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Identification of Nursing-Sensitive Indicators on Pressure Injuries/Ulcers: A Systematic Review

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ABSTRACT

This systematic review aims to develop a conceptual framework to identify nursing-sensitive indicators for preventing and managing pressure ulcers. The first step involves defining evidence-based indicators critical to effective prevention and management. The second step examines the relationships influencing the management of these indicators, using insights derived from scientific research findings. This review is guided by a conceptual framework rooted in Structural State Theory and uses a methodological approach. A total of 956 articles were identified through a search of original references from Medline/PubMed, Scopus, Cochrane Library, and CINAHL, covering the period from 2012 to 2023. A systematic review of 29 studies identified 241 relationships between dependent and independent variables. A theoretical conceptual framework highlighted nursing-sensitive indicators (independent variables) related to patients, nurses, pressure injury/ulcer management, organizational structure, and their association with pressure injury/ulcer outcomes (dependent variables). The analysis showed that patient-focused studies had the highest frequency of relationships. This review highlights the complexity of managing pressure injuries/ulcers and the essential role of nursing care practices and interventions in shaping outcomes. The findings highlight the need for specialized wound care nurses and further research on nursing interventions, urging hospitals to invest in structural changes and nurse education.

1 | Introduction

Chronic wounds pose a global health challenge by increasing mortality, morbidity, and healthcare costs while diminishing patients' and families' quality of life (Probst S. DClincPrac et al. 2014). Pressure injuries (PIs) are among chronic wounds defined as localized skin and soft tissue damage caused by prolonged pressure or shear. Although the terms decubitus ulcer, pressure sore, and pressure ulcer have often been used interchangeably, international professional organizations focusing on PIs, such as the National Pressure Injury Advisory Panel (NPIAP, formerly National Pressure Ulcer Advisory Panel

centered in the United States and serving internationally), European Pressure Ulcer Advisory Panel (EPUAP), and Pan Pacific Pressure Injury Alliance, have offered the term PI because open ulceration does not always occur. This definition also aims to explain the most basic etiology comprehensively. Besides, other terms used to describe PIs over the years are still used in daily practice by health professionals. A PI is diagnosed and classified according to the tissues affected (epidermis, dermis, adipose tissue, muscle tissue, bone, and supporting tissues), depth, and amount of visible tissue loss (Tew et al. 2014). In this context, the most up-to-date classification system was established by the NPIAP in 2016 and has been

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recognized as standard criteria worldwide. Once a PI develops, it is recommended to diagnose and classify based on this system as Stage 1 PI, Stage 2 PI, Stage 3 PI, Stage 4 PI, Unstageable PI, and Deep Tissue PI (European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance 2019).

PIs are a global health concern that poses a serious threat to patient safety, leading to increased mortality and morbidity, higher healthcare costs, extended hospital stays, and a diminished quality of life for both patients and their families (Ayello and Sibbald 2019). The prevalence of PIs varies by country and care settings (acute care, intensive care, nursing homes, home care, etc.) (European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance 2019). In the meta-analysis studies conducted on the subject related to acute care, the global prevalence of PIs was determined as 14.8%, the rate of hospital-acquired PIs was defined as 8.4% (Li et al. 2020), and the global incidence was determined as 10.0%–25.9%. The prevalence was 16.9%–23.8% in intensive care patients (Chaboyer et al. 2018). Considering the negative impacts of PIs and global data, preventive strategies and effective wound care management have gained importance (European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance 2019). PIs are recognized as one of the key quality indicators of patient care and hospital performance, reflecting both clinical effectiveness and patient safety measures (Oner et al. 2021).

Nurses are among the healthcare professionals who primarily participate in the prevention and management practices of PIs. Moreover, ensuring and maintaining skin integrity is one of the fundamental elements of nursing care and constitutes the nurse's autonomous area of responsibility (Behrendt et al. 2020). Additionally, impaired tissue integrity and the risk of impaired tissue integrity are key nursing diagnoses recognized by NANDA International (NANDA-I) (Herdman et al. 2024). Therefore, ensuring and maintaining skin integrity is an essential clinical quality improvement issue (Ayello and Sibbald 2019). Maintaining skin integrity and managing PIs become particularly challenging due to intrinsic and extrinsic risk factors (such as age, malnutrition, chronic disease, circulatory insufficiency, immunosuppression, trauma, infection, medications, hypoxia, etc.) that adversely affect healing. In this process, healthcare professionals need intensive support in accessing and utilizing evidence-based information (Karadağ and Çakar 2021). Comprehensively and accurately performing and monitoring nursing interventions to ensure skin integrity and objectively presenting patient outcomes is essential for the objective results of nursing care (Hoedl et al. 2019). Furthermore, it is necessary to determine care indicators specific to the community and institution to measure, standardize, and establish a common language regarding nursing care for PIs among the skin integrity issues sensitive to nursing care (Burston et al. 2014).

Nursing-sensitive indicators are metrics used to assess changes in health status that can be directly influenced by nursing care (Joint Commission International JCI 2013). These indicators have gained recognition as reliable and valid tools due to their

ability to provide objective assessments, enhance clinical practice, evaluate the quality and performance of nursing care, and support informed decision-making for patients when choosing a hospital for their care (Oner et al. 2021). In this context, the need for evidence-based care indicators to evaluate the quality of care for preventing and managing PIs is becoming increasingly important. When nursing care-sensitive indicators for assessing skin integrity can be validated, substantial evidence can be provided for controlling and managing PIs, contributing to care guidance. The literature on the quality-of-care indicators related to PIs, which pose a problem for skin integrity, is limited (Dufour et al. 2020; Freitas et al. 2015; Seaton et al. 2020). Additionally, the increase in clinical experiences and global quality improvement and accreditation efforts brings with it the need for specialized nursing care and objective care measurement. This study aims to determine nursing care-sensitive indicators for PIs that can provide strong evidence to evaluate the quality and effectiveness of nursing care.

2 | Aims

This study aims to systematically review research conducted between 2012 and 2023 to develop a conceptual framework to identify critical nursing-sensitive indicators for preventing and managing injuries/ulcers (PI/U). The first step focuses on identifying evidence-based indicators for effective prevention and management. The second step examines and analyzes the relationships that influence the management of these indicators, using insights from the latest scientific research findings. This approach aims to provide a solid foundation for evaluating the quality and effectiveness of nursing care.

This review is guided by the following research questions:

1. What empirical studies on PI/U outcomes have been conducted in the past decade that provide evidence for assessing the quality and effectiveness of nursing care?
2. What are the key nursing-sensitive indicators for PI/U outcomes within a conceptual framework that includes contextual and structural elements?
3. What are the primary relationships between nursing-sensitive indicators affecting the incidence and management of PI/U in healthcare settings, and what is the direction of these relationships?

3 | Methods

3.1 | Design

This systematic review was conducted using a qualitative approach. First, a broad pool of articles from academic journals was identified. Relevant studies were then selected through a rigorous evaluation process using predefined inclusion and exclusion criteria. The review was guided by Structural Contingency Theory, which posits that an organization's effectiveness depends on aligning its structural elements with environmental demands. This theoretical framework informed the categorization and analysis of nursing-sensitive indicators by linking them

to organizational processes and patient outcomes. Through this approach, the study systematically evaluated how nursing-sensitive indicators impact the prevention of PI/U across diverse healthcare settings, offering valuable insights into optimizing nursing practices and improving patient care. This systematic review protocol was registered with the OSF database and has been reported under the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement (Supporting Information S1: Appendix A) (Page et al. 2021).

3.2 | Search Methods

Three nursing researchers working in the field of PI/U were asked about their opinions on keywords. The three nursing scientists compiled a comprehensive keyword list for their research and cross-referenced it with terms from important reviews in the field, including those by Monaco et al. (2021) and Stadnyk et al. (2018). Keywords were identified based on the PICOS approach. For the purpose of this systematic review, authors included nurse for Population (P); wound care, wound management, chronic wound, pressure ulcer, PI, pressure sore, tissue viability, decubitus for Intervention (I); nursing-sensitive indicator, wound care criteria, nurse-sensitive quality for Comparison (C); PI/U results for Outcome (O), and experimental, quasi-experimental, cross-sectional, and qualitative studies for Study Design (S). This ensured a thorough coverage of nursing-sensitive indicators pertinent to PI/U studies. The final keyword combinations were combined through Boolean operators (OR, AND); (a) *nurs**, (b) *indicator or criteria**, (c) *wound* or injury* or ulcer*, and (d) *skin integrity or tissue viability or pressure or decubitus**. Two reviewers (B.O. and V.C.) independently searched the major databases in nursing literature, including Medline/PubMed, Scopus, the Cochrane Library, and CINAHL, to collect all accessible articles in a peer-reviewed journal between January 2012 and September 2023 that had the pre-specified keywords in the abstract or title. The reference lists of included studies were examined for other potentially relevant sources that may have been missed by the database searches.

3.3 | Inclusion and/or Exclusion Criteria

The inclusion criteria for the review were empirical or primary peer-reviewed studies published in English after 2012. The review included studies where nurses were the primary study population and where the focus was on nursing management of PI/U outcomes. This encompassed experimental, quasi-experimental, cross-sectional, and longitudinal studies aimed at identifying nursing-sensitive indicators. Additionally, to enhance the analytical rigor, studies that specifically used regression analysis to determine the direction of relationships between these indicators were included.

The study's exclusion criteria were set in advance to filter out articles that did not align with its objectives. These criteria encompassed aspects such as relevance to the main topic, adherence to a specific time frame, the credibility of the source, and the study's methodological rigor, ensuring that the review

focused on high-quality, relevant research. Excluded studies included those that were: (1) not published in English; (2) without full texts, abstracts, or authors; (3) gray literature, such as editorial, thesis, books, conference papers, proceedings, etc.; (4) general medicine, treatment, diagnosis, devices, and product testing studies; (5) device, drug, medicine to prevent or predict for wound studies, diagnosis, classification studies, method, model, study protocol, algorithm, scale, tool development/risk assessment/early detection studies, prevalence and incidence studies; (6) management, treatment of chronic wound studies, nursing intervention, education, knowledge, management, quality studies; (7) nursing specific field, related to pediatric studies; (8) systematic review/literature reviews; (9) descriptive studies/non-parametric analysis/non-regression analysis; (10) case studies; and (11) method study (Supporting Information S1: Appendix B).

3.4 | Search Outcome

The study reporting process was structured in four main stages as guided by PRISMA 2020: identification, screening, eligibility, and inclusion of studies (Supporting Information S1: Appendix A). Collectively, these stages enabled rigorous and systematic reporting on the inclusion of relevant literature in the review. Initially, 956 articles were identified through searches of the core four nursing databases. A total of 167 publications with duplicates were excluded, yielding 789 publications. The process for determining the inclusion or exclusion of studies began by assessing their titles, followed by a review of their abstracts. Two reviewers (B.O. and V.C.) independently selected articles for inclusion based on the review questions and inclusion/exclusion criteria, using separate Zotero accounts to ensure accuracy and minimize bias. Any disagreements about eligibility during this process were resolved through discussion, with a third reviewer (M.K.) consulted when necessary. Following these rigorous procedures and applying the established exclusion criteria, 139 articles were selected for full-text review. After reviewing the full texts, articles classified as literature reviews, systematic reviews, descriptive studies, nonempirical studies, those lacking regression analysis, methodological studies, and case studies were excluded. According to the inclusion criteria, only 29 studies were deemed suitable for inclusion (Supporting Information S1: Appendix B).

3.5 | Quality Appraisal

Two reviewers (B.O. and M.K.) assessed the quality of the 29 selected articles using the National Institutes of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Heart, Lung, & Blood Institute 2014), a quality assessment tool appropriate for the type of study. This tool, which includes a 14-item checklist, is designed to assess the internal validity of studies and detect potential biases such as selection and measurement errors. Each study was graded according to its quality according to this tool, with results labeled as "good," "fair," or "poor," as detailed in Supporting Information S1: Appendix C. Two reviewers (B.O. and M.K.) independently assessed these articles to ensure they met

the inclusion criteria. Discrepancies were discussed, and disagreements or questions were discussed with the other reviewer (V.C.) when they arose. All studies were assessed as being of moderate to good quality, and no studies were excluded because they met the minimum quality threshold for inclusion in the systematic review. This approach ensured a comprehensive analysis of the available evidence while maintaining methodological rigor.

3.6 | Data Abstraction

Two reviewers (B.O. and V.C.) independently extracted data from the included articles and collaborated to resolve any discrepancies throughout the data collection process. The data extraction was conducted using Microsoft Excel version 16.16.27, which was customized with drop-down menus to enhance the efficiency of data categorization. The extracted data from each of the 29 studies (including authors, year of publication, journal name, study country, objectives, design, population, variables, type of analysis, relationship results, and summary of key findings) were systematically organized in a data extraction table (these details are summarized in Supporting Information S1: Appendix D, and comprehensive tables used in the study are available from the corresponding author upon request).

The data extraction process focuses on the variables extracted from the included publications and the relationships between these variables. Specifically, we extracted variables included in the regression analyses conducted by the authors of these studies. As reported in the original publications, these regression analyses were meticulously tabulated, presenting the direction of the relationships, their statistical significance (p values), and the context in which they were examined. A conceptual framework based on Structural Contingency Theory was developed to systematically analyze and categorize the extracted variables (Figure 1). This theory posits that the effectiveness of an organization is contingent upon the alignment between its structure and its environment, providing a robust framework for examining various organizational contexts and structures. It underscores that different contexts significantly influence organizational effectiveness and that organizations must adapt their structures as these contexts change (Donaldson 2001).

Based on this theory, categories were created to classify the findings. According to this framework, the dependent variables focus on PI/U outcomes and reflect the effectiveness of the theoretical framework. In contrast, the independent variables from each included article represent the context and structure of the theory, serving as nursing-sensitive indicators in this field, and are conceptualized at four levels: (1) patient, (2) nurse, (3) PI/U management, and (4) organizational structure.

1. *Patient-Focused Nursing-Sensitive Indicators (context)*: These factors are external to the organization but critically impact the effectiveness of PI/U management, such as patient demographics, health status, and comorbidities. The organization's structure must be flexible and responsive to these patient-focused factors.

2. *Nurse-Focused Nursing-Sensitive Indicators (context)*: This level considers job satisfaction, intent to stay, leadership, and learning and development. The harmony here relates to nurse staffing commitment to the organization.
3. *PI/U Management-Focused Nursing-Sensitive Indicators (context)*: This context level includes the strategies, protocols, and practices directly involved in preventing and treating PI/U. Eligibility here includes nursing interventions or collaborative interventions.
4. *Organizational Structure-Focused Nursing-Sensitive Indicators (structure)*: This level consists of two main headings: (a) Hospital Characteristics, which may include characteristics such as the size and type of the hospital, bed capacity, areas of expertise, and location. These features affect the hospital's general structure and the scope of services it provides; and (b) Nurse Staffing, which includes factors such as the number of nurses, nurses' qualifications and education levels, working hours, and nurses' workload. The composition of nurse staffing is considered a critical indicator as it directly impacts the quality of patient care and the effectiveness of health services.

Within the framework of Structural Contingency Theory, it is assumed that the alignment between these three context categories and the structure category, represented by organizational structure, influences the PI/U outcome. The independent variables at these three context levels interact with each other. Their fit with the structural characteristics of the organization leads to outcomes focused on PI/U (the utilized dependent/independent variables, their frequencies based on the number, and dependent/independent variables included in main-dependent/independent groups of articles are provided in Supporting Information S1: Appendices E and F). Therefore, the study aims to identify nursing-sensitive indicators for PI/U based on context and structure factors that may impact PI/U-focused outcomes in the hospital environment.

3.7 | Synthesis

The qualitative data were analyzed using a thematic synthesis approach, which provided a comprehensive summary of the qualitative findings. The analysis involved several structured steps. First, each relationship between the dependent and independent variables from each study was meticulously recorded in a Microsoft Excel sheet, with each row representing a distinct relationship. This detailed recording demonstrated the complex interactions between variables, clearly showing how multiple independent and dependent variables interacted within and across studies. This approach was crucial as it identified patterns and relationships that might not have been immediately obvious, contributing to a deeper understanding of the organizational contexts and structures being examined. Second, the relationships between variables were grouped into broader categories based on a conceptual framework derived from the theoretical foundation. Each dependent variable (PI/U outcomes) and independent variable (nursing-sensitive indicators) was categorized under these dimensions to streamline the analysis process. Finally, cross-tabulations and descriptive statistics were used at

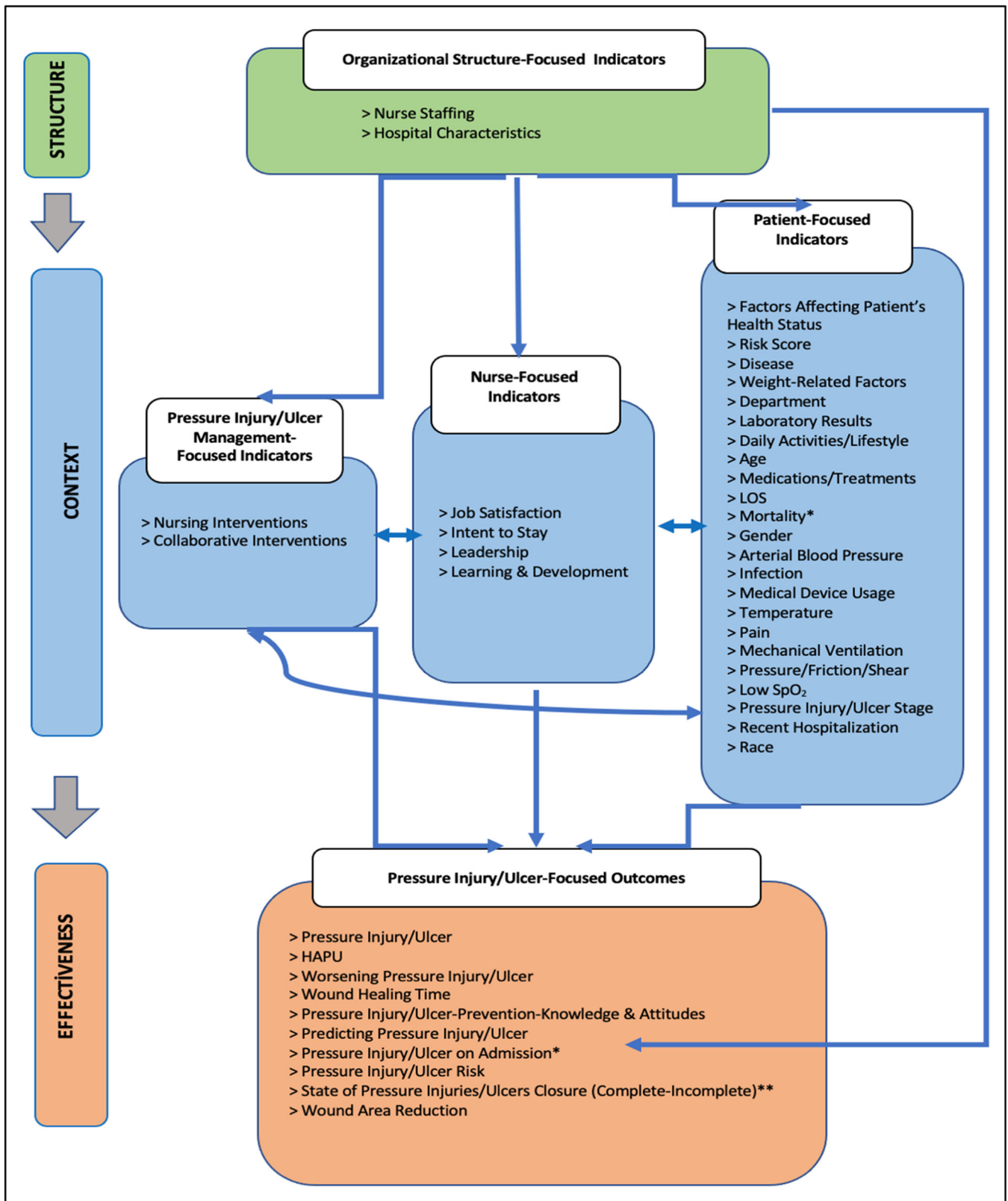


FIGURE 1 | Conceptual framework. The conceptual framework consists of variables from the 29 studies examined. HAPU, hospital-acquired pressure injuries/ulcers; LOS, length of stay; SpO₂, peripheral oxygen saturation. *In McGee et al. (2019) study, PI/U on admission was examined as an independent variable, whereas LOS and mortality were examined as dependent variables and were included in this systematic review study because they are closely related to PI/U. *In Gurun et al. (2023) study, PI/U stage was examined as an independent variable, whereas mortality was examined as a dependent variable and was included in this systematic review study because it is closely related to PI/U.

various synthesis stages to examine the data, summarizing the frequency and significance of relationships between variables.

The regression analysis results of each article were examined. For this review, the statistical significance threshold was set at $p \leq 0.05$, and p values above this threshold indicated no significant relationship between the variables. In the regression analysis, a positive relationship suggests that an increase in the independent variable causes an increase in the dependent variable, indicating a proportional relationship between the independent and dependent variables. A negative relationship suggests that an increase in the independent variable causes a decrease in the dependent variable, indicating an inversely proportional relationship between the independent and dependent variables. A meta-analysis was not conducted due to the data's qualitative nature and the heterogeneity of the included studies. Instead, frequency distributions were used to effectively present the findings, as they offered a straightforward way to illustrate how often specific associations occurred across studies. Vote counting was also used to quantify the number of associations observed between variables, clearly depicting trends within the data. All analysis steps were performed collaboratively by two researchers and overseen by a senior researcher to ensure accuracy and rigor throughout the process, culminating in the last version.

4 | Results

This systematic review identified 956 studies on nursing-sensitive indicators related to PI/U through a comprehensive literature search from 2012 to 2023. The goal was to examine and synthesize the relationships and dynamics of various influencing factors. After removing duplicates and applying the inclusion and exclusion criteria, 29 publications were finally included. Approximately 72% of the analyzed articles were published after 2018. The geographic distribution of the studies shows that 24% originated from the United States and approximately 42% from Australia, China, and South Korea. Approximately 59% of the studies had a longitudinal design, and 41% had a cross-sectional design (Supporting Information S1: Appendix G).

4.1 | Overall Distribution of Explored Relationships

This systematic review of 29 studies identified 241 relationships, highlighting the diversity of relationships between the independent and dependent variables under study. Supporting Information S1: Appendix I presents the frequency distribution of the relationships between nursing-sensitive indicators (independent variables) focused on patients, nurses, PI/U management, and organizational structure, and PI/U outcomes (dependent variables), categorized as positive, negative, or no relationship. The analyses reveal that the highest frequency of relationships was observed in studies focused on patient-focused aspects, with 140 relationships. Within this category, concerning dependent variables, PI/U presence (62 relationships) and the worsening of PI/U (34 relationships) were the most frequently examined topics. The most studied independent variables include “factors

affecting the patient's health status,” “risk score,” “disease,” and “weight-related factors.”

A total of 101 nursing-sensitive indicators were identified in studies that were organizational structure-focused (65 relationships), PI/U management-focused (21 relationships), and nurse-focused (15 relationships) and were associated with PI/U outcomes. In these categories, hospital-acquired pressure ulcers (HAPU) and the presence of PI/U were the most frequently examined dependent variables in PI/U outcomes. The most examined independent variables, considered nursing-sensitive indicators, include nurse staffing within the organizational structure-focused, collaborative interventions within PI/U management-focused, and job satisfaction and intent to stay within the nurse-focused group. Moreover, the results highlight a significant correlation between HAPU, a key dependent variable, and nurse staffing, an aspect of organizational structure, with 24 identified relationships. With 57 relationships showcasing a negative correlation, 61 indicating a positive correlation, and 123 showing no relationships, Supporting Information S1: Appendix I provides a comprehensive overview of the factors most frequently and significantly associated with PI/U outcomes, laying the groundwork for targeted interventions and improved patient care practices. Additionally, Supporting Information S1: Appendix I highlights variables that are less often studied, shedding light on research gaps in this field.

4.2 | Relationships Between Nursing-Sensitive Indicators and PI/U Outcomes

In this study, patient-focused, organizational structure-focused, PI/U management-focused, and nurse-focused nursing-sensitive indicators were identified and examined concerning PI/U outcomes. The analyses revealed that the highest frequency of relationships was observed in patient-focused studies (140 relationships), followed by organizational structure-focused (65 relationships), PI/U management-focused (21 relationships), and nurse-focused studies (15 relationships). Therefore, this review primarily presents the findings based on patient-focused and organizational structure-focused studies, where the most significant (positive or negative) associations were identified. The nursing-sensitive indicators for all focus groups and their relationships with PI/U outcomes are detailed in Supporting Information S1: Appendices J–L. Supporting Information S1: Appendices J–L present detailed association results (negative, positive, no relationship) between the variables of the reviewed articles, together with the sub-dimensions of the independent variables, author, year, country, and sample sizes. It can be assumed that the terms “positive” and “negative” mean that the indicators increase or decrease the PI/U results.

4.2.1 | Interplay of Patient-Focused Nursing-Sensitive Indicators and PI/U Outcomes

Supporting Information S1: Appendix J summarizes the results of the four patient-focused nursing sensitive indicators most frequently examined for PI/U-related outcomes: “Factors affecting patient health status,” “risk scores,” “diseases,” and

“weight-related factors.” Less frequently examined were “department,” “laboratory results,” “daily activities/lifestyle,” “age,” “medications/treatments,” “length of stay (LOS),” “mortality,” “gender,” “arterial blood pressure,” “infections,” “medical device use,” “temperature,” “pain,” “mechanical ventilation,” “pressure/friction/shear,” “low peripheral oxygen saturation (SpO₂),” “PI/U stage,” “recent hospitalization,” and “race” (Supporting Information S1: Appendix J).

4.2.2 | Interplay of Organizational Structure-Focused Nursing-Sensitive Indicators and PI/U Outcomes

Supporting Information S1: Appendix K presents the most significant associations between nursing-sensitive indicators focused on organizational structure and PI/U-focused outcomes. All relationship results from 29 publications on these topics are explained in detail in Supporting Information S1: Appendix K. Supporting Information S1: Appendix K presents the nurse staffing category under the organizational structure-focused nursing-sensitive indicators, including nurse age, education, experience, work hours, PI/U training, ratio of Certified Wound Care Nurse (CWCN), Advanced Practice Registered Nurse (APRN) as Wound Care Consultant (WCC), and skill mix.

4.2.3 | Interplay of PI/U Management-Focused and Nurse-Focused Nursing-Sensitive Indicators and PI/U Outcomes

Supporting Information S1: Appendix L provides a detailed overview of the most significant relationships between PI/U management-focused and nurse-focused nursing-sensitive indicators and PI/U outcomes, based on findings from 29 publications. These relationships are systematically categorized and presented in the Supporting Information. The PI/U management-focused indicators are further divided into two subheadings: collaborative intervention and nursing intervention. However, the nurse-focused indicators are organized under the subheadings job satisfaction, intent to stay, leadership, and learning and development. Each subheading highlights the key variables, their relationships to PI/U outcomes, and the contexts in which they were examined, providing a comprehensive summary of the evidence reported in the literature.

5 | Discussion

This systematic review aims to identify key nursing-sensitive indicators associated with PI/U prevention and management while developing a conceptual framework to explore their relationships and impacts. These indicators are categorized into patient, organizational structure, PI/U management, and nurse. The conceptual framework highlights a comprehensive array of parameters that influence the development and management of PI/U, either directly or indirectly, providing a structured approach to understanding these complex interconnections.

The findings highlight the crucial role of patient-focused nursing-sensitive indicators in influencing PI/U outcomes.

Nurses' knowledge of patient-focused indicators is essential in directing the patient care process. Consequently, this study provides valuable insights into patient-focused risk factors that impact the prevention and management of PI/U. It underscores the need for personalized and comprehensive care strategies to effectively prevent and manage these injuries in clinical settings. The study also offers significant data on various aspects, such as PI/U presence, the risk and prediction of PI/U, their progression, the wound area reduction, the presence of PI/U upon admission, and the duration of wound healing (Supporting Information S1: Appendix I). These insights are essential for identifying existing knowledge gaps and directing future research in this field.

5.1 | Relationships Between Patient-Focused Nursing-Sensitive Indicators and PI/U Outcomes

5.1.1 | Factors Affecting the Patient's Health Status

In an Australian study by Jeon et al. (2019), the relationships between indicators such as “care delivery,” “wellbeing,” “management and staff,” “meals,” “living environment,” “overall satisfaction,” and “rights and responsibilities” and PI/U outcomes were analyzed, revealing negative correlations (Jeon et al. 2019). Similarly, a study conducted in Israel by Jaul et al. (2019) identified a positive correlation between the “spasticity” variable and the presence of PI/U (Supporting Information S1: Appendix J).

5.1.2 | Risk Score

International guidelines (European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance 2019) provide various PI/U risk assessment tools for nurses to identify, score, and evaluate patients' risk of developing PI/U. Mixed-method studies conducted in different countries have demonstrated a strong negative relationship between scores on the Braden Scale and Norton Scale, designed to assess PI/U risk, and the presence of PI/U. Higher risk scores have been associated with a greater incidence of PI/U (Supporting Information S1: Appendix J) (Brienza et al. 2018; Garcia-Carretero et al. 2021; Wenzel and Whitaker 2021). Additionally, the subscales of the Braden Risk Assessment Scale, including nutrition, mobility, activity, friction, and moisture, have been highlighted as crucial for providing valuable insights into the prognosis of PI/U (Alderden et al. 2018; Kwak and Ko 2022). Therefore, assessing PI/U risk by considering patients' clinical findings and planning care accordingly is critical (Moore and Patton 2019). The findings emphasize that nurses' risk assessment analyses significantly impact patient outcomes, particularly in PI/U prevention and management. Thus, further studies evaluating the impact of nurses' risk assessment analyses on patient outcomes are recommended. Moreover, incorporating risk scores as a quality indicator could enhance the reliability and importance of nurses' risk assessments, encouraging them to prioritize these evaluations in their practice.

5.1.3 | Disease and Age

Studies highlight the critical role of mobility and daily functioning in PI/U risk. Regarding “age” and “disease,” factors such as advanced age, as well as conditions like advanced dementia and heart failure, have shown a positive correlation with PI/U outcomes. This correlation may reflect the increased vulnerability of older adults and individuals with severe health conditions to PI/U (Supporting Information S1: Appendix J) (Jaul and Calderon-Margalit 2015; Kim and Bae 2018; Sethuraman et al. 2021; Soodmand et al. 2019). These findings underscore the importance of nurses knowing how these conditions influence PI/U prevention and management. It also emphasizes the need for nurses to utilize critical thinking skills to manage nursing care effectively in preventing and managing PI/U. Furthermore, it is recommended to plan studies focusing on PI/U prevention and management among patients with these comorbidities, which could lead to developing care models tailored for complex cases. Such initiatives would also allow the evaluation of nurses’ problem-solving skills in preventing and managing PI/U within the framework of quality indicators.

5.1.4 | Weight-Related Factors

The studies assessed indicate that “weight-related factors” had negative associations with PI/U outcomes, suggesting that patients with specific weight characteristics or unmet nutritional needs may face a higher risk of developing PI/U (Alhaug et al. 2017; Garcia-Carretero et al. 2021; Kim and Bae 2018; Wenzel and Whitaker 2021). Additionally, a negative relationship was observed between albumin and hemoglobin levels—key indicators of nutritional status—and PI/U outcomes, whereas positive relationships were identified with blood sugar, creatinine, and lactate levels (Supporting Information S1: Appendix J) (Alderden et al. 2018; Jaul and Calderon-Margalit 2015; Jiang et al. 2020b; Kwak and Ko 2022; Lee et al. 2019). Despite the well-established relationship between nutrition and the development and healing of PI/U and the various nursing interventions addressing patients’ nutritional needs, the evidence highlights insufficient research on this topic, particularly in the context of nursing-sensitive quality indicators.

This study identifies a comprehensive range of nursing-sensitive indicators and their subcategories, including department, laboratory results, daily activities/lifestyle, age, medications/treatments, LOS, mortality, gender, arterial blood pressure, infection, medical device usage, temperature, pain, mechanical ventilation, pressure/friction, shear, low SpO₂, PI/U stage, recent hospitalization, and race. Detailed results regarding these parameters are available in Supporting Information S1: Appendix J and can be requested from the corresponding author.

The detailed results in Supporting Information S1: Appendix J demonstrate that the specified parameters are significant risk factors for the development and progression of PI/U. Therefore, nurses must adopt a comprehensive approach, recognize these risk factors, and tailor their interventions accordingly. Planning

future studies to evaluate the impact of nursing interventions on patient outcomes related to PI/U will not only enhance our understanding but also underscore the importance of these parameters as nursing-sensitive quality indicators.

5.2 | Relationships Between Organizational Structure-Focused Nursing-Sensitive Indicators and PI/U Outcomes

Numerous studies have assessed the effectiveness of nurse staffing in preventing HAPU and PI/U. However, there remains a significant gap in research specifically exploring the impact of nurse staffing on PI/U deterioration, wound size reduction, and wound healing time (Supporting Information S1: Appendix K). Wound management is a specialized area requiring expertise, which falls within the scope of wound care nurses. Although wound care nurses play a critical role in this process, various influencing factors (Fernández-Araque et al. 2024) may explain the limited number of nurse-led studies in this field. This highlights the urgent need for specialized wound care nursing and underscores the importance of wound care nurses assuming leadership roles in research (Gethin et al. 2020).

Findings from studies on nurse staffing in Korea and Australia reveal inconsistent results. The bed-to-nurse ratio in general wards typically determines nurse staffing grades. An increase in this ratio, which reflects a higher number of patients per nurse, is associated with poorer outcomes. For example, nurse staffing grade 2 shows a positive relationship with PI/U incidence compared to the reference grade 1, whereas grade 3 demonstrates a contradictory negative relationship (Supporting Information S1: Appendix K) (Kim and Bae 2018). These inconsistencies may stem from differences in risk assessment tools or seasonal variations, emphasizing the need for more detailed research. Additionally, higher nurse-to-bed ratios during after-hour shifts have been associated with fewer PI/Us (Nhongo et al. 2022). Similarly, a large-scale US study analyzing 4 years of data from 10,752 patients demonstrated that incorporating APRNs as WCCs significantly reduced the probability of HAPUs. The likelihood of HAPUs following the introduction of WCCs dropped to 20% of the rate observed in the 2 years prior, showing a highly significant negative correlation (Irvin et al. 2017). Furthermore, a higher ratio of CWCNs per 1000 beds was negatively correlated with HAPU incidence (Supporting Information S1: Appendix K) (Padula et al. 2021), reinforcing the importance of specialized nurses in improving PI/U outcomes. A 4-year longitudinal study comparing preventive care interventions in rural and urban nursing units provided additional insights. In rural settings, a 10% increase in the percentage of patients undergoing any risk assessment was associated with a 21% reduction in PI/U incidence. In urban units, a 10% increase in patients undergoing skin assessment at admission corresponded to a 5% reduction in PI/U incidence (Baernholdt et al. 2020). Australian and US studies also highlight a positive relationship between understaffed shifts, case mix index, and PI/U and HAPU incidence (Supporting Information S1: Appendix K) (Padula et al. 2021; Twigg et al. 2015).

Education and training also play a pivotal role in improving PI/U outcomes. Data from China suggest that higher education

levels and more PI/U training for nurses significantly enhance prevention knowledge and attitudes (Supporting Information S1: Appendix K) (Jiang et al. 2020a). Consequently, in-service training policies should be developed, and their impact on PI/U outcomes should be rigorously evaluated. Incorporating PI/U-focused courses and specialized programs into undergraduate nursing curricula could further enhance nursing students' knowledge and skills (Abrahams et al. 2023). These findings underscore the multifaceted organizational and staffing factors affecting PI/U outcomes. They highlight the critical need for appropriate nurse staffing ratios, ongoing education and training, specialized nursing roles, and sufficient resources in more extensive facilities. A comprehensive approach integrating organizational policies with clinical practices is essential to enhance patient care and outcomes related to PI/U.

5.3 | Evaluation of the Relationship Between Nursing-Sensitive Indicators and PI/U Outcomes in the Context of the Theoretical Framework

Structural Contingency Theory argues that the organizational structure should be shaped according to changing contextual requirements. Our study examined how increasing the number of nurses influences PI/U outcomes based on evidence from relevant studies. Our findings show that this relationship does not consistently have a direct positive effect but varies depending on contextual factors. It has been determined that increasing the number of nurses creates different effects depending on the patient group and organizational context. The following stand out among our findings:

Increasing the number of nurses can reduce the occurrence of PI/U by increasing nursing care hours per patient day. Increasing the proportion of nurses with advanced wound care training significantly improves PI/U management (Supporting Information S1: Appendix K) (Irvin et al. 2017; Kim and Bae 2018; Padula et al. 2021). However, the variability in findings indicates that increasing nurse numbers alone does not consistently improve PI/U outcomes. It has been observed that other factors, such as education level, nurses' job satisfaction, leadership, learning and development, and collaboration within the team, also play an active role in PI/U management (Supporting Information S1: Appendices K and L) (Hahnel et al. 2020; Jeon et al. 2019; Khalil et al. 2015; Lazareth et al. 2012; Santamaria et al. 2015; Zhang et al. 2021). Especially in intensive care units and high-risk patient groups, even increasing the number of nurses in cases where the workload is not distributed evenly is not sufficient to improve PI/U outcomes (Supporting Information S1: Appendix K) (Kim and Bae 2018; Nhongo et al. 2022; Padula et al. 2021).

These findings confirm the assumption of Structural Contingency Theory that contextual factors should shape the organizational structure. According to the theory, when the balance between the structural characteristics of the organization (e.g., number of nurses, hospital size, and resource distribution) and environmental variables (e.g., patient characteristics, risk factors, and hospital policies) is not achieved, the expected improvement in patient care outcomes may not be seen. In our study, evidence was found that the number of nurses alone is

not a solution and that this number should be aligned with the needs of the patient population and organizational support mechanisms (Baernholdt et al. 2020; Jiang et al. 2020a; McEvoy et al. 2022).

In conclusion, our findings support the validity of Structural Contingency Theory in the context of PI/U management. However, they also highlight that changes in organizational structure must be integrated with contextual factors to achieve meaningful improvements.

6 | Implications

6.1 | Limitations of the Study

This review may not fully capture the breadth of existing literature, as it excluded publications specifically addressing nursing fields, diagnoses, diseases, treatment studies, and gray literature. Additionally, the study is restricted to empirical research examining relationships between independent and dependent variables, focusing on studies using regression analysis to determine the consistency and direction of these relationships. Although this methodological approach ensures a focused examination of the relationships under investigation, the findings may have limitations in terms of their generalizability.

6.2 | Implications for Future Studies

Future research should examine the impact of nurse staffing on PI/U deterioration, wound size reduction, and healing time. The theoretical framework developed here enhances originality and can inform future studies. Applying Structural Contingency Theory to PI/U quality indicators may clarify how organizational structure and contextual factors affect management strategies. This study also provides a foundation for future meta-analyses of nursing-sensitive indicators.

Emphasis should be placed on evaluating specialized wound care training for nurses and its effects on patient outcomes. Research should also explore evidence-based protocols and structural changes in healthcare settings, such as staffing levels, to optimize PI/U management. Large-scale studies could provide robust data to support the need for specialized wound care teams and continuous professional development for nurse staffing.

7 | Conclusion

This systematic review highlights the complexity of PI/U management and the crucial role of nursing practices in prevention and treatment. Although extensive research exists on nursing's role in preventing HAPU and PI/U, studies evaluating their effects on PI/U deterioration, wound size, and healing remain limited. This gap stems from wound care being a specialized field, often requiring trained wound care nurses, whose global scarcity exacerbates this issue.

Findings underscore the need for specialized wound care nurses, comprehensive risk assessments, and proactive care strategies. Hospitals should invest in structural improvements, nursing education, and specialized wound care teams to enhance patient outcomes. Further research is needed to evaluate these measures' impact on PI/U management.

Author Contributions

Study design: B.O., M.K., V.C., and A.K. Data collection: B.O. and V.C. Data analysis: B.O. and V.C. Study supervision: M.K. and A.K. Manuscript writing: B.O., M.K., V.C., and A.K. Critical revisions for important intellectual content: B.O., M.K., and A.K.

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Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are openly available on request from the corresponding author.

The review was registered with OSF and is available at <https://doi.org/10.17605/OSF.IO/EWK3N>.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.