ree

ORIGINAL ARTICLE

Prevention of infections associated with peripheral catheters: instrument development and validation

Prevenção de infecções associadas a cateteres periféricos: elaboração e validação de instrumento

Aline Eloá Barbosa Pelizari[1], Raíssa Souza Silva[2], Daniela Sanches Couto[1], Thais Roberto Magalhães Fittipaldi[1], Lívia Cristina Scalon da Costa Perinoti[1], Rosely Moralez de Figueiredo[1]

ABSTRACT

Objectives: To develop and validate, for appearance and content, an instrument to assess the knowledge of nursing professionals and students on measures to prevent peripheral venous catheter-related bloodstream infection. **Method:** Methodological study carried out in two stages: instrument development, based on national and international guides, and appearance and content validation by ten expert judges, considering Content Validity Index ≥0.80 on clarity, relevance, and pertinence, as well as semantic analysis together with the target demographic. **Results:** After accepting the experts' suggestions, the final instrument consisted of 36 questions in 6 dimensions with an overall Content Validity Index >0.90. **Conclusion:** The availability of the instrument responds to a gap in knowledge and can be used to assess the knowledge of nursing professionals and students regarding measures to prevent bloodstream infections associated with peripheral venous catheters.

Descriptors: Catheterization, Peripheral; Catheter-Related Infections; Infection Control; Validation Study; Nursing.

RESUMO

Objetivos: Elaborar e validar, por aparência e conteúdo, instrumento para avaliação do conhecimento de profissionais e estudantes de enfermagem sobre medidas de prevenção de infecção de corrente sanguínea associada a um cateter venoso periférico. **Método:** Estudo metodológico realizado em duas etapas: elaboração de instrumento, baseado em guias nacionais e internacionais, validação de aparência e conteúdo por dez juízes especialistas, considerando Índice de Validade de Conteúdo ≥ 0,80 sobre clareza, relevância e pertinência, bem como análise semântica junto ao público-alvo. **Resultados:** Após acatar sugestões dos especialistas, o instrumento final foi composto por 36 questões e 6 dimensões com Índice de Validade de Conteúdo global >0,90. **Conclusão:** A disponibilização do instrumento responde a uma lacuna na área de conhecimento e pode ser utilizado para avaliação de conhecimentos de profissionais e estudantes de enfermagem sobre as medidas de prevenção das infecções de corrente sanguínea associadas a cateter venoso periférico.

Descritores: Cateterismo Periférico; Infecções Relacionadas a Cateter; Controle de Infecções; Estudo de Validação; Enfermagem.

[1]Universidade Federal de São Carlos – São Carlos (SP), Brazil. E-mails: lieloa_b@hotmail.com, dsanchescouto@gmail.com, tha_maga@yahoo.com.br, livia.scalon@hotmail.com, rosely@ufscar.br

[2]Universidade Federal de São João Del-Rei – Divinópolis (MG), Brazil. E-mail: rssouza.ra@gmail.com

Funding: This study was carried out with the support of the Coordination for the Improvement of Higher Education Personnel (CAPES), Código de Financiamento 001.

How to cite this article: Pelizari AEB, Silva RS, Couto DS, Fittipaldi TRM, Perinoti LCSC, Fiqueiredo RM. Prevention of infections associated with peripheral catheters: instrument development and validation. Rev. Eletr. Enferm. [Internet]. 2021 [cited on: _____];23:67583. Available from: https://doi.org/10.5216/ree.v23.67583.

Received on: 02/03/2021. Accepted on: 06/11/2021. Available on: 10/15/2021.

INTRODUCTION

Healthcare-associated Infections (HAIs) are frequent adverse events, being considered a major public health problem worldwide. They are also seen as a two-way phenomenon, affecting both professionals and healthcare users[1].

Despite being the most preventable HAI[1], Bloodstream Infection (BSI) is the third most frequent (14% of the total) and its mortality rate can reach 40%. The most common causes of BSI are related to the presence of a catheter retained in a blood vessel and to vascular catheterization, a technological resource used in approximately 70 to 90% of hospitalized patients hospital, with 95.4% of these catheters being peripherally inserted[2]. The Peripheral Venous Catheter (PVC) is an indispensable device for the care of people undergoing intravenous drug therapy, whether in the administration of solutions, medications, nutrients, blood products, or in blood collection[3-5].

A Spanish study, carried out in a community hospital, shows that for every 60 PVC insertions, a central venous catheter is inserted. These data give an idea of the frequency with which this device is used, in addition to the relevance of its proper use. The study also points out that there is a lack of knowledge among professionals regarding its correct handling, as well as the opportune time for its removal. This factor means that about 19% of installed catheters are no longer necessary for the patient's therapy during the hospitalization period, with daily records available in only 40.6% of cases[6].

Although there is evidence in the literature of interventions aimed at reducing BSI in some units or sectors of hospital institutions, such as the intensive care unit, few actions have been implemented in sectors with an abundant supply of PVC, such as in the case of wards[1,3]. Therefore, it is understood that the existence of a validated instrument that enables for obtaining accurate data on how BSI prevention practices are carried out or not in healthcare services, would enable the implementation of singularized professional qualification strategies aimed at adopting best practices for insertion, maintenance, and infection control measures related to the vascular catheter[7].

This study aimed to develop and validate, for appearance and content, an instrument to assess the knowledge of nursing professionals and students on measures to prevent peripheral venous catheter-related bloodstream infection.

METHOD

This is a descriptive and methodological study, with a quantitative approach, carried out between November 2018 and April 2019, in a city in the interior of the state of São Paulo. For the elaboration of the instrument, the following steps were followed: establishment of the conceptual structure; definition of objectives and population; construction of items and response scale; selection and organization of items; and instrument structuring[8,9]. Instrument validation occurred in two steps, content validation and semantic analysis (pre-test) [8,9].

Establishment of the conceptual structure of the instrument and the definition of the objectives and target population were based on a literature review. The following references were selected and used: Healthcare-Related Infection Prevention Measures (2017), published by the National Health Surveillance Agency (ANVISA)[1]; Guidelines on Hand Hygiene in Health Care: a Summary (2009), published by the Word Health Organization (WHO) [10]; and Recommendations on the use of gloves in health services (2016), published by the Center for Epidemiological Surveillance (CVE) of the state of São Paulo Paulo[11]. From the analysis and synthesis of the concepts and recommendations contained in the selected references, the steps of construction of the items and the response scale, selection and organization of the items, and structuring of the instrument were carried out.

The instrument's statements were carefully constructed to ensure clarity, objectivity, simplicity, absence of mistakes, and relevance to the construct[8,9]. As such, the dimensions, items, and response scale of the instrument were based on the selected literature. The elaborated instrument was then submitted to and discussed by peers during research group meetings, and subsequently forwarded to the expert judges.

For the validation of the instrument by expert judges, 21 nurses were invited, selected for convenience and not probabilistically, by consulting the CVs of researchers registered on the Lattes Platform of the National Council for Scientific and Technological Development (CNPq), using the available filters. The following inclusion criteria were observed: minimum professional experience of two years in hospital care; experience in infection control; and being a researcher in the field of nursing in infection control.

Initial contact with the expert judges took place by e-mail, when the invitation to participate was sent, along with information about the research (objective, justification, relevance of the concept involved, and the instrument), the criteria for their appointment as a judge, and a link, generated by the Google Forms® platform, to access the electronic survey form.

If the judge agreed to participate, they were to access the link, read the Informed Consent Form (ICF) and "accept", and only then continue the session with specific instructions on the procedure for judging content validity (how to evaluate each item; how to evaluate the instrument in its entirety; and how to complete the questionnaire) and the instrument itself.

The instrument was organized into two modules, namely: Module A, containing 36 statements that were to be analyzed for clarity, relevance, and pertinence, using a four-point Likert-type scale of Totally agree (4), Partially agree (3), Partially Disagree (2), and Totally Disagree (1); and 'Module B', containing six dichotomous questions — no (1) and yes (2) — in order to verify the relevance, scope, and representativeness of the material as a whole.

Of the 21 experts invited, only ten agreed to participate in the study. It should be noted that, according to the literature, to carry out content validation, a group of at least five to ten expert judges in the field of the measurement instrument is necessary[8,9].

At the end of the validation stage by the experts, the semantic analysis stage (pre-test) was carried out[8]. To this end, the snowball technique was used to recruit members of the population for which the instrument is intended, that is, professionals from different categories of nursing (nurses, nursing technicians, and nursing assistants), and students of technical courses and undergraduate nursing programs.

Thus, a key participant was identified, who recommended another potential participant, who was also part of the population for which the instrument was intended, and so on. These professionals answered the validated instrument, and at the end of each question they could issue an opinion on the understanding, clarity, and comprehension of the item, in addition to suggesting possible changes to the wording.

For the semantic analysis (pre-test), 75 representatives of the target demographic were invited, of which 42 agreed to participate, answering the instrument and informing their understanding of the items and words used, in addition to the clarity and comprehension of the statements.

Regarding the analysis of the results, in the stage of content validation by the judges, the Content Validity Index (CVI) of the items was calculated, adding the number of questions answered with options "3" and "4" and dividing the result by the total number of responses. To consider the item validated, a CVI ≥ to 80% agreement among the experts was adopted, this being considered an adequate index in the literature[8]. Items that did not reach this index were revised according to the experts' recommendations.

In the semantic analysis stage (pre-test), the respondents' correct answers were counted, such that the higher the number of correct answers, the closer to ideal. In addition, the suggestions for changes to the statements were accepted in order to better understand the sentences.

The project was approved by Research Ethics Committee of the Federal University of São Carlos under decision No. 2,655,362, according to Resolution 466/12 of the National Health Council and the participants signed the ICF.

RESULTS

The developed instrument was based on the recommendations of ANVISA[1]; the WHO[10], and the CVE[11]. It contains 36 statements, 20 correct and 16 incorrect, organized into six dimensions that respected the logical order of execution of the peripheral venous catheter insertion technique, namely: Hand hygiene; Use of procedure gloves; Skin preparation; Stabilization and coverage; Flushing and Maintenance of the peripheral venous catheter; and Removal of the peripheral venous catheter .

Regarding the validation stage, all ten judges were women from the state of São Paulo. Most (60%) had ten or more years of professional training and the remainder (40%) had seven to nine years of training. The highest professional degree was a doctorate (70%), followed by a master's (20%), and specialist (10%), with 20% attending a post-doctoral internship. Regarding the length of professional experience, those with ten or more years of experience predominated (40%), followed by those with six to nine years (40%), and over 20 years (20%). Regarding professional practice, those who worked in teaching prevailed (40%), followed by those who worked in health care (30%) and in infection control (20%).

As per the judges' suggestions, some items were altered in regard to the vocabulary and placement syntax, in order to make the statements clearer, more objective, and more direct. In a global assessment, the instrument obtained 100% agreement from the judges regarding the adequacy of language, scope, and relevance to the professional practice of the target demographic.

The average CVI obtained for each dimension, in relation to clarity and representativeness, was >0.90 (Table 1).

All items, when evaluated individually, had a CVI >0.90 in relation to clarity and representativeness.

Dimensions 1 and 2 had an agreement rate of 80% regarding the need to exclude or include items. However, in both cases, the non-agreeing judges did not indicate which items should be excluded, included, or modified. Thus, after discussion with the research group, the decision was made to maintain the items unchanged.

Dimension 3, in turn, achieved an agreement rate of 90%, although one of the judges indicated the need to exclude the item "In cases where there is a need to touch the catheter insertion site after antisepsis, the professional should use sterile gloves", which was accepted.

One of the judges suggested joining two statements in dimension 5, which was accepted, even though 100% agreement was obtained. Thus, the final wording, after unification, was "Flushing or washing of the peripheral venous catheter must be performed before each infusion to check the permeability of the catheter, and after each infusion, to

Table 1. Judges' agreement rate as a percentage of each dimension. São Carlos, São Paulo, 2021.

Dimension	Clarity – Mean CVI	Representativeness – Mean CVI
Dimension 1 – Hand Hygiene	0.96	0.98
Dimension 2 – Use of procedure gloves	0.97	0.98
Dimension 3 – Skin preparation	0.98	0.98
Dimension 4 – Stabilization and coverage	0.98	1
Dimension 5 - Flushing and maintenance of the peripheral venous catheter	0.97	0.97
Dimension 6 – Removal of the peripheral venous catheter	1	1

ensure complete infusion of the medication and reduce fibrin deposits and drug precipitation".

In the global assessment of the instrument, there was 100% agreement of the judges regarding the adequacy of language, scope, and relevance to the professional practice of the target demographic.

In the semantic analysis stage (pre-test), of the 42 participants, 27 (64.3%) were nurses, 7 (16.7%) were nursing technicians, 6 (14.3%) were undergraduate nursing students, 1 (2.4%) was a nursing assistant, and 1 (2.4%) was a nursing technician student.

Table 2 shows the results obtained for the responses of the participants in the semantic analysis, noting that dimensions 1, 2, 3 and 5 obtained a correct-answer percentage > to 80%, while dimensions 4 and 6 received a correct-answer percentage of 70.2% and 74.3%, respectively. Statements related to catheter stabilization and coverage had the highest error-ratings (29.8%).

Participants in the semantic analysis also suggested specific modifications to the statements, such as changing words for synonyms, in order to facilitate understanding. There was consensus (n=41; 97.6%) in this group regarding clarity, objectivity, and ease of understanding the language used in the instrument. In addition, all participants indicated that it is a comprehensive and pertinent instrument for the professional practice of the target demographic.

In summary, the initial instrument did not undergo major alterations during the validation process, with the exclusion of a single item, the unification of two questions, small changes in the wording in another ten items in the validation stage by the judges, and four minor wording changes in the semantic analysis.

After making the modifications suggested by the judges and the target demographic, the final version of the instrument was obtained (Appendix 1). To guide the use of the instrument, an operational manual was prepared and is available from the study authors.

DISCUSSION

The high rate of acceptance by the judges (CVI ≥ to 90%) can be explained both by the rigor of the theoretical basis of the content covered, and by the refinement to which the instrument was submitted, having been exhaustively discussed by the research group members until arriving at the version sent to the judges. The values obtained demonstrate that the instrument is harmonious and robust, since the index recommended in the literature for evaluating individual items must be >0.78 and for evaluation in general, it must be >0.80[8].

The same consideration is valid for the semantic analysis (pre-test), which also reached an adequate number[8] of participants from the target demographic, including at least one representative of each category for which the instrument is intended. Furthermore, an overall CVI >97.6% was achieved, demonstrating that the set of items was satisfactory, considering an adequate agreement rate in the literature of > to 90%[8].

As with this study, the availability of validated instruments in the area of preventing the transmission of microorganisms has taken shape in recent years[12,13]. This will soon make it possible to compare studies with standardized results.

What follows is a discussion of the themes that made up the instrument and the answers obtained in the semantic analysis step (pre-test).

Dimension 1 — Hand hygiene — obtained 93.6% correct answers. Overall, more than 90% of the pre-test participants know how and when to sanitize their hands, but 25% still use soap and water as their first choice instead of hand sanitizer. These findings are corroborated by the literature, which also points out professionals' difficulty in incorporating the use of hand sanitizer[14-17].

The statements in dimension 2 — Use of procedure gloves — which dealt with the use of gloves as a protective barrier, as well as the use of gloves not replacing hand hygiene, were indicated as correct by almost 90% of respondents. It is understood that, although knowledge

Table 2. Correct-answer percentage by pre-test participants, by dimension (n=42). São Carlos, São Paulo, 2020.

Dimension	Correct answers (%)
Dimension 1 – Hand hygiene	93.6
Dimension 2 – Use of procedure gloves	88.7
Dimension 3 – Skin preparation	81.4
Dimension 4 – Stabilization and coverage	70.2
Dimension 5 – Flushing and maintenance of the peripheral venous catheter	87.4
Dimension 6 – Removal of the peripheral venous catheter	74.3

on the use of gloves had a high answer-rating, the literature indicates that, in the observation of practice, the rates of compliance with the use of gloves and hand hygiene are still below ideal, both in absence as well as in misuse[15,17-20].

In dimension 3 — Skin preparation — 33.3% of respondents did not recognize the recommended application time of the skin antisepsis solution, an important measure for the reduction of microbiota at the puncture site. According to ANVISA, the application time is 30 seconds for both 70% alcohol and chlorhexidine gluconate >0.5%[1]. Also in dimension 3, 57.1% of the participants mentioned the practice of removing hair with a razor blade before puncture. However, the use of razors can subject the skin to microscopic trauma, predisposing the invasion of microorganisms. A study[21] identified a postoperative infection rate of 0.9% when hair is not removed, 1.4% when hair is removed with an electric razor, and 2.5% when razor blades are used in the region.

In dimension 4 — Stabilization and coverage — 29.8% of the participants are unaware of BSI prevention measures related to the stabilization and coverage of the catheter. Aspects such as not valuing the importance of viewing the insertion site through a transparent cover (11.9%); the use of non-sterile adhesive tapes (42.8%); and affirmation of the need to change the semi-permeable membrane covering at pre-established intervals (76.2%) were the main incorrect answers. Furthermore, 38.1% of participants did not identify the use of transparent semi-permeable membrane or sterile adhesive tapes as part of their daily practice. The use of this type of coverage is not yet a reality in every health institution. A study carried out in the interior of São Paulo shows that 32.4% (141) of catheters observed had non-transparent and non-sterile coverage[22].

The non-adoption of recommended practices increases the risk of contamination of the insertion and coverage of the catheter, becoming a potential trigger of HAI[23]. These findings reinforce the need for changes in the concept and updating of professionals on the applicability and importance of stabilization and coverage as a measure to prevent BSI by PVC.

In dimension 5 — Flushing and maintenance of the peripheral venous catheter — it should be noted that approximately 20% of the professionals who participated in the semantic analysis step (pre-test) of the instrument indicated that flushing between medications was unnecessary. This finding agrees with a Brazilian article[24] that observed 234 procedures related to the maintenance of the PVC and found that professionals did not perform flushing between medications in 24.8% (n=58) of the observations performed. A study carried out in Portugal demonstrated that the lack of adherence to flushing may have influenced the permanence time of the observed catheters, as most were removed due to obstruction, especially in the first 48 hours after insertion. In addition to the permeability of the catheter, flushing prevents the incompatibility of different drugs administered sequentially[25].

Finally, in dimension 6 — Removal of the peripheral venous catheter — the suspension of routine exchange, the removal of unused PVC within 24 hours, and the suspension of the replacement of PVC within 72 hours[1] are still new for the participants in the semantic analysis step of the instrument in this study. The low overall correct-answer percentage in this dimension (74.3%) can be attributed to the slow incorporation of new guidelines into daily practice.

As a limitation, this is a methodological study on the development and validation of an instrument, therefore, the answers obtained in the semantic analysis step (pre-test) were part of the instrument validation process and, as such, do not have sample representativeness. Thus, the results obtained cannot be extrapolated, but used only as preliminary data to guide future studies. Furthermore, it should be noted that HAI prevention measures, such as those published by ANVISA, are constantly updated and, therefore, the now validated instrument will need to be updated as soon as new scientific evidence on the subject is published.

CONCLUSION

The instrument was validated by expert judges regarding appearance and content. Participants in the semantic analysis (pre-test) considered it clear and with accessible, easy-to-understand language; comprehensive; and relevant to professional practice.

The availability of the instrument fills a gap in the area of knowledge, since there is no similar validated material available that is specific to PVC.

The questionnaire can serve as an important tool for assessing knowledge on measures to prevent bloodstream infections associated with PVC, as well as a device for monitoring the impact of pedagogical interventions implemented with a view to teaching and researching the subject.

REFERENCES

1. Brasil. Ministério da Saúde (BR). Medidas de prevenção de infecção relacionada à assistência à saúde. Brasília, DF: ANVISA; 2017 [cited 2020 May 20]. Available from: https://segurancadopaciente.com.br/wp-content/uploads/2015/09/ebook-anvisa-04-medidas-de-prevencao-de-de-infeccao-relacionada-a-assistencia-a-saude.pdf.
2. Ferrer C, Almirante B. Infecciones relacionadas con el uso de los catéteres vasculares. Enferm Infecc Microbiol Clin [Internet]. 2014 [cited 2020 May 20];32(2):115-24. Available from: https://doi.org/10.1016/j.eimc.2013.12.002.
3. Danski MTR, Oliveira GLR, Johann DA, Pedrolo E, Vayego SA. Incidence of local complications in peripheral venous catheters and associated risk factors. Acta Paul Enferm [Internet]. 2015 [cited 2020 May 18];28(6):517-23. Available from: https://doi.org/10.1590/1982-0194201500087.
4. Danski MTR, Johann DA, Vayego SA, Oliveira GRL, Lind J. Complications related to the use of peripheral venous catheters: a randomized clinical trial. Acta Paul Enferm [Internet]. 2016 [cited 2020 May 18];29(1):84-92. Available from: http://doi.org/10.1590/1982-0194201600012.
5. Urbanetto JS, Peixoto CG, May TA. Incidence of phlebitis associated with the use of peripheral IV catheter and following catheter removal. Rev Lat Am Enfermagem [Internet]. 2016 [cited 2020 May 20];24:e2746. Available from: https://doi.org/10.1590/1518-8345.0604.2746.
6. Capdevila-Reniu A, Capdevila JA. Peripheral venous catheter, a dangerous weapon. Key points to improve its use. Rev Clin Esp [Internet]. 2017 [cited 2020 May 10];217(8):464-7. Available from: https://doi.org/10.1016/j.rce.2017.04.001.
7. Raynak A, Paquet F, Marchionni C, Lok V, Gauthier N M, Frati F. Nurses' knowledge on routine care and maintenance of adult vascular access devices: a scoping review. J Clin Nurs [Internet]. 2020 [cited 2020 May 12];29(21-22):e15419. Available from: https://doi.org/10.1111/jocn.15419.
8. Coluci MZO, Alexandre NMC, Milani D. Construção de instrumentos de medida na área da saúde. Cienc Saude Coletiva [Internet]. 2015 [cited 2020 May 12];20(3):925-36. Available from: https://doi.org/10.1590/1413-81232015203.04332013.
9. Polit DF, Beck CT. Fundamentos de pesquisa em enfermagem: avaliação de evidências para a prática da enfermagem. Porto Alegre: Artmed; 2018.
10. World Health Organization (WHO). Guidelines on hand hygiene in health care: a summary. Geneva: World Health Organization; 2009 [cited 2020 June 20]. Available from: https://www.who.int/gpsc/5may/tools/who_guidelines-handhygiene_summary.pdf
11. Ministério da Saúde (BR). Recomendações sobre o uso de luvas em serviços de saúde. Brasília, DF: Ministério da Saúde; 2016 [cited 2020 May 12]. Available from: http://www.saude.sp.gov.br/resources/cve-centro-de-vigilancia-epidemiologica/areas-de-vigilancia/infeccao-hospitalar/bmr/doc/ih16_bmr_uso_luvas.pdf.
12. Sako MP, Felix AMS, Kawagoe JY, Padoveze MC, Ferreira SA, Zem-Mascarenhas SH, et al. Knowledge about precautions in primary health care: tool validation. Rev Bras Enferm [Internet]. 2018 [cited 2020 May 15];71(suppl. 4):1589-95. Available from: https://doi.org/10.1590/0034-7167-2017-0886.
13. Souza RS, Oliveira PP, Dias AAL, Simão DAS, Pelizari AEB, Figueiredo RM. Prevention of infections associated with peripheral catheters: construction and validation of clinical scenario. Rev Bras Enferm [Internet]. 2020 [cited 2020 July 30];73(5):e20190390. Available from: https://doi.org/10.1590/0034-7167-2019-0390.
14. Floriano DR, Rodrigues LS, Dutra CM, Toffano SEM, Pereira FMV, Chavaglia SRR, et al. Compliance with standard precautions by nursing professionals in high complexity care. Esc Anna Nery [Internet]. 2019 [cited 2020 May 20];23(2):e20180263. Available from: https://doi.org/10.1590/2177-9465-EAN-2018-0263.
15. Silva DM, Marques BM, Galhardi NM, Orlandi FS, Figueiredo RM. Hands hygiene and the use of gloves by nursing team in hemodialysis service. Rev Bras Enferm [Internet]. 2018 [cited June 10];71(4):1963-9. Available from: https://doi.org/10.1590/0034-7167-2017-0476.
16. Maroldi MAC, Felix AMS, Dias AAL, Kawagoe JY, Padoveze MC, Ferreira SA, et al. Adherence to precautions for preventing the transmission of microorganisms in primary health care: A qualitative study. BMC Nurs [Internet]. 2017 [cited 2020 May 15];16(49):4-11. Available from: https://doi.org/10.1186/s12912-017-0245-z.

17. Baloh J, Thom KA, Perencevich E, Rock C, Robinson G, Ward M, et al. Hand hygiene before donning nonsterile gloves: healthcareworkers' beliefs and practices. Am J Infect Control [Internet]. 2019 [cited 2020 May 24];47(5):492-7. Available from: https://doi.org/10.1016/j.ajic.2018.11.015.
18. Wilson J, Prieto J, Singleton J, O'Connor V, Lynam S, Loveday H. The misuse and overuse of non-sterile gloves: application of an audit tool to define the problem. J Infect Prev [Internet]. 2015 [cited 2020 June 12];16(1):24-31. Available from: https://doi.org/10.1177/1757177414558673.
19. Barratt R, Gilbert GL, Shaban RZ, Wyer M, Hor S. Enablers of, and barriers to, optimal glove and mask use for routine care in the emergency department: an ethnographic study of Australian clinicians. Australas Emerg Care [Internet]. 2019 [cited 2020 June 25];23(2):105-13. Available from: https://doi.org/10.1016/j.auec.2019.10.002.
20. Slater K, Cooke M, Scanlan E, Rickard CM. Hand hygiene and needleless connector decontamination for peripheral intravenous catheter care-time and motion observational study. Am J Infect Control [Internet]. 2019 [cited 2020 June 10];47(8):1017-9. Available from: https://doi.org/10.1016/j.ajic.2019.01.022.
21. Shi D, Yao Y, Yu W. Comparison of preoperative hair removal methods for the reduction of surgical site infections: a meta-analysis. J Clin Nurs [Internet]. 2017 [cited 2020 May 13];26(19-20):2907-14. Available from: https://doi.org/10.1111/jocn.13661.
22. Estequi JG, Roseira CE, Jesus JB, Figueiredo RM. Boas práticas na manutenção do cateter intravenoso periférico. Enferm Foco [Internet]. 2020 [cited 2020 May 10];11(1):10-4. Available from: https://doi.org/10.21675/2357-707x.2020.v11.n1.2246.
23. Helm RE. Accepted but unacceptable: peripheral iv catheter failure: 2019 follow-up. J Infus Nurs [Internet]. 2019 [cited 2020 May 12];42(3):149-50. Available from: https://doi.org/10.1097/NAN.0000000000000324.
24. Lanza VE, Alves APP, Camargo AMS, Cacciari P, Montandon DS, Godoy S. Preventive measures of infection related to peripheral venous catheter: adherence in intensive care. Rev Rene [Internet]. 2019 [cited 2020 May 10];20:e40715. Available from: https://doi.org/10.15253/2175-6783.20192040715.
25. Braga LM, Parreira PMSD, Arreguy-Sena C, Carlos DM, Mónico LSM, Henriques MAP. Incidence rate and the use of flushing in the prevention of obstructions of the peripheral venous catheter. Texto Contexto Enferm [Internet]. 2018 [cited 2020 May 22];27(4):e2810017. Available from: https://doi.org/10.1590/0104-07072018002810017.

Appendix 1. Extracted from the master's thesis by Aline Eloá Barbosa Pelizari, entitled "Assessment of the knowledge of nursing professionals on measures to prevent bloodstream infection associated with peripheral venous catheters" under the guidance of doctor professors. Rosely Moralez de Figueiredo and Raissa S. Souza, of Programa de Pós-Graduação em Enfermagem, Universidade Federal de São Carlos (PPGEnf/UFSCar).

Assessment of the knowledge of nursing professionals and students on measures to prevent peripheral venous catheter-related bloodstream infection (Suggestion: insert the data here regarding the categorization of the population, such as initials, age, sex, function, sector of work)

READ AND ANALYZE THE FOLLOWING STATEMENTS BY MARKING YOUR RESPONSE WITH AN X

Dimension 1 – Hand hygiene		
Affirmative	**Correct**	**Incorrect**
1.1 – Hand hygiene by the health professional must be performed immediately before and after the insertion of peripheral venous catheters. Ans.: C		
1.2 – For the manipulation of devices connected to venous catheters, such as: extenders, IV sets, connectors and "caps", prior hand hygiene is not necessary, since there will be no direct contact with the catheter. Ans.: I		
1.3 – If hands are visibly dirty prior to insertion and handling of peripheral venous catheters or connected devices, cleaning should be performed with soap and water. Ans.: C		
1.4 – The use of hand sanitizer for hand hygiene is only indicated when there are no sinks available for this purpose. Ans.: I		
1.5 – Hand hygiene must be carried out immediately before and after using gloves. Ans.: C		
1.6 – The use of procedure gloves replaces hand hygiene. Ans.: I		
Dimension 2 – Use of procedure gloves		
Affirmative	**Correct**	**Incorrect**
2.1 – The use of procedure gloves represents a protective barrier between the user's bodily fluids and the healthcare professional's skin. Ans: C		
2.2 – The use of gloves is not mandatory for the removal of peripheral venous catheters. Ans.: I		
2.3 – After insertion, fixation and manipulation of the peripheral venous catheter, the procedure gloves must be removed immediately. Ans.: C		
2.4 – After using procedure gloves for handling peripheral venous catheters and devices connected to them, the same gloves can be used to perform any other activity. Ans.: I		
Dimension 3 – Skin preparation		
Affirmative	**Correct**	**Incorrect**
3.1 – If there is visible dirt on the skin at the site selected for insertion of the peripheral venous catheter, soap and water should be used to remove it and only then antiseptic applied. Ans.: C		
3.2 – After an unsuccessful attempt to insert a peripheral venous catheter, the same catheter can be used for further attempts. Ans.: I		
3.3 – The antisepsis of the peripheral venous catheter insertion site must take place immediately before puncturing, respecting the application and drying time of each product. Ans.: C		
3.4 – When skin preparation for peripheral catheter insertion is performed with 70% alcohol or chlorhexidine gluconate > 0.5%, the application time is 30 seconds. Ans.: C		
3.5 – The professional should not touch the peripheral venous catheter insertion site after antisepsis has been performed. Ans.: C		
3.6 – When it is necessary to remove hair from the chosen location for insertion of the peripheral venous catheter, razor blades should be used. Ans.: I		

Continue...

Appendix 1. Continuation.

Dimension 4 – Stabilization and covering		
Affirmative	**Correct**	**Incorrect**
4.1 – The stabilization of the peripheral venous catheter after insertion does not require the use of the aseptic technique. Ans.: I		
4.2 – The peripheral venous catheter covering should not interfere with the assessment and monitoring of the insertion site. Ans.: C		
4.3 – Non-sterile adhesive tapes (adhesive tape and microporous type tapes) must not be used to cover peripheral venous catheters. Ans.: C		
4.4 – Stabilization and covering of the peripheral venous catheter must be performed with sterile material, such as gauze and sterile adhesive tape or a transparent semi-permeable membrane (polyurethane membrane). Ans.: C		
4.5 – Peripheral venous catheter coverings with a transparent membrane, must be changed at pre-established intervals. Ans.: I		
4.6 – The peripheral venous catheter covering should be changed immediately if contamination is suspected and always when wet, loose, dirty, or when it is structurally compromised. Ans.: C		
Dimension 5 - Flushing and maintenance of the peripheral venous catheter		
Affirmative	**Correct**	**Incorrect**
5.1 – Flushing or washing of the peripheral venous catheter must be performed before each infusion to check the permeability of the catheter and after each infusion to ensure complete infusion of the medication and reduce fibrin deposits and drug precipitation. Ans.: C		
5.2 – Flushing or washing the peripheral venous catheter is unnecessary between the administration of different medications during the same period. Ans.: I		
5.3 –To carry out flushing, a 0.9% sodium chloride solution must be used in single-use ampoules. Ans.: C		
5.4 – An ampoule of sterile water can be used for flushing. Ans.: I		
5.5 – Bags or vials of 0.9% sodium chloride of greater volume can be fractioned to obtain flushing for different patients. Ans.: I		
5.6 – Flushing should preferably be performed with 1 ml syringes as they provide greater pressure in the lumen of the catheter. Ans.: I		
5.7 – If the health professional observes resistance in performing the flushing, they must press the syringe plunger until they are able to infuse the liquid. Ans.: I		
Dimension 6 – Removal of the peripheral venous catheter		
Affirmative	**Correct**	**Incorrect**
6.1 – The nursing professional must assess the need for permanence of the peripheral venous catheter daily. Ans.: C		
6.2 – The peripheral venous catheter must be removed when there are no prescribed intravenous medications and in cases where it has not been used in the last 24 hours. Ans.: C		
6.3 - When the peripheral venous catheter is installed in an emergency, with compromised aseptic technique, it must be replaced after 96 hours. Ans.: I		
6.4 – The peripheral venous catheter must be removed when there is suspicion of contamination, complications, or malfunction. Ans.: C		
6.5 – Peripheral venous catheter replacement should be routinely performed every 72 hours. Ans.: C		

Ans. C: correct; Ans. I: incorrect.