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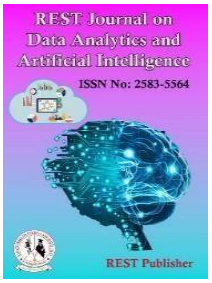

Prioritizing Nursing Interventions Using WASPAS: A Data Analytics Approach

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Abstract: *Delving into the critical role of nursing care plans in Australian aged care, the introduction of electronic systems in these facilities aimed to elevate the standard of documentation. While standardized nursing terminologies, designed to promote communication and professional growth in nursing, aren't obligatory in aged care settings, there's a clear imperative to explore the language employed by nurses in their care plans. Additionally, investigating the influence of electronic systems on documentation quality in residential aged care stands as a significant area of inquiry. This study sought to delineate documentation practices within Australian residential aged care homes, conducting a thorough audit across seven facilities. The review encompassed 111 paper-based and 194 electronically managed nursing care plans, strategically selected for comprehensive assessment. The results underscored the efficacy and practicality of employing decision support mechanisms to capture patient preferences and integrating them into nursing care plans. This integration was found to significantly augment the quality of nursing care and subsequently improve patient outcomes. These encompass the selection processes for cutting fluids, electroplating systems, forging conditions, arc welding procedures, industrial robots, milling conditions, material machinability, and electro-discharge micro-machining parameters. The research emphasizes the WASPAS method's proficiency in precisely ranking alternatives across all these decision-making scenarios. Furthermore, the study delves into examining how the parameter λ (lambda) influences the ranking performance of the WASPAS method.*

keywords*: Assessment, nursing diagnosis, collapse, trees, interventions, simplification, evolution, patient-centred, documentation, support*

1. INTRODUCTION

The nursing process model serves as the foundational structure guiding nursing documentation in Australian aged care [1]. Central to this model, the nursing care plan (NCP) acts as the primary documentation, encapsulating the nursing process and validating the provision of top-tier care. While critiques have questioned its efficacy in acute care setups [2], distinct hindrances such as brief hospital stays or fluctuating patient conditions are notably absent in aged care environments [2, 3]. In this context, the NCP assumes a critical role in the continual care of individuals grappling with prolonged health challenges or functional limitations. Through personalized and regularly updated care benchmarks outlined in the NCP for each resident, nurses can ensure seamless care continuity and resident safety. Furthermore, to meet accreditation and quality improvement prerequisites, aged care facilities are mandated to institute outcome centered evaluation and clinical management systems to ensure the efficacy of care [4]. The Nursing Care Plan (NCP) stands as a vital element within this structure, steering nurses through a continuous loop of identifying, planning, delivering care, and assessing outcomes, fostering ongoing enhancements in quality. Multiple studies have evaluated the Nursing Care Plan (NCP), scrutinizing the breadth and excellence of information related to the nursing process [13]. Quantity assessment focused on specific step presence [14–17], while quality evaluation centered on adherence to standardized nursing terms, emphasizing completeness and accuracy in the PES (Problem, Etiology, Signs and Symptoms) formats of nursing diagnoses [18,19], and the interrelation among the five nursing process steps [20,21]. Nonetheless, there exists a research gap in appraising NCP quality within aged care settings, both nationally and internationally. This study aims to fill this gap by examining the impact of an electronic documentation system on elevating the caliber of the NCP. Decision-makers in manufacturing regularly face the intricate task of appraising multiple options, aiming to select

the most suitable one amidst conflicting criteria. Choosing the optimal alternative isn't solely governed by a single definitive criterion; rather, it involves assessing a myriad of criteria. Hence, there's a distinct necessity for clear, systematic, and logical methods or mathematical tools to aid decision-makers in navigating these conflicting selection criteria and their correlations. The primary goal of any selection process is to pinpoint the relevant assessment criteria and ascertain the most fitting combination aligned with actual needs. Consequently, emphasis should be placed on identifying the criteria significantly impacting optimal alternative selection for a given problem. Utilizing straightforward and logical methodologies becomes pivotal in eliminating unsuitable options and pinpointing the most suitable one, thereby reinforcing existing selection procedures. In tackling complex selection dilemmas in modern manufacturing, numerous Multi-Criteria Decision-Making (MCDM) methods have been formulated and refined by earlier researchers. Typically, each selection problem encompasses four fundamental elements: alternatives, attributes or criteria, the relative importance (weight) assigned to each attribute and the performance metrics of alternatives across these attributes. Problems structured in this fashion lend themselves well to resolution through MCDM techniques. Therefore, the primary aim of any MCDM approach is to identify the best choice from a range of viable alternatives, even in the presence of conflicting criteria. This paper seeks to validate the applicability and accuracy of a relatively new MCDM approach, known as the Weighted Aggregated Sum Product Assessment (WASPAS) method, by applying it to address eight real-world selection challenges prevalent in contemporary manufacturing environments.

2. NURSING CARE PLANNING

The primary author, NW, conducted the audit and subsequent data analysis independently due to resource limitations, which prevented the involvement of another person in these procedures. Raw data were initially entered into an Excel file and then imported into statistical software SPSS (version 18) for analysis. Descriptive statistics were used to illustrate both the quantity and quality aspects of the Nursing Care Plans (NCPs). As the dataset did not display a normal distribution, the non-parametric Mann–Whitney U-test was employed to identify noteworthy disparities in the quantity and quality of NCPs between the paper-based and electronic documentation systems. Nursing Care Plan (NCP) systems, falling under Nursing Information Systems (NISs), are purposefully designed to develop care plans. These systems facilitate the creation of care plans by providing a variety of nursing diagnoses, defining characteristics, related factors, anticipated outcome goals, correlated nursing interventions, and outcome evaluations. In recent times, these systems have gained traction and received increasing endorsements for outlining patient conditions (Getty et al., 1999; Lee et al., 2002). The importance of computerized documentation is emphasized for legal compliance to ensure proper care, patient safety, and reimbursements from third parties (Chase, 1997). Furthermore, computerized systems are recognized for providing instant access to information, automated referrals (Morrow, 2002), guiding care practices, and aiding in the communication of crucial information (Daly et al., 2002). Additionally, NCP systems not only equip nurses with technological proficiency in patient care but also enhance their knowledge and expertise (Rinard, 1996). As nurses play a pivotal role as primary care providers in healthcare settings, and Nursing Care Plan (NCP) systems are tailored to align with their patient care end eavors, comprehending nurses' perspectives on the documentation process significantly shapes the advancement of this technology and the formulation of educational initiatives for care plan utilization. Hence, this study aimed to delve deeper into how the substance or content within an NCP system impacts nurses' perceptions of the documentation process while creating care plans. While computerized care plan systems are replacing paper-based formats, their impact on nursing care quality and professional development remains a subject of ongoing investigation. In a prior qualitative study by Lee et al. (2002) examining the same NCP system, nurses' experiences were explored. Findings from interviews in that study suggested that while nurses appreciated the speed and reduction of paper usage facilitated by the computerized care plans, they also expressed concerns about the potential compromise on their critical thinking and professional judgment when utilizing the system. Comprehending nurses' viewpoints regarding the computerized documentation process not only assists in their adaptation to this technology but also has the potential to improve the quality of patient care through the enhancement of care plan content and training initiatives. Therefore, this present study sought to delve deeper into how the content embedded within the NCP system influences nurses' perspectives during the creation of care plans.

WASPAS method: The WASPAS method stands as a distinctive fusion of two established Multiple Criteria Decision Making (MCDM) techniques: the weighted sum model (WSM) and the weighted product model (WPM). In its operational framework, the methodology unfolds in several key steps. Firstly, it entails the acquisition of linearly normalized performance values, establishing a common ground for comparison across various criteria. Subsequently, the approach delves into the computation of both WSM and WPM measures for each alternative, leveraging the strengths and nuances of both models. Next, through a calculated aggregation process, the method arrives at an overarching measure specific to the WASPAS approach for each alternative, synthesizing the evaluations from multiple angles. Finally, the alternatives are ranked in descending order based on their respective

WASPAS Coefficients, offering a comprehensive and ordered perspective on their suitability or preference within the decision context. This amalgamation of methodologies presents a robust system for decision-makers seeking a nuanced and comprehensive evaluation framework for multiple criteria scenarios.

3. RESULT AND DISCUSSION

TABLE 1. Evaluation Parameters

C1	Determining nursing diagnosis
C2	Determining the aim of nursing diagnosis
C3	Forming nursing interventions
C4	Evaluation of nursing care plan
C5	Forming nursing record

Table 1 outlines the Evaluation Parameters employed in this study, comprising five key criteria (C1 to C5) integral to the assessment of nursing care processes. These parameters encompass determining nursing diagnoses (C1), establishing the purpose of nursing diagnoses (C2), formulating nursing interventions (C3), evaluating nursing care plans (C4), and creating nursing records (C5). Each criterion delineates a specific aspect of the nursing care continuum, serving as essential components for comprehensive evaluation and analysis within the context of this study. The utilization of these distinct parameters aims to provide a holistic assessment framework, enabling a thorough examination of critical elements fundamental to the nursing care process.

TABLE 2. Data Set

	C1	C2	C3	C4	C5
Mental state	0.47	0.55	0.61	0.36	0.34
Communication/talking	0.21	0.38	0.49	0.34	0.3
Neurological system	0.54	0.44	0.53	0.4	0.58
Nutrition	0.24	0.23	0.34	0.35	0.4
Physical activity	0.15	0.27	0.4	0.4	0.32
Vital signs	0.19	0.27	0.27	0.23	0.38
Self-care	0.43	0.33	0.34	0.17	0.14
Nursing care plan	0.74	0.83	0.84	0.82	0.79

Table 2. In this data set, various criteria relevant to nursing care are evaluated across different stages of the nursing process. Each criterion, ranging from determining nursing diagnoses to forming nursing interventions and evaluating care plans, is assigned specific weightings across different aspects of care. For instance, mental state holds a weight of 0.47 in determining nursing diagnoses, while it is weighted at 0.36 in evaluating the nursing care plan. Communication/talking, neurological system, nutrition, physical activity, vital signs, and self-care all bear differing degrees of importance across these stages, showcasing their varied significance within the nursing process. Notably, the criterion of nursing care plan itself carries substantial weight across all stages, emphasizing its centrality in the entire process. This data set presents a comprehensive view of the relative importance of different criteria at distinct stages of nursing care, offering insights into the prioritization and emphasis placed on each aspect throughout the care continuum.

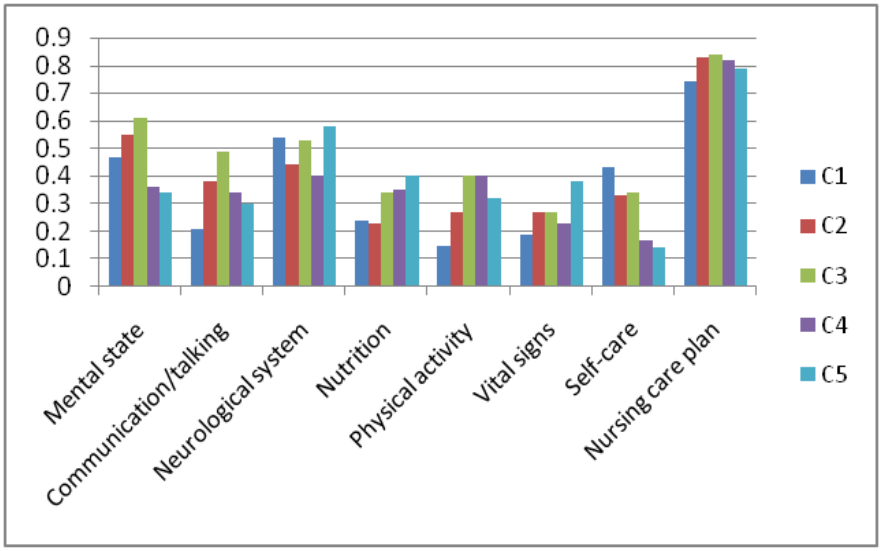

Figure 1. Performance Value

Figure 1 outlines performance values across distinct stages of the nursing process, attributing specific numerical representations to the effectiveness or achievement levels of different criteria. For instance, in the determination of nursing diagnoses, the criterion of mental state exhibits a performance value of 0.63514, suggesting a relatively high level of effectiveness compared to other criteria such as communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan, each assigned their respective performance values across this stage. This pattern continues across subsequent stages including determining the aim of nursing diagnosis, forming nursing interventions, evaluating the nursing care plan, and forming nursing records. These performance values offer a quantitative perspective on the success or effectiveness of each criterion at distinct stages of the nursing process, providing valuable insights for decision-making and prioritization within the domain of nursing care.

TABLE 3. Weight

	C1	C2	C3	C4	C5
Mental state	0.20	0.20	0.20	0.20	0.20
Communication/talking	0.20	0.20	0.20	0.20	0.20
Neurological system	0.20	0.20	0.20	0.20	0.20
Nutrition	0.20	0.20	0.20	0.20	0.20
Physical activity	0.20	0.20	0.20	0.20	0.20
Vital signs	0.20	0.20	0.20	0.20	0.20
Self-care	0.20	0.20	0.20	0.20	0.20
Nursing care plan	0.20	0.20	0.20	0.20	0.20

Table 3 the weights assigned to different criteria across various stages of the nursing process are depicted. Each criterion, including mental state, communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan, carries an equal weightage of 0.20 within each stage. These uniform weightings signify an equitable distribution of importance or significance attributed to each criterion across the distinct stages of determining nursing diagnoses, establishing the aim of nursing diagnoses, formulating nursing interventions, evaluating the nursing care plan, and forming nursing records. By assigning identical weights to all criteria across these stages, this approach implies an equal level of importance or contribution expected from each criterion within the overall decision-making framework of the nursing process.

TABLE 4. WSM Weighted normalized decision matrix

	C1	C2	C3	C4	C5
Mental state	0.12703	0.13253	0.14524	0.08780	0.08608
Communication/talking	0.05676	0.09157	0.11667	0.08293	0.07595
Neurological system	0.14595	0.10602	0.12619	0.09756	0.14684
Nutrition	0.06486	0.05542	0.08095	0.08537	0.10127
Physical activity	0.04054	0.06506	0.09524	0.09756	0.08101
Vital signs	0.05135	0.06506	0.06429	0.05610	0.09620
Self-care	0.11622	0.07952	0.08095	0.04146	0.03544
Nursing care plan	0.20000	0.20000	0.20000	0.20000	0.20000

Table 4 the Weighted Sum Model (WSM) Weighted Normalized Decision Matrix demonstrates the calculated values for each criterion across different stages of the nursing process. These values represent the weighted contributions of each criterion within the decision-making framework. For instance, in the determination of nursing diagnoses, mental state holds a calculated value of 0.12703, showcasing its weighted significance relative to other criteria such as communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan, each assigned their respective calculated values across this stage. Similarly, these calculated values persist across subsequent stages including determining the aim of nursing diagnosis, forming nursing interventions, evaluating the nursing care plan, and forming nursing records. These numerical representations encapsulate the weighted contributions of each criterion, aiding decision-makers in understanding their relative impacts within each stage of the nursing process as governed by the Weighted Sum Model.

TABLE 5. WPM Weighted normalized decision matrix

	C1	C2	C3	C4	C5
Mental state	0.91322	0.92099	0.93802	0.84820	0.84483
Communication/talking	0.77732	0.85534	0.89781	0.83856	0.82395
Neurological system	0.93893	0.88080	0.91201	0.86626	0.94007
Nutrition	0.79835	0.77362	0.83453	0.84343	0.87274
Physical activity	0.72673	0.79884	0.86210	0.86626	0.83465
Vital signs	0.76191	0.79884	0.79692	0.77550	0.86384
Self-care	0.89711	0.83155	0.83453	0.73001	0.70746
Nursing care plan	1.00000	1.00000	1.00000	1.00000	1.00000

Table 5 the Weighted Product Model (WPM) Weighted Normalized Decision Matrix showcases the computed values for each criterion across distinct stages of the nursing process. These values represent the weighted product of each criterion's importance within the decision-making framework. For instance, in determining nursing diagnoses, mental state demonstrates a computed value of 0.91322, indicating its weighted significance compared to other criteria like communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan, each allocated their respective computed values across this stage. These computed values persist through subsequent stages such as determining the aim of nursing diagnosis, forming nursing interventions, evaluating the nursing care plan, and forming nursing records. These numerical representations encapsulate the weighted product of each criterion's impact, providing decision-makers with insights into their relative importance within each stage of the nursing process as governed by the Weighted Product Model.

TABLE 6. WSM and WPM Preference Score

	WSM Preference Score	WPM Preference Score
Mental state	0.57868	0.56534
Communication/talking	0.42387	0.41243
Neurological system	0.62256	0.61421
Nutrition	0.38787	0.37941
Physical activity	0.37941	0.36186
Vital signs	0.33300	0.32493
Self-care	0.35359	0.32152
Nursing care plan	1.00000	1.00000

Table 6 the Preference Scores for both the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) across various criteria are presented. These scores encapsulate the relative importance or preference assigned to each criterion within each model. The WSM Preference Scores illustrate the weighted cumulative assessment of the criteria, with the nursing care plan receiving the highest score of 1.0, signifying its paramount importance within this model. Other criteria like mental state, communication/talking, neurological system, nutrition, physical activity, vital signs, and self-care display varying degrees of preference within the WSM, delineating their relative significance within the decision-making process governed by this model. Conversely, the WPM Preference Scores portray a different perspective, with similar criteria demonstrating slightly adjusted preferences. Once again, the nursing care plan retains its maximal score of 1.0, indicating its unparalleled importance within the weighted product framework. However, the nuances of preference for other criteria such as mental state, communication/talking, neurological system, and others, slightly differ from the WSM, showcasing the subtle variations in their prioritization under the WPM. These Preference Scores in both models provide a clear delineation of the comparative significance of each criterion within the distinct decision-making paradigms offered by the WSM and WPM, offering valuable insights for decision-makers in different contexts.

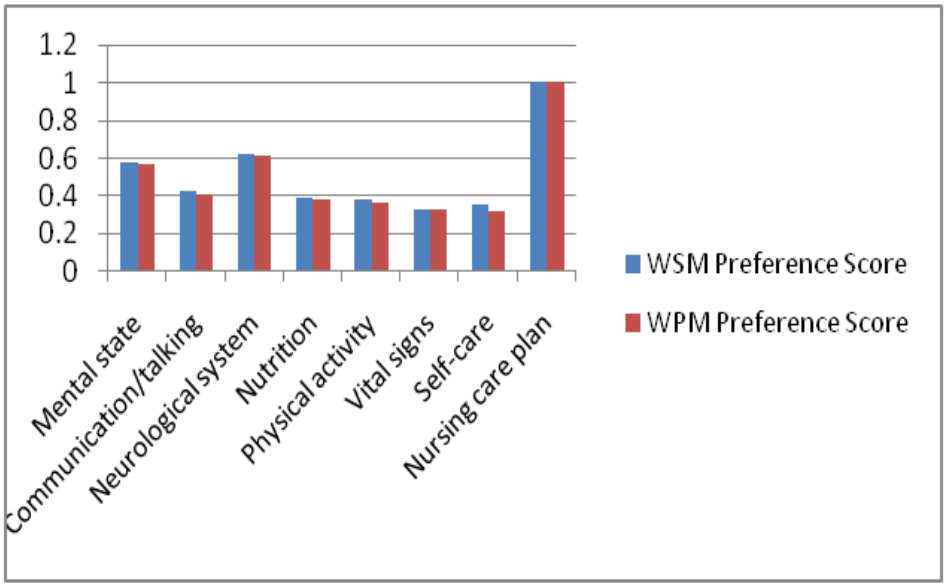

FIGURE 2. Preference Score

Figure 2 both the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) present their respective Preference Scores for various criteria within the decision-making framework. These scores depict the relative importance or preference assigned to each criterion under each model. For instance, within the WSM, the nursing care plan receives a maximum Preference Score of 1.0, denoting its utmost significance within this model. Meanwhile, criteria like mental state, communication/talking, neurological system, nutrition, physical activity,

vital signs, and self-care exhibit varying Preference Scores, showcasing their relative importance within the decision-making process governed by the WSM. On the other hand, the WPM demonstrates slightly different preferences, with similar criteria displaying nuanced variations in their scores. Despite these subtleties, the nursing care plan maintains the maximum score of 1.0, indicating its unparalleled importance within the Weighted Product Model. Other criteria like mental state, communication/talking, neurological system, and others, showcase distinct yet comparable preferences under the WPM. These Preference Scores in both models offer a clear understanding of the comparative significance of each criterion within the distinct decision-making paradigms presented by the WSM and WPM, aiding decision-makers in varied contexts and approaches. A lambda value of 0.5 typically signifies equal importance or weight given to two equally weighted components or criteria within a decision-making process. In various decision models, the lambda value often represents the balancing factor between different aspects or criteria, suggesting a neutral standpoint where both components hold an equal level of significance. For instance, in some multi-criteria decision-making methods, a lambda value of 0.5 might imply an equal trade-off or consideration between two competing or complementary factors, ensuring an even influence of both components on the final decision or outcome.

TABLE 7. WASPAS Coefficient

	WASPAS Coefficient
Mental state	0.57201
Communication/talking	0.41815
Neurological system	0.61838
Nutrition	0.38364
Physical activity	0.37064
Vital signs	0.32896
Self-care	0.33755
Nursing care plan	1.00000

Table 7 presents the WASPAS Coefficients, showcasing the relative significance of different criteria within the WASPAS method. The coefficients outline the weighted amalgamation of each criterion's importance within the decision-making framework. Notably, the nursing care plan holds the highest coefficient of 1.0, denoting its utmost importance within the WASPAS approach. Meanwhile, other criteria such as mental state, communication/talking, neurological system, nutrition, physical activity, vital signs, and self-care display varying degrees of coefficients, illustrating their relative importance within this decision-making methodology. These coefficients encapsulate the weighted perspectives of each criterion, aiding decision-makers in understanding their comparative relevance within the context of the WASPAS method.

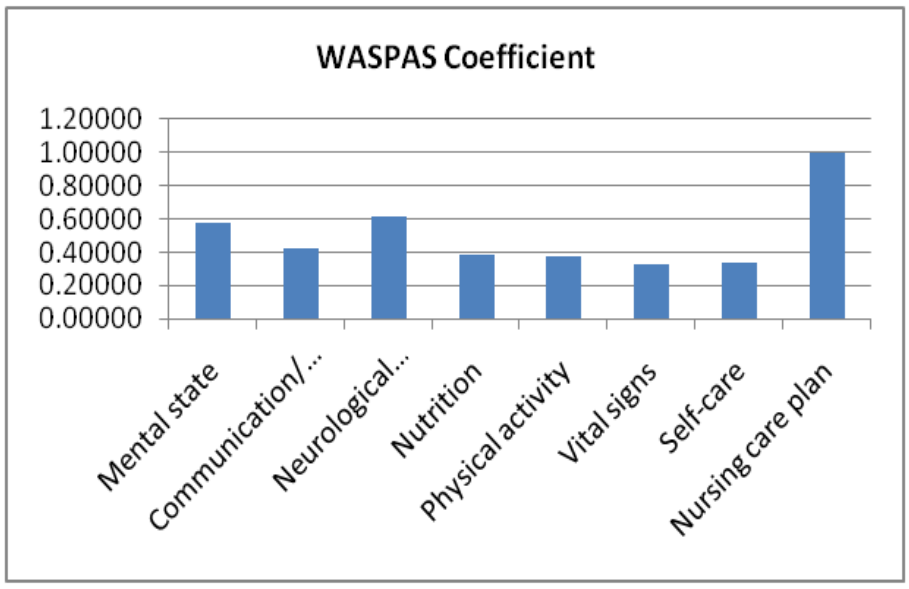

FIGURE 3. WASPAS Coefficient

Figure 3 the WASPAS Coefficients are presented, reflecting the relative significance or coefficients assigned to various criteria within the WASPAS method. Each criterion, such as mental state, communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan, is attributed a specific coefficient value. Notably, the nursing care plan holds the highest coefficient of 1.0, denoting its utmost importance within the WASPAS methodology. Meanwhile, other criteria like neurological system, mental state, communication/talking, and others display varying coefficients, delineating their comparative relevance within

this decision-making framework. These coefficient values offer a quantitative insight into the weighted importance of each criterion within the context of the WASPAS method, aiding decision-makers in understanding the hierarchical significance of criteria when making complex decisions.

TABLE 8. Rank

	Rank
Mental state	3
Communication/talking	4
Neurological system	2
Nutrition	5
Physical activity	6
Vital signs	8
Self-care	7
Nursing care plan	1

Table 8 the rankings of various criteria within the decision-making context are detailed. Each criterion—such as mental state, communication/talking, neurological system, nutrition, physical activity, vital signs, self-care, and the nursing care plan—is assigned a specific rank denoting its position in terms of importance or priority within the framework. The nursing care plan holds the top rank of 1, indicating its paramount significance within this decision-making hierarchy. Following this, the neurological system secures the second rank, while mental state, communication/talking, nutrition, self-care, physical activity, and vital signs occupy subsequent ranks, offering a clear sequence of their prioritization within the decision-making framework. These rankings provide a structured understanding of the hierarchical order and relative importance of each criterion, aiding decision-makers in navigating their significance within this context.

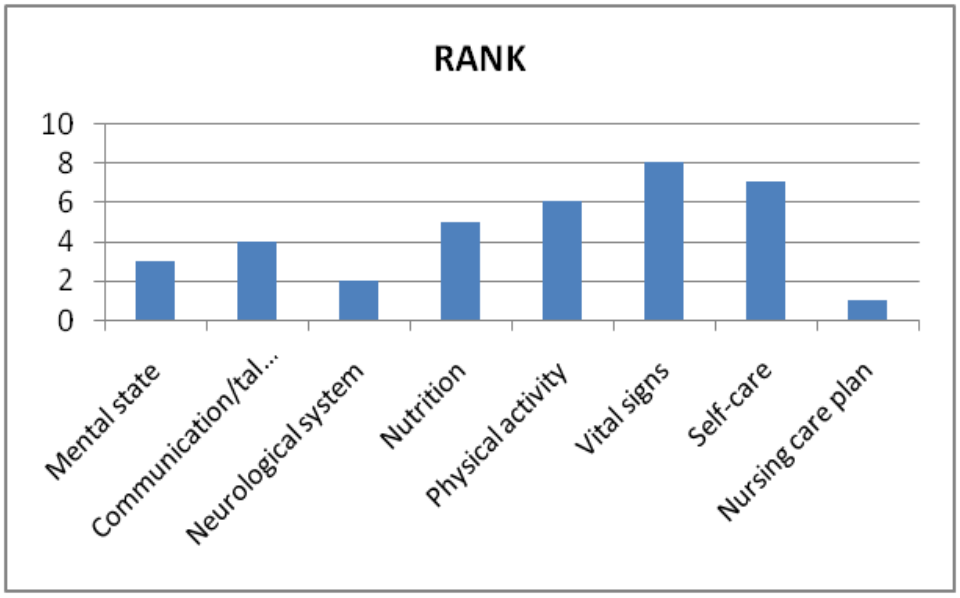

FIGURE 4. Rank

Figure 4 the rankings of different criteria based on their significance within the decision-making context are displayed. The rankings illustrate the relative positions of each criterion concerning their importance within the framework under consideration. The nursing care plan secures the top rank of 1, indicating its paramount significance within this decision-making hierarchy. Meanwhile, other criteria like neurological system, mental state, communication/talking, nutrition, self-care, physical activity, and vital signs occupy subsequent ranks, showcasing their varying degrees of importance within this ranking order. These rankings offer a clear perspective on the prioritization of each criterion, aiding decision-makers in understanding their hierarchical relevance within the decision-making framework.

4. CONCLUSION

Understanding the role of Nursing Care Plan (NCP) systems and their impact on nurses' perceptions is vital in shaping the integration of technology into healthcare practices. As healthcare increasingly embraces computerized documentation, this study's exploration of how NCP system content influences nurses' views during care plan creation is pivotal. The findings shed light on the complex interplay between technological adaptation and the preservation of critical thinking in nursing practice. Previous studies highlighted nurses' appreciation for the

efficiency and reduced paper dependency offered by computerized care plans. However, concerns were raised about potential compromises in professional judgment and critical thinking in utilizing these systems. This study's deeper exploration into nurses' perceptions regarding the NCP system's content adds nuance to these concerns. Enhancing nurses' adaptation to this technology while preserving their critical thinking skills remains a crucial challenge. By understanding how the content within NCP systems influences nurses' perspectives, improvements in training programs and care plan designs can be made, ultimately contributing to higher-quality patient care. In conclusion, this study emphasizes the need for a balanced approach, leveraging technology for efficiency while ensuring it augments, rather than replaces, nurses' critical thinking and professional judgment in care plan creation and delivery. It sets the stage for refining NCP systems to align better with nurses' needs, ultimately enhancing both technology integration and patient care outcomes. This evaluation of nurses' rankings provides crucial insights into the multifaceted nature of their perceptions regarding the NCP system, paving the way for targeted improvements to align technology more effectively with nursing practice for improved patient outcomes.

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