Cogitare Enfermagem

ORIGINAL ARTICLE

PROCESS OF INSERTION, MAINTENANCE AND REMOVAL OF PERIPHERAL INTRAVENOUS CATHETERS: PREVENTIVE RISK ANALYSIS

HIGHLIGHTS

1. Risks associated with the use of peripheral intravenous catheters.
2. Mapping of risks on catheter insertion, maintenance, and removal.
3. Risk prevention through process mapping.
4. Preventive strategies aiming at the safety of intravenous therapy.

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ABSTRACT

Objective: to demonstrate the applicability of the Healthcare Failure Mode and Effect Analysis tool to analyze, preventively, the risks related to the process of insertion, maintenance, and removal of peripheral intravenous catheters. **Method:** theoretical study, conducted from August to November 2022, in São Paulo-SP, Brazil, whose process was mapped in stages/activities, detailing the failure modes, using the tool. The Risk Priority Number was calculated, the severity and probability matrix was elaborated, adapted to health by DeRosier and collaborators, and actions were proposed to reduce failure modes. **Results:** The major risks identified were: "perform antisepsis of the area to be punctured with an alcohol swab" and "disinfect the connector with an alcohol swab", and were recommended training and use of kit materials as the main mitigation strategies. **Conclusion:** knowing the risks associated with peripheral intravenous catheters is the basis for the implementation of preventive strategies, minimizing the occurrence of damage and the associated healthcare costs.

DESCRIPTORS: Catheterization, Peripheral; Administration, Intravenous; Nursing Care; Hospital Units; Risk Management.

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INTRODUCTION

The insertion of a peripheral intravenous catheter (PIC) consists of a puncture, through a device, usually performed in the region of the forearm or dorsum of the hand, often performed by nursing professionals. It is required for patients who need to administer intravenous therapy (IVT) such as fluids and drugs and is generally safe and easy[1].

The proper insertion, maintenance and removal of a PIC requires that the nursing professional knows the associated risks to promote patient safety and quality of care, prioritizing activities that can mitigate the occurrence of adverse events (AEs) such as phlebitis, infiltration, extravasation, and catheter obstruction.

Health services have experienced increased costs related to the time spent and resources consumed for the management of injuries resulting from preventable AEs[2-3]. It is noteworthy that the time spent by health care professionals to repairing a particular injury could be directed to the adoption of proactive actions to prevent the occurrence of AEs, providing other care and health education to the patient and family.

A study conducted in the United States of America (USA), when evaluating the complications and failures related to IVT (phlebitis, infection, infiltration, extravasation, and occlusion of the PIC), found that the cost related to attempted punctures corresponded to US$ 122,850/month and the cost related to the puncture of a new PIC was US$ 13,860.00/month[3]. In Brazil, a study estimated the total average direct cost at US$ 866,18/year for 656 procedures performed for the treatment of 107 phlebitides in 96 patients[2].

According to the World Health Organization (WHO), providing safe care in complex environments such as healthcare is one of the most difficult challenges today, and the harm from AEs costs trillions of dollars annually. In Europe, 15% of hospital expenses can be attributed to AEs treatment. Thus, the cost of preventing AEs from occurring is less than the cost of treating it. In the US, after the implementation of safety improvements in the care provided in Medicare hospitals, the savings were approximately $ 28 billion between the years 2010 and 2015[4].

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recommends the implementation of a preventive program to identify risks and define actions to reduce errors in the provision of care. With this intent, it indicated the adoption of the Failure Mode and Effect Analysis (FMEA) tool, for its focus on anticipating problems and addressing hypothetical situations, if failures can occur, even with skilled and attentive people[5].

Based on the FMEA, the Healthcare Failure Mode and Effect Analysis (HFMEA) was developed, adapting the severity and frequency concepts to the healthcare area. The HFMEA is conducted through five steps: 1) identification of the topic, area of risk or vulnerability; 2) definition of the cross-functional team, related to the topic, area of risk or vulnerability; 3) description of the process flows and sub-processes; 4) risk analysis, classifying the failure modes according to the severity and probability of each sub-process; 5) definition and conduction of actions to reduce failure modes, responsible parties, and expected results[6].

It is noteworthy that the increasing complexity of care and the insertion of new technologies in health services may represent a greater risk of harm to patients, requiring vigilance with a view to safe care[7]. From this perspective, the present study aimed to demonstrate the applicability of the Healthcare Failure Mode and Effect Analysis tool to analyze, preventively, the risks related to the process of insertion, maintenance, and removal of peripheral intravenous catheters.

METHOD

This is a theoretical study, carried out from August to November 2022, through which the process of insertion, maintenance, and removal of PIC was mapped, detailing the failure modes of each stage.

For the preparation of the HFMEA, a group composed of two nurses (one specialized in medical-surgical clinic and the other in vascular access) and an engineer (with theoretical and practical knowledge of this tool) was formed that: a) defined the PIC insertion, maintenance and removal procedure, based on the recommendations of the Infusion Nursing Society (INS)[8] and the National Health Surveillance Agency (ANVISA- in Portuguese)[9]; b) unfolded the process and activities; c) identified the hazards, effects of potential failures and controls; d) assigned probability and severity scores and calculated the RPN (Risk Priority Number); e) identified and standardized actions for failure mode reduction; f) prioritized the actions; and g) developed a proposal for a preventive and recurrent management agenda.

We categorized the severity of each hazard by assigning scores from 1 to 4, as follows: 1) mild - does not bring aggravation to the patient's health status, has no future consequences on his health status and does not increase the period of hospitalization; 2) moderate - temporary aggravation of easy recovery, with no future consequences on health status and without increasing the period of hospitalization; 3) severe - relevant aggravation to the patient's health, resulting in increased period of hospitalization; and 4) catastrophic - causing patient death, due to non-recoverable consequences or loss of function or organ failure[6]. Regarding probability, the risk could be categorized as: score 1 - remote, unlikely to occur (sometime between five and 30 years); score 2 - uncommon, possible to occur sometime (between two and five years); score 3 - occasional, likely to occur (may occur many times during one or two years); and score 4 - frequent, likely to occur immediately or within a short period (several times during a year)[6].

The Risk Priority Number (RPN) was calculated by multiplying the severity and probability categories, mitigation actions should be taken when the RPN is greater than or equal to eight.

RESULTS

The PIC insertion, maintenance, and removal process has been mapped into 10 steps as presented in Figure 1:

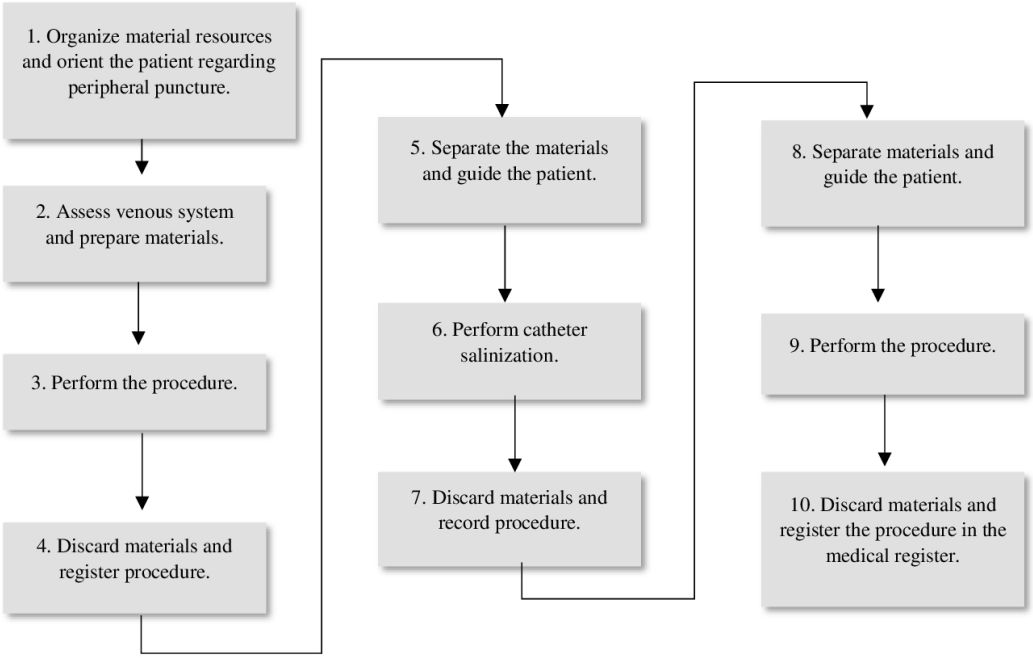

Figure 1 - PIC insertion, maintenance, and removal process mapping: steps one to 10 - São Paulo, SP, Brazil, 2022

The mapped process was broken down into 45 activities, of which 24 related to steps one to four (Chart 1) and 21 to steps five to 10 (Chart 2), all analyzed through the application of the HFMEA tool.

Chart 1 - Detailing of activities, hazards, probability, severity, and risk categorization associated with steps one to four of the CIP insertion, maintenance, and removal process - São Paulo, SP, Brazil, 2022

Activity	Hazard	Probability	Severity	Risk
1. Check indication for peripheral venous puncture	Unnecessary punching, wrong choice of device	4	1	4
2. Separate materials for puncture	Separate incorrect material, forget material, inappropriate device	4	1	4
3. Enter the patient's room and explain the reason for the puncture	Refusal to puncture, delay in therapy, change of route to administer medication	3	1	3
4. Clean the hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
5. Put a tourniquet on the arm and analyze the venous net to choose the puncture site and the size of the access	Not considering the best access option, puncturing arm with restriction, tourniquet too long, not positioning the tourniquet above the site	2	1	2
6. Release the tourniquet	Forget to release the tourniquet	2	1	2

7. Open materials	Contamination of material, dropping material on the floor, damaging material, waste	1	1	1
8. Sanitize hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
9. Perform antisepsis of the area to be punctured with alcohol swap for 3 times or until it comes out clean	Contamination	3	3	9
10. Put on the procedure gloves	Not putting on gloves	3	1	3
11. Put the arm back in tourniquet	Too much garrote for too long, or forget to garrote	2	1	2
12. Perform the puncture with an angle of 15 to 45 degrees	Use inadequate angle	2	1	2
13. Observe venous return	Do not observe venous return	2	1	2
14. In the case of puncture with an intravenous catheter, introduce the external part of the device (silicone part)	Transfix vein, not silicone progression	2	1	2
15. Remove the tourniquet	Forget to release the tourniquet	2	1	2
16. Press with your thumb on the skin where the device is pointed and remove the mandrel	Loss of access, work accident with sharp	2	1	2
17. Connect the micro-claves	Forget to connect, contaminate the clave	2	3	6
18. Aspirate the venous return	Not aspirating and salinizing may lead to infiltration, loss of access	2	1	2
19. Proceed with the salinization of 20ml of SF 0.9%	Use less than 20ml, catheter obstruction, loss of access, vessel rupture due to capillary fragility	2	1	2
20. Fix the access by placing the appropriate cover	Use non-standardized cover, inadequate fixation	2	1	2
21. Dispose of the perforating-cutting material in appropriate garbage	Accident at work with sharp objects	2	1	2
22. Remove gloves and sanitize hands	Professional contamination with biological material, contamination	2	1	2
23. Dispose of the rest of the materials	Inadequate disposal of regular garbage, environmental contamination	2	1	2
24. Make nursing notes.	Not documenting materials involved, or puncture failures	4	1	4

Source: The Authors (2022).

Chart 2 - Detailing of activities, hazards, probability, severity and risk categorization associated with steps five to ten of the PIC insertion, maintenance and removal process - São Paulo, SP, Brazil, 2022

Activity	Hazard	Probability	Severity	Risk
25. Separate materials for salinization	Not separating material properly, forgetting some material	3	1	3
26. Sanitize hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
27. Enter the patient's room and explain the reason for salinization	Not explaining properly, the importance of salinization	3	1	3
28. Sanitize the hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
29. Inspect insertion site for signs of inflammation	Not checking for signs of inflammation	2	2	4
30. Disinfect connector with alcohol swap	Carry out disinfection without vigor, for inadequate time, forget to perform disinfection procedure	3	3	9
31. Connect the syringe to the connector	Contaminate connector during connection, no salinization	3	2	6
32. Infuse serum content and check for resistance, swelling, pain complaint, note any changes in access insertion	Do not check for signs of inflammation when infusing	2	2	4
33. Dispose of material in the trash	Improperly disposing of in common garbage, environmental contamination	2	1	2
34. Sanitize hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
35. Write down procedure	Not documenting materials involved, or puncture failures	4	1	4
36. Separate materials for removal from access	Not separating material properly, forgetting some material	3	1	3
37. Sanitize hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
38. Enter the patient's room and explain the reason for removing the access	Failure to properly explain the reason for removal	2	1	2
39. Wash hands	Incorrect technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
40. Remove the film from the patient's skin	Removing film, causing pain to the patient	2	1	2
41. Remove access and press the insertion site with cotton	Bleeding, hematoma	2	1	2
42. Place bloodstop	Bleeding, hematoma	2	1	2

43. Dispose of material in the trash	Improper disposal of common garbage, environmental contamination	2	1	2
44. Sanitize hands	Improper technique, inadequate hygiene due to poor choice of solution, forgetfulness	2	3	6
45. Write down procedure	Not documenting materials involved, or punching failures	4	1	4

Source: The Authors (2022).

The prioritization of preventive actions was calculated by weighting the number of hazards related to each activity and their respective risks. As shown in Chart 3, among the actions proposed to reduce failure modes in the process of insertion, maintenance and removal of the PIC, the following stand out periodic training on PIC and hand hygiene, care audit, and the establishment of a kit of materials and the deployment and implementation of a bundle of specific care for PIC.

Chart 3 - Prioritization of preventive actions to reduce failure modes in the process of insertion, maintenance, and removal of PIC - São Paulo, SP, Brazil, 2022

Risk Priority Number - RPN							
Preventive Action	**1**	**2**	**3**	**4**	**6**	**9**	**Total**
Carrying out periodic training on PIC	1	28	3	8	6	18	64
Carrying out periodic training on hand hygiene		2			48		50
Carrying out an audit of the procedure		2			48		50
Establishment of a materials kit		12	6	4	6	18	46
Implantation and implementation of a Bundle			6	16			22
Periodic awareness-raising about the importance of proper nursing notes				12			12
Adoption of saline syringe for the maintenance of the AVP		2			6		8
Total	**1**	**46**	**15**	**40**	**108**	**36**	**252**

Source: The Authors (2022).

DISCUSSION

The activities classified as risk six and nine were the most serious due to the risk of infection, such findings corroborate the study on interventions for prevention and treatment of AE phlebitis, in which the proper antisepsis of the patient's skin and handwashing of the professional performing them were evidenced as the best preventive actions10, both requiring knowledge and attitude of the professional who is assisting the patient. It is

noteworthy that the practice of continuous periodic training, changes in the behavior of professionals and in the culture of the institution are important to improve adherence to hand hygiene[11]. In addition, the use of the traditional approach associated with audiovisual media and innovative techniques, mediated by technology, has been associated with better positive results in training[12].

Based on the HFMEA analysis, the institution can establish a periodic training agenda so that the priority issues are constantly addressed and incorporated by the health team professionals. The management of priorities clarifies the objectives for leaders and their teams, focusing on preventive and recurrent actions, contributing to a good work environment. Therefore, it is essential to involve managers in planning and implementing educational actions[13].

The HFMEA highlighted the importance of patient involvement during the process, which, besides being a complementary safety measure, has the potential to improve the patient's experience now of care. Therefore, the health team needs to be prepared to promote patient involvement during care, and the institutions need to promote this interaction in a sustainable way[14]. In parallel to the training actions for the health team professionals, the patients' involvement can be developed, as an example, through the interprofessional team round, in which the objectives for each patient are discussed, and they are involved in their own care[15]. For that, educational actions directed to the patient are essential, and for good learning it is necessary to consider the barriers, their level of understanding, and which resources to use (visual, written and/or auditory)[16].

In the present study, auditing was indicated as an action that prevents the occurrence of 50 hazards. Research in Uganda has shown that the implementation of auditing increases hand hygiene practices and can be used as a tool to improve healthcare practice, even in a low resource setting[17]. It is emphasized that the use of observation/auditing is recommended as one of the strategies for the promotion of hand hygiene in health services[18].

The establishment of a kit of materials would be an action that would prevent 46 dangers, and its use has also been reported in the literature. A controlled-randomized study that followed two products for antisepsis of the skin before insertion of the PIC, showed that the use of alcohol-associated Chlorhexidine resulted in a lower occurrence of local infection and colonization of the catheter when compared to the alcohol-associated povidone-iodine. He emphasized the importance of antisepsis before PIC puncture, since this procedure prevents complications such as local and bloodstream infection[19].

Qualitative research, conducted through interviews with nurses about the implementation of a kit for peripheral puncture, showed that nursing professionals can help in choosing the items that should be included in the kit based on their experience. With the use of the kit, there were favorable reports about the minimization of errors and omissions, as well as the optimization of the time spent by professionals[20]. Therefore, the use of standardized puncture kits prevents the lack of some material, facilitates the performance of the recommended activities and the non-forgetfulness of some step, contributing to the proper fulfillment of good practices.

Regarding the establishment of protocols and periodic and continuous training, a systematic review summarized the evidence on the effectiveness of bundles in the insertion and maintenance of PIC aiming at preventing AEs and, although the beneficial effect of bundles is unquestionable, it is necessary that their construction is based on the best evidence, with the involvement of health team professionals and support from institutional leadership to ensure their feasibility[21].

A study on central catheter bundles in neonates and children showed that it reduces early and late complications, being considered effective and safe[22]. Considering that the bundle aims to implement a set of therapeutic measures to improve patient care, the importance of its deployment and implementation in care practice is reiterated. However, the literature shows that few studies with PIC have been conducted in this direction.

Another study, that developed a bundle for prevention of peripheral vascular trauma, identified that after its implementation there was a 46.41% reduction in the incidence of vascular trauma associated with PIC and highlighted that nursing care should be preventive and based on the best evidence[23].

Yet another cross-sectional study investigated the characteristics, management practices, and outcomes of PIC in hospitalized patients in 406 hospitals in 51 countries; 40,620 PIC in 38,161 patients were analyzed. It was verified the inadequacy of PIC documentation, in 49.0% there was no record of the insertion date, in 10.0% there was no record of the professional responsible for the insertion and in 36.0% there was no record of the PIC conditions on the day[24]. The nursing note is an ethical and legal duty of the professional, it is necessary to fully record the care provided. It is necessary to continuously sensitize the health team about the relevance of records, developing education programs, problematizing the situation, and involving professionals[25].

Given the relevance of promoting a culture of voluntary reporting of errors and near-misses through tools for systematic documentation of AEs and awareness programs on human errors, it is noteworthy that the attribution of blame and the application of punishment rarely promote effective countermeasures, being inappropriate for individuals who did not choose to err[26]. Voluntary reporting of errors or near-misses should be done in a specific form, for further analysis of the AEs, to support the implementation of continuous preventive improvements[27].

From this perspective, this study highlights the importance of promoting the systems approach to error management, through the HFMEA tool, rather than the personal culpability approach. It is worth noting that on the premise of the systems approach, humans are fallible, and errors are expected. Therefore, an effective risk management system can be established through the culture of recording errors and analyzing barriers to prevent them[28].

Regarding the use of saline syringes, a study using the HFMEA analyzed the risks related to the maintenance of the patency of the Peripherally Inserted Central Catheter and showed that the use of saline ampules represents a greater risk to the patient, since it requires four more steps when compared to syringes filled with saline solution; in addition to increasing the risk of contamination, which may negatively affect the patient's health[29]. The INS recommends the use of a filled syringe due to the reduced preparation time and risk of infection[8]. Salinizing the PIC maintains permeability and may prolong the length of time the device remains in the patient. In addition, the use of a syringe filled with saline solution significantly reduces PIC failure and increases its length of stay[30].

A limitation of this study is the fact that it was not conducted in a healthcare institution, which would allow the participation of nursing professionals involved in the process of insertion, maintenance, and removal of peripheral intravenous catheters, favoring the identification of risks and the proposition of preventive strategies, deliberated together, aiming to mitigate the occurrence of AEs.

CONCLUSION

The application of the HFMEA tool enabled the mapping of the insertion, maintenance, and removal process of the PIC, consisting of ten steps that were broken down into 45 activities. To perform antisepsis of the area to be punctured with an alcohol swab and disinfection of the connector with an alcohol swab were the riskiest activities, being recommended, as preventive mitigation actions, the performance of periodical training on PIC and hand hygiene, assistance audit of the process and the establishment of a kit of materials and the deployment and implementation of a bundle of specific care for PIC.

Providing safe care in complex healthcare settings is a current challenge. Therefore, understanding the risks involved in different processes, such as insertion, maintenance, and removal of the peripheral intravenous catheter, contributes to the implementation of strategies that promote safe care, reducing the incidence of damage and the associated health care costs. For the verticalization of knowledge, from future studies, it is recommended to estimate the costs associated with failure modes and the preventive mitigation actions proposed.

REFERENCES

1. Bertoglio S, Van Boxtel T, Goossens GA, Dougherty L, Furtwangler R, Lennan E, *et al*. Improving outcomes of short peripheral vascular access in oncology and chemotherapy administration. J Vasc. [Internet] 2017 [cited in 2022 Feb 02];18(2):89-96. Avaliable in: https://doi.org/10.5301/jva.5000668.

2. Furlan M da S, Lima AFC. Direct cost of procedures for phlebitis treatment in an Inpatient Unit. Rev. esc. enferm. USP. [Internet] 2020 [cited in 2022 Feb 02];54:e03647. Avaliable in: https://doi.org/10.1590/S1980-220X2019011403647.

3. Jones RK. Short peripheral catheter quality and economics: the intravenous quotient. J Infus Nurs. [Internet] 2018 [cited in 2022 Feb 02]; 41(6):365-71. Avaliable in: https://doi.org/10.1097/NAN.0000000000000303.

4. World Health Organization. Patient safety: making health care safer. [Internet] 2017 [cited in: 2022 feb 02]. Available in: https://apps.who.int/iris/bitstream/handle/10665/255507/WHO-HIS-SDS-2017.11-eng.pdf?sequence=1&isAllowed=y.

5. Joint Commission International. Joint Comission Resources. Failure mode and effects analysis in health care: proactive risk reduction. 3. ed. Illinois; 2010.

6. DeRosier J, Stalhandske E, Bagian JP, Nudell T. Using health care failure mode and effect analysis™: the VA National Center for Patient Safety's Prospective Risk Analysis System. Jt Comm J Qual Improv. [Internet] 2002 [cited in 2022 Feb 02];27(5):248–67. Avaliable in: https://doi.org/10.1016/S1070-3241(02)28025-6.

7. Slawomirski L, Auraaen A, Klazinga N. The economics of patient safety - Strengthening a value-based approach to reducing patient harm at national level. Organisation for Economic Co-operation and Development-OECD. [Internet] 2017 [cited in 2022 Feb 02]. Avaliable in: https://doi.org/10.1787/18152015.

8. Gorski LA, Hadaway L, Hagle ME, Broadhurst D, Clare S, Kleidon T, *et al*. Infusion therapy standards of practice. J Infus Nurs. [Internet] 2021 [cited in 2022 Mar 03]; 44(Suppl 1S), S1–S224. Available in: https://doi.org/10.1097/NAN.0000000000000396.

9. Agência Nacional de Vigilância Sanitária. Medidas de Prevenção de Infecção Relacionada à Assistência à Saúde. [Internet] Brasília: Anvisa, 2017 [cited in 2022 Mar 03]. Avaliable in: http://www.riocomsaude.rj.gov.br/Publico/MostrarArquivo.aspx?C=pCiWUy84%2BR0%3D.

10. Guanche-Sicilia A, Sánchez-Gómez MB, Castro-Peraza ME, Rodríguez-Gómez JA, Gómez-Salgado J, Duarte-Clíments G. Prevention and treatment of phlebitis secondary to the insertion of a peripheral venous catheter: a scoping review in a nursing perspective. Healthcare (Basel). [Internet] 2021 [cited in 2022 Mar 03]; 9(5): 611. Avaliable in: https://doi.org/10.3390/healthcare9050611.

11. Silva BR da, Carreiro M de A, Simões BFT, Paula DG de. Monitoring hand hygiene adherence in na intensiva care unit. Rev. enferm. UERJ. [Internet] 2018 [cited in 2022 Mar 03]; 26 (e33087). Avaliable in: http://dx.doi.org/10.12957/reuerj.2018.33087.

12. Martos-Cabrera, MB, Mota-Romero E, Martos-García R, Gómez-Urquiza JL, Suleiman-Martos

N, Albendín-García L, *et al*. GA. Hand hygiene teaching strategies among nursing staff: a systematic review. Int. J. Environ. Res. [Internet] 2019 [cited in 2022 Mar 03]; 16(17): 3039. Avaliable in: https://doi.org/10.3390/ijerph16173039.

13. Eddy K, Jordan Z, Stephenson M. Health professionals' experience of teamwork education in acute hospital settings: a systematic review of qualitative literature. JBI Database System Rev Implement Rep. [Internet] 2016 [cited in 2022 Mar 03]; 14(4):96-137. Avaliable in: https://doi.org/10.11124/JBISRIR-2016-1843.

14. Malloggi L, Leclère B, Le Glatin C, Moret L. Patient involvement in healthcare workers' practices: how does it operate? A mixed-methods study in a French university hospital. BMC Health Serv Res. [Internet] 2020 [cited in 2022 June 15];20(1):391 Avaliable in: https://doi.org/10.1186/s12913-020-05271-w.

15. Oxelmark L, Ulin K, Chaboyer W, Bucknall T, Ringdal M. Registered Nurses' experiences of patient participation in hospital care: Supporting and hindering factors patient participation in care. Scand J Caring Sci. [Internet] 2018 [cited in 2022 Jun 15]; 32(2):612-21. Avaliable in: https://doi.org/10.1111/scs.12486.

16. Fisher CA, Myers M. Patient education: a win-win opportunity. J. Nurs. Manag. [Internet] 2019 [cited in 2022 June 15]; 47(3), 18-20. Avaliable in: https://doi.org/10.1097/01.NUMA.0000480766.01332.d5.

17. Muhumuza C, Gomersall JS, Fredrick ME, Atuyambe L, Okiira C, Mukose A, *et al*. Health care worker hand hygiene in the pediatric special care unit at Mulago National Referral Hospital in Uganda: a best practice implementation project. Int J Evid Based Healthc. [Internet] 2015 [cited in 2022 June 15];13(1):19-27. Avaliable in: http://doi.org/10.1097/XEB.0000000000000013.

18. Brasil. Agência Nacional de Vigilância Sanitária. Segurança do Paciente em Serviços de Saúde: Higienização das mãos. [Internet] Brasília: Anvisa; 2009 [cited in 2023 Jan. 30]. 105p. Avaliable in: https://bvsms.saude.gov.br/bvs/publicacoes/seguranca_paciente_servicos_saude_higienizacao_maos.pdf.

19. Guenezan J, Marjanovic N, Drugeon B, O Neill R, Liuu E, Roblot F, *et al*. Chlorhexidine plus alcohol versus povidone iodine plus alcohol, combined or not with innovative devices, for prevention of short-term peripheral venous catheter infection and failure (CLEAN 3 study): an investigator-initiated, open-label, single centre, randomised-controlled, two-by-two factorial trial. Lancet Infect Dis. [Internet] 2021 [cited in 2022 June 15]; 21(7):1038-48. Avaliable in: https://doi.org/10.1016/S1473-3099(20)30738-6.

20. Salgueiro-Oliveira A de S, Bastos ML, Braga LM, Arreguy-sena C, Melo MN, Parreira PM dos SD. Práticas de enfermagem no cateterismo venoso periférico: a flebite e a segurança do paciente doente. Texto Contexto Enferm. [Internet] 2019 [cited in 2022 June 15]; 28:e20180109. Avaliable in: http://dx.doi.org/10.1590/1980-265X-TCE-2018-0109.

21. Ray-Barruel G, Xu H, Marsh N, Cooke M, Rickard CM. Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: a systematic review. Infect Dis Health. [Internet] 2019 [cited in 2022 July 11]; 24(3):152-68. Avaliable in: https://doi.org/10.1016/j.idh.2019.03.001.

22. Pittiruti M, Celentano D, Barone G, D'Andrea V, Annetta MG, Conti G. A GAVeCeLT bundle for central venous catheterization in neonates and children: a prospective clinical study on 729 cases. J Vasc Access. [Internet] 2022 [cited in 2022 July 11]. Avaliable in: https://doi.org/10.1177/11297298221074472.

23. Krempser P, Arreguy-Sena C, Parreira PM dos SD, Salgueiro-Oliveira A de S. Protocol of nursing in the prevention of vascular trauma: bundle of peripheral catheterism in urgency. Rev Bras Enferm. [Internet] 2019 [cited in 2022 July 11];72(6):1512-8. Avaliable in: http://dx.doi.org/10.1590/0034-7167-2018-0457.

24. Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, *et al*. Use of short peripheral intravenous catheters: characteristics, management, and outcomes worldwide. J Hosp Med. [Internet] 2018 [cited in 2022 Jul 11];13(5). Avaliable in: http://dx.doi.org/10.12788/jhm.3039.

25. Candido ASG, Cunha ICKO, Munhoz S. Informações de Enfermagem registradas nos prontuários

frente às exigências do Conselho Federal de Enfermagem. Rev Paul Enferm. [Internet] 2018 [cited in 2022 July 11];29(1-2-3):31-8. Avaliable in: https://pesquisa.bvsalud.org/portal/resource/pt/biblio-970750.

26. Reason J. Understanding adverse events: human factors. Qual Health Care. [Internet] 1995 [cited in 2022 July 11];4(2):80-9. Avaliable in: https://doi.org/10.1136/qshc.4.2.80.

27. Siman AG, Cunha S, Brito M. The practice of reporting adverse events in a teaching hospital. Rev. Esc. Enferm USP. [Internet] 2017 [cited in 2022 Dec 09]; 51, e03243. Avaliable in: https://doi.org/10.1590/S1980-220X2016045503243.

28. Reason J. Human error: models and management. BMJ. [Internet] 2000 [cited in 2022 Dec 09];18;320(7237):768-70. Avaliable in: https://doi.org/10.1136/bmj.320.7237.768.

29. Lima AFC, Saba A, Berger S, Bianchini SS, Berssaneti FT. Preventive risk analysis in the maintenance of patency of the peripherally inserted central catheter. Rev Esc Enferm USP. [Internet] 2019[cited in 2022 Dec 09]; 53,e03462. Avaliable in: https://doi.org/10.1590/S1980-220X2018011803462.

30. Saliba P, Cuervo G, Hornero A, Carli G de, Marani A, Puro V, *et al*. The impact of flushing with pre-filled saline syringes on the incidence of peripheral venous catheter failure: a quasi-experimental study. J Vasc Access. [Internet] 2020 [cited in 2022 Dec 09];21(4):490-6. Avaliable in: https://doi.org/10.1177/1129729819888423.

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Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - **Furlan M da S, Saba A, Berger S, Lima AFC**. Drafting the work or revising it critically for important intellectual content - **Furlan M da S, Saba A, Berger S, Lima AFC**. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - **Furlan M da S, Saba A, Berger S, Lima AFC**. All authors approved the final version of the text.

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