Original Article

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CONSTRUCTION AND VALIDATION OF CHECKLIST FOR SAFE MANAGEMENT OF PERIPHERAL INTRAVENOUS CATHETERS IN OUTPATIENT ANTINEOPLASTIC THERAPY

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ABSTRACT

Objective: To develop and validate a checklist for the implementation of good practices related to the safe management of peripheral intravenous catheters in antineoplastic therapy, performed by nurses at an outpatient level.
Method: This is a descriptive study with a methodological approach, developed in three stages between August and December 2023: scope review, instrument development, and validation of psychometric properties. Eight expert judges were included to validate the content, and subsequently, 49 nurses performed the validation as the target audience. For data analysis, the Content Validity Coefficient, the Kaiser-Meyer-Olkin and Bartlett's Sphericity tests were used to verify sampling adequacy, followed by Exploratory Factor Analysis and the assessment of internal consistency using McDonald's Omega and Cronbach's Alpha coefficients.
Results: The conceptual framework underpinning the construction of the checklist was established through a scoping review that included 16 publications. The content validity coefficient was 0.99, with 12 eigenvalues greater than one identified. Six factors were found to account for 42.6% of the total variance. The checklist, initially composed of 59 items, was completed with 37, and proved to be reliable, with results of 0.70 for the McDonald Omega test and 0.79 in Cronbach's Alpha.
Conclusion: The checklist proved to be valid and reliable for use in the implementation of good nursing practices related to peripheral intravenous catheterization for outpatient antineoplastic therapy.

DESCRIPTORS Catheterization, Peripheral. Antineoplastic agents. Ambulatory care. Nursing. Medical Oncology.

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CONSTRUÇÃO E VALIDAÇÃO DE *CHECKLIST* PARA MANEJO SEGURO DO CATETER INTRAVENOSO PERIFÉRICO NA TERAPIA ANTINEOPLÁSICA AMBULATORIAL

RESUMO

Objetivo: construir e validar um *checklist* para a implementação de boas práticas relacionadas ao manejo seguro do cateter intravenoso periférico na terapia antineoplásica, realizada pelo enfermeiro em nível ambulatorial.
Método: trata-se de um estudo descritivo, de abordagem metodológica, desenvolvido em três etapas entre agosto e dezembro de 2023: revisão de escopo, construção do instrumento e validação das propriedades psicométricas. Oito juízes especialistas foram incluídos para validar o conteúdo, e posteriormente, 49 enfermeiros realizaram a validação como público-alvo. Para a análise dos dados, empregaram-se o Coeficiente de Validade de Conteúdo, os testes de Kaiser-Meyer-Olkin e de Esfericidade de Bartlett para verificar a adequação amostral, seguidos da Análise Fatorial Exploratória e da avaliação da consistência interna por meio dos coeficientes Ômega de McDonald e Alfa de Cronbach.
Resultados: a estrutura conceitual que fundamentou a construção do *checklist* foi estabelecida por meio de uma revisão de escopo que incluiu 16 publicações. O coeficiente de validade de conteúdo foi de 0,99, sendo identificados 12 autovalores acima de um. Foram encontrados seis fatores responsáveis por explicar 42,6% da variância total. O *checklist*, inicialmente composto por 59 itens, foi finalizado com 37, e demonstrou-se confiável, com resultados de 0,70 para o teste Ômega de McDonald e 0,79 no Alfa de Cronbach.
Conclusão: o *checklist* mostrou-se válido e confiável para ser utilizado na implementação de boas práticas de enfermagem relacionadas ao cateterismo intravenoso periférico para terapia antineoplásica ambulatorial.

DESCRITORES Cateterismo Periférico. Antineoplásicos. Assistência Ambulatorial. Enfermagem. Oncologia.

CONSTRUCCIÓN Y VALIDACIÓN DE LISTA DE VERIFICACIÓN PARA EL MANEJO SEGURO DE CATÉTERES INTRAVENOSOS PERIFÉRICOS EN LA TERAPIA ANTINEOPLÁSICA AMBULATORIA

RESUMEN

Objetivo: Construir y validar una lista de verificación para la implementación de buenas prácticas relacionadas con el manejo seguro de catéteres intravenosos periféricos en la terapia antineoplásica, realizado por enfermero a nivel ambulatorio.
Método: Se trata de un estudio descriptivo con enfoque metodológico, desarrollado en tres etapas entre agosto y diciembre de 2023: revisión del alcance, construcción del instrumento y validación de propiedades psicométricas. Se incluyeron ocho jueces expertos para validar el contenido y, posteriormente, 49 enfermeros realizaron la validación como público objetivo. Para el análisis de los datos se utilizó el Coeficiente de Validez de Contenido, las pruebas de Kaiser-Meyer-Olkin y Esfericidad de Bartlett para verificar la adecuación del muestreo, seguido del Análisis Factorial Exploratorio y la evaluación de la consistencia interna mediante los coeficientes Omega de McDonald y Alfa de Cronbach.
Resultados: El marco conceptual que sustenta la construcción de la lista de verificación se estableció a través de una revisión de alcance que incluyó 16 publicaciones. El coeficiente de validez de contenido fue de 0,99, identificándose 12 valores propios por encima de uno. Se encontró que seis factores eran responsables de explicar el 42,6% de la varianza total. La lista de verificación, inicialmente compuesta por 59 ítems, finalizó con 37, y demostró ser confiable, con resultados de 0,70 en el test Omega de McDonald y 0,79 en el Alfa de Cronbach.
Conclusión: La lista de verificación demostró ser válido y confiable para su uso en la implementación de buenas prácticas de enfermería relacionadas con la cateterización intravenosa periférica para la terapia antineoplásica ambulatoria.

DESCRIPTORES Cateterismo periférico. Antineoplásicos. Atención ambulatoria. Enfermería. Oncología.

INTRODUCTION

In recent decades, there has been a significant expansion of outpatient cancer treatments, which currently account for more than 56% of therapeutic modalities. This trend, in addition to contributing to the reduction of hospital resource consumption, has been providing improvements in patients' quality of life. This is due to the reduction in hospital stay time, waiting time for beds in oncology wards, and the need for patients to travel to a treatment center, since the outpatient clinic can be located close to their home[1–4].

Although the use of other routes, such as oral and subcutaneous, for the administration of antineoplastic therapy is increasing, the intravenous route is still the most used in the outpatient setting, as it is considered safer in relation to absorption and serum levels of the drug. Recent studies indicate that between 60% and 76% of antineoplastic therapies are administered through this route, which accounts for approximately 55.5% of the total costs of oncology drugs[5–6].

The infusion of these drugs is predominantly through the Peripheral Intravenous Catheter (PIVC), being able to achieve a 90% completion rate of first-line therapies in some types of cancer[4,7]. This device is defined by the Infusion Nursing Society as those inserted into superficial veins, located just beneath the skin in the superficial tissue, as well as into deeper veins, located beneath the muscle tissue. These veins are located in the periphery, including the extremities, the external jugular vein, and the scalp veins in newborns[8].

Patients undergoing cancer treatment are considered to have difficult intravenous access, and their venous network is excessively manipulated, either for the infusion of antineoplastic therapy, clinical support therapies, or for the administration of contrast agents in imaging exams. Under these circumstances, they are subject to successive attempts to insert a PIVC, which causes discomfort, increases the risk of incidents and adverse events, as well as infections and healthcare costs. The clinical response to treatment may also be compromised if difficulty with insertion of the device results in delays in starting or continuing therapy[9].

Despite the widespread use of PIVC, these devices present significant risks to patient safety, especially due to the clinical characteristics of the oncology population. Researchers warn of failures in up to 35% of PIVCs used in this population, related to mechanical, infectious and inflammatory events, with the incidence of complications ranging from 34.9% to 50%[10–11].

Such failures can result in serious clinical outcomes, especially considering that these patients have additional risk factors, such as immunosuppression, malnutrition, complex therapeutic needs, and veins compromised by multiple puncture attempts. In this scenario, the safe use of PIVC requires rigorous protocols, training of the nursing team, continuous surveillance, and the adoption of good care practices to minimize risks and promote cancer patients' safety[10–11].

In this sense, according to Resolution No. 569 of 2018 of the Federal Nursing Council (Cofen), the administration of antineoplastic drugs is an exclusive responsibility of nurses[12]. This professional must have knowledge about these medications and their adverse effects, and have to perform a thorough evaluation of the patient's venous network to ensure safety in administering the proposed therapy, since many complications with PIVC can be prevented with this approach[13].

Research shows that even with the emergence of new recommendations on a topic, they do not always reach practice in a timely manner, and are often applied differently in the same service[14]. In view of the evaluation of peripheral catheterization practices for outpatient antineoplastic therapy, the literature argues that reliable and validated instruments for systematic application, in particular checklists, allow the implementation of individualized professional qualification strategies oriented towards the adoption of best practices in vascular catheter care[14–15].

Although the literature presents studies that propose audit instruments for insertion and maintenance of vascular catheters[15] and bundles to prevent complications such as extravasation[16], the absence of specific checklists that systematically guide nursing practices in the use of PIVC for the administration of antineoplastic drugs in outpatient settings is observed. Although there are tools that assist in decision-making for the evaluation and safe removal of peripheral catheters, in addition to supporting audits to verify employee compliance with institutional manuals[15], checklists related to the steps of the procedure, as well as their development and validation, are lacking, and this is the main gap to be filled by this study.

The objective of this study is to develop and validate a checklist for the implementation of good practices related to the safe management of peripheral intravenous catheters in antineoplastic therapy, performed by nurses at an outpatient level.

METHOD

This is a descriptive study with a methodological approach, developed in three stages: scope review, instrument development, and validation of psychometric properties. This research followed the guidelines of the Consensus-based Standards for the selection of Health Measurements Instruments (COSMIN)[17].

The first stage, carried out in August 2023, involved the development of the conceptual framework of the checklist, based on a scoping review according to the JBI and PRISMA Extension for Scoping Reviews: Checklist and Explanation (PRISMA-ScR). The protocol was registered in the Open Science Framework with number DOI: 10.17605/OSF.IO/KUMAD. The following databases were included: US National Library of Medicine (PubMed), EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCOhost, Scopus, Latin American and Caribbean Literature in Health Sciences (LILACS), Nursing Databases (BDENF), Cochrane Library and in the library of Scientific Electronic Library Online (SciELO). The search strategy also included gray literature, carried out on Google Scholar and Open Access Theses and Dissertations (OATD)[18–19].

The scientific information retrieval strategy used the Health Sciences Descriptors (DeCS), Medical Subject Headings (MeSH) and keywords, adapted according to the particularities of each database, namely: Peripheral Catheterization; Peripheral Venous Catheterization; Antineoplastic agents; Pharmacotherapy; Chemotherapy; Outpatient Care and Outpatient Care Institutions, using Boolean operators (AND and OR).

In the second stage, carried out between September and November 2023, the construction of the checklist was carried out by the study's main researcher, a master's student in the Nursing Graduate Program at the Nursing School of a federal public university located in the *Zona da Mata Mineir*a region. This process was supported by the publications included in the scoping review, which addressed practices related to peripheral intravenous catheterization. Additionally, the researchers incorporated gray literature documents, including a technical note on safe practices for preventing incidents involving peripheral intravenous catheters in healthcare settings[13], as well as the guidelines of the Infusion Nursing Society[8].

The third stage took place in December 2023 and corresponded to content validation. Eight expert judges were intentionally selected[20]. The inclusion criteria were: experience of at least one year and a minimum postgraduate qualification (specialization in oncology) and, as an exclusion criterion, exclusive participation in administrative activities. The specialists worked for two outpatient clinics specialized in systemic cancer treatment, responsible for serving the public in Juiz de Fora, Minas Gerais, and the surrounding region. These services are aimed at the treatment of solid and

hematologic tumors in adults, in addition to offering clinical care in medical consultations specializing in clinical oncology, radiotherapy, mastology, oncological surgery, thoracic surgery, oncocardiology, hematology, and oncogenetics.

An explanatory approach was adopted for the research, in which an envelope containing an invitation letter was personally delivered to the participants at their respective workplaces. The Delphi technique, used to seek consensus among experts regarding content validation of checklist, was implemented through up to four rounds, with the possibility of being interrupted at any time after reaching consensus among the experts[21]. After receiving the evaluation instructions and signing the Free and Informed Consent Form (FICF), the expert judges had access to the printed form containing sociodemographic information and the instrument for content validation.

The instrument used for content validation considered three main criteria: clarity of language, practical relevance, and theoretical relevance. The assessment was carried out using a Likert scale from 1 to 5, where 1 indicated “no application” and 5, “fully applicable”. Additionally, a field was made available so that participants could suggest changes to each item. A 20-day deadline was established for returning the material, with the envelopes being delivered personally to the researcher in charge.

The expert judges’ evaluations were entered into the database of Microsoft Excel 2020® and subsequently analyzed by the responsible researchers. During this stage, the scores assigned to each item and the observations recommended by the judges were verified. The suggestions analyzed and accepted in the first round were consolidated into a single table, with the aim of defining the revised version to be used in the next round. In this new stage, the documents were delivered to the judges in the same way as in the first round. Two rounds of evaluation were necessary, with a two-week interval between them. There were no sample losses during the study stages.

To validate the content of the checklist, the Content Validity Coefficient (CVC) was used. Likert scale results were calculated from the average of the experts’ scores, divided by the maximum possible number of scores, adjusted for bias. Bias was calculated as 1 divided by the number of judges. A CVC greater than 0.80 was considered satisfactory, being the cut-off criterion for validating the instrument when the sample varies from six to eight professionals[22].

For validation with the target audience, the final version of the checklist obtained in the second and final Delphi round was used. To select the target audience, a search was carried out on the professional network LinkedIn®. Initially, the term “oncology” was used on the platform and then the filters “People”, “Companies” and “Services” were applied. The evaluation of the participants’ profiles considered three criteria: current position, academic background, and experience in health services, prioritizing nurses with experience in outpatient clinics and administration of antineoplastic therapy. An explanatory message about the study, along with the link of *Google Forms*® containing the FICF and the checklist proposed in this study, was sent directly to each selected professional. In addition to the participants approached on the social network, the researchers adopted the non-probabilistic sampling technique known as snowball, in which the professionals initially contacted acted as intermediaries, indicating other participants with the desired profile to participate in the research[23].

To validate the psychometric properties of the checklist, different statistical approaches were used. Initially, in addition to the Content Validity Coefficient, an exploratory factor analysis (EFA) was performed to identify the underlying structure of the instrument’s items and variables.

The adequacy of the sample was verified by the Kaiser-Meyer-Olkin (KMO) index, which measures the correlation between items. A minimum value of 0.5 was considered acceptable to proceed with the EFA. In addition, Bartlett’s Sphericity Test was applied to confirm the existence of significant correlations between the items, with a significance level of $p < 0.05$ being adopted.

In this regard, the identification of factors followed the eigenvalue criterion, in which only factors with eigenvalues greater than 1 were retained, ensuring that these factors explained a significant portion of the variance. To facilitate the interpretation of the results, the identified factors were subjected to an oblique rotation using the promax method. During this stage, items with factor loadings lower than 0.3 were eliminated.

The reliability of the checklist was assessed using McDonald's Omega and Cronbach's Alpha tests, which measure the internal consistency of the instrument. For both tests, the minimum criterion established was 0.70, indicating that the items evaluated were sufficiently correlated and that the instrument presented adequate reliability to measure the construct under analysis. All statistical analyses were performed by a statistician using the *J*effrey's Amazing Statistics Program (JASP), version 18.3.0.

This research was approved by the Research Ethics Committee (*CEP*). All participants signed the FICF.

RESULTS

The development stage was carried out based on a scoping review. A total of 433 studies were identified through database searches. Nine articles found in the search strategy, three publications identified in the gray literature, and four in the reverse search were included in this review, following the PRISMA-ScR recommendations. Using the simple content analysis technique, 59 items distributed across six categories were initially included in the checklist.

The first category included the evaluation of the medical prescription and medication label; the second addressed the procedures for evaluating the puncture site and selecting the device; the third addressed the puncture procedure; the fourth related the practices for securing and stabilizing the peripheral intravenous catheter; the fifth described maintenance practices; and, finally, the sixth addressed the removal and disposal of the puncture device. In the end, the tool was called "Checklist for the implementation of good practices in peripheral intravenous catheterization for outpatient antineoplastic therapy".

In the content validation process, the committee of expert judges consisted of eight professionals in two rounds, since consensus was established and it was not necessary to carry out the next stages using the Delphi technique.

Regarding the profile of the eight specialist judges, their ages ranged from 25 to 47 years, with an average of 34 years. The average length of time since graduation was 9.25 years, ranging from two to 20 years. Regarding experience in oncology, the average time was 4.75 years, with a minimum of two years and a maximum of 10 years. All experts were female (100%). Regarding academic training, half of the participants had a graduate certificate (50%), while the other four (50%) had completed residency. Regarding professional practice, half of the participants worked exclusively in secondary care (50%), three (37.5%) worked in both secondary and tertiary care, and only one (12.5%) worked in secondary and tertiary care, and teaching.

During content validation, modifications in the checklist were suggested. The changes consisted of eliminating 13 items and condensing seven, aiming to make the tool more compact and replicable in the practice of nursing professionals. In addition, five questions had their wording adjusted to avoid double interpretation and ambiguity, while another five were rewritten to increase objectivity.

The first version of the checklist, which achieved a CVC of 0.85, was applied to the specialist judges. In the second round, aiming to obtain greater consensus among the experts, the version of the tool, which had been adjusted according to previous suggestions, was delivered to the participants. This version was reduced to 39 items distributed among the six categories, obtaining a CVC of 0.99. Table 1 presents the final consensus among the judges regarding the items analyzed.

Table 1 – Content validation carried out by expert judges using the criteria of clarity of language, practical relevance, and theoretical relevance. Juiz de Fora, Minas Gerais, Brazil, 2024.

Instrument items	Content Validity Coefficient		
	Clarity of language	Practical relevance	Theoretical relevance
Category 1 - Evaluation of medical prescription and medication label			
1. Identify prescribed medications and infusion solutions and classify them according to their properties: vesicant, irritant, non-vesicant, and non-irritant.	1.00	1.00	1.00
2. Check the order of infusion of medications, prioritizing the infusion of vesicant drugs first whenever possible.	0.98	1.00	1.00
Category 2 - Puncture site assessment and device selection			
3. Select a flexible PIVC of the smallest gauge and cannula that will accommodate the prescribed therapy.	1.00	0,93	0.95
4. Utilize vascular visualization technology (near infrared, ultrasound) to increase first-attempt success in patients with difficult intravenous access.	0.98	0.90	0.98
5. Discuss preference for site selection with the patient and/or caregiver, including recommendations for using sites on the nondominant side.	1.00	0.95	0.98
6. Prefer veins from the dorsal and ventral surfaces of the forearms, such as the cephalic, basilic, median forearm and elbow.	1.00	0.93	1.00
7. Do not puncture: painful areas, areas with compromised skin, open wounds and/or with inflammatory signs.	1.00	1.00	0.95
8. Do not use the external jugular vein, veins in the lower extremities, visible veins in the chest, breast, abdomen or other locations on the trunk of the body.	1.00	1.00	1.00
9. Perform venipuncture in upper limbs contralateral to lymphadenectomy or radiotherapy.	1.00	1.00	1.00
10. Avoid venipuncture in an extremity with paralysis or hemiparesis and do not puncture the vessels of limbs with a functioning arteriovenous fistula.	1.00	1.00	1.00
11. Use an appropriate method to promote vasodilation: use of controlled heating, gravity and prevention of venous flow with the use of a tourniquet.	1.00	1.00	1.00
Category 3 – Procedure			
12. Do not use an established PIVC punctured more than 24 hours before.	1.00	0.98	0.98
13. Perform hand hygiene and maintain proper aseptic technique at all times when handling the PIVC.	1.00	1.00	1.00
14. Perform skin antisepsis with an alcoholic antiseptic agent and wait for it to dry spontaneously before proceeding with the puncture.	1.00	1.00	1.00

Table 1 – Cont.

Instrument items	Content Validity Coefficient		
	Clarity of language	Practical relevance	Theoretical relevance
15. Remove with soap and water or 2% chlorhexidine degerming agent if visible dirt is identified at the puncture site.	1.00	0.98	0.98
16. Employ fear-reducing techniques whenever possible, which may include distraction.	1.00	0.98	1.00
17. Provide a new PIVC device for each puncture attempt on the same patient.	1.00	1.00	1.00
18. Use a pair of non-sterile gloves to insert the PIVC.	1.00	1.00	1.00
19. Do not touch or palpate the insertion site after skin antisepsis.	1.00	1.00	1.00
20. Restrict two puncture attempts per professional and four in total per patient.	1.00	1.00	1.00
21. Use tourniquets that can be cleaned between patients.	1.00	0.95	0.98
Category 4 – Fixation and stabilization			
22. Apply a transparent, semipermeable sterile dressing that allows visual inspection and evaluation of the vascular access insertion site and does not exert pressure on or under the device.	1.00	0.95	0.98
23. Assess the skin for potential risk of injury associated with fixation and due to age, joint movement, and presence of edema.	1.00	0.98	0.98
24. Do not reintroduce a displaced PIVC into the vein.	1.00	1.00	1.00
25. Replace dressing when damp, loose or visibly soiled.	1.00	1.00	1.00
26. Record on the chart the catheter gauge, number of attempts, and the name of the professional responsible for insertion.	1.00	1.00	1.00
Category 5 – Maintenance			
27. Inspect the PIVC site regularly at each bedside visit by visual inspection and palpation to determine tenderness and identify potential complications early.	1.00	1.00	1.00
28. Flush and aspirate to check blood return before each infusion.	1.00	0.98	0.98
29. Infuse 20ml of 0.9% saline solution before each medication administration.	1.00	1.00	1.00
30. Use commercially available single-dose vials or pre-filled syringes for flushing and lock of the catheter.	1.00	0.90	1.00

Table 1 – Cont.

Instrument items	Content Validity Coefficient		
	Clarity of language	Practical relevance	Theoretical relevance
31. Disinfect the connection of each route, side injector and occluders with 70% alcohol before administering the medication through the catheter.	1.00	1.00	1.00
32. Use 10ml syringes for flushing. In case of resistance, evaluate possible factors (such as, for example, closed clamps or kinked extenders and infusion lines).	1.00	1.00	1.00
33. Use positive pressure technique to minimize blood return to the PIVC lumen.	1.00	0.98	1.00
34. Instruct the patient and/or companion on catheter maintenance care and warning signs that should be reported.	1.00	1.00	1.00
35. Do not use an infusion pump to administer vesicant drugs.	1.00	1.00	1.00
Category 6 - Removal and disposal			
36. Remove the PIVC if contamination is suspected, or if complications or malfunctions occur.	1.00	1.00	1.00
37. Apply firm pressure to the site after removing the cannula until hemostasis is achieved.	1.00	1.00	1.00
38. Examine PIVC for integrity after removal and before disposal.	1.00	1.00	1.00
39. Discard sharps immediately after puncture in a specific collector and discard flexible catheters along with the infusion circuit, without disconnecting them, in waste collector B.	1.00	1.00	1.00

Regarding validation with the target audience, carried out in May 2024, the KMO test obtained an acceptable result (0.50) and Bartlett's Sphericity Test showed statistical significance (p<0.01). Initially, an EFA was performed, excluding items 8 (do not use the external jugular vein, veins in the lower extremities, visible veins in the chest, breast, abdomen or other locations on the trunk of the body) and 20 (restrict two puncture attempts by each professional and four in total, per patient) as they were not absolute values. Subsequently, a new analysis was performed, in which 12 eigenvalues greater than 1.00 were found. Considering the explained variance criterion, the distribution and arrangement were determined in six factors, this being the best outcome for the study, representing 54.4% of the explained variance (Table 2).

Table 2 – Description of the explained variance of the factors of the checklist for implementation of good practices related to peripheral intravenous catheterization for antineoplastic therapy at an outpatient level. Juiz de Fora, Minas Gerais, Brazil, 2024.

F	Initial eigenvalues			Rotation sum of squared loadings		
	Total	%	Cumulative percentage	Total	%	Cumulative percentage
Factor 1	6.520	16.7	17.0	4.607	11.8	11.8
Factor 2	4.825	12.0	29.0	4.170	10.7	22.5
Factor 3	2.851	7.0	36.0	2.667	6.8	29.3
Factor 4	2.578	7.0	43.0	1.470	3.8	33.1
Factor 5	2.459	6.0	49.0	1.405	3.6	36.7
Factor 6	2.272	6.0	54.0	1.398	3.6	40.3
Factor 7	2.008	5.0	59.0	1.374	3.5	43.8
Factor 8	1.772	4.0	64.0	1.292	3.3	47.1
Factor 9	1.405	3.0	67.0	1.285	3.3	50.4
Factor 10	1.354	3.0	70.0	1.264	3.2	53.7
Factor 11	1.184	3.0	73.0	1.189	3.0	56.7
Factor 12	1.106	3.0	76.0	1.177	3.0	59.7
Factor 13	1.061	2.0	78.0	1.144	2.9	62.7
Factor 14	1.022	2.0	81.0	1.139	2.9	65.6
Factor 15	0.918	2.0	83.0	1.095	2.8	68.4
Factor 16	0.898	2.0	84.0	1.094	2.8	71.2
Factor 17	0.695	1.0	86.0	1.026	2.6	73.8
Factor 18	0.604	1.0	87.0	0.984	2.5	76.4
Factor 19	0.569	1.0	88.0	0.983	2.5	78.9
Factor 20	0.451	1.0	89.0	0.971	2.5	81.4
Factor 21	0.431	1.0	89.0	0.926	2.4	83.7
Factor 22	0.367	1.0	90.0	0.894	2.3	86.0
Factor 23	0.317	1.0	90.0	0.685	1.8	87.8
Factor 24	0.275	0	91.0	0.556	1.4	89.2
Factor 25	0.199	0	91.0	0.397	1.0	90.2
Factor 26	0.166	0	91.0	0.272	0.7	90.9
Factor 27	0.146	0	92.0	0.186	0.5	91.4
Factor 28	0.122	0	92.0	0.158	0.4	91.8

Regarding the assessment of internal reliability, the instrument presented satisfactory values in the McDonald Omega and Cronbach's Alpha tests (Table 3).

The instrument final version consisted of 37 items, being the main social contribution of this study. This tool was validated by maintaining the division between the six initial categories, namely: evaluation of the medical prescription and medication label, evaluation of the puncture site and device selection, procedure, fixation and stabilization, maintenance, removal, and disposal.

Table 3 – Analysis of the instrument's reliability using McDonald's Omega and Cronbach's Alpha. Juiz de Fora, Minas Gerais, Brazil, 2024.

Applied test	Value
McDonald's Omega	0.70
Cronbach's alpha	0.79

DISCUSSION

This study developed and validated the psychometric properties of the checklist proposed. The content validation and internal reliability of the items showed satisfactory values. The use of this tool in clinical practice can contribute to decision-making about care, treatments, interventions, and the development of health programs and institutional policies, especially in outpatient antineoplastic therapy[24,25]. The literature states that the validation process contributes to the production of reliable instruments, easy to apply and interpret, capable of promoting healthcare safety, either for the promotion of new practices or for the evaluation of practices carried out[15].

Regarding PIVC, the topic is justified as the object of this study, since published research is still predominantly focused on the use of central venous catheters. Central devices such as fully implantable and peripherally inserted catheters can represent up to 60% of use in the oncology context, being considered safer for vesicant drugs and more comfortable for the patient. However, they are associated with complications such as arrhythmia, bleeding, malpositioning, embolism, vessel and nerve injury, occlusion, thromboembolism, infection, migration, and mechanical dysfunction[26].

Although PIVC is associated with mechanical, chemical, and infectious complications, it has been shown to be well tolerated in the outpatient setting, achieving completion rates of up to 90% of the proposed therapy and presenting lower complication rates when compared to central venous access devices. These data suggest that peripheral intravenous access is a safe and effective way to administer antineoplastic drugs, playing an important role in all stages of cancer treatment[4].

Outpatient treatment requires intermittent peripheral venipunctures which, combined with the patient's own conditions, contribute to the difficulty of obtaining these accesses in the oncological context[27]. Researchers have questioned the quality and safety of care during peripheral vascular interventions, pointing to a prevalent culture of outdated practices among professionals. Often, these professionals ignore the integration of the patient's clinical profile, their preferences, the indicated therapy, the available resources, the team's skills, and the best available evidence[11,28].

In this regard, the provision of a valid and reliable checklist is essential for professionals to produce appropriate measures[15]. In this study, a tool was developed that brings together updated practices to prevent complications associated with the use of PIVC in the outpatient administration of antineoplastic drugs, promoting therapeutic safety and reducing iatrogenesis.

The checklist contemplated six fundamental categories in the practice of venipuncture. The categories involve care in analyzing the vascular toxicity of infused drugs, patient characteristics and preferences, factors related to the choice of device and dressing, biosafety criteria, in addition to incorporating venous visualization technologies that monitor the progress of PIVC use, among other practices recommended by national and international studies and guidelines[8,13,16].

The instrument proposes an assessment of the selection of the puncture site, with guidelines to prioritize the non-dominant limb. This approach is aligned with principles of patient-centered care and user autonomy, although studies indicate low frequency of this practice among professionals[11]. Its inclusion as an item of the checklist aims to promote a more participatory and humanized approach to the catheter insertion process.

Careful selection of the puncture site is another fundamental aspect considered in the checklis*t*. Practices such as avoiding puncture in paralyzed extremities, with functioning arteriovenous fistulas, in areas with compromised skin, open wounds or inflammatory signs are widely supported by the literature as measures that promote the safety and effectiveness of the procedure[11]. Such care is also relevant for preventing infections, leaks and failures in device maintenance.

It is important to highlight item no. 4 of the checklist, which deals with the use of venous visualization technologies. Although its application has not yet been incorporated into clinical practice in some health services, this resource is widely recommended in the literature as it allows for greater success in the first puncture attempt, reduced time to perform the procedure, more precise selection of the puncture site, in addition to contributing to the reduction of patient anxiety and discomfort. The use of this technology is also associated with the prevention of vascular complications, such as accidental punctures of arteries or nerves, and the reduction of local trauma, justifying its inclusion as a good care practice[29].

The adoption of methods to promote vasodilation before puncture, such as controlled heating, use of gravity and tourniquet, is also planned. The literature highlights that such strategies improve venous visualization and facilitate successful puncture, especially in cancer patients with difficult venous access[30]. These measures contribute to reducing the number of attempts and patient comfort, and are recommended as effective, simple, and low-cost practices.

In what regards antisepsis, the checklist recommends the use of an alcoholic antiseptic and then waiting for the skin to dry spontaneously before inserting the catheter, in addition to avoiding touching the area after antisepsis. Evidence suggests that failure to adhere to these steps compromises the effectiveness of the technique and increases the risk of infection. In international studies, it was observed that a significant number of professionals did not wait for the area to dry completely or manipulated the area after cleaning, without further antisepsis[11].

Device maintenance practices are also covered in detail. The checklist includes guidelines on how to perform flushing with aspiration to check for reflux before infusion, standardize volumes of 0.9% saline solution, and employ the positive pressure technique. These practices aim to ensure catheter patency, prevent occlusions, and reduce the risk of infusion-related adverse events[11].

Disinfecting connections with 70% alcohol before administering medications is another key point addressed. This practice is recognized as an essential measure for preventing healthcare-associated infections. Although the literature indicates variations in adherence and the type of antiseptic used, standardizing the use of 70% alcohol and correctly rubbing the connection before each manipulation are highly recommended practices[11].

In this context, regular inspection of the insertion site during nursing team visits is also provided for in the checklist, through visual inspection and palpation for early detection of signs of complications. This practice favors timely interventions, preventing greater harm to the patient. However, studies indicate that not all professionals carry out this assessment systematically[11].

Finally, the checklist includes hand hygiene as a critical step before, during and after handling the peripheral intravenous catheter. Despite being a widely consolidated recommendation, researchers show that its full application still presents flaws, especially in complementary moments of care, such as before preparing the material and after adjusting the environment[11].

The analysis of these items highlights the robustness of the checklist proposed in this study, which is anchored in evidence-based practices and aligned with patient safety guidelines. Content validation with experts and the pre-testing stage with the target audience confirmed the relevance and applicability of the included recommendations, reinforcing their potential as a tool to support safe clinical practice in the management of peripheral intravenous catheters in outpatient cancer patients.

In this sense, it should be noted that the adoption of practices based on scientific evidence and guidelines can bring significant improvements in clinical practice, reducing failures related to PIVC. This not only ensures the continuity of the proposed treatment, but also avoids costs associated with the need to replace the device. For this reason, the proposal of this study is focused on an approach that aims at greater adherence to best care practices, ensuring quality of care[31–33].

An observational study evaluating nurses' adherence to the peripheral intravenous catheter maintenance and replacement protocol at a university hospital in Spain examined the impact of protocol adherence on PIVC loss and patient safety, as well as related costs. Failure to follow the protocol resulted in 80% more catheter losses and increased cannulation costs by 46.84%. Poor adherence to PIVC care guidelines increases the risk of catheter loss, emphasizing the importance of training and rigorous application of evidence-based practices. Data highlights nursing's essential role in patient safety[34].

In this research, the recommendations in the literature on quantitative and qualitative criteria were followed in the selection of experts who evaluated the content of the instrument developed. The Delphi technique was employed, as recommended by other authors in content validation studies, to ensure that the checklist precisely assist in what is proposed to be implemented[16,35]. The careful selection of experts, based on professional experience, scientific production in the area of interest, and academic expertise, contributes to the validation of the tool being more rigorous. This technique promotes the convergence of ideas and the elimination of ambiguities, ensuring the reliability and precision necessary for the clinical and/or academic practice of the instrument[21].

Eight expert judges were selected for content validation, which initially contained 59 items and was reduced to 39 after establishing consensus. The participation of a group of experts allows for consistency in item assessments to be verified, identifying potential issues of ambiguity, lack of clarity, or excessive complexity that may affect participants' understanding and responses. The ideal number of participants is not a consensus in the literature[16]; however, studies using the Delphi technique recommend between five and ten expert judges to evaluate the content proposed in the research[35].

The expert judges reviewed the original checklist, removing 13 items and condensing seven to facilitate their applicability. There was consensus that the tool was extensive and needed to be clearer and more objective. In the end, the CVC reached 0.99, indicating its validity in terms of clarity of language, practical relevance, and theoretical relevance. This result corroborates the literature, which recommends a CVC of 0.83 for studies with six to eight expert judges[20].

In the validation phase with the target audience, nurses who used the checklist confirmed its clarity and ease of understanding. This is a recommended step, also implemented in another survey to assess the comprehensibility of items by the target audience. In this study, 49 professionals participated, a number higher than that suggested by other researchers, who generally recommend between 30 and 40 representatives of the professionals involved in the process[15]. This fact demonstrates an expanded and diversified sample, fundamental for validating its applicability in clinical practice.

In this study, the KMO test and Bartlett's Sphericity Test indicated the performance of EFA. In the end, two items were excluded because they did not present absolute values and it was possible to identify six factors as the best outcome for the tool. This analysis is used to verify, through multivariate techniques, the validity of the structural construct, which establishes the definition of factors, as well as the relationship between the variables. It was possible to identify in the literature that this technique is widely used in instrument development and validation studies, as it allows finding the best structure in a data matrix and determining the number and nature of the factors that best represent a set of variables[29,36].

Finally, the internal reliability of the checklist was verified by McDonald's Omega and Cronbach's Alpha tests. Performing both tests simultaneously is not necessary; however, the researchers chose to perform them because the value obtained in the first test was the minimum considered satisfactory (0.70). Thus, they performed the second analysis in a complementary manner, as was observed in another study investigating the psychometric properties of the Portuguese-adapted version of a health literacy questionnaire[37]. It is worth noting that Cronbach's Alpha verifies the homogeneity of the items considering the same factor loading, while McDonald's Omega provides a more accurate estimate of reliability when considering differential item weights[38].

In this scenario, the proposition of specific checklists, such as the one developed in this study, represents an advance in offering a systematized, evidence-based tool aimed at the oncology outpatient context. Unlike generic instruments aimed at the use of vascular devices in different scenarios, the one proposed in this research contemplates the particularities of the administration of antineoplastic agents via the peripheral route, favoring the standardization of nursing conducts. These conducts include aspects of occupational health, especially during the catheter removal and disposal phase, moments that considerably increase the possibility of contamination of professionals by cytotoxic drugs. Studies reveal several serious occupational hazards for nurses handling dangerous oncology medications[39].

Thus, the importance of future studies that evaluate its clinical applicability, impact on safety indicators, and possible adaptations to different contexts is highlighted, contributing to the effective translation of knowledge in oncological care[11,40–41]. However, the contribution of this study to clinical practice lies on the rigorous development of a checklist. By offering a solid methodological framework, the study facilitates access to essential scientific knowledge for nursing professionals working in antineoplastic treatment outpatient clinics. The information contained in the tool not only serves as a scientific basis for the implementation of new practices, but also reflects the critical evaluation of existing practices.

The limitation of this study is associated with the possible learning effect, in which expert judges responding to the checklist multiple times can learn to respond more efficiently, influencing the consistency of responses. To reduce this factor, the selection of professionals using the defined inclusion criteria was meticulous. Also included is the lack of definition in the literature of an ideal sample of experts included in the validation process and in the application with the target population.

CONCLUSION

The checklist proved to be valid and reliable for use in the implementation of good nursing practices related to peripheral intravenous catheterization for outpatient antineoplastic therapy. The consensus among the judges and the results achieved in the content validation and psychometric properties indicate that this tool can be used by nursing professionals in a reproducible manner at a national level. This represents a difference in expanding nurses' knowledge about PIVC care practices, which can promote the quality and safety of the care provided.

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NOTES

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CONTRIBUTION OF AUTHORITY
Study design: de Paula VAA, Alvim ALS.
Data collection: de Paula VAA.
Data analysis and interpretation: de Paula VAA, Alvim ALS.
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