national program on CLABSI rates.	A collaborative cohort study Implemented in 1,071 adult ICUs from 44 states, reporting 27,153 ICU-months and 4,454,324 catheter-days of data. Duration of reporting: between 1-18months	• Central line–associated bloodstream infections (CLABSIs): reported as cases per catheter days	• Nurse leaders • Frontline nurses • Ancillary staff • Unit-level physician • Infection preventionist • Hospital quality and safety leaders; • Senior executives	• The overall mean CLABSI rate significantly decreased from 1.96 cases per 1,000 catheter-days at baseline to 1.15 cases at the sixth quarter after implementation • The number of ICUs per quarter that achieved a mean CLABSI rate of less than 1 case per 1,000 catheter-days increased from 461 (56%) at baseline to 661 (70%) • Statistically significant decrease in CLABSI rates were demonstrated during all the observation periods compared with baseline

Coombs *et al*., (2016) New Zealand	To find out how nurses prepare families for and support families during withdrawal of life-sustaining treatments in intensive care	An integrative literature review using data sources MEDLINE, CINAHL plus, Psych INFO, PUBMED, Scopus, EMBASE and Web of Knowledge, searched for papers published between 2000 to May 2015	• Clear articulation of care given by nurses to patient and family
			• Information and communication
			• Managing withdrawal of life-sustaining treatment
			  ○ How individual treatments are withdrawn
			  ○ Timing of withdrawal
			  ○ Managing resultant symptoms from withdrawal
			• Continuing to care
				ICU nurses	• 24 out of 479 papers included in analysis
					• Most studies focussed on withdrawal of life –sustaining treatments as part of an exploration of end-of-life care
					• Three themes emerged on how nurses prepare and support families:
					  ○ Equipping families for end of life through information and communication

			○ Preparing the patient ○ Emotional support ○ Adapting the environment ○ Nurse presence with the family ○ Creating memories		○ Managing the withdrawal of life-sustaining treatment ○ Continuing to care
Danielis *et al*., (2019) Italy	To explore the characteristics of the available studies on nursing sensitive outcomes in the ICU; and To identify all reported outcomes used to date to measure the contribution of nursing care in this setting.	• A scoping review	• Pressure ulcers: prevalence and/or incidence rate using Norton Scale (risk identification) • Ventilator-associated pneumonias: prevalence and/or incidence rate • Physiological parameters: patient bedside monitor • Delirium: Confusion-Assessment Method-ICU; Intensive Care Delirium Screening Checklist; Neecham tool and/or Confusion-Assessment Method-ICU; Automatic Prediction of Delirium • Central Line-Associated Bloodstream Infections: prevalence and/or incidence rate • Mortality: ICU mortality; 30-day mortality; In-hospital mortality • ICU length of stay: number of ICU days	• Critically-ill adult patients admitted to the ICU.	• The most studied outcome was pressure ulcers (n = 20), followed by ventilator-associated pneumonias (n = 19), physiological parameters (n = 14), and delirium (n = 13). • The least often studied outcomes were quality of life, secretion clearance, patient-ventilator dysnchrony, and post-extubation dysphagia, all reported in only one study respectively. • The measurement systems used included instruments/tools (e.g., Confusion-Assessment Method-ICU), direct clinical measures (e.g., level of glycemia), administrative data (e.g., length of stay), and patients' narratives (e.g., interviews and informal conversations). • 22 studies did not report a description outcome

			• Length of mechanical ventilation: number of ventilator days		• Outcomes most often studied are those regarding safety (n = 77, 33.1%), followed by clinical (n = 72, 30.9%), functional (n = 70, 30.0%), and perceptual (n = 14, 6.0%) domains
Driscoll *et al*., (2018) USA, UK, Australia	To identify studies conducted in acute specialist units, which examine the association between nurse staffing levels (NPRs) and nurse-sensitive patient outcomes.	A systematic review by searching electronic databases and grey literature (Medline (OvidSP), Medline in Process (OvidSP), CINAHL (Cumulative Index to Nursing and Allied Health Literature) (EBSCO), PsycInfo (OvidSP), Embase (OvidSP), HMIC (Health Management Information Consortium) (OvidSP), Cochrane Database of Systematic Reviews, Web of Science; Science Citation Index Expanded (ISI Web of Knowledge), Web of Science	Nurse per patient ratio (NPR) • the number of nurses working per shift or over a 24-hour period divided by the number of beds occupied by a patient over the same time period; or • the number of nursing hours per patient bed days (NHPPD) Postoperative in-hospital mortality in ICU • Unplanned readmission to ICU or operating theatre • Unplanned readmission and/ or in-hospital mortality in the general wards • Cardio pulmonary resuscitation • Falls • Falls with injury • Hospital-acquired pressure ulcers • Medication occurrences • Restraint use • Monthly mortality • Ventilator days		This analysis found that a higher level of nurse staffing was associated with a decrease in the risk of in hospital mortality (OR 0.86, 95% CI 0.79–0.94) and nurse-sensitive outcomes. In ICUs, they found a higher number of NHPPD was associated with a lower FTR rate Patients cared for with a higher number of NHPPD were 68% less likely to experience bloodstream infections (95% CI 0.15–.17), 79% less likely to experience pneumonia (95% CI 0.08–0.53) and there was a 31% reduction in risk for a decubitus pressure ulcer (95% CI 0.49–0.98). Median NPR (per shift): 1:1.5 and IQR 1:1.3 -1:1.8 In univariate analysis lower NPRs were associated with fewer nosocomial infections (RR 0.42, 95% CI 0.32–0.55)

			• ICU length of stay • In-hospital mortality • Incidence of VAP • Use of physical restraints • Annual mortality • ICU-acquired infections • Early onset VAP Late onset VAP • Duration of ventilation • Hospital length of stay • Mortality at time of ICU discharge by shift • Quality of care was • Failure to rescue • mortality in surgical patients preceded by a hospital-acquired complication such as pneumonia, DVT, pulmonary embolism, sepsis, acute renal failure, shock or cardiac arrest and gastrointestinal haemorrhage or acute ulcer)		In multivariate analysis, NPR was not associated with nocosomial infections As the NHPPD decreased so did the risk of developing shock increase 3-fold (RR 3.48, Average NHPPD was 17 (SD+5.1) Higher NHPPD were significantly associated with a lower incidence rate of: • 30-day mortality (OR 0.81, 95% CI 0.69–0.95, P≤0.001) • CLBSI (OR 0.32, 95%CI 0.15–0.70, P≤0.05) • Decubiti (OR 0.69, 95% CI 0.49–0.98, P≤0.01) VAP (OR 0.21, 95%CI 0.08–0.53, P≤0.05) Average nursing hours to weighted patient cases was 36.2 (SD+9.3) Increase in number of nursing hours was associated with six fewer deaths for every 1000 discharged patients Median NPR: Day shift: 1.3 (IQR 1.0–1.8) Evening shift: 1.6 (IQR 1.2–2.0) Night shift: 2.0 (IQR 1.4–2.5) As the NPR increased, patients were 30% more likely to experience a parental medication error (OR 1.3, 95% CI 1.03–1.64, P=0.03) (multivariate regression) The mean acuity-adjusted nursing hours per patient day (NHPPD)

			• Nosocomial device associated infections: • number of ventilator infections • number of central venous catheter associated infections per 1000 device days • Deep vein thrombosis • Pneumonia • Upper GI bleed • Parenteral medication errors: wrong dose, wrong drug, wrong route, wrong time, missed medication • Postoperative complications Postoperative respiratory failure Urinary tract infections • Hospital-acquired pneumonia • Hospital-acquired sepsis		was 2.62 (SD=0.29) No significant association was found between NHPPD and patient outcomes They estimated that 121 infections could be avoided if the NPR <2.2 NPR was variable; 1:2 in (5 units), 1:3 in (10 units) and 1:4 or more (13 units) Lower NPR (1:2) was independently associated with a lower 28-day mortality (HR 0.459, 95% CI 0.211–0.998) NPRs ranged from 1:1 to 1:>2.5 As NPRs increased the risk of death increased- by a factor of 3.5 (1.3–9.1) when the NPR was :>2.5 15.52 NHPPD (2.03 SD) Statistically significant association between higher NHPPD and lower rates of failure to rescue in ICUs Average total nursing hours per patient day in ICU was 15.98 (SD 3.42) A higher number of NHPPD was associated with lower fall rates (OR 0.95, 95% CI 0.94–0.97, P<0.001) Average total nursing hours per patient day was 15.98 (SD 3.42) A decrease of NPR by one patient was associated with a 30% infection risk reduction in

					univariate analysis. Association remained unchanged in multivariate model, indicating that none of the other variables examined were true confounding factors Median daily NPRs were 1.9 nurse per patient; range 1.4–5.3 (IQR 1.8–2.2) A lower NPR ratio was associated with a decreased risk for late-onset VAP (HR 0.42, 95% CI 0.18–0.99) NPR varied from 1:1 to 1:4 Number of restraints increased as the NPR increased ($\chi 2=17.17$ P=0.001) or every increase of one patient per nurse there was a 3.7% increase in annual ICU Average total NHPPD ranged from 9.56 (SD±0.4) in medical/surgical wards to 18.27 (SD±3.9) in CCUs Significant correlation between higher total NHPPD and lower incidence of hospital acquired pressure ulcers (P<0.05). Significant correlation between lower restraint uses with higher NHPPD (P<0.05) No significant correlations between all other outcome measures and total NHPPD

					Mean NPR 1:0.50 Lower NPRs were associated with lower ventilator days (OR −2.08, 95% CI −5.377 to −0.166, P=0.037) Secondary care intensive care unit NPR: 1:0.98 Every additional patient per nurse resulted in a 9% increase in the odds of death (OR 1.09, 95% CI 1.04–1.14) Each additional patient cared for by a nurse would result in an additional 15 deaths per 1000 patients NPR varied from 1: 1 to 1:3 VAP incidence was significantly lower in ICU units with 1:1 NPR compared to units with a ratio of >1:1 (9.3% vs. 24.4%, P=0.002) (univariate analysis)
Dubois *et al.,* (2017) Canada	To determine an optimal set of indicators that can be used on a priority basis to assess the performance of nursing care providers and their contribution to healthcare system	Reaching a consensus on which indicators can be used on priority basis in three steps: 1.Establishing a preliminary list of indicators that appears most frequently in the literature for in-depth analysis	• Quantity and intensity of nursing resources • Composition of care team • Number of continuous hours worked • Nursing interventions for prevention and promotion • Symptom management (pain and fatigue) • Discharge planning • Pressure ulcers • Medication management errors	• Nursing research experts	25 indicators were identified in the first step These were reduced to 12 based on the 5 criteria

	performance based on the most up-to-date scientific knowledge regarding scientific evidence to the nursing sensitivity attribute; relevance or importance; feasibility; potential for bench marking; and usability	2. Listing the theoretical and empirical evidence supporting each of the selected indicators and confirming that they are related to nursing 3. Independently rating each one of the indicators in the preliminary list by an expert panel based on 5 pre-determined criteria	• Urinary infections • Falls • Length of stay • Readmissions		
Duszynska *et al*., (2016) Poland	To evaluate the incidence of UTI in ICU patients, to determine their aetiological factors, to assess the compliance with the preventive recommendation and to compare the trend of CAUTIs with international reports and	A prospective study in surgical-medical ICU between 01.01.2012 and 31.12.2014. Data recorded daily in infection surveillance cards	• Device utilization ratio (DUR): determining the percentage of patients with urinary catheters UCU-R=number of in-dwelling catheter days ÷ total number of patient days x 100 • Incidence of density of UTIs: UTI density ratio = number of patients with UTIs ÷ total number of catheter-days X 1000 • Incidence rate i.e., number of new cases per unit time – a year (2012, 2013, 2014) – per 100 ICU admissions	Patients with indwelling catheters for longer than 48 hours	UTI diagnosed in 91 (7%) out of 1261 ICU patients during 14006 person-days of hospitalization Incidence rate: 7.22/100 patients admitted to the ICU. CAUTI constituted 36% (n= 255) of total number of hospitals acquired infections over the study period. Total number of catheter utilization days was 12917 Incidence of CAUTI was 6.81 (3.02 – 9.18) per 1000 catheter-days. Central catheter utilization rate was 92.21±4.51%.

	findings from earlier studies				Bundle element most strictly observed was prevention of improper catheter location.
Evangelou *et al*., (2020) Cyprus	To identify potential nursing QIs for adult ICUs through a survey and expert consensus process	Validated QIs initially identified via a systematic literature review by the same author was presented to 2 different expert panels from Europe and Cyprus to reach a consensus on feasibility, representativeness and importance based on agreement on a 4-point Likert scale. Those attaining 60% consensus were further subjected to a 3rd expert panel in a face-to-face consensus meeting.	• Surgical wound • Application of physical restraints • patient falls • health care associated VAP • Accidental removal of IV catheters • Removal of NGT occasioned by occlusion • Unplanned extubation • MDR • Healthcare (ICU) associated UTI • Medication administration errors • Pressure ulcers • Health care associated (ICU) central line infections (CLBSI) • Readmission rates • Ventilator days • Standardized mortality rates • LOS	Nursing research experts	To identify potential nursing QIs for adult • ICUs through a survey and expert consensus process
Evangelou *et al*., (2018) Cyprus	To identify potential QIs, specifically patient-centred clinical NSOs, that may be measured in the ICU and have	An integrative literature review focused on search of electronic databases Ovid Medline, PubMed, Cumulative Index of Nursing and Allied Health	• Falls: annual rates per 1000 patient days • Medication administration errors: annual rates per 1000 patient days • Skin breakdowns: annual rate per 1000 patient days	Nursing research experts	To identify potential Qis, specifically patient-centred clinical NSOs, that may be measured in the ICU and have been found to be associated with variables reflecting the quantity and/or quality of nursing care, and to

	been found to be associated with variables reflecting the quantity and/or quality of nursing care, and to assess the methodological quality of the QIs identified.	Literature (CINAHL) and Cochrane library for relevant articles published between 2000 and 2016.	• Urinary tract infection: annual rate per 1000 patient days • Central catheter line infection: annual rate per 1000 patient days • Blood stream infection: annual rate per 1000 patient days • Mortality: deaths that occurred in the hospital or on the date of hospital discharge • Complications related to mortality and are nurse sensitive: • Cardiac complications: - acute MI (ICD-9-CM code: 410); arrest (ICD9-CM code: 4275) • Complications after a procedure • Respiratory complications: pulmonary insufficiency after a procedure; reintubation; aspiration; ventilation > 96 hrs • Other complications: acute renal failure; septicaemia: platelets transfusion • hospital LOS; cost • postoperative infection; aspiration; reintubation; pulmonary insufficiency; pneumonia; septicaemia; cardiac complications; cardiac arrest; acute MI; renal failure;		assess the methodological quality of the QIs identified.

			reoperation for bleeding; surgical complications • CVC associated with BSI: according to the NNIS system definition per 1000 CVC days • PU: number of hospital acquired PUs (grade II or greater)/number of patients assessed for skin break down • Medication errors: number of reported medication errors/ number of dispensed doses • Falls: number of unplanned descents to the floor/ number of patient days • Patient satisfaction with pain management: percentage of patients responding very satisfied • Restraint application: number of hours in restraints/ number of total hours available to restrain patients • Readmissions • Critical incidence • Cost • Human errors: venous lines and catheters, respiratory system, cardiovascular system, drug related complications, neurological system complications, urinary system complications, gastrointestinal		

			system complications, skin and muscular system, management complications: All definitions of critical incidents and categorization of complications were listed including diagnostic criteria • Sentinel events. All sentinel events were presented as rates per 100 patient days • Airway: unplanned extubation - artificial airway obstruction; cuff leakage; prompting reintubation • Indwelling lines: iv cannulas and the attachment fluid delivery sets; catheters: arterial line, CVP, pulmonary artery catheters, foley, dialysis; probes and drains: unplanned dislodgment, inappropriate, disconnection of chest drains and nasogastric tubes • Equipment failure: infusion devices; ventilator and accessories; renal replacement devices; power and oxygen supply • Alarms: inappropriate turn off • NGT loss: definition of ANA, National Database of Nursing QIs		

			• CVC loss: number of CVC losses/ number of patients with CVC per day x 100 • Extubation incidence: definition of ANA, National Database of Nursing QI • VAP: according to definition and formula of NNIS protocols • UTI: according to definition and formula of NNIS protocols • 30-day mortality: the date of index admission in inpatient standard analytic file to the date of death in the denominator file,		
Floroff *et al*., (2014) USA	To investigate the use of PIMs and DBI and their associations with clinical outcomes in critically ill elderly patients with neurological injury during their admission in the neuroscience ICU (NSICU). Specific aims were: • Identify PIMs and determine a	Retrospective review of medical records of consecutive critically ill adult patient ≥65 years of age admitted to the NSICU of Virginia Commonwealth University from March 2011 to July 2011 to identify PIMs in these patients and use these values to calculate DBI.	• Potentially Inappropriate Medication (PIM) described as a medication having potential risks that outweigh its potential benefit in an elderly patient measured as prevalence (%) using Medication Appropriateness Index, or Beers Criteria, or STOPP and/or START Drug Burden Index (DBI) is a measure of use of specific PIM with anticholinergic and/or sedative properties calculated for each medication by dividing the daily dose by the recommended minimum daily dose (Dose/Minimum Daily Dose). Total	•	There were 112 critically ill elderly NSICU patients included in this study. • Of these, 76 patients received B2 intermittent PIMs and 36 received >2 int PIMs during NSICU admission • The median (IQR) NSICU LOS, during which PIMs were prescribed, was <2 days for patients who received B2 intPIMs and <4 days for patients who received >2 intPIMs. • A change in RASS score occurred with 50 PIM doses. RASS scores decreased with 28 (56 %) PIM doses and were

	DBI for patients • Determine if a change in neurological status occurred pre- to post-PIM dosing, using the GCS and RASS scores as measures of neurological status. Determine if the number of PIMs administered during the ICU stay and DBI is associated with clinical outcomes.		DBI is determined by summing the daily DBI for each PIM. Minimum daily dose is identified by means of Physician's Desk Reference and the product information of each PIM.		most frequently associated with opioid use • The median NSICU LOS and hospital LOS for patients who received B2 intPIMs, as compared to those with >2 intPIMs, were shortened by 2.16 and 4.5 days ($p < 0.001$). There was no statistically significant difference in mortality between groups
Foster *et al*., (2020) Australia and New Zealand	To investigate the prevalence of discharge delay and the association between discharge delay and patient outcomes including hospital	A retrospective study using data from the Adult Patient Database, collected from de-identified individual patient data for all patients discharged alive to a ward, from their first ICU admission in the	• Discharge delay: mortality and readmission rates to ICU declines with increasing discharge delay, in patients with high severity of illness on admission to ICU. • Hospital mortality • Readmission to ICU • Length of stay	Adult ICU patients	1,014,540 patients were discharged alive from 190 ICUs to a ward. Overall, 756,131 (75%) of patients left the ICU within 6 hours of being deemed ready for discharge Most patients were deemed ready (time of day when the decision was made) for discharge between 9 and 11 A.M. Discharges from ICU increased between 2011 and

	mortality, readmission to ICU, and length of hospital stay after ICU discharge.	contributing hospitals between January 2011 and December 2019 inclusive.			2019, and longer discharge delays become more frequent The overall mortality was 3.1%, with the lowest unadjusted mortality seen in those who were discharged within 6 hours of a decision that the patient was ready to leave Discharge delay between 24 and 72 hours was associated with a lower odds of mortality. This was lowest between 48 and 72 hours (OR, 0.87; 95% CI, 0.79–0.94). Adjusted in-hospital mortality was highest when the decision for ICU discharge occurred in the evening (OR, 1.26; 95% CI, 1.19–1.34). There was a statistically significant interaction between categories of baseline risk and discharge delay (P<0.001).
Fraser *et al*., (2015) USA	To assess four nurse-sensitive quality-of-care indicators: falls, ventilator-associated events, pressure ulcers, and catheter-associated urinary tract	A retrospective chart review of 66 ICU patients receiving routine care and 66 receiving early mobility. Richmond Agitation–Sedation Scale (RASS) scores, delirium days, and functional outcomes using Barthel Index	• National Database of Nursing Quality Indicators data collection and submission guidelines was used to indicate the presence of falls, ventilator associated events, pressure ulcers, and CAUTI • Sedation levels was measured by RASS score or CAM-ICU	• Critical care RN • Physical therapist • Respiratory therapists (RTs)	• 15 patients (23%) in the routine care group were readmitted to the ICU within 30 days, whereas only seven patients (11%) in the mobility group were readmitted • The routine care group had two falls, one ventilator-associated event, two pressure ulcers, and 12 CAUTIs compared with the

	infections [CAUTIs]), as well as hospital costs, and sedation levels	scores was used to compare outcomes in patients who received an early mobility intervention from a dedicated mobility team with ICU patients who received routine care			mobility group, which had only one CAUTI. • The mean ICU length of stay was slightly shorter in the mobility group than in the routine care group (6.4 versus 6.5 days) • The mean hospital length of stay was longer in the mobility group than in the routine care group (12.6 versus 10.6 days). • In-hospital mortality occurred in nine routine care patients (14%) versus no deaths occurred in the mobility patients. • Compared with the routine care group, 12 additional mobility group patients were discharged to rehabilitation • The mean cost per patient was lower in the mobility group than in the routine care group ($125,309 versus $127,000 • Deeper sedation in the routine care group (RASS score −2.18) versus greater wakefulness (RASS score −0.82) in the mobility group • The mobility group also had significantly fewer delirium days, as measured by CAM-

					ICU, than the routine care group. • The mean Barthel Index score for the mobility group increased significantly from 45.9 at ICU admission to 85 at ICU discharge. • Mechanical ventilation days in the routine care and mobility groups were 3.3 and 3.8 days, respectively. However, patients in the mobility group got out of bed on 2.5 more days than patients in the routine care group
Ju *et a*l., (2017) China	To establish scientific, practical, evidence-based nursing-sensitive quality indicators for emergency nursing.	Systematic literature review to establish and select evidence-based indicators followed by an expert Delphi panel to reach a consensus on the indicators	• Patients' satisfaction with emergency nursing service • Rate of prompt provision of painkillers to patients with severe pain • Pain assessment rate • Pain reassessment rate in patients with moderate/severe pain • Rate of falls • Incidence of pressure ulcers • Rate of drug delivery errors • Time compliance rate for b2 receptor agonist and bronchodilator treatment in acute severe asthma patients • Percentage of patients with severe infection or infectious	Delphi panel of 40 experts included • Chief nurse (n = 2) • associate chief nurse (n = 6) • nursing supervisor (n = 25) • chief physician (n = 2) • associate chief physician (n = 5)	Final list: 1. Patients' satisfaction with emergency nursing service 2. Rate of prompt provision of painkillers to patients with severe pain 3. Pain assessment rate 4. Pain reassessment rate in patients with moderate/severe pain 5. Rate of falls 6. Accident incidence 7. Incidence of pressure ulcers 8. Rate of drug delivery errors 9. Eligible triage rate 10. Bloodstream infection rate following emergency insertion of central venous catheter

			shock who receive broad-spectrum antibiotics within 1 hr after a definite diagnosis • BLS/ACLS certification rate • Critical value immediate reporting rate • Green channel: emergency care–ICU time compliance rate • Triage target response time attainment rate • First aid medication compliance rate		11. Rate of EKG examination within 10 min. after arrival of acute myocardial infarction patients 12. The thrombolysis/PCI rate of acute myocardial infarction patient 13. PCI treatment rate within 90 min. among patients requiring basic PCI treatment 14. Thrombolysis treatment rate within 90 min. among myocardial infarction patients with ST-segment elevation verified by a first EKG 15. Time compliance rate for b2 receptor agonist and bronchodilator treatment in acute severe asthma patients 16. Rate of CT examination within 40 min. after arrival at the ED for among patients who appear to have acute stroke 17. Blood glucose test rate in the ED among patients with acute 18. EKG record among patients with acute stroke 19. Percentage of patients with severe infection or infectious shock who receive broad-spectrum antibiotics within 1 hr after a definite diagnosis

					20. Active bleeding time compliance rate from admission until disposition 21. Time compliance rate for patients with head injuries from admission until CT scan 22. BLS/ACLS certification rate 23. Availability of first aid equipment 24. Critical value immediate reporting rate 25. Green channel: emergency care– operating room time compliance rate 26. Green channel: emergency care–ICU time compliance rate
Klompas *et a*l., (2014) USA	To assess the preventability of ventilator-associated events (VAE)	Multi centre quality improvement collaborative prospective study of VAE surveillance among 20 ICUs between November 2011 and May 2013. Nurses and respiratory therapists performed paired daily spontaneous awakening trials (SAT) and spontaneous breathing trials (SBT) and temporal trends in VAE measured	• Ventilator days • SAT rates SBT rates	• Nurses • Respiratory therapists	5164 consecutive mechanical ventilations Frequencies of SATs, SBTs, and percentage of SBTs performed off sedatives increased SAT performance rates increased form 14% of days where indicated to 77% where indicated corresponding to increase from 5% of ventilator days to 21% of ventilator days SBT performance rates increased from 49 to 75% of ventilator days corresponding to 37% of ventilator days in the 1st month of collaborative and 35% of

					ventilator days in the last month of collaborative Percentage of SBT performed with sedatives off increased from 6.1 to 87% of SBT Improvements in SAT and SBT performance rates were paralleled by significant decrease in VAE rates. Mean duration of mechanical ventilation dropped by 2.4 days Significant association between monthly unit SAT and SBT performance rates and length-of –stay, mortality and VAEs
Koch *et al*., (2020) Switzerland	To determine indicators of nursing care performance by identifying structures, processes, and outcomes that are relevant, feasible, and have the potential for benchmarking in Swiss acute hospitals.	A modified Delphi technique consisting of a series of subsequent rounds using 3-point Likert scale, interrupted by controlled feedback (based on the information provided in the previous round), that seek to gain the most reliable consensus of a group of experts. Beginning the process with a set of carefully selected 19 indicator items	• Pressure ulcer (hospital acquired) Prevalence (%) • Falls • Nursing care hours per patient: • Composition of care teams: Levels of missed care (1RN/4 patients) • Nursing turn over • Use of restrains (vests and limbs) • Urinary infection from catheter use (hospital acquired) • Mortality (in hospital) • Length of hospital stay • Nursing interventions for promotion/prevention	• Clinical nurse specialist • Nursing management • Nursing research	12 indicators were found to be relevant, feasible, and has high potential for benchmarking: • Use of restrains (vests and limbs) • Quality of the working environment (assessed by the nurses) • Falls • Urinary infection from catheter use (hospital acquired) • Medication management errors • Nursing staff turnover • Nursing interventions for promotion/prevention

		from Dubois et al. (2017)	• Quality of the working environment (assessed by the nurses) • Medication management errors • Discharge planning (patient satisfaction) • Failure to rescue • Readmission, unplanned • 30-day death (mortality) rates • Patient satisfaction with nursing care • Number of continuous hours worked Functional status change		• Pressure ulcer prevention (hospital acquired) • Nursing care hours per patient • Discharge planning (patient satisfaction) • Failure to rescue
Kouatly et al. 2018 Lebanon	To describe the relationship between nurse staffing and NSOs at a Magnet designated, university hospital in a low-income country.	A 48- month prospective study	• Patient falls: • Injury falls: • HAPI: Hospital acquired pressure injuries • CAUTI: catheter-associated urinary tract infections		• Patient falls: defined as the rate per 1,000 patient days at which patients experience an unplanned descent to the floor; • Injury falls: defined as the rate per 1,000 patient days that resulted in an injury; • HAPI: defined as the total number of patients with any stage of pressure ulcer on the day of the prevalence study (excluding patients admitted with a pressure ulcer); • CAUTI: defined as the rate per 1,000 patient days at which patients experience an infection related to a catheter;

			• VAP: ventilator associated pneumonia • CLABSI: central line blood stream infections		• VAP: defined as the rate of infection related to 1,000 patient days on a ventilator; CLABSI: defined as any infection per 1,000 patient days related to a central line.
Mullin *et al*., (2017) USA	To implement and describe a multifaceted intervention to decrease CAUTIs in ICUs with an emphasis on indications for obtaining a urine culture.	A prospective study comparing result pre and post implementation (2013 and 2014) among ICUs aligning routine culturing practice with American College of Critical Care Medicine (ACCCM) and Infectious Disease Society of America (IDSA) guidelines for evaluating a fever in a critically ill patient. Surveillance data for CAUTI and hospital-acquired bloodstream infection (HABSI) were recorded prospectively according to National Healthcare Safety Network (NHSN) protocols. Device utilization ratios (DURs), rates of	• CAUTI rate • Device utilization rate • HABSI	Representatives from all intensive care unit (ICU) disciplines (i.e., paediatric, medical, surgical, neurologic, cardiac, heart failure, and cardiothoracic surgery) and infection prevention (IP)	There were 11,117 ICU admissions in 2013, resulting in 74,705 patient days; there were 11,589 admissions in 2014, resulting in 75,569 patient days. The DURs were 0.7 in 2013 and 0.68 in 2014. The number of urine specimens cultured decreased from 4,749 in 2013 to 2,479 in 2014. The CAUTI rate decreased from 3.0 per 1,000 catheter days in 2013 to 1.9 in 2014 (P= .0003; rate ratio, 0.6291; 95% confidence interval [CI], 0.49–0.81) The HABSI rates per 1,000 patient days decreased from 2.8 in 2013 to 2.4 in 2014 (P= .15). The rates of HABSI secondary to Enterobacteriaceae per 1,000 patient days decreased from 0.71 in 2013 to 0.66 in 2014 (P= .72; rate ratio, 1.1; 95% CI, 0.73–1.60). Conclusion: emphasized "stewardship of testing" by following published guidance for evaluation of a fever prior to

		CAUTI, HABSI, and urine cultures were calculated and compared.			ordering a urine culture in a critically ill patient.
Myers *et al*., (2018) Australia	To identify suitable indicators for measuring the impact of nurse staffing and nurse skill mix variations on patient outcomes in stand-alone high acuity areas.	A systematic review based on Population, Intervention, Comparator, Outcome, Study Design (PICOS)	• Mortality, • Length of stay, • Central-line-associated bloodstream infection, • Ventilator-associated pneumonia, • Sepsis, • Falls with injury, • reintubation, • Medication errors.	adult patients in stand-alone high acuity areas such as coronary care, intensive care, high dependency units,	Mortality was the most tested indicator with 13 studies reporting a significant association with nurse staffing, and six reporting no association. A range of infections in most studies, were significantly associated with nurse staffing variables. Pneumonia, sepsis, and pathogen presence were also found to have a significant association with staffing variables In several studies, the evidence supporting an association between nurse staffing and falls was stronger than that for pressure injuries. length of stay including hospital length of stay as and ICU length of stay, was significantly associated with nurse staffing in half of the studies that included this outcome Medication errors and reintubation were significantly

					associated with nurse staffing in most studies that assessed these outcomes
Noome *et al*., (2016) The Netherlands	To gain insight into the roles and tasks of ICU nurses during end-of-life care (EOLC) in the ICU	An integrative review of 3 electronic databases PubMed, CINAHL and EMBASE	• Care for ICU patient • Care for the family • Environmental aspects of EoLC • Organisational aspects of EOLC	Adult ICU ICU nurses	• Providing optimal pain and symptom management for the comfort of the patient is regarded as an important nursing intervention • Pain and symptom management is described in most studies solely as administering analgesics and sedatives • Gap exists between the theoretical models and actual care provided by ICU nurses during EOLC
Nowicki *et al.*, (2017) Australia	To report hospital acquired pressure injury (PI) incidence in intensive care and non-intensive care patients, and to assess the clinical characteristics and outcomes of ICU patients reported as having a hospital acquired PI to better	The setting for this study was a 630 bed, government funded, tertiary referral teaching hospital. A secondary data analysis was undertaken on all patients with a recorded PI on the hospital's critical incident reporting systems and admitted patient data collection from July 2006 to March 2015.	A PI is a localised injury to skin and soft tissues usually over a bony prominence due to pressure, friction or sheer forces or a combination of these. It is measured as number of PI per 100 or 1000 patient separations (discharged, died, transferred, or statistically separated) from any hospital permitted to admit patients, including public psychiatric hospitals	Quality effectiveness support team and the podiatry team	Total of 5280 HAPI reports in 3860 patients, which consisted of 726 ICU reports and 4554 non-ICU reports. Both HAPI incident reports and patients with HAPI have increased over time In the ICU, there was an overall increase in HAPI of 2.9/100 separations from 2007 (4.6 per 100 separations) to 2015 (7.5 per 100 separations) In the hospital, there was a mean decrease in PI of 2.1/1000 from 5.8/1000 separations in 2007 to 3.7/1000 separations in 2015.

	understand patient factors associated with their development in comparison to ward patients				During the study period, hospital activity increased from 24281 separations with an average length of stay of 6.4 days in 2007 to 50101 separations with an average length of stay of 3.5 days in 2015. Overall, the incidence of HAPI using the QHAPDC was 4.5/100 separations in ICU patients and 4.1/1000 separations in non-ICU patients. Incident reports limited to ICU patients with PI not present on admission have increased over time
Oner *et al*. (2021) USA	To provide a systematic review of the literature from 1997 to 2017 on nursing-sensitive indicators. To present a comprehensive perspective over the last 20 years,	Systematic review using a qualitative design with a deductive approach and mapping the relationships among all dependent and independent variables in the reviewed studies.	• Urinary tract infection • Pneumonia • Wound infection • Hospital acquired sepsis • Postoperative/post treatment infections • Respiratory tract infections		
Rajamani *et al*., (2020) Australia	Evaluate PPE preparedness in Asia-Pacific ICUs with reference to WHO	A cross-sectional web-based survey conducted between March and May 2020 in ICUs in Asia Pacific countries	• PPE preparedness • Level of PPE stock	Intensivists	633 ICU <u>Training</u> Training of endotracheal intubation reported in 35% of ICU (range: 18 – 79%)

	recommendations				Special intubation teams with senior anaesthetist/intensivist used in 66% of ICU (range: 33 – 93%) Training in donning and doffing regularly provided in 60% of ICU (range: 42 – 100%) Intrahospital transport provided in 20% of ICU (range: 8-50%) Waste disposal training provided in 39% of ICUs (range: 33-56%) <u>Choice of PPE</u> N95/P2 masks used for AGP only (38% of ICUs) N95/P2 masks used routinely irrespective of AGP (59% of ICUs) Use of personal air purifying respirators in 6% of ICUs Use of full body suits (35%; range: 0 – 94%) Use of head covers/caps – 71% Use of shoe covers – 45% Use of neck covers – 37% Use of hospital scrubs – 58% Routine showering/shampooing of hair after shifts – 60% Routine showering/shampooing of hair after PPE breach – 15% N95/P2 mask fit testing – 27% Mandatory observer monitoring of donning/doffing “(“buddy system”) – 37% of ICUs

					<u>Disposal of patients with Covid-19 in ICU</u> Managed in negative pressure room – 37% of ICU Avoidance of high-flow nasal oxygenation – 68% Others Adequate PPE stock – 52% Visitation rights – prohibited in 66%; unchanged in 28%
Saint *et al*., (2016) USA	To reduce catheter associated UTIs and improve attitudes and behaviour with respect to safety	Assessment of sustainability by dissemination of information to hospitals followed by data collection and guidance on key technical and socio-adaptive factors in the prevention of catheter associated UTI. Data collected on catheter use and CAUTI rates during 3 phases: at baseline, during implementation, and during sustainability. Multilevel binomial models were then used to assess	• Catheter use: defined as the proportion of patients with indwelling urinary catheters monitored as a process measure and calculated as the number of catheter-days divided by the number of patient days and multiplied by 100 • Catheter associated urinary tract infection rates: defined as the number of CAUTIs divided by 1000 catheter days	• ICU • Non-ICU	926 units in 603 hospitals in 32 states evaluable 59.7 were non-ICU and 40.3 were ICU located ICU were more likely to be in teaching hospital than in rural or critical access hospitals <u>CAUTI rates</u> Un-adjusted CAUTI rates decreased by 22.3% from 2.82 infections per 1000 catheter-days at the end of base-line to 2.19 per 1000 catheter-days at the end of sustainability period In adjusted analysis catheter days decreased from 2.40 infections per 1000 catheter-days at end of base-line to 2.05 per 1000 catheter-days at the end of sustainability period (IRR 0.86; 95% CI, 0.76-0.96; p=0.009)

		changes in catheter use and CAUTI rates.			Most reduction seen in non-ICU: from 2.28 to 1.54 (IRR 0.68; 95% CI, 0.66 to 0.82; p<0.001) Less reduction seen in ICUs: from 2.48 to 2.50 (IRR 1.01; 95% CI, 0.87 to 1.17; p=0.90) <u>Catheter use</u> Unadjusted catheter use decreased from 19.8% to 18.2% in non-ICU and from 61.1% to 57.6% in ICUs • Adjusted catheter use decreased from 20.1% to 18.8% in non-ICU (IRR 0.93; 955 CI, 0.90 to 0.96; p<0.001) but did not change in ICU (from 62.8% to 61.9% [IRR 0.98; CI 0.96 to 1.01; p= 0.15]
Sampathkumar *et al*., (2016) USA	To identify a bundle of interventions to reduce CAUTI	Piloting of a bundle consisting of 6 easy to remember elements, the "6 Cs" of CAUTI reduction, namely: consider alternatives to daily indwelling catheter; connect with a securement device; keep it clean; keep it closed; call for bladder scan before irrigating; culture urine only when indication is clear	• CAUTI rates per 1000 catheter-days • Standardised infection ratio (SIR) defined as the ratio of actual cases compared to what would be expected for that setting	• Infection prevention and control • Hospitalist • Patient care nurse • Urology technician advisor • Nurse educator • Nurse manager and supervisor	• CAUTI rates decreased by 70% from the 2013 baseline of 2.0/1000 catheter-days to 0.6/1000 catheter-days in 2015 • SIR for CAUTI in ICU reduced from 1.0 in 2013 and 2014 to 0.25 in 2015

				• Healthcare system engineer Administrators	
Stifter *et al.*, (2021) USA	To share the investigators' first-round experience in caring for critically ill COVID-19 patients	A description of the work and outcomes of institutional staff-driven PI teams utilizing the Plan-Do-Study-Act approach to quality improvement.	• Central line–associated bloodstream infection • Hospital-acquired pressure injuries • CLABSI case reviews • Prone-positioning team • Wound ostomy • Continence care nurse rounds • Catheter-associated urinary tract infections rates • Falls and falls with injury • A new standard for catheter care • pressure ulcers • patient satisfaction	• Registered nurses • Frontline practitioners • Specialty nurses, infection control nurses • Clinical nurse specialists • Unit leadership • PI staff	The following innovative plans were implemented in response to the influx of critical care patients and to optimize resources: • prone positioning, • placement of IV pumps outside of the patient rooms • iPads to facilitate virtual communication • redeployment of RNs as respiratory therapist extenders to assist with non-ventilated patients • acute care nurses were redeployed to work in the ICU environment led by an ICU RN
Sutton & Jarden, (2017) New Zealand	To describe a nurse-initiated quality improvement (QI) project that improved the care of critically ill patients in a New Zealand tertiary ICU	Developing the indicators and initiating intervention then recording outcomes and giving feedback	• Early enteral nutrition within 24 hours of admission • Timely antibiotics within an hour of admission • Daily mobilization • Daily sedation interruption • 3 hourly repositioning • Daily mobilization	• Senior nursing team responsible for infection control and health and safety. • Frontline nurse representatives	Compared outcome data for 2 consecutive time periods: 2014 and 2015 • All eligible patients have enteral nutrition commenced within the first 24 h of ICU admission (3% increase); • All eligible patients receive antibiotics within 30 min of prescription time (6% increase); • All eligible patients have a DSI (24% increase);

			• Endotracheal tubes repositioned and retied every 12 hours • Nasogastric tubes repositioned and retied and every 12 hours • Contextual factors such as ICU patient flow and acuity and nursing staffing levels	• Interprofessional decision makers • QI approval team • Resource acquisition team	• All eligible patients are mobilized early, between day 0 and 3 of their ICU stay (79% of patients in 2014 and 53% in 2015) • All eligible patients are mobilized daily in their ICU stay (11% increase in percentage of patients mobilized daily). Variable quarterly and annual improvement in relation to the three remaining standards (the three pressure ulcer prevention strategies)
Tabah *et al*., (2020) Australia	To describe the current reported practice, availability, training, confidence in use and adverse effects due to extended use of PPE by HCW from around the world caring for covid-19 patients who require ICU management	A web-based survey in order to elicit HCW reports surrounding PPE related to covid-19 pandemic. HCW involved with care of patients in critical care setting over 2 weeks from March 30 2020.	• Availability of PPE • Adequacy of training • Adverse effects • Usage of PPE	• Physicians (n= 1797; 67%) • Nurses (n=744; 27%) • Allied (n=170; 6%)	Most had formal training in use of PPE 2-person technique for doffing and donning – 26% Confidence with technic of using available PPE – 45% PPE-shift – 4 hours Adverse effect – 80% (heat [51%]; thirst [47%]; pressure areas [44%]; headaches [28%]; inability to use bathroom [27%]; and extreme exhaustion [20%])
Theeranut et al. 2019 Thailand	To examine the validity of the	Prospective descriptive study conducted in the ICUs	Pressure ulcer: incidence (%)	• Patients admitted to ICU	288 cases studied, of which 32 patients developed PUs Median APACHE II score was 18

	Braden scale in the ICU setting -off points. To demonstrate the performance of each tool at the optimal cut	of a tertiary care hospital from January to April 2019 by comparing the overall performance of the Braden scale in predicting the development of PUs in ICU patients with those of three risk assessment scales that have proven to be effective in the ICUs: the Braden (ALB) scale, the COMHON Index, and CALCULATE.		• Nurse	Majority of patients (52.8%) were admitted to the ICU because of organ failure (52.8%), and the median length of stay was 5 days. PU risk scores in predicting PU risk was fair with any of the three scales. The overall performance of the COMHON Index and Braden scale was poor. The optimal cut-off point for the Braden (ALB) scale was 13, resulting in a sensitivity of 65.62% and specificity of 73.04%. At a cut-off point of 3, the seven-item CALCULATE had a sensitivity of 68.75% and specificity 68.75%. The optimal cut-off point for the Braden scale was 12, with a sensitivity of 50% and specificity of 80.15%. A cut-off points of 14 for the COMHON Index yielded a sensitivity and specificity of 37.5% and 83.98%, respectively.
Yang *et al*. (2018) China.	To utilize the Delphi method to develop reliable indicators for the quality of ICU nursing care across China	Comprehensive literature search to identify relevant articles from which QIs were extracted. QIs were then presented to expert teams in 2 Delphi rounds to obtain consensus.	• Implementation rate of standard enteral nutrition management • Incidence of ventilator-related pneumonia (VAP) • Incidence of intravascular catheter-related infection (IVCI)	• Nurse managers Nurse specialists	• VAP: Number of patients who had ventilator-related pneumonia ÷ Total days of patients using the ventilator • IVCI: Number of ICU patients who had intravascular catheter related infection ÷ Total days of ICU patients using the central venous catheter

		Consensus was determined by analysing degree of authority (Cr) based on the educational level of the expert and the basis for judgment (experience, theoretical analysis, reference to data at home and abroad, and intuitive feelings) (Ca), and the degree of the expert's familiarity with the questions (Cs) such that: Cr = (Ca + Cs)/2	• Incidence of urinary catheter-related urinary tract infection • Incidence of pressure ulcer (PU) • Ratio of reaching the standard in the management of the blood glucose level • Implementation of early and appropriate broad-spectrum antibiotics within 1 hr after definite diagnosis • Implementation rate of hand hygiene • Rate of ICU staff who had completed advanced cardiac life support training • Rate of using restraints • Incidence of outgoing transport-related accident • Rate of evaluation for sedation • Rate of evaluation for analgesia • Rate of evaluation for delirium		• PU: Number of patients who had pressure ulcer during the period of research ÷Number of ICU patients' total hospitalization days (Patients who had "pressure ulcer" before being admitted to the ICU were excluded from the numerator and denominator). • Number of patients who had a serious infection or septic shock and were treated with broad spectrum antibiotics within 1 hr after definite diagnosis ÷ Number of patients who had a serious infection or septic shock) × 100% • (Number of days using restraints ÷ Number of ICU patients' total hospitalization days) ×100 • Number of patients who underwent evaluation for sedation ÷ Number of ICU patients who took sedative drugs) × 100 • Number of patients who underwent evaluation for delirium ÷ Number of patients in the ICU) ×100 • Number of nurses who had worked in the ICU for more

			• Percentage of nurses who had worked in the ICU for more than 3 years • Ratio of reaching the standard in the management of the blood glucose level • Ratio of deep vein thrombosis • Incidence of incontinence-associated dermatitis • incidence of unplanned extubation following endotracheal intubation in the ICU • Incidence of outgoing transport-related accidents		than 3 years ÷ Number of registered ICU nurses at the same period) ×100 • (Total number of time with blood glucose level reaching 8–10 mmol/L ÷ Total number of blood glucose measurements performed for critically ill patients) × 100 • (Number of patients who received DVT prevention ÷Number of patients in the ICU) ×100 • Incidence (‰) = (Number of patients who had incontinence-associated dermatitis ÷ Number of ICU patients' total days of hospitalization) ×1000 • Incidence (‰) = (Number of cases of unplanned extubation following endotracheal intubation ÷Total duration of endotracheal intubation [Days]) ×1000 Incidence (‰) = (Number of cases with outgoing transport-related accidents ÷Number of transported patients) ×1000

ANNEXURE B 3

NURSE-SENSITIVE INDICATORS IDENTIFIED AND ARTICLES

Annexure B3 Nurse sensitive indicators for ICU identified within included articles

	Altalfin et al., (2014)	Berenholtz et al., (2014)	Coombs et al., (2016)	Danielis et al., (2019)	Driscoll et al., (2017)	Dubois et al., (2017)	Duszynska et al., (2016)	Evangelou et al., (2020)	Evangelou et al., (2018)	Floroff et al., (2014)	Foster et al., (2020)	Fraser et al ., (2015)	Ju et al., (2017)	Klompas et al., (2014)	Koch et al., (2020)	Kouatly et al., (2018)	Maullin et al., (2017	Myers et al., (2018)	Noome et al., (2016)	Nowicki et al., (2017)	Oner et al., (2021)	Rajamani et al., (2020)	Saint et al., (2016)	Sampathkumar et al., (2016)	Stifter et al., (2021)	Sutton & Jarden (2017)	Tabah et al., (2020)	Theeranut et al., (2019	Yang et al., (2018)
VAP				X	X			X	X			X				X		X			X								X
Length of mechanical ventilation				X	X			X						X															
Unplanned endotracheal extubation								X	X																				X
Endotracheal re-intubation									X									X								X			
CLABSI		X		X				X	X							X	X	X							X				X
Accidental removal of IV catheters								X																	X				
Implementation rate of DVT prevention					X																								X
Evaluation of delirium				X																									X
Evaluation rate of level of sedation												X		X															X
Evaluation rate of analgesia						X			X				X																X
Use of restraints					X			X	X						X														X
Prescription/consent for restraints								X																					X
Upper GI bleeding					X																								
Implementation of enteral nutrition																									X				X
Management of blood glucose levels																													X

NGT removal due to occlusion and re-positioned								X	X																	X			X
Pressure ulcers				X	X	X		X	X			X	X		X	X				X					X			X	X
Incontinence associated dermatitis																													X
Implementation of early appropriate broad-spectrum antibiotic					X								X													X			X
Implementation of hand hygiene																													X
Use of PPE																						X					X		
CAUTI						X	X		X			X			X	X	X						X	X					X
Use of urinary tract bundles						X	X														X		X	X					
Potentially inappropriate medications						X		X	X	X			X		X			X											
Medication administration errors																													
Out-going transport related accidents																													
Inappropriate turn-off of the alarms																													
Discharge planning						X					X				X														
Failure to rescue						X									X														
Nursing staff turn-over															X														
Number of continuous hours worked					X	X									X														
Professional nurse per ICU bed	X				X																								
ICU nursing staff with ACLS													X																X
Nurses who worked in ICU for < 3 years																													X
Composition of care teams						X									X														
Falls/ falls with injury					X	X		X	X				X		X	X		X							X				

Length of stay				X		X		X	X		X				X			X												
ICU readmission rate					X	X		X	X						X															
Cost of treatment									X																					
Mortality				X	X				X		X				X			X												
Do not resuscitate / end of life care			X																X											

Annexure B 4 Nurse-sensitive indicators in adult ICU with definitions and formular

INDICATOR	FORMULA FOR CALCULATION	INDEX	METHOD OF COLLECTION
Respiratory system			
Ventilator associated pneumonia	(Number of patients who had ventilator-related pneumonia ÷ Total days of patients using the ventilator) x 100	%	Patient chart
Length of mechanical ventilation	Number of ventilator days		Patient chart
Unplanned endotracheal tube extubation	(Number of cases of unplanned extubation following endotracheal intubation ÷Total duration of endotracheal intubation [Days]) ×1000	Per 1000	Patient chart
Re-intubation	Endotracheal tubes repositioned and retied every 12 hours		Patient chart
Cardiovascular system			
Central line associated blood stream infections (CLABSI)	(Number of CLABSI ÷ Number of central line days) x 1000	Per 1000	Patient chart
Accidental removal of IV catheters			Patient chart
Implementation rate of DVT prevention	(Number of patients who received DVT prevention ÷Number of patients in the ICU) ×100	%	Patient chart
Neurological system			
Evaluation of delirium	(Number of patients who underwent evaluation for delirium ÷ Number of patients in the ICU) ×100	%	Patient chart
Evaluation of the level of sedation	(Number of patients who underwent evaluation for sedation ÷ Number of ICU patients who took sedative drugs) × 100	%	Patient chart
Evaluation of analgesia	(Number of patients responding very satisfied ÷ Number of patients in the ICU) ×100	%	Patient chart
Use of restraints	(Number of days using restraints ÷ Number of ICU patients' total hospitalization days) ×100	%	Patient chart
Prescription/consent for restraints use			Patient chart
Gastrointestinal system			
Upper GI bleeding			

Implementation of enteral nutrition	(Number of eligible patients who receive enteral nutrition within 24 hours of admission ÷ Total number of patients who received enteral nutrition at the same period) × 100		Patient chart
Nasogastric tube removal due to obstruction and re-positioned			Patient chart
Management of blood glucose level	(Total number of time with blood glucose level reaching 8–10 mmol/L ÷ Total number of blood glucose measurements performed for critically ill patients) × 100	%	Patient chart
Integumentary system			
Pressure ulcers	(Number of patients who had pressure ulcer during the period under consideration ÷ Number of ICU patients' total hospitalization days) x 100	%	Patient chart
Incontinence associated dermatitis	(Number of patients who had incontinence-associated dermatitis ÷ Number of ICU patients' total days of hospitalization) ×1000	Per 1000	Patient chart
Infection control			
Implementation of early appropriate broad-spectrum antibiotic	(Number of patients who had a serious infection or septic shock treated with broad spectrum antibiotics within 1 hr after definite diagnosis ÷ Number of patients who had a serious infection or septic shock) × 100%	%	Patient chart
Implementation of hand hygiene	(Frequency of implementation of qualified hand hygiene during the observation period ÷ Frequency of hand hygiene implementation at the same period) × 100	%	Unit report
Use of personal protective equipment			Unit report
Urinary system			
Catheter related urinary tract infection	(Number of patients who experienced an infection related to a catheter ÷ Number of catheter days) x 1000	Per 1000	Patient chart
Use of urinary tract bundles	Most frequently used urinary tract bundle		Patient chart
Patient safety			
Potentially inappropriate medications	PIM is a medication having potential risks that outweigh its potential benefits		Adverse events report

Medication administration errors	(Number of reported medication errors within the statistical period÷ number of dispensed doses during the statistical period) x 1000 patient days	Per 1000	Adverse events report
Outgoing transport related accidents	(Number of cases with outgoing transport-related accidents ÷Number of transported patients) ×1000	Per 1000	Unit report
Patient falls	(Number of patients who experience an unplanned descent to the floor ÷Number of patient days) x 1000	Per 1000	Patient chart
Inappropriate turn-off of alarms			
Nursing processes			
Implementation of discharge planning process			Patient chart
Failure to rescue	(Number of deaths ÷ Number of deaths resulting from complications of care such as pneumonia, deep vein thrombosis/pulmonary embolism, sepsis, acute renal failure, shock/cardiac arrest, or gastrointestinal haemorrhage/acute ulcer)		Adverse events report
Work-load			
Nursing staff turnover rate			Personnel data
Number of continuous hours worked	Nursing care hours per patient day		Unit report
Professional nurse per ICU bed	(Number of ICU nurses registered during the period of research ÷ ICU beds at the same period) ×100	%	Unit report
Training and experience			
ICU nursing staff with ACLS	(Number of ICU staff who had completed the advanced cardiac life support training ÷ Number of registered ICU nurses at the same period) × 100	%	Personnel data
Nurses who worked in ICU for < 3 years	(Number of nurses who had worked in the ICU for more than 3 years ÷ Number of registered ICU nurses at the same period) ×100	%	Personnel data
Composition of care teams			
Falls/ falls with injury			
Institution related			
Length of stay	mean ICU length of stay (days)		Unit report
ICU readmission	Number of patients readmitted to the ICU within 30 days		Unit report

Cost of treatment	Hospital cost per patient		Hospital data
ICU mortality	30-day mortality		Monthly report
Do not resuscitate/ end of life care			

Annexure B 5 Questionnaire for Delphi round 1

QUESTIONNAIRE

Title: Consensus on nurse-sensitive quality indicators for adult ICU in South Africa

Principal Investigator: Rose A. Okello

Supervisor: Prof IM Coetzee

My name is Rose Okello, a master of nursing science student at the Department of Nursing Science, University of Pretoria, and principal investigator in this study. I would like to invite you, because you are either a professional nurse in ICU, or a nurse manager, or a nurse educator, to participate in this research project. The aim of the study is to reach a consensus on nurse sensitive-quality indicators that can be used to monitor and the evaluate care that adult patients receive in ICUs in South Africa. Nurse-sensitive quality indicators consists of principles, programmes, or objective assessment scales that measure nursing related tasks and help to ensure high quality nursing care a patient receives. A significant contribution of patient care in the intensive care unit is made by the nursing staff who provides continuous care every day. Evaluating the quality of nursing care is therefore an important part of evaluating the overall quality of care provided to the patient.

Your participation in this study is very important and will help to develop a set of nurse-sensitive quality indicators suitable for use in adult ICU in South Africa in future. Please note that this study will be used for dissertation for my master's degree qualification, and we would like to publish the result in an accredited professional journal.

There are no recognised risks to participate in this study. While there will not be individual benefit of participating in this study, it will be an opportunity to contribute to enhance the quality-of-care patients receive in ICU. On a professional level, the

unique knowledge gathered from this study will improve quality patient care efforts, by specifying indicators that are useful and effective in monitoring and evaluating nursing care we provide to our patients in ICU.

Any information that you provide is confidential. For example, your name will not appear on any of the questionnaire and there will be no means to identify your specific answers. Your response will be in your personal capacity and will not reflect the views of your employer or institution. The data will be kept in the researcher's and the supervisor's persona; computers that is password protected and will be destroyed after the study in accordance with the University of Pretoria research ethics guidelines. All measures will be taken to make sure that your response is not viewed by unauthorised persons. Your participation is entirely voluntary and you are free to decline to participate. If you decline, this will not affect you negatively in any way. You are also free to withdraw from the study at any point and that includes completing the questionnaire after you have started, even if you did agree to take part, initially.

I would be grateful if you would complete the full survey. If you choose to participate, it will take you about 15 minutes to 30 minutes to answer the questions.

Should you have any questions regarding the research study, please feel free to email me or my supervisor at the following addresses:

Rose Okello (Principal Investigator) arokellof@yahoo.co.uk
Prof IM Coetzee (Supervisor) (Isabel.coetzee@up.ac.za

I have read and understood the information provided in this study and, I agree to participate by completing this survey.

☐Yes

☐No

You may now continue with the survey if you answered **YES** to the above statement.

1. **Age**

☐18 - 29

☐30 – 39

☐40 – 49

☐≥50

2. **Gender**

☐Female

☐Male

☐Do not wish to disclose

3. **Position at work**

☐Registered nurse (ICU Trained)

☐Registered nurse (ICU Experienced)

☐Nurse manager

☐Nurse educator

4. **Number of years worked in ICU**

☐5- 10 years

☐10-15years

☐More than 15years

SECTION B

Below is a list of indicators commonly used to measure the quality of healthcare provided by the nurses in ICU. You are kindly asked to assist in reaching a consensus on the indicators that are **relevant**, **feasible**, and have the potential of being **implemented** on a **priority** basis in adult ICU to evaluate nursing care performance.

Please indicate your level of agreement with each indicator by placing a tick mark (√) against only one of the 4 options that best describes your choice. You may also add own opinion or opinion comments that might assist in identifying the priority indicators in the spaces provided.

INDICATORS	DESCRIPTION	YOUR AGREEMENT WITH HOW IMPORTANT THE INDICATOR IS TO EVALUATE QUALITY OF NURSING CARE				ANY ADDITIONAL COMMENT OR OPINION?
		4	3	2	1	
		Strongly agree	Agree	Disagree	Strongly disagree	
Respiratory system						
Ventilator associated pneumonia (VAP)	VAP is a frequent iatrogenic complication of mechanical ventilation that increases mortality	☐	☐	☐	☐	
Length of mechanical ventilation	Number of days a patient is on a mechanical ventilator affects recovery	☐	☐	☐	☐	
Unplanned endotracheal tube extubation	Accidental extubations include accidental slippage or removal of an endotracheal tube by nonmedical practices	☐	☐	☐	☐	
Re-intubation	Re-intubation done properly in a timely manner can prevent respiratory complications	☐	☐	☐	☐	
Cardiovascular system						
Central line associated blood stream infections	Central line catheterization plays an important role in the treatment of critically ill patients, but can increase the risk of infection	☐	☐	☐	☐	
Accidental removal of IV catheters	Risk of complications and complete device failure are increased when dislodgement occurs	☐	☐	☐	☐	
INDICATOR	DESCRIPTION	Strongly agree	Agree	Disagree	Strongly disagree	COMMENTS AND OPINIONS

Implementation of DVT prevention	ICU patients have limited mobility and are at a high risk of developing deep vein thrombosis	☐	☐	☐	☐	
Neurological system						
Delirium	Untreated delirium may prolong the duration of mechanical ventilation resulting in prolonged LOS and increase the mortality rate or an increase in hospital costs	☐	☐	☐	☐	
Evaluation rate of level of sedation	Excessive sedation may prolong the duration of mechanical ventilation and increase the LOS resulting in increased hospital costs and increased rate of morbidity and mortality.	☐	☐	☐	☐	
Evaluation of analgesia	Untreated pain can do great harm to the patient and result in a high metabolic state, cardiopulmonary dysfunction, or arrhythmias, and ultimately, complications and poor recovery	☐	☐	☐	☐	
Use of restraints	Restraints are used to secure restless patients or when performing potentially painful procedures.	☐	☐	☐	☐	
Gastrointestinal system						
Implementation of enteral nutrition	Compared to those on parenteral nutrition, patients on enteral nutrition have better prognosis and may have a significantly low mortality, infection rates, and reduced length of stay	☐	☐	☐	☐	
Management of blood glucose level	Close monitoring of blood glucose in a critically ill patients is necessary because hyperglycaemia and hypoglycaemia may affect the rate of recovery	☐	☐	☐	☐	
Integumentary system						
Pressure ulcers	Prolonged contact between the skin and devices used in patient care can result in pressure ulcers	☐	☐	☐	☐	
Incontinence associated dermatitis	Promotion of skin integrity is a fundamental nursing intervention and a patient outcome associated with the quality of nursing care, hospital costs, and liability	☐	☐	☐	☐	

INDICATOR	DESCRIPTION	Strongly agree	Agree	Disagree	Strongly disagree	COMMENTS AND OPINIONS
Infection control						
Implementation of early appropriate broad-spectrum antibiotic	Early and appropriate broad-spectrum antibiotic therapy within 1-hour of diagnosis can improve the prognosis of patients with severe infection or sepsis.	☐	☐	☐	☐	
Implementation of hand hygiene	The hand is an important route for transmission of microbes	☐	☐	☐	☐	
Urinary tract system						
Catheter related urinary tract infection	Urinary tract infection caused by an indwelling catheter is one of the most common nosocomial infections	☐	☐	☐	☐	
Patient safety						
Potentially inappropriate medications (PIM)	A PIM is a medication having potential risks that outweigh its potential benefits, use of which may result in adverse drug reactions, and is related to increased health-related expenditures	☐	☐	☐	☐	
Medication administration errors	Giving a patient the wrong drug, wrong dose, wrong concentration, wrong route, at the wrong time or even to the wrong patient can cause serious harm or death to the patient	☐	☐	☐	☐	
Outgoing transport related accidents	Transferring an unstable patient out of ICU can have serious harm to the patient's outcome	☐	☐	☐	☐	
Patient falls	Patient falls can be used to assess the variation in patient safety and explore whether nurse staffing may be associated with safety	☐	☐	☐	☐	
Inappropriate turn-off of alarms	patient safety depends on the stable functioning of technical equipment, and attending to alarms when they go off, failure of which may lead to events that compromise patient safety, with some deaths attributable to the failure of a device or alarms that are switched off	☐	☐	☐	☐	
Nursing processes						

INDICATOR	DESCRIPTION	Strongly agree	Agree	Disagree	Strongly disagree	COMMENTS AND OPINIONS
Discharge planning	Discharge planning focuses on the patient's problem, including prevention, rehabilitation and nursing care that provides the patient and their family with an understanding of the disease and any caring interventions	☐	☐	☐	☐	
Failure to rescue	Nurses spend most of the time at the patient's bedside, and are in the best position to recognize signs of deterioration in a patient's condition, record and report these changes, and intervene with treatments.	☐	☐	☐	☐	
Work-load						
Nursing staff turnover rate	Adverse outcomes have been attributed to a series of deficiencies including high nursing staff turnover	☐	☐	☐	☐	
Number of continuous hours worked	Associations have been found between extended work shifts and the risk of occurrence of adverse events	☐	☐	☐	☐	
Professional nurse per ICU bed	Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care	☐	☐	☐	☐	
Training and experience						
ICU nursing staff with ACLS	Advanced life support training enables nurses to deal with patient's resuscitation process more effectively and with confidence, thereby increasing the chances of patient's survival.	☐	☐	☐	☐	
Nurses who worked in ICU for < 3 years	A nurse who has worked in the ICU for more than 3 years is perceived to have a relatively strong professional competence and extensive clinical experience	☐	☐	☐	☐	
Institution related						
Length of stay (LOS)	Decreased LOS has been associated with decreased risks of opportunistic infections and side effects of medication, improvements in treatment outcome and lower mortality rates.	☐	☐	☐	☐	

INDICATOR	DESCRIPTION	Strongly agree	Agree	Disagree	Strongly disagree	COMMENTS AND OPINIONS
ICU readmission rates	ICU readmission is defined by a patient's return to the same or a different ICU after discharge to an area that provided a lower level of care during the same hospital stay	☐	☐	☐	☐	
Cost of treatment	Treating a patient in ICU involves the use of expensive equipment's, investigations, and expensive medicine	☐	☐	☐	☐	
ICU mortality	The number of deaths in ICU within a 30 day Period.	☐	☐	☐	☐	

We have reached the end of the survey. Thank you for your participation.

Annexure B 6 Questionnaire for Delphi round 2

CONSENSUS: DELPHI ROUND 2

Title: Consensus on nurse-sensitive quality indicators for adult ICU in South Africa

Principal Investigator: Rose A. Okello

Supervisor: Prof IM Coetzee

Dear participant,

Good day,

My name is Rose Okello, a master of nursing science student at the Department of Nursing Science, University of Pretoria, and principal investigator in this study. I would like to invite you, because you are either a professional nurse in ICU, or a nurse manager, or a nurse educator, to participate in this research project. The aim of the study is to reach a consensus on nurse sensitive-quality indicators that can be used to monitor and the evaluate care that adult patients receive in ICUs in South Africa. Nurse-sensitive quality indicators consists of principles, programmes, or objective assessment scales that measure nursing related tasks and help to ensure high quality nursing care a patient receives. A significant contribution of patient care in the intensive care unit is made by the nursing staff who provides continuous care every day. Evaluating the quality of nursing care is therefore an important part of evaluating the overall quality of care provided to the patient.

Your participation in this study is very important and will help to develop a set of nurse-sensitive quality indicators suitable for use in adult ICU in South Africa in future. Participation is anonymous and you are not required to indicate your name on the

questionnaire. Please note that this study will be used for dissertation for my master's degree qualification, and we would like to publish the result in accredited professional journals.

There are no recognised risks to participate in this study. While there will not be individual benefit of participating in this study, it is an opportunity to contribute to quality patient care. On a professional level, the unique knowledge gathered from this study will enhance quality patient care efforts, by specifying indicators that are useful and effective in monitoring and evaluating nursing care we provide to our patients in ICU.

Any information that you provide is confidential. For example, your name will not appear on any of the questionnaire and there will be no means to identify your specific answers. Your response will be in your personal capacity and will not reflect the views of your employer or institution. The data will be kept in the researcher's and the supervisor's personal computers that is password protected and will be destroyed after the study in accordance with the University of Pretoria research ethics guidelines. All measures will be taken to make sure that your response is not viewed by unauthorised persons. Your participation is entirely voluntary and you are free to decline to participate. If you decline, this will not affect you negatively in any way. You are also free to withdraw from the study at any point and that includes completing the questionnaire after you have started, even if you did agree to take part, initially. The University of Pretoria Faculty of Health Sciences ethics committee has granted ethics approval for this study with certificate number 185/2021.

I would be grateful if you would complete the full survey. If you choose to participate, it will take you about 30 minutes to answer the questions.

Should you have any questions regarding the research study, please feel free to email me or my supervisor at the following addresses:

Rose Okello (Principal Investigator) arokellof@yahoo.co.uk

Prof IM Coetzee (Supervisor) (Isabel.coetzee@up.ac.za

I have read and understood the information provided in this study and, I agree to participate by completing this survey.

☐Yes

☐No

SECTION A: Demographic profile

You may now continue with the survey if you answered **YES** to the above statement.

1. **Age**

   ☐18 - 29

   ☐30 – 39

   ☐40 – 49

   ☐≥50

2. **Gender**

   ☐Female

   ☐Male

   ☐Do not wish to disclose

3. **Position at work**

   ☐Registered nurse (ICU Trained)

   ☐Nurse manager

   ☐Nurse educator

4. **Number of years worked in ICU**

   ☐5 to 10 years

☐10 to 15 years

☐More than 15 years

SECTION B: Nurse-sensitive indicators

Below is a list of thirty-two (32) nurse-sensitive indicators which nursing experts in different ICU in South Africa suggested (during round 1 of Delphi evaluation) could be used to measure the quality of healthcare provided by the nurses in adult ICU in South Africa. You are kindly requested to assist in reaching a consensus on a final list of indicators that are **relevant**, **feasible**, and have the potential of being **implemented** on a **priority** basis in adult ICU in South Africa to evaluate nursing care performance.

You are requested to critically appraise the indicators listed below then indicate your level of agreement with each one of them by placing a mark (X) or a mouse click inside the square against only one of the 4 options that best describes your choice. For the best indicator you may select “Strongly agree” and the worst indicator you will select “Strongly disagree.” The other options “Agree” and “Disagree” are in between the first two, respectively. Please email back your completed sheet.

INDICATOR	DESCRIPTION	YOUR AGREEMENT WITH HOW IMPORTANT THE INDICATOR IS TO EVALUATE QUALITY OF NURSING CARE			
		1	2	3	4
		Strongly disagree	Disagree	Agree	Strongly agree
Respiratory system					
Ventilator associated pneumonia (VAP)	VAP is a frequent iatrogenic complication of mechanical ventilation that increases mortality	☐	☐	☐	☐
Length of mechanical ventilation	Number of days a patient is on a mechanical ventilator affects recovery	☐	☐	☐	☐
Unplanned endotracheal tube extubation (removal)	Accidental extubations (removal) include accidental slippage or removal of an endotracheal tube by nonmedical practices	☐	☐	☐	☐
Re-intubation	Re-intubation done properly in a timely manner can prevent respiratory complications	☐	☐	☐	☐

Cardiovascular system					
Central line associated blood stream infections	Central line catheterization plays an important role in the treatment of critically ill patients, but can increase the risk of infection	☐	☐	☐	☐
Accidental removal of IV catheters	Risk of complications and complete device failure are increased when dislodgement occurs	☐	☐	☐	☐
INDICATOR	DESCRIPTION	Strongly disagree	Disagree	Agree	Strongly agree
Implementation of DVT prevention	ICU patients are with limited physical activity are at a high risk of deep vein thrombosis	☐	☐	☐	☐
Neurological system					
Evaluation rate of level of sedation	Excessive sedation may prolong the duration of mechanical ventilation and increase the LOS resulting in increased hospital costs and increased rate of morbidity and mortality.	☐	☐	☐	☐
Evaluation of analgesia	Untreated pain can do great harm to the patient and result in a high metabolic state, cardiopulmonary dysfunction, or arrhythmias, and ultimately, complications and poor recovery	☐	☐	☐	☐
Gastrointestinal system					
Implementation of enteral nutrition	Compared to those on parenteral nutrition, patients on enteral nutrition have better prognoses and may have a significantly lower mortality, infection rates, and length of stay	☐	☐	☐	☐
Management of blood glucose level	Close monitoring of blood glucose in a critically ill patients is needed because hyperglycaemia and hypoglycaemia may affect the rate of recovery	☐	☐	☐	☐
Integumentary system					
Pressure ulcers	Prolonged contact between the skin and devices used in patient care can result in pressure ulcers	☐	☐	☐	☐
Incontinence associated dermatitis	Promotion of skin integrity is a fundamental nursing intervention and a patient outcome associated with nursing quality, hospital costs, and liability	☐	☐	☐	☐

INDICATOR	DESCRIPTION	Strongly disagree	Disagree	Agree	Strongly agree
Infection control					
Implementation of early appropriate broad-spectrum antibiotic	Early and appropriate broad-spectrum antibiotic therapy within 1-hour of diagnosis can improve the prognosis of patients with severe infection or sepsis.	☐	☐	☐	☐
Implementation of hand hygiene	The hand is an important route for transmission of microbes	☐	☐	☐	☐
Use of Personal Protective Equipment	Personal protective equipment (PPE) is key to protecting healthcare workers from COVID-19 infection and other communicable diseases	☐	☐	☐	☐
Urinary tract system					
Catheter related urinary tract infection	Urinary tract infection caused by an indwelling catheter is one of the most common nosocomial infections	☐	☐	☐	☐
Urine test	Dipstick analysis, the microscopic exam, and other information gathered from a urine test enable decision-making for a variety of diagnostic, therapeutic, and disposition issues	☐	☐	☐	☐
Patient safety					
Potentially inappropriate medications (PIM)	A PIM is a medication having potential risks that outweigh its potential benefits, use of which may result in adverse drug reactions, and is related to increased health-related expenditures	☐	☐	☐	☐
Medication administration errors	Giving a patient the wrong drug, wrong dose, wrong concentration, wrong way, at the wrong time or even to the wrong patient can seriously harm or cause death of the patient	☐	☐	☐	☐
Outgoing transport related accidents	Transferring an unstable patient out of ICU can have serious harm to the patient's outcome	☐	☐	☐	☐
Inappropriate turn-off of alarms	ICU depends on the stable functioning of technical equipment, failure of which may lead to events that compromise patient safety, with some deaths attributable to the failure of a device	☐	☐	☐	☐

INDICATOR	DESCRIPTION	Strongly disagree	Disagree	Agree	Strongly agree
Nursing processes					
Discharge planning	Discharge planning focuses on the patient's problem, including prevention, rehabilitation and nursing care that provides the patient and their family with an understanding of the disease and any caring interventions	☐	☐	☐	☐
Failure to rescue	Nurses spend most of the time at the patient's bedside, and are in the best position to recognize signs of deterioration in a patient's condition, record and report these changes, and intervene with treatments.	☐	☐	☐	☐
Work-load					
Nursing staff turnover rate	Adverse outcomes have been attributed to a series of deficiencies including high nursing staff turnover	☐	☐	☐	☐
Number of continuous hours worked	Associations have been found between extended work shifts and the risk of occurrence of adverse events	☐	☐	☐	☐
Professional nurse per ICU bed	Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care	☐	☐	☐	☐
Training and experience					
ICU nursing staff with ACLS	Advanced life support training enables nurses to deal with patient's resuscitation process more effectively and with confidence, thereby increasing the chances of patient's survival.	☐	☐	☐	☐
Institution related					
Length of stay (LOS)	Decreased LOS has been associated with decreased risks of opportunistic infections and side effects of medication, improvements in treatment outcome and lower mortality rates.	☐	☐	☐	☐
Cost of treatment	Treating a patient in ICU involves the use of expensive equipment's, investigations, and expensive medicine	☐	☐	☐	☐

INDICATOR	DESCRIPTION	Strongly disagree	Disagree	Agree	Strongly agree
ICU mortality	The number of deaths in ICU within a 30-day period	☐	☐	☐	☐
Do Not Resuscitate /End of Life Care	Support given to families during transition from active treatment to end of life care is related to the interaction between patient, family, and the nurses	☐	☐	☐	☐

We have reached the end of the survey. Thank you for your participation.

Annexure B 7 Final set of nurse-sensitive indicators for adult ICU in South Africa

INDICATOR	SIGNIFICANCE	FORMULA FOR CALCULATION	INDEX	SOURCE OF DATA
Respiratory system				
Ventilator associated pneumonia (VAP)	VAP is a frequent iatrogenic complication of mechanical ventilation that increases mortality	(Number of patients who had ventilator-related pneumonia ÷ Total days of patients using the ventilator) x 100	%	Patient chart
Length of mechanical ventilation	Number of days a patient is on a mechanical ventilator affects recovery	Number of ventilator days		Patient chart
Unplanned endotracheal tube extubation (removal)	Accidental extubations (removal) include accidental slippage or removal of an endotracheal tube by nonmedical practices	(Number of cases of unplanned extubation following endotracheal intubation ÷Total duration of endotracheal intubation [Days]) ×1000	Per 1000	Patient chart
Re-intubation	Re-intubation done properly in a timely manner can prevent respiratory complications	Endotracheal tubes repositioned and retied every 12 hours	Per 1000	Patient chart
Cardiovascular system				
Central line associated blood stream infections	Central line catheterization plays an important role in the treatment of critically ill patients, but can increase the risk of infection	(Number of CLABSI ÷ Number of central line days) x 1000	Per 1000	Patient chart
Accidental removal of IV catheters	Risk of complications and complete device failure are increased when dislodgement occurs			Patient chart
Implementation of DVT prevention	ICU patients are with limited physical activity are at a high risk of deep vein thrombosis	(Number of patients who received DVT prevention ÷Number of patients in the ICU) ×100	%	Patient chart
Neurological system				
Evaluation rate of level of sedation	Excessive sedation may prolong the duration of mechanical ventilation and increase the LOS resulting in increased hospital costs and increased rate of morbidity and mortality.	(Number of patients who underwent evaluation for sedation ÷ Number of ICU patients who took sedative drugs) × 100	%	Patient chart
Evaluation of analgesia	Untreated pain can do great harm to the patient and result in a high metabolic state, cardiopulmonary dysfunction, or arrhythmias, and ultimately, complications and poor recovery	(Number of patients responding very satisfied ÷ Number of patients in the ICU) ×100	%	Patient chart

Gastrointestinal system				
Implementation of enteral nutrition	Compared to those on parenteral nutrition, patients on enteral nutrition have better prognoses and may have a significantly lower mortality, infection rates, and length of stay	(Number of eligible patients who receive enteral nutrition within 24 hours of admission ÷ Total number of patients who received enteral nutrition at the same period) × 100		Patient chart
Management of blood glucose level	Close monitoring of blood glucose in a critically ill patients is needed because hyperglycaemia and hypoglycaemia may affect the rate of recovery	(Total number of time with blood glucose level reaching 8–10 mmol/L ÷ Total number of blood glucose measurements performed for critically ill patients) × 100	%	Patient chart
Integumentary system				
Pressure ulcers	Prolonged contact between the skin and devices used in patient care can result in pressure ulcers	(Number of patients who had pressure ulcer during the period under consideration ÷ Number of ICU patients' total hospitalization days) x 100	%	Patient chart
Incontinence associated dermatitis	Promotion of skin integrity is a fundamental nursing intervention and a patient outcome associated with nursing quality, hospital costs, and liability	(Number of patients who had incontinence-associated dermatitis ÷ Number of ICU patients' total days of hospitalization) ×1000	Per 1000	Patient chart
Infection control				
Implementation of early appropriate broad-spectrum antibiotic	Early and appropriate broad-spectrum antibiotic therapy within 1-hour of diagnosis can improve the prognosis of patients with severe infection or sepsis.	(Number of patients who had a serious infection or septic shock treated with broad spectrum antibiotics within 1 hr after definite diagnosis ÷ Number of patients who had a serious infection or septic shock) × 100%	%	Patient chart
Implementation of hand hygiene	The hand is an important route for transmission of microbes	(Frequency of implementation of qualified hand hygiene during the observation period ÷ Frequency of hand hygiene implementation at the same period) × 100	%	Unit report
Use of Personal Protective Equipment	Personal protective equipment (PPE) is key to protecting healthcare workers from COVID-19 infection and other communicable diseases			

Urinary tract system				
Catheter related urinary tract infection	Urinary tract infection caused by an indwelling catheter is one of the most common nosocomial infections	(Number of patients who experienced an infection related to a catheter ÷ Number of catheter days) x 1000	Per 1000	Patient chart
Urine test	Dipstick analysis, the microscopic exam, and other information gathered from a urine test enable decision-making for a variety of diagnostic, therapeutic, and disposition issues			
Patient safety				
Potentially inappropriate medications (PIM)	A PIM is a medication having potential risks that outweigh its potential benefits, use of which may result in adverse drug reactions, and is related to increased health-related expenditures	PIM is a medication having potential risks that outweigh its potential benefits		Adverse events report
Medication administration errors	Giving a patient the wrong drug, wrong dose, wrong concentration, wrong way, at the wrong time or even to the wrong patient can seriously harm or cause death of the patient	(Number of reported medication errors within the statistical period÷ number of dispensed doses during the statistical period) x 1000 patient days	Per 1000	Adverse events report
Outgoing transport related accidents	Transferring an unstable patient out of ICU can have serious harm to the patient's outcome	(Number of cases with outgoing transport-related accidents ÷Number of transported patients) ×1000	Per 1000	Unit report
Inappropriate turn-off of alarms	ICU depends on the stable functioning of technical equipment, failure of which may lead to events that compromise patient safety, with some deaths attributable to the failure of a device			
Nursing processes				
Discharge planning	Discharge planning focuses on the patient's problem, including prevention, rehabilitation and nursing care that provides the patient and their family with an understanding of the disease and any caring interventions			Patient chart
Failure to rescue	Nurses spend most of the time at the patient's bedside, and are in the best position to recognize signs of deterioration in a patient's condition, record and report these changes, and intervene with treatments.	(Number of deaths ÷ Number of deaths resulting from complications of care such as pneumonia, deep vein thrombosis/pulmonary embolism, sepsis, acute renal failure, shock/cardiac arrest, or gastrointestinal haemorrhage/acute ulcer)		Adverse events report
Work-load				
Nursing staff turnover rate	Adverse outcomes have been attributed to a series of deficiencies including high nursing staff turnover			

Number of continuous hours worked	Associations have been found between extended work shifts and the risk of occurrence of adverse events	Nursing care hours per patient day		Unit report
Professional nurse per ICU bed	Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care	(Number of ICU nurses registered during the period of research ÷ ICU beds at the same period) ×100	%	Unit report
Training and experience				
ICU nursing staff with ACLS	Advanced life support training enables nurses to deal with patient's resuscitation process more effectively and with confidence, thereby increasing the chances of patient's survival.	(Number of ICU staff who had completed the advanced cardiac life support training ÷ Number of registered ICU nurses at the same period) × 100	%	Personnel data
Institution related				
Length of stay (LOS)	Decreased LOS has been associated with decreased risks of opportunistic infections and side effects of medication, improvements in treatment outcome and lower mortality rates.	Mean ICU length of stay (days)		Unit report
Cost of treatment	Treating a patient in ICU involves the use of expensive equipment's, investigations, and expensive medicine	Number of patients readmitted to the ICU within 30 days		Unit report
ICU mortality	The number of deaths in ICU within a 30-day period	Hospital cost per patient		Hospital data
Do Not Resuscitate /End of Life Care	Support given to families during transition from active treatment to end of life care is related to the interaction between patient, family, and the nurses			

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TO WHOM IT MAY CONCERN

I hereby certify that I have edited Rose Okello's Master's dissertation, **Consensus on nurse-sensitive indicators for adult intensive care units in South Africa**, for language and content.

IM Cooper

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