



VALIDATION AND EVALUATION OF A COMPUTERIZED TOOL FOR IMPLEMENTING THE NURSING PROCESS IN A NEONATAL UNIT

VALIDAÇÃO E AVALIAÇÃO DE UMA FERRAMENTA INFORMATIZADA PARA APLICAÇÃO DO PROCESSO DE ENFERMAGEM EM UMA UNIDADE NEONATAL

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RESUMO

Objetivo: Verificar evidências de validade de conteúdo de uma ferramenta informatizada para aplicação do processo de enfermagem (PE) e avaliar seu desempenho com enfermeiros em uma unidade neonatal. **Método:** Estudo metodológico conduzido em duas etapas: i) verificação da validade de conteúdo dos instrumentos do PE por especialistas e ii) avaliação da ferramenta informatizada por enfermeiros de uma unidade neonatal. A coleta de dados ocorreu por meio de questionários respondidos pelos enfermeiros. As análises incluíram o índice de validade de conteúdo (IVC) e as pontuações atribuídas às características da ferramenta. **Resultados:** A ferramenta apresentou IVC > 0,83 para o exame físico e IVC < 0,83 para alguns diagnósticos de enfermagem, motivando as alterações necessárias. Na avaliação do material, observaram-se bons índices de adequação funcional, usabilidade, eficiência de desempenho e compatibilidade. **Conclusão:** A ferramenta informatizada apresentou evidências adequadas de validade para apoiar a aplicação do PE no contexto neonatal.

Descritores: Unidades de Terapia Intensiva Neonatal; Enfermagem neonatal; Recém-nascido; Processo de enfermagem; Terminologia Padronizada em Enfermagem; Informática em enfermagem.

ABSTRACT

Objective: To assess content validity evidence for a computerized tool designed to support implementation of the nursing process (NP) and to evaluate its performance with nurses in a neonatal unit. **Methods:** Methodological study conducted in two stages: i) content validity appraisal of NP instruments by experts and ii) evaluation of the computerized tool by nurses working in a neonatal unit. Data were collected using nurse-completed questionnaires. Analyses included the content validity index (CVI) and user-assigned scores for tool characteristics. **Results:** The tool achieved CVI > 0.83 for the physical examination component and CVI < 0.83 for some nursing diagnoses, prompting targeted revisions. In the assessment of usability, the tool demonstrated favorable ratings for functional adequacy, usability, performance efficiency, and compatibility. **Conclusion:** The computerized tool showed adequate validity evidence to support application of NP in neonatal care settings.

Descriptors: Neonatal Intensive Care Units; Neonatal Nursing; Newborn; Nursing Process; Standardized Nursing Terminology; Nursing Informatics.

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INTRODUCTION

The first 28 days of extrauterine life define the neonatal period, during which the child is considered a neonate⁽¹⁾. This phase is marked by adaptation of the newborn to the external environment, supported by essential physiological and functional changes required for survival⁽²⁾.

Some conditions inherent to this period — often linked to prematurity and/or low birth weight — heighten susceptibility to adverse outcomes⁽³⁻⁴⁾. Prominent examples include hyperbilirubinemia and sepsis⁽³⁾, bronchopulmonary dysplasia⁽⁵⁾, and hypothermia⁽⁴⁾, all of which increase vulnerability and typically necessitate intensive interventions, longer hospitalization, and specialized follow-up⁽⁶⁾.

Within neonatal intensive care units (NICUs) — settings essential for managing at-risk newborns — care should be structured around early diagnosis, appropriate management at admission, and continuity of care^(3,7). The nursing process (NP) guides nursing practice through five interrelated steps — assessment, diagnosis, planning, implementation, and evaluation — promoting systematic, high-quality care⁽⁸⁾.

Adopting the NP benefits professional practice by organizing services, preventing errors, and enhancing team communication through consistent documentation⁽⁹⁾. Nonetheless, barriers to implementation persist, including gaps in training, limited knowledge of the steps, workload burden, insufficient staffing, and team resistance⁽⁹⁻¹⁰⁾.

Information and communication technologies (ICTs) may mitigate several of these obstacles by organizing data, supporting decision-making, reducing documentation time, and expanding nurses' availability for direct care — thereby advancing more humanized care for newborns⁽¹¹⁻¹²⁾.

Accordingly, the aims of this study were to assess content validity evidence for a computerized tool designed to apply the NP and to evaluate the tool with nurses working in a neonatal unit.

METHOD

This methodological study validated and evaluated a computerized tool for implementing the NP for patients admitted to a neonatal unit. The study proceeded in two stages: i) verification of content validity by expert reviewers and ii) evaluation of functional adequacy, reliability, usability, performance efficiency, compatibility, and security by nurses from a neonatal unit. To ensure methodological rigor, we followed the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines⁽¹³⁾.

The tool was grounded in Wanda Horta's Basic Human Needs theoretical model, which conceptualizes needs as manifestations of human imbalance, prioritized by urgency and classified as psychobiological, psychosocial, and psycho-spiritual⁽¹⁴⁾. Psycho-spiritual needs were not considered when classifying nursing diagnoses (NDs) in the validated instrument because the tool targets care for newborns, a population without developed consciousness or formation related to religiosity, ethics, or philosophy of life. In this context, such needs were not pertinent to the NP applied to neonatal patients.

Beyond the theoretical framework, development of the physical examination template and the list of NDs for neonatal inpatients—both validated in this study—was informed by an integrative literature review. This review

guided construction of the nursing assessment form and the selection of NDs included in the computerized system. Searches were conducted in PubMed, SciELO, BDENF, and LILACS using the descriptors “*recém-nascido*,” “*diagnóstico de enfermagem*,” “*processo de enfermagem*,” and “*unidades de terapia intensiva*.” The guiding question was: What are the clinical indicators of the most prevalent NDs among newborns admitted to the NICU? We included articles in Portuguese, English, and Spanish whose populations comprised newborns hospitalized in NICUs, that listed NDs and corresponding clinical indicators in the NICU setting, and that addressed the research question. Editorials, duplicates, and articles without free full-text access were excluded. The search identified 1,235 records; after applying criteria and screening titles, 115 abstracts were reviewed and 35 full texts were read, yielding a final sample of six articles. Standard textbooks were consulted for topics not covered by the review.

NANDA International⁽¹⁵⁾ and the Nursing Interventions Classification⁽¹⁶⁾ informed the selection and definition of NDs and nursing interventions incorporated into the system.

In Stage 1, we examined evidence of content-based validity, consistent with American Psychological Association recommendations that define validity as the relationship between instrument content and the construct it intends to measure⁽¹⁷⁾. This stage occurred between October and December 2022 and involved six experts — nurses with at least 5 years of clinical or academic experience caring for newborns in the neonatal unit of a university hospital in the state of Pernambuco, Brazil. Experts received the first printed version of the tool's contents and a data-collection instrument with items evaluating clarity, practical relevance, and theoretical relevance of the physical examination template, the NDs, and the set of interventions listed for each ND. A 4-point Likert scale was used, with higher scores indicating greater agreement; free-text space for suggestions was provided at the end.

Evaluations were analyzed using the Content Validity Index (CVI), which expresses the proportion of agreement among judges regarding instrument attributes. Item-level CVI was calculated by summing responses scored 3 or 4 and dividing by the total number of responses to that item. A minimum acceptable CVI of 0.83 was adopted⁽¹⁸⁾. Items with CVI < 0.83 were excluded or modified in accordance with expert suggestions.

In Stage 2 — assessment of functional suitability, reliability, usability, performance efficiency, compatibility, and security in accordance with ISO/IEC 25010:2011⁽¹⁹⁾ — eight nurses from the neonatal unit participated, meeting the minimum sample recommended by ABNT ISO/IEC 25062:2011⁽²⁰⁾. We recruited nurses directly involved in the care of at-risk newborns at a university hospital in Pernambuco, as the tool is intended for routine clinical use in this institution. Nurses on vacation, on leave, or otherwise unavailable during data collection (January-February 2023) were excluded.

To conduct the evaluation, each nurse used the tool to apply the NP to a newborn hospitalized on the day of data collection: they performed the physical examination, identified the pertinent nursing diagnoses (NDs), and prescribed the necessary interventions — exclusively within the tool and without interference from the research team. Participants then completed a printed questionnaire covering the six eval-

uated characteristics. This instrument was based on a prior study that developed and validated a NICU NP application⁽¹²⁾. Response options were “agree,” “disagree,” or “not applicable.” “Disagree” responses required justification; items marked “not applicable” were excluded from the final analysis. Each characteristic was deemed satisfactory when at least 70% of responses were positive, consistent with ABNT NBR ISO/IEC 14598-6, Annex C (Informative)⁽²¹⁾, as adapted by Sperandio⁽²²⁾.

The study complied with Resolution No. 466/2012 governing research with human subjects and was approved by the Research Ethics Committee at Centro Universitário Integrado de Saúde Amaury de Medeiros, Universidade de Pernambuco (approval No. 5.639.278; CAAE 61363922.8.0000.5191). All participants provided written informed consent.

RESULTS

Content validity evidence

Six female experts (100%) participated. Most were married (66.7%), with a mean age of 42.2 years and a mean time since graduation of 17.3 years. Regarding experience, 83.3% had ≥ 5 years in clinical neonatal care and 66.7% had ≥ 5 years in neonatal teaching. As for education, 66.7% held a specialist degree and 33.3% held a MSc.

For the instrument appraisal, the physical examination template achieved a CVI of 1.00 for clarity, practical relevance, and theoretical relevance. Even so, the panel’s

suggestions were incorporated after review by the research team, adding: items for pain assessment, recording of gastric residuals, and a dedicated field for describing respiratory auscultation. For pain assessment, the Neonatal Infant Pain Scale was adopted because it is a validated scale, widely known among health professionals — especially nursing staff — easy to understand and apply, and demonstrates adequate reliability⁽²³⁾.

For the nursing diagnoses, “readiness for enhanced breastfeeding,” “impaired swallowing,” “risk for neonatal hyperbilirubinemia,” and “insufficient fluid volume” had CVI < 0.83 in at least one evaluated attribute (Table 1). All other categories met the established cutoff.

NDs with CVI < 0.83 in the criteria of practical pertinence and/or theoretical relevance, along with their corresponding intervention groups, were excluded from the tool. Only the ND “deficient fluid volume” was retained, as its clinical indicators — such as reduced skin moisture, increased heart rate, decreased peripheral perfusion, and decreased urinary output — are frequently observed in hospitalized newborns⁽¹⁵⁾.

Regarding the nursing intervention groups associated with the retained NDs, all achieved CVI > 0.83. Among the suggestions provided, the inclusion of the intervention “apply minimal adhesive dressings” was particularly noted for the NDs “risk for impaired skin integrity” and “impaired skin integrity.” This recommendation was considered relevant to nursing practice and was incorporated into the set of interventions.

Table 1 – Content validity index for nursing diagnoses (NDs) by clarity, practical pertinence, and theoretical relevance. Recife, Brazil, 2023

NDs	Clarity	Practical pertinence	Theoretical relevance
Ineffective breastfeeding	1	1	1
Interrupted breastfeeding	1	0.83	0.83
Readiness for enhanced breastfeeding	0.67	0.50	0.50
Impaired swallowing	0.67	0.67	0.83
Ineffective infant suck-swallow response	1	0.83	0.83
Risk for unstable blood glucose level	1	1	1
Neonatal hyperbilirubinemia	1	1	1
Risk for neonatal hyperbilirubinemia	0.83	0.67	0.67
Risk for electrolyte imbalance	1	1	1
Deficient fluid volume	0.83	0.83	0.67
Excess fluid volume	0.83	0.83	0.83
Impaired urinary elimination	1	1	1
Diarrhea	1	0.83	1
Ineffective breathing pattern	1	1	1
Ineffective peripheral tissue perfusion	1	1	1
Dysfunctional ventilatory weaning response	1	1	1
Dysfunctional family processes	1	1	1
Risk for infection	1	1	1
Risk for surgical site infection	1	1	1
Risk for aspiration	1	1	0.83
Ineffective airway clearance	1	1	1
Impaired skin integrity	1	1	1
Risk for impaired skin integrity	1	1	0.83
Risk for neonatal pressure injury	1	1	1
hyperthermia	1	1	1
Neonatal hypothermia	1	1	1
Risk for neonatal hypothermia	1	1	1
Ineffective thermoregulation	1	1	1
Risk for ineffective thermoregulation	1	1	1
Acute pain	1	0.83	1

Tool evaluation

Eight nurses evaluated the tool with respect to functional suitability, reliability, usability, performance efficiency, compatibility, and security. The results for these dimensions are presented in Tables 2, 3, and 4.

Deficiencies were identified in only two characteristics of the tool: reliability and usability. Regarding reliability, the subcharacteristics rated as unsatisfactory were fault tolerance (25%) and recoverability (50%). As for usability, the accessibility subcharacteristic achieved adequacy in fewer than 70% of evaluations. Detailed results are presented

in Table 3.

Identified issues were reported to the hospital’s information technology team; nevertheless, the tool was deemed adequate because its use was not compromised.

Participants reported satisfactory response and execution times, as well as resources, capacity, and speed consistent with routine clinical workflows. They also rated favorably the interaction among modules and the system’s ability to prevent deletion or unauthorized modification of stored information (Table 4).

Table 2 – Distribution of nurses’ responses on functional suitability and reliability of the tool (n = 8). Recife, Brazil, 2023

Characteristic	Item evaluated	Agree, n (%)	Disagree, n (%)	Not applicable, n (%)	Total, n (%)
Functional suitability					
Functional completeness	The tool supports application of the NP	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool provides all functions needed to execute the NP	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Functional correctness	The tool enables correct execution of the NP	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool is accurate in performing NP functions	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool facilitates execution of the NP	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Reliability					
Maturity	The tool does not fail frequently	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Fault tolerance	When failures occur, the tool continues to function as expected	2 (25.0)	5 (62.5)	1 (12.5)	8 (100.0)
Recoverability	The tool can recover data affected by failures	4 (50.0)	3 (37.5)	1 (12.5)	8 (100.0)
Availability	The tool is accessible when needed	7 (87.5)	1 (12.5)	0 (0.0)	8 (100.0)

NP = nursing process.

Table 3 – Distribution of nurses’ responses on tool usability (n = 8). Recife, Brazil, 2023

Characteristic	Item evaluated	Agree, n (%)	Disagree, n (%)	Not applicable, n (%)	Total, n (%)
Appropriateness	It is easy to understand the concept and its application	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Learnability	It is easy to perform its functions	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	It is easy to learn to use	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Operability	The tool facilitates user data entry	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool facilitates user data output	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool has attributes that make executing the nursing process easier	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Accessibility	The tool provides clear help	7 (87.5)	1 (12.5)	0 (0.0)	8 (100.0)
	Error protection	4 (50.0)	2 (25.0)	2 (25.0)	8 (100.0)
	The tool informs the user of invalid data entry	3 (37.5)	2 (25.0)	3 (37.5)	8 (100.0)
User interface aesthetics	The graphic design is pleasant to the user	6 (75.0)	2 (25.0)	0 (0.0)	8 (100.0)

Table 4 – Distribution of nurses’ responses on performance efficiency, compatibility, and security of the tool (n = 8). Recife, Brazil, 2023

Characteristic	Item evaluated	Agree, n (%)	Disagree, n (%)	Not applicable, n (%)	Total, n (%)
Performance efficiency					
Time	The tool’s response time is adequate	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool’s execution time is adequate	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Resources	The resources used by the tool are adequate	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Capacity	The tool allows smooth navigation	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
	The tool is fast	6 (75.0)	2 (25.0)	0 (0.0)	8 (100.0)
Compatibility					
Interoperability	The tool enables interaction among modules (identification, history, diagnoses, interventions)	8 (100.0)	0 (0.0)	0 (0.0)	8 (100.0)
Security					
Integrity	The tool can prevent deletion or unauthorized alteration of stored information	7 (87.5)	0 (0.0)	1 (12.5)	8 (100.0)

DISCUSSION

Using the NP is essential for nurses' decision-making because it enables safe, higher-quality care that is systematic, continuous, and centered on the patient's individuality. Its implementation also improves team communication through structured records and strengthens clinical reasoning, contributing to professional visibility and to the consolidation of nursing as a science⁽⁹⁾.

As a theoretical–scientific instrument that guides safe, high-quality care, NP implementation should be grounded in a nursing framework capable of supporting practice with evidence derived from each individual's needs⁽²⁴⁾. In this study, the computerized tool for applying the NP integrated the Basic Human Needs Theory with NDs to facilitate identification of priority problems in hospitalized newborns and to support NP application by the nursing staff, thereby promoting safer and more humanized care.

Despite advances in nursing, including the development of theories and care models, systematic care through the NP is not yet fully adopted. Reported barriers include documentation that is poorly integrated with care, work overload, and training gaps^(9,11). In this context, ICTs have emerged as important resources for strengthening the NP by making its execution and team documentation easier⁽¹¹⁾.

ICTs are widely used in health care, particularly in nursing practice. Reported advantages include optimizing the time required to document the NP, increasing availability for direct care of the newborn, and improving service quality and communication among staff — factors that support effective, high-quality care^(11,25).

Tools embedded in computerized systems to implement the NP should be developed and validated beforehand. Their construction requires a literature review to identify the best available scientific evidence on the topic⁽²⁶⁾.

Regarding validation, it is essential to ensure methodological rigor by verifying the relationship between instrument content and the construct to be measured, thereby guaranteeing reliability for nursing care^(17,26). In this study, beyond the literature searches, content appraisal by nurses with clinical or teaching experience in neonatology contributed to developing a valid instrument for use with newborns without risk conditions.

The participation and experience of the expert judges were pivotal during validation, yielding a tool with scientific, standardized language that is easy to adopt and tailored to the local context, with potential for incorporation into routine practice⁽²⁷⁻²⁸⁾.

Although the CVI for the physical examination was satisfactory, we implemented expert-suggested adjustments: inclusion of items for assessment of pain, recording of gastric residuals, and a field for detailed respiratory auscultation. These changes were appropriate given that many hospitalized newborns — owing to prematurity and physiologic immaturity — require enteral and/or parenteral nutrition, which justifies documenting gastric residuals⁽²⁹⁾.

Moreover, exposure to the stressful NICU environment and multiple potentially painful procedures makes systematic pain assessment indispensable⁽³⁰⁾. Using validated scales enables analysis of physiologic and/or behavioral responses and guides management, minimizing adverse effects on growth and neurocognitive, emotional, and motor development⁽³¹⁻³²⁾.

In the evaluation of NDs, “readiness for enhanced breastfeeding,” “impaired swallowing,” and “risk for neonatal hyperbilirubinemia” had CVI < 0.83 for relevance and/or pertinence and were therefore excluded along with their respective intervention groups, except for “deficient fluid volume.” Although this ND also showed CVI < 0.83, it was retained because it relates to dehydration associated with cardiovascular and gastrointestinal conditions, skin lesions, and temperature alterations, making it highly relevant in newborn care⁽¹⁵⁾.

Following content validation and the resulting refinements, we proceeded to evaluate the tool's functional suitability, reliability, usability, performance efficiency, compatibility, and security based on ISO/IEC 25010⁽¹⁹⁾. In a study conducted at a university hospital in southeastern Brazil on the development and validation of a mobile application for the NP in the NICU, only the “recoverability” subcharacteristic within reliability failed to reach 70% positive responses, underscoring that computerized tools are subject to failures and limitations⁽¹²⁾.

Developing and evaluating instruments that support NP implementation is crucial because they enable correction of remediable issues and strengthen the tool, making it safer, more reliable, and more useful in clinical practice. There is a scarcity of studies with comparable statistical data on validation of computerized tools for neonatal NP^(12,25,27,33). This study helps address that gap by presenting objective data evaluated according to international quality standards (ISO/IEC 25010).

This study has limitations. Not all NP stages were completed within the system, as we could not incorporate nursing outcomes evaluation using the Nursing Outcomes Classification (NOC), leaving this stage subjective in the tool. Using nursing outcomes to formulate objectives and evaluate care remains a challenge in developing computerized systems; when digitized, objectives are not always specific, measurable, achievable, relevant, and time-bound⁽³³⁾. This difficulty was also reported in an integrative review that identified tools without NOC application, reinforcing the need for studies that enable its incorporation and, consequently, full operationalization of the NP⁽³⁴⁾.

CONCLUSION

The computerized tool for implementing the NP in a neonatal unit was deemed valid by expert reviewers. The physical examination component achieved an adequate CVI, whereas some NDs did not meet the cutoff and were excluded along with their corresponding intervention groups, except for deficient fluid volume. In the tool evaluation, inadequacies were recorded only in reliability and recoverability — system characteristics for which the authors had limited capacity to implement adjustments — without compromising usability or overall use.

Validation is relevant to nursing practice: computerizing the NP organizes and stores newborn information in a single system, reduces documentation time, facilitates direct and individualized care, strengthens decision-making, and improves team communication. Because the tool was evaluated by nurses engaged in clinical care and/or teaching, it preserves standardized, scientific language and contributes to safe, effective, high-quality care.

In sum, this study presents the development and vali-

dition of a computerized NP tool tailored to a real clinical setting, with clear potential for direct application in neonatal care.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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All authors are responsible for the writing and critical review of the intellectual content, for the final published version, and for all ethical, legal, and scientific aspects related to the accuracy and integrity of the study.



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