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CARE TECHNOLOGY PROTOTYPE FOR FLUSHING PRACTICE IN INTRAVENOUS CATHETER MAINTENANCE

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ABSTRACT

Objective: to elaborate, based on the assessment of the nursing team's flushing practice, a care technology prototype aimed at promoting good practices in intravenous catheter maintenance in intensive care.
Method: a technology elaboration study, developed in three stages: flushing practice assessment through a questionnaire completed by 108 nursing professionals working in intravenous catheter maintenance in intensive care settings of a public hospital located in the city of Rio de Janeiro, Brazil. Data collection took place from November 2019 to January 2020, with descriptive and inferential data analysis; analysis of this practice regarding the existence of errors according to the main guidelines and scientific evidence, with classification of types of errors in the light of the conceptual framework of patient safety; and technology prototype development.
Results: 88% of participants perform flushing in their practice; 49.5% apply the continuous pressure technique on the syringe plunger; 22% perform flushing before, between and after medication administration; predominance of use of volume and syringes with gauges of 5 ml and 10 ml. Variables related to knowledge were associated with not performing flushing. There were active and latent errors that guided the technology prototype construction.
Conclusion: a care guide was built that aims to increase nursing team's knowledge about good flushing practices and is configured as a barrier to error recurrence.

DESCRIPTORS: Nursing Care. Patient Safety. Central Venous Catheters. Catheterization Peripheral. Biomedical Technology.

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PROTÓTIPO DE TECNOLOGIA DE CUIDADO PARA PRÁTICA DO FLUSHING NA MANUTENÇÃO DE CATETERES INTRAVENOSOS

RESUMO

Objetivo: elaborar, com base na avaliação da prática do *flushing* da equipe de enfermagem, um protótipo de tecnologia de cuidado voltado a promover as boas práticas na manutenção dos cateteres intravenosos em terapia intensiva.
Método: estudo de elaboração de tecnologia, desenvolvido em três etapas: avaliação da prática do *flushing* através de questionário preenchido por 108 profissionais de enfermagem atuantes na manutenção dos cateteres intravenosos em cenários de terapia intensiva de um hospital público localizado no município do Rio de Janeiro, Brasil. A coleta de dados ocorreu de novembro de 2019 a janeiro de 2020, com análise descritiva e inferencial dos dados; análise dessa prática quanto à existência de erros segundo as principais diretrizes e evidências científicas, com classificação dos tipos de erros à luz do referencial conceitual da segurança do paciente; e elaboração do protótipo da tecnologia.
Resultados: 88% dos participantes realizam o *flushing* na sua prática;49,5% aplicam a técnica de pressão contínua no êmbolo da seringa; 22% realizam o *flushing* antes, entre e após a administração de medicamentos; predomínio da utilização do volume e de seringas com calibres de 5 ml e 10 ml. Variáveis relacionadas ao conhecimento associaram-se à não realização do *flushing*. Houve erros ativos e latentes que orientaram a construção do protótipo da tecnologia.
Conclusão: construiu-se um Guia de Cuidado que objetiva ampliar o conhecimento da equipe de enfermagem sobre as boas práticas do *flushing* e se configura como uma barreira à recorrência dos erros.

DESCRITORES: Cuidados de enfermagem. Segurança do paciente. Cateteres venosos centrais. Cateterismo periférico. Tecnologia biomédica.

PROTOTIPO DE TECNOLOGÍA DE CUIDADO PARA LA PRÁCTICA DE FLUSHING EN EL MANTENIMIENTO DE CATÉTERES INTRAVENOSOS

RESUMEN

Objetivo: elaborar, a partir de la evaluación de la práctica de flushing del equipo de enfermería, un prototipo de tecnología asistencial con el objetivo de promover buenas prácticas en el mantenimiento de catéteres intravenosos en cuidados intensivos.
Método: estudio de elaboración de tecnología, desarrollado en tres etapas: evaluación de la práctica de flushing a través de un cuestionario completado por 108 profesionales de enfermería que actúan en el mantenimiento de catéteres intravenosos en Unidades de Cuidados Intensivos de un hospital público ubicado en la ciudad de Río de Janeiro, Brasil. La recolección de datos ocurrió de noviembre de 2019 a enero de 2020, con análisis de datos descriptivo e inferencial; análisis de esta práctica en cuanto a la existencia de errores según las principales guías y evidencias científicas, con clasificación de tipos de errores a la luz del marco conceptual de seguridad del paciente; y desarrollo del prototipo tecnológico.
Resultados: el 88% de los participantes realizan flushing en su consulta; el 49,5% aplica la técnica de presión continua sobre el émbolo de la jeringa; el 22% realiza flushing antes, entre y después de la administración de medicamentos; hubo predominio del uso de volumen y jeringas con calibres de 5 ml y 10 ml. Las variables relacionadas con el conocimiento se asociaron con no realizar el flushing. Existieron errores activos y latentes que orientaron la construcción del prototipo tecnológico.
Conclusión: se elaboró una guía de atención que tiene como objetivo aumentar el conocimiento del equipo de enfermería sobre las buenas prácticas de flushing y se configura como una barrera para la recurrencia de errores.

DESCRIPTORES: Atención de Enfermería. Seguridad del Paciente. Catéteres Venosos Centrales. Cateterismo Periférico. Tecnología Biomédica.

INTRODUCTION

Intravenous catheter flushing is a technique that aims to maintain catheter permeability, ensuring the free flow of fluid inside it. Moreover, it makes it possible to assess whether the vascular access device presents blood return when aspirated through a syringe. Thus, flushing is defined as the manual injection of 0.9% sodium chloride (0.9% saline) into a short peripheral intravenous catheter (SPIVC) or central venous catheter (CVC), with the aim of cleaning the catheter, test its functioning and prevent complications related to intravenous therapy[1–2].

Among the complications of intravenous therapy, obstruction is one of the main ones, which results in loss of catheter functionality. Studies have shown that obstruction in venous catheters is a frequent unfavorable outcome that compromises patient safety[3–4]. In this regard, the practice of maintaining permeability reduces the occurrence of obstructions, preventing catheter occlusion due to the accumulation of blood and other products on its internal surface, in addition to removing fibrin deposits from the lumen and preventing interactions due to incompatibility of fluids/medications[1–2].

Evidence-based national and international guidelines recommend blood reflux assessment before each infusion and the application of flushing before and after the administration of each drug, according to the SAS order, namely: injection of 0.9% saline solution (S), followed by drug or fluid administration (A) and, finally, injection of 0.9% saline solution (S)[1,5–6].

Failure to perform these recommended flushing steps are considered medication errors, and, therefore, the resulting unfavorable outcomes represent adverse events (harm to the patient). Such medication errors are related to medication administration, i.e., deviations from procedures, policies and/or best practices for medication administration, creating conditions for adverse consequences for patients[5].

Investigations have shown that negligence in this practice of catheter maintenance generates negative impacts on care, such as the need to replace the catheter, phlebitis and bloodstream infection[3–4]. These impacts can culminate in increased length of stay, costs and the rate of adverse events. Furthermore, the need to replace new device results in interruption of therapy, pain associated with the procedure and increased time spent by professionals[2–3,7–8].

It should be noted that the problem of medication errors continues to deserve the attention of the World Health Organization (WHO), which launched, in 2017, the document Patient Safety Challenge on Medication Safety, with the objective of reducing by 50% over five years (2017-2022) the occurrence of medication errors due to failures in care processes and the resulting serious harm[9].

The best evidence on flushing indicates that its performance by the nursing team guarantees the effectiveness of treatment and the quality of the care provided[1,6,8]. On the other hand, an integrative review of publications carried out between 2016 and 2020 found that there are still disagreements about the volume, frequency, preparation solution, technique and devices for performing flushing. In particular, in the Brazilian scenario, no research developed on the subject in this period was identified[10].

Existing research between 2009 and 2015 only verified whether or not flushing was performed as one of the administration stages of intravenous therapy, without going into depth about its characteristics[10], which points to the need for further studies on the subject from patient safety's perspective, with a view to reducing errors.

Therefore, it is important to consider that, in the conceptual model of safety, the defended form of error handling is the system approach. From the system's perspective, the aim is not to blame those involved in errors, but initially to know the characteristics of how they occur, in order to create barriers to avoid their repetition[11]. Defenses, barriers and safeguards occupy a key position in the system approach, with the function of protecting potential victims[11].

In this systemic model of analysis of incidents, proposed by James Reason, the health system vulnerabilities are compared to the holes in a "Swiss Cheese"[11]. Such vulnerabilities refer to active errors (committed by professionals who are in direct contact with patients) and latent errors (related to the management level). In general, the presence of holes in any "slice of cheese" does not normally cause a bad result, but when holes in many layers line up, conditions are created for an accident to occur, which carries a risk of harm to victims (patients)[11].

This comprehensive understanding of the contributing factors to incident supports the formulation of new strategies for improving the various layers of defense in the patient care process[11]. Therefore, in order to prevent errors related to flushing, it is necessary to identify the characteristics of how they occur, in order to create safety barriers, i.e., technological tools to strengthen the system's safety.

This study aimed to develop, based on the assessment of the nursing team's flushing practice, a care technology prototype aimed at promoting good practices in intravenous catheter maintenance in intensive care.

METHOD

This is a study of technology production, which followed one of the methods of elaborating care-educational technologies, namely the elaboration of product based on evidence of reality[12]. Thus, initially, flushing practice by nursing professionals was analyzed regarding the existence and typology of errors based on field research and, based on that, the dimensions that were the focus of construction of a care technology prototype were selected, with the intention that it works as a safety barrier to prevent such errors.

The first stage was a quantitative, cross-sectional survey of characteristics of nursing professionals' flushing practice. The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) tool was used to present the data of this stage. The second stage consisted of analyzing this practice for the existence of errors, using the following references: for the identification of potential errors, the Infusion Nurses Society (INS)[1,6] international guidelines and Brazilian National Health Regulatory Agency (ANVISA - *Agência Nacional de Vigilância Sanitária*)[5] national guidelines on good practices related to flushing as well as an integrative literature review by the authors;[10] and, for the analysis of these errors, James Reason's safety incident analysis model[11].

The justification for using this model is based on the need for an expanded analysis of error occurrence, i.e., it is understood that it is necessary, in addition to identifying the characteristics of errors committed by professionals, in the light of guidelines and scientific evidence (active errors), understand what are the latent conditions that contribute to their occurrence, with a view to thinking about the creation of safety barriers, an analysis that is made possible by the model proposed by James Reason.

The third stage was technology prototype elaboration, from the selection of the most relevant contents to guide professional practice, based on the analysis of errors arising from the previous stages.

In stage 1, the research was carried out at a public university hospital located in the city of Rio de Janeiro between November 2019 and January 2020. The research sites were four critical patient care sectors, namely the General Intensive Care Unit (ICU), the Coronary Unit, the Cardiac ICU and the Intermediate Post-Operative Unit. Such units include clinical and surgical hospitalizations of highly complex patients, therefore, with a high demand for the use of intravenous therapy and diversified use of intravenous devices, which justified the choice of these settings.

Participants were nursing team members involved in flushing practice. The following inclusion criteria were established: being a member of the nursing team in the sectors chosen for the research; and be active in direct patient care in intravenous device maintenance and medication administration. The population of the four sectors involved consisted of 120 professionals; therefore, we sought to work with all possible participants, with the objective of guaranteeing internal validity. However, 12 professionals from the nursing team did not participate, due to vacation, leave or refusal to participate. Thus, this stage of research had 108 participants, a sample equivalent to 90% of the population.

Data collection took place from November 19, 2019 to January 31, 2020, totaling 74 days over the four intensive care settings that served as the locus for the research. Data collection took place through the application of a structured questionnaire that was completed by a nursing professional working in intravenous device maintenance. Therefore, in each setting investigated, an initial setting was carried out, with the objective of knowing the sector's general characteristics in relation to intravenous therapy, performing the preliminary approach of professionals and the subsequent invitation to participate in the research. In this setting phase, we sought to identify, together with the management of the services, the existence of guidelines and protocols for intravenous therapy, a team to monitor vascular accesses, and to learn about the dynamics of the sectors regarding team organization for medication administration and catheter maintenance.

This period of approach to participants also contributed to reducing the normative pressure related to the presence of the researcher during data collection, which could interfere with the responses that involved care practice asessment. Thus, with this strategy, as well as with coding the questionnaire to guarantee anonymity, we sought to reduce the response bias to the instrument adopted.

The questionnaire was produced as part of a survey carried out in Portuguese by international researchers[13] with whom the authors have academic partnerships, having been adapted to the Brazilian reality with the authorization of the main researcher. It contemplated, in the first part, the profile of the professionals' unit of action regarding the number of patients and intravenous devices used in care. The second part consisted of variables on flushing practice, such as the frequency of performance, the gauge of the syringe used, the volume administered for each device, the technique used, among other information. Frequency was graded on a Likert-type scale ranging from 1-never to 5-always. The third part was related to obtaining information to characterize the professional profile of participants and previous knowledge/training regarding flushing.

The questionnaire was applied at the most convenient times to fill it out, chosen after approaching the reality of each sector. A printed form was delivered to participants, along with a clipboard for support and a blue ballpoint pen, with instructions to respond at the same time and return it to the researcher. Upon return, the instrument was revised immediately, in order to avoid not filling in the data and the potential loss of a participant.

In the analysis phase, a database of the questionnaire variables was built using the Software Statistical Package for the Social Sciences 23 (SPSS®). The variables on flushing practice were descriptively analyzed using absolute and relative frequency and central tendency measure - median. Bivariate analysis was performed using Pearson's chi-square test. Performing flushing was considered as a dependent variable, and as independent variables, profile characteristics, such as professional category, work shift, having knowledge of recommendations or guidelines on flushing, specific training related to venous access and job tenure. Variables with a p value ≤0.05 were classified as having a significant difference. An inferential analysis was also performed with the Odds Ratio test, using a 95% confidence interval.

This analysis of the professional profile association aimed to complement the analysis on the existence of latent factors that contribute to error, considering that the literature points out that the level of experience, knowledge, professional training and the existence of guidelines/protocols are indirect factors that interfere with flushing practice[10].

In step 2, the quantitative data obtained underwent analysis regarding compliance with national and international guidelines recommendations as well as other evidence in the literature on good flushing practices. Non-assistance was considered an error, thus defined in the light of the conceptual framework of patient safety "as a general term embracing all those occasions when a traced sequence of mental or physical activities fails to achieve the expected result and when these failures cannot be attributed to the intervention of chance"[14:9]. Errors were categorized into active and latent, according to the conceptualization previously presented.

Based on the analysis and interpretation of these most relevant errors, a technological tool was developed aimed at assisting nursing professionals in intravenous therapy. In the elaboration phase, the selection of contents that would integrate the technology prototype, the development of illustrations and layout by the researchers was made, which originated the first version. Still in this elaboration phase, for the preliminary prototype content, design and potential applicability relevance assessment, four researchers (three national and one international) were chosen for convenience, considering the cooperation networks of the research group that the main author is part of.

Such researchers were nurses, PhD in nursing, professors, with experience in intravenous therapy, nursing care, intensive care, patient safety and care technologies. One of the researchers was active in one of the sectors of the researched institution and participated in the institutional Patient Safety Center. From the first assessment, carried out in two group sessions with the researchers, adjustments were made to content and design that resulted in the elaboration of the final version of the technology prototype presented in the article on screen.

The research was approved by the Research Ethics Committee of the investigated hospital, and participants signed the Informed Consent Form, in compliance with the national ethical norm requirements for research with human beings. Moreover, each questionnaire was identified by an alphanumeric code, so as not to allow the participant to be recognized, thus guaranteeing the anonymity of the individuals surveyed.

RESULTS

Of the 120 nursing professionals working in the studied sectors, 108 composed the research. When characterizing the profile of participants, it was found that 70% were women; 63% with a degree in nursing; 57% working at the investigated institution and in another employment relationship. Regarding experience, 69.5% had worked for more than five years and 62% had worked for more than five years in the sector studied. About the knowledge of recommendations or guidelines that address the practice of flushing, only 57% answered affirmatively; 53% reported not having specific training related to intravenous therapy.

In the characterization of the research setting carried out from the adaptation period, the existence of an institutional Standard Operating Procedure for intravenous medication administration was identified, which only indicated the need to assess catheter permeability and avoid medication incompatibility, focusing on the application of flushing after medication administration. Furthermore, regarding the dynamics of team organization to perform intravenous therapy, it was found that each setting had a different work process, i.e., there were units in which only one professional per shift was responsible for administering medication to all patients and, in others, in which each professional prepared and administered the medication of patients under their responsibility, which could be nurses or nursing technicians.

It was also highlighted that training on intravenous therapy was irregular and there was no specific team for monitoring and assessing vascular accesses in the institution and proposing practical guidelines.

As for the data from the first stage, of the 108 members of the nursing team who answered the questionnaire, 88% (n=95) reported performing flushing to maintain intravenous device permeability. Among those who perform flushing, 93% (n=88) described 0.9% saline solution as the solution used, followed by distilled water with 7% (n=7) of the answers.

Regarding the technique employed, 49.5% (n=47) applied continuous pressure on the syringe plunger; 35% (n=33) pushed pause; 11.5% (n=11) pushed pause + positive pressure; 3% (n=3) used the flushing function through the infusion pump; and 1% (n=1) performed continuous pressure on the syringe plunger + positive pressure.

Of the 95 participants who answered flushing, in the details of the steps, 40% said they did it before administering the medication, 10%, between, and 98%, after administering the medication. Only 22% of participants mentioned that they flush before, between and after administering a medication.

Despite this indication of predominance of flushing after drug administration, when participants classified the frequency of this practice on a scale that ranged from never to always, a median of 4 (often) was evidenced in flushing practice in both moments, before, between and after. For instance, in the CVC, it was found that 64% reported that they often/always perform flushing before administering the drug, 66%, often/always during medication administration, and 79% do it many times/always afterwards. This characterization by type of catheter is illustrated in Table 1.

Table 1 – Frequency of flushing practice steps reported by the intensive care nursing team according to the type of catheter, Rio de Janeiro, RJ, Brazil, 2020 (n=95).

Flushing performance frequency n(%)	**1 Never**	**2 Very little**	**3 Intermediate**	**4 Often**	**5 Ever**	**M_d***
Before						
Intravenous catheter Short peripheral	7(7.5%)	7(7.5%)	22(23%)	23(24%)	36(38%)	4
Central venous catheter	7(7.5%)	8(8%)	18(18.5%)	31(33%)	31(33%)	4
Between						
Intravenous catheter Short peripheral	0(-)	1(1%)	25(27%)	22(23%)	47(49%)	4
Central venous catheter	0(-)	7(7%)	25(27%)	27(28%)	36(38%)	4
After						
Intravenous catheter Short peripheral	0(-)	2(2%)	15(16%)	31(33%)	47(49%)	4
Central venous catheter	0(-)	2(2%)	18(18.5%)	36(38%)	39(41.5%)	4

* M_d: median.

Table 2 presents the characteristics of flushing practice mentioned by participants regarding syringe gauge, method of preparation and administered volume. In the syringe gauge for use in CVC and SPIVC, there was a predominance of 10 ml syringe for flushing after drug administration. In the stages before and between drug administration, there was a balance between the use of 5 ml and 10 ml syringes. It is noteworthy that 20 ml syringe was indicated for use after administering drugs in SPIVC by 15% of respondents.

Table 2 – Characteristics of flushing practice of the intensive care nursing team regarding syringe gauge, administered volume and method of preparation, Rio de Janeiro, RJ, Brazil, 2020 (n=95).

Characteristics of flushing practice n(%)	Syringe gauge				Method of preparation				Administered volume			
	5 ml	10 ml	20 ml	NA*	Use the serum in progress on patient	New 0.9% saline solution large volume bottle for washing	Professionally prepared syringe with 0.9% saline solution	NA	5 ml	10 ml	20 ml	NA
Before												
Intravenous catheter Short peripheral	33(34%)	31(33%)	0(-)	31(33%)	44(46%)	2(2%)	46(48%)	3(4%)	59(62%)	33(35%)	0(-)	3(3%)
Venous catheter central	28(30%)	36(38%)	0(-)	31(32%)	46(48%)	0(-)	43(45%)	6(7%)	50(53%)	42(44%)	0(-)	3(3%)
Between												
Intravenous catheter Short peripheral	41(43%)	44(46%)	0(-)	10(11%)	10(11%)	12(12%)	73(77%)	0(-)	68(72%)	24(25%)	0(-)	3(3%)
Venous catheter central	41(43%)	44(46%)	0(-)	10(11%)	12(12%)	10(11%)	73(77%)	0(-)	64(68%)	31(32%)	0(-)	0(-)
After												
Intravenous catheter Short peripheral	21(22%)	50(52%)	14(15%)	10(11%)	23(24%)	3(3%)	69(73%)	0(-)	26(27%)	47(50%)	22(23%)	0(-)
Venous catheter central	11(11%)	74(78%)	0(-)	10(11%)	23(24%)	3(3%)	69(73%)	0(-)	25(27%)	53(55%)	17(18%)	0(-)

*NA: not applicable (when not performing the procedure).

As for the source of solution preparation for flushing CVC and SPIVC, 48% and 46%, respectively, stated that they used patients' current serum for the permeability assessment stage, which was also repeated for 24% of patients respondents in the stage after drug administration in CVC and SPIVC. In turn, more than 70% pointed to the syringe prepared by professionals with 0.9% saline solution as the choice for performing the flushing between and after administering medications.

The 5 ml volume was more used before and between drug administrations in CVC and SPIVC. A 10 ml volume was the most chosen for use afterwards; however, when adding the number of responses for the use of 20 ml and 5 ml after drug administration, a greater balance was found in this distribution.

Table 3 shows that variables related to professionals' knowledge of flushing recommendations or guidelines were significantly associated with their practice. Not having knowledge of recommendations or guidelines led to 33 times more chances of professionals not performing flushing, while not attending specific training related to venous access resulted in a 16 times higher chance of professionals not performing flushing.

Table 3 – Association of the professional profile of the nursing team with flushing practice, Rio de Janeiro, RJ, Brazil, 2020 (n=108).

Association of the profile of nursing professionals with flushing performance	Performs flushing (n=95)		Does not flush (n=13)		p*	OR†	95% Confidence Interval
	n	%	n	%			
Work shift							
Night	44	46%	8	61%	0.303	1.85	0.16-1.77
Day	51	54%	5	39%			1
Professional category							
Nurse	41	43%	3	23%	0.167	2.53	0.1-1.53
Nursing technician	54	57%	10	77%			1
Knowledge of recommendations or guidelines on flushing practice							
No	25	26%	12	92%	< 0.001	33.6	4.15-271.78
Yes	70	74%	1	8%			1
Attend training related to venous access							
No	41	53%	12	96%	< 0.001	15.80	1.97-126.51
Yes	54	47%	1	4%			1
Job tenure							
< 5 years	27	34%	1	10%	0.110	4.76	0.03-1.69
> 5 years	68	66%	12	90%			1

*chi-square test; †OR: Odds Ratio.

The analysis of the results of the study on screen in relation to established guidelines and evidence from the literature indicated errors in flushing practice, which were categorized according to the safety reference according to Chart 1.

Chart 1 – Analysis of characteristics of flushing practice according to the study's references, Rio de Janeiro, RJ, Brazil, 2020.

Flushing practice characteristics	Guideline recommendations and evidence	Error types
Failure to perform flushing during medication administration	Perform flushing before, between and after drug administration	Active error
Use of the large volume vial as a source of preparation and the ongoing serum in the patient	Use of single-dose vials (10 ml ampoule)	Active error
Syringe use with gauges of 5 ml and 20 ml	Use of 10 ml syringes	Active error
Failure to perform flushing in the steps before and between medications	Perform flushing before, between and after drug administration	Active error
Administered volume of 5 ml in the CVC and 20 ml in the CVC and SPIVC	Volume of 10 ml for CVC and 5 ml for SPIVC	Active error
Use of continuous flow technique and infusion pumps	Pulsed flow/push-pause technique with positive pressure	Active error
Lack of standardization of the dynamics of the nursing team's intravenous therapy practice	Define the scope of infusion therapy administration practice	Latent error
Outdated flushing standard operating procedure	Using available evidence and current research findings on infusion therapy to organize and review practice guidelines	Latent error
Irregular training of the team/ Professionals without knowledge of guidelines and guidelines	Assess professional skills regularly and promote educational programs to develop skills and competencies	Latent error
Absence of vascular access monitoring team	Interdisciplinary team of vascular access and infusions	Latent error

Based on the identified latent errors, a technology prototype was proposed in the format of a care guide for flushing focusing on good practices. In the construction rounds, the need for improvements was considered, such as reducing the excess of textual information, improving the design and layout, including data related to the main errors identified, not using acronyms and changing some terms. Figure 1 shows the elaborated version.

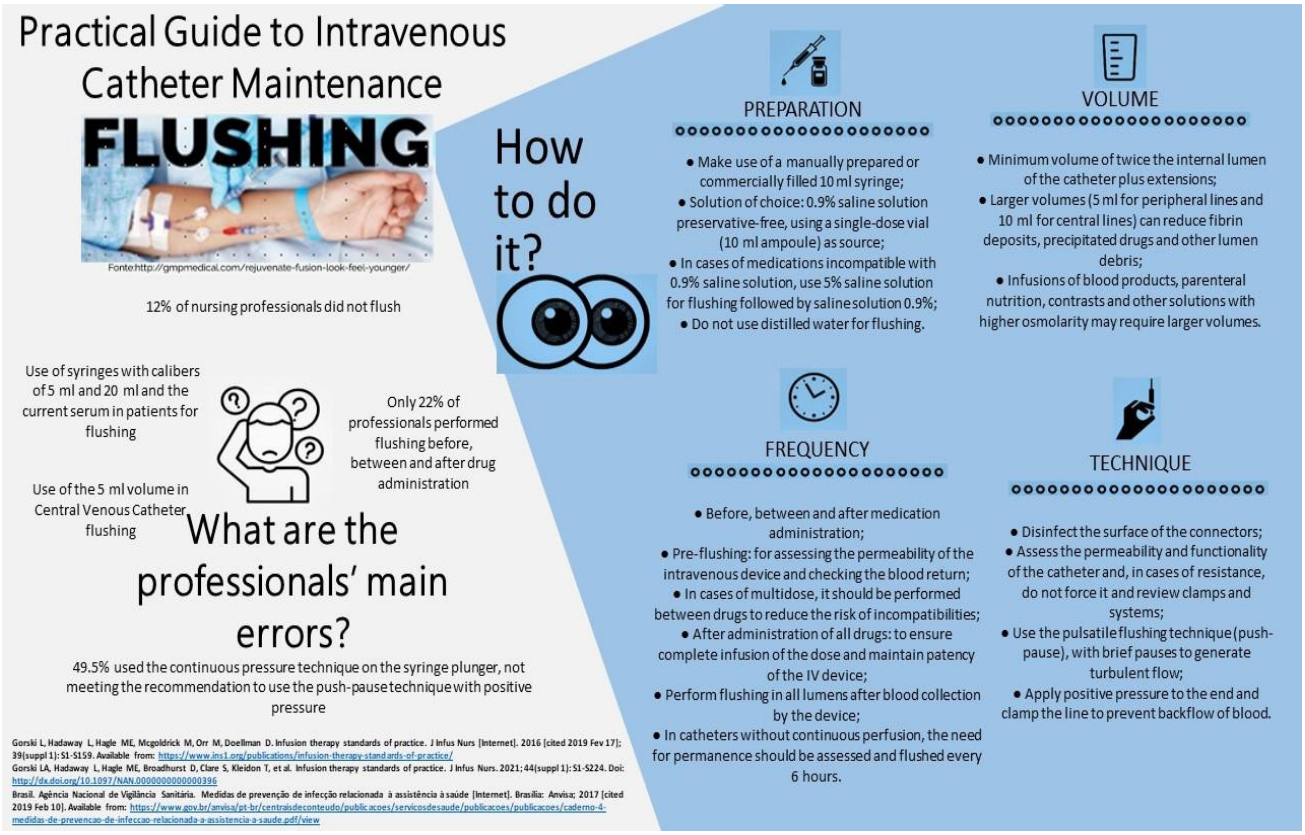

Figure 1 – Guide to flushing practice, Rio de Janeiro, RJ, Brazil, 2020.

DISCUSSION

The overall results showed that 12% of participants did not carry out the flushing procedure to maintain the intravenous devices. Although 88% reported practicing flushing, there were deviations in the various stages of its implementation, namely 60% reported that they do not perform it before administering the medication and 90% do not perform it between medications, with greater emphasis on the use of flushing after drug administration, with 98%.

National and international studies obtained results similar to those identified in this research, pointing out the difficulties of nursing professionals in the effective implementation of all stages of flushing[7,13,15]. In the case of studies related to peripheral devices, an investigation carried out with 76 Brazilian and Portuguese nurses sought to identify practices related to flushing through an online questionnaire. It was verified, based on the data, that most nurses (84.2%) stated that they performed flushing after inserting the catheter, before and after drug administration, however, with inconsistencies in the solution used, syringe volume and size. There was also recognition of the omission of this procedure due to time constraints, lack of familiarity and unavailable material[13].

Survey on flushing practice of Australian nurses showed that, of 1,178 instruments answered, 584 of them reported performing CVC flushing. Regarding the frequency, the authors considered that they were wide and varied, with the most reported moments being pre- and post-medication administration, with 21%, and pre- and post-medication plus 6-hour administration, with 22%[15].

In the further analysis of flushing frequency by type of catheter, the results indicated a higher number of answers from professionals categorized as “often/always” in the moments before, between and after medication administration, in both types of catheter, despite having previously recorded a lower percentage of flushing before and between medications.

These data on the implementation of flushing in practice show that nursing care in intravenous device maintenance is inconsistent and does not always respect the INS and ANVISA guidelines[1,5–6], which recommend blood reflux assessment before each infusion and the application of flushing before and after the administration of each medication.

With regard to the method of preparation and solution used, there was a predominance of 0.9% saline solution as the solution of choice for flushing, with compliance greater than 90%. Regarding its preparation, using 0.9% saline solution, which is in continuous infusion in patients, especially before drug administration, is in contrast to what is standardized by ANVISA and INS, which recommend single-dose vials or commercially available syringes filled with 0.9% saline solution[5–6].

Regarding the use of 0.9% saline solution, the INS indicates that its use is safe and effective in preventing catheter occlusion in adult populations with CVC[5]. This recommendation is consistent with the results of recently developed international investigations. Systematic review with meta-analysis involving 7,875 individuals assessed the effectiveness of 0.9% saline solution versus heparinized solution in maintaining CVC patency in adult patients[15]. Results showed that 0.9% saline solution can be equally, if not more effective, in keeping catheters working. Of the studies that reported secondary outcomes, the heparinized solution was not shown to be superior to the non-heparinized solution[16].

Other studies have shown discrepancies in flushing practice in relation to the solution used in ICU settings. One of them on flushing practice of Australian nurses indicated that 96% reported using 0.9% saline solution for SPIVC flushing and 75% for CVC flushing. In 25% of CVC flushings, there was some concentration of heparin. The 10 ml syringe was the most frequent; however, 24% used smaller gauge syringes and 10% pre-filled syringes. The study concluded that there was inconsistency in practices, which reflects the current lack of evidence in the area of flushing[15].

Using 0.9% saline solution free of preservatives for flushing is also indicated in SPIVC[1,5–6]. A current systematic review corroborates the indication of the main guidelines and pointed out that the normal saline solution seems to outperform the heparin solution in maintaining SPIVC permeability and preventing complications[17].

Participants reported mostly using 10 ml syringe, but there were also reports of using 5 and 20 ml syringes for flushing practice. This result demonstrates variability in the choice of flushing syringe gauge, which results in different pressures in the catheter lumen. The smaller the syringe gauge, the greater the pressure it can generate, exposing the patient to the risk of catheter rupture. For this reason, flushing with a 10 ml syringe is recommended, which generates a pressure of 20 Psi[1].

Another flushing method pointed out by participants was that of the ongoing serum in patients. An American study compared intermittent flushing and locking with the continuous use of patients' current serum to maintain SPIVC. A total of 85 catheters were monitored and, although the group with intermittent maintenance with 0.9% saline solution lock had a slightly longer catheter duration, it was not statistically significant. Factors such as the desire to ambulate or the nocturnal release of access lines deserve consideration in SPIVC care decisions[18].

Regarding the technique used, continuous pressure on the syringe plunger was mentioned in 49.5% of the questionnaires, followed by the push pause technique (pulsatile) in 35%. INS and ANVISA propose using the pulsatile technique as a good practice[1,5–6]. Maintenance must associate the pulsatile technique between drug administration and positive pressure after administration, i.e., it is indicated to leave a small amount (0.5-1.0 ml) of flushing solution in a syringe to avoid compression of the plunger joint, minimizing blood backflow into the catheter lumen[8,19].

Pulsed flushing relies on fluid flow dynamics, i.e., wall shear stress through 10 short boluses of 1 ml solution interrupted by brief pauses. This shear is more efficient in clearing solid deposits in the catheters compared to a 10 ml continuous flow[6,20].

The 5 ml volume of flushing was more frequent before and between drug administrations, both in CVC and SPIVC, while the use of 10ml predominated after drug administration in these intravenous devices. The use of 5 ml and 20 ml after drug administration together, mainly in the CVC, was approximately 50%.

This non-uniformity may result from the absence of confirmed evidence indicating the correct volume to be applied[7,10,14]. Recommendations can be imprecise in this context as the flushing solution volume depends on several factors such as device type and gauge, patient age and type of infusion therapy to be administered. The minimum is at least twice the catheter volume, i.e., 3-5 ml for SPIVC and 10 ml for CVC, increasing to 20 ml after blood collection or flushing after vesicant drugs at each step[1,8,14].

To handle the identified errors, Reason's safety model is in favor of creating barriers, with a view to intercepting the error[11], and developing actions and strategies focused on strengthening safety culture[21]. Thus, considering that care technologies related to intravenous therapy that intercept the "Swiss cheese holes" and keep medication systems safe are incipient, the developed technology prototype may contribute to the dissemination of best practices in relation to flushing, such as a barrier to drug administration error.

The choice of technology modality presented in this article is based on evidence that shows that knowledge about flushing guidelines influences professionals' practices. A study showed the positive effect of nursing team education/training on SPIVC in the maintenance of these intravenous devices[22]. On the other hand, the lack of guidelines and protocols that guide care with the catheter and flushing performance in the place where nurses work has a negative impact, favoring negligence and failures in practice[10].

The choice to carry out the study in intensive care settings is a limitation of this research, as it may have restricted SPIVC maintenance assessment. It is also pointed out that, although the questions in the questionnaire referred to the current practice of flushing, as this type of instrument recorded the report on practice, it may not accurately reflect the way in which flushing is performed in daily care, which is a limit, and it is important to deepen the analysis of the findings with results from observational studies on this phenomenon.

It is recognized as other limitations the fact that the technology prototype will still undergo, in the next stages of the investigation, improvements in its design and functionalities, and the phases of validity with judges and testing in clinical practice with nursing professionals. In the improvement phase, it is planned to include QR Codes that will lead users to instructional videos, with clinical simulation of flushing moments and the technique that should be applied. In turn, the results of the validity and testing stages of the prototype regarding the impacts on flushing performance may support its incorporation in health institutions as an educational and care strategy to improve flushing practices by nursing professionals.

CONCLUSION

Flushing practice recorded by the nursing team for intravenous catheter maintenance used in patients hospitalized in intensive care was characterized by errors regarding the source for preparation, syringe gauge, flushing procedure, administered volume and applied technique. These errors guided the construction of a technology prototype in the format of a care guide for flushing practice in the researched institution.

The care guide expands the nursing team's knowledge about intravenous catheter maintenance, bringing together the main active errors and recommendations for carrying out the flushing steps as a barrier to the recurrence of errors.

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NOTES

ORIGIN OF THE ARTICLE

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There is no conflict of interest.

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