

# MANAGEMENT OF CENTRAL CATHETERS IN NEWBORNS AND CHILDREN HOSPITALIZED IN INTENSIVE CARE UNITS

## MANEJO DE CATETERES CENTRAIS EM RECÉM-NASCIDOS E CRIANÇAS INTERNADAS EM UNIDADES DE TERAPIA INTENSIVA

## MANEJO DE CATÉTERES CENTRALES EN RECIÉN NACIDOS Y NIÑOS HOSPITALIZADOS EN UNIDADES DE CUIDADOS INTENSIVOS

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**Objective:** to identify the care strategies adopted by nursing professionals in the handling of central catheters in children and newborns hospitalized in an Intensive Care Unit. **Method:** descriptive research, with quantitative approach, of the non-participant systematic observation type, in a tertiary public hospital in Rio de Janeiro. A structured checklist was applied to the professionals who assisted this clientele. The data were submitted to simple descriptive analysis and organized in graphs. **Results:** 80 observations were obtained, separated into three stages: moments of hand hygiene; manipulation of the deep catheter; equipment and connectors. **Conclusion:** the nursing team has satisfactory support to items considered essential in the care and prevention of bloodstream infections related to central catheters in children and newborns hospitalized in the Intensive Care Unit.

**Descriptors:** Pediatric Nursing. Neonatal Nursing. Pediatric Intensive Care Units. Neonatal Intensive Care Units. Central Venous Catheterization. Nursing Care.

*Objetivo: identificar as estratégias de cuidado adotadas pelos profissionais de enfermagem no manuseio dos cateteres centrais em crianças e recém-nascidos internados em Unidade de Terapia Intensiva. Método: pesquisa descritiva, com abordagem quantitativa, do tipo observação sistemática não participante, em um hospital público terciário do Rio de Janeiro. Foi aplicado um check-list estruturado aos profissionais que assistiram essa clientela. Os dados foram submetidos a análise descritiva simples e organizados em gráficos. Resultados: obteve-se 80 observações, separadas em três etapas: momentos da higienização das mãos; manipulação do cateter profundo; equipamentos e conectores. Conclusão: a equipe de enfermagem possui uma adesão satisfatória aos itens considerados essenciais no cuidado e na prevenção de infecções da corrente sanguínea relacionados a cateteres centrais em crianças e recém-nascidos internados em Unidade de Terapia Intensiva.*

*Descritores: Enfermagem Pediátrica. Enfermagem Neonatal. Unidades de Terapia Intensiva Pediátrica. Unidades de Terapia Intensiva Neonatal. Cateterismo Venoso Central. Cuidados de Enfermagem.*

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*Objetivo: identificar las estrategias de cuidado adoptadas por los profesionales de enfermería en el manejo de catéteres centrales en niños y recién nacidos hospitalizados en una Unidad de Cuidados Intensivos. Método: investigación descriptiva, con enfoque cuantitativo, del tipo observación sistemática no participante, en un hospital público terciario de Río de Janeiro. Se aplicó una lista de verificación estructurada a los profesionales que asistieron a esta clientela. Los datos fueron sometidos a un análisis descriptivo simple y organizados en gráficos. Resultados: se obtuvieron 80 observaciones, separadas en tres etapas: momentos de higiene de manos; manipulación del catéter profundo; equipos y conectores. Conclusión: el equipo de enfermería cuenta con un apoyo satisfactorio a los ítems considerados esenciales en el cuidado y prevención de infecciones del torrente sanguíneo relacionadas con catéteres centrales en niños y recién nacidos hospitalizados en la Unidad de Cuidados Intensivos.*

*Descriptor: Enfermería Pediátrica. Enfermería Neonatal. Unidades de Cuidados Intensivos Pediátricos. Unidades de Cuidados Intensivos Neonatales. Cateterismo Venoso Central. Cuidados de Enfermería.*

## Introduction

The use of central vascular catheters (CVC) in the therapeutic process enables the continuous administration of intravenous fluids, medications, prolonged parenteral nutrition, blood products, chemotherapy and invasive hemodynamic monitoring of blood pressure, central venous pressure, pulmonary artery pressure, cardiac output measurement, and may also be part of the hemodialysis process<sup>(1-2)</sup>.

Regarding the location of this device, the distal end of the central venous catheter is inserted into the superior or inferior vena cava. Precisely for this reason, it is considered a vascular access of extreme utility, because it provides, in a safe way, access to systemic circulation, which allows the administration of drugs whose pH and/or osmolarity are incompatible with the peripheral pathway, due to the irritating and/or vesicating potential of the solutions<sup>(2)</sup>.

These devices are classified into the following categories: peripherally inserted central catheter (PICC), short-term CVC (introduced by guided or direct puncture of a central vein), semi-implanted CVC (tunneled) and fully implanted CVC<sup>(3)</sup>. The choice of the appropriate type of deep catheter should be discussed and indicated in advance by the multidisciplinary team accompanying the patient, based on the expected duration of treatment and consideration of potential complications. It should be talked, when possible, with patients and family members at the time of selection<sup>(4)</sup>.

Based on the favorable results in relation to their use, central catheters are widely

recommended by the scientific literature for use in children (1 month to 12 years incomplete years) and neonates (from birth to 28 days of life), because they enable a safe route of administration of intravenous drugs for long periods, especially vasoactive drugs, antibiotic therapy, antineoplastic and total parenteral nutrition<sup>(5)</sup>.

However, although the use of these devices is increasingly recommended as an assertive choice for long-term drug therapy, central catheters disrupt the integrity of the skin, thus increasing the risk of infection at the insertion site<sup>(5-6)</sup>, called by the National Health Surveillance Agency (ANVISA) as central catheter-related bloodstream infection (CCRBI). Regarding physiopathogeny, we can relate it to two main mechanisms: extraluminal colonization and intraluminal colonization<sup>(7)</sup>.

In the first two weeks, there is a predominance of extraluminal colonization (skin bacteria form a biofilm on the external face of the catheter), responsible for the origin of CCRBI. After this period, intraluminal colonization becomes important as a source of infection. This is due to the increasing number of manipulations of the catheter connector or hub, because they are long-stay catheters, widely used in drug therapy, which favors its contamination<sup>(7)</sup>.

The spread of infection in the bloodstream presents a major problem to the patient and a challenge to the health team due to the risk of hemodynamic and organic dysfunctions<sup>(2)</sup>.

According to Anvisa, in 2015, 19,941 cases of CVC-associated primary bloodstream infection

(PBI) were reported in intensive care units of 1,692 Brazilian hospitals, of which 15,434 were laboratory diagnostic (PBI)<sup>(7)</sup>.

In this sense, it is perceived the impact of intravenous therapy on the daily lives of hospitalized children and newborns, as well as the importance of the nursing team working in the execution of care strategies, in the management of central catheters, with the purpose of maintaining the drug therapy implemented.

In view of these issues, it is necessary to plan care and use systematic measures to prevent PBI to improve the quality of care provided, reduce costs with hospitalization time and consequently reduce infant morbidity and mortality rates. Strategies and guidelines have been developed to reduce the incidence of PBI, called Guidelines for the Prevention of Intravascular Catheter-Related Infections, proposed by the Centers for Disease Control and Prevention (CDC), which consists of a package of measures or bundle, which should be applied in a systematized manner by the team, in order to achieve good results<sup>(8)</sup>.

It is essential to implement permanent education actions regarding the bundle of insertion and maintenance of CVC to minimize the risks of contamination and, consequently, hospital infection associated with the use of CVC in pediatrics<sup>(8)</sup>. A study conducted in a tertiary hospital in Beijing, China<sup>(9)</sup>, indicates that the training of nurses and the adoption of packages of measures (bundle) of insertion and maintenance of CVC drastically reduce the rate of PBI.

In view of the above, the present study aims to identify the care strategies adopted by nursing professionals in the handling of central catheters in children and newborns hospitalized in the Intensive Care Unit.

## Method

This is a descriptive study, with a quantitative approach, of the non-participant systematic observation type, carried out in a large tertiary hospital of the public network, located in the central region of Rio de Janeiro, Brazil.

Observation is a method often used in health sciences and sociology, in which the researcher

makes use of the senses to understand certain reality. However, it is not only about seeing and hearing, but in a deep knowledge of the facts or phenomena that one wishes to study, in order to achieve its proposed objective, as well as to bring the researcher closer to the reality studied<sup>(10-11)</sup>.

In this study, data were collected in a Pediatric Intensive Care Unit (PICU) and in a Neonatal ICU, belonging to a large hospital of the federal network, located in Rio de Janeiro. The pediatric ICU, with eight beds, has a mixed clinical-surgical profile and serves the clientele from 1 month to 18 years of age. The Neonatal ICU (NICU) is divided into eight intensive care beds and eight intermediate unit beds. The unit receives high-risk newborns, with a view to being a reference in the care of pregnant women with systemic arterial hypertension, diabetes mellitus and obesity, in addition to pregnant women belonging to the program of care for patients with human immunodeficiency virus/Human Immunodeficiency Syndrome (HIV/AIDS).

The participants were the nursing professionals (nurses and technicians) of the said institution, belonging to the sector, regardless of the time of operation, with a 12x60, day or daily labor work regime, who directly assist children and newborns using a central venous catheter.

Exclusion criteria: nursing professionals who had a night shift regimen; professionals who were on sick leave or on vacation during the data collection period; medical professionals who manipulated central venous access.

Data collection occurred from September to December 2020, and 80 observations of each item (40 observations in the NICU and 40 in the PICU) were made by the researchers. As a research instrument, the previously structured checklist was used, with criteria based on the ANVISA manual<sup>(12)</sup>, to evaluate the performance of the following actions related to the handling of deep catheters: hand hygiene before and after the procedure, use of procedure gloves, disinfection technique and active mechanical friction of non-needled connections (scrub the hub) for 5-15 seconds with antiseptic solution before handling, flushing or washing with saline

solution before and after handling, performing the positive pressure technique or pulsatile turbidity (“push” and “stop” mode”).

Regarding the treatment of the study data, a simple descriptive analysis was performed using graphs, made based on the data entered and stored in the Excel 2013 version program.

The ethics of the research was ensured in accordance with Resolution n. 466/12 of the *Conselho Nacional de Saúde*, taking into account the relevant ethical and scientific foundations. To this end, the research was inserted in the *Plataforma Brasil*, in addition to being approved by the Research Ethics Committee (REC) of that institution under Opinion n. 4.322.902, Certificate of Presentation of Ethical Appreciation (CAAE) n. 38692420.9.0000.5252. The participants received and Informed Consent Form (ICF) prior to data collection, and after the consent and signature of each professional, the application of the observational research instrument began.

## Results

After organizing the empirical material, aiming at a satisfactory visualization and better understanding of the results, the information was separated into three stages, considering that these are different moments related to the planning of

nursing care in infusion therapy. They are: step I – moments of hand hygiene; step II – catheter handling; step III – dropper and connectors.

Step I, entitled “Moments of hand hygiene”, contains data regarding hand hygiene before and after performing the procedure.

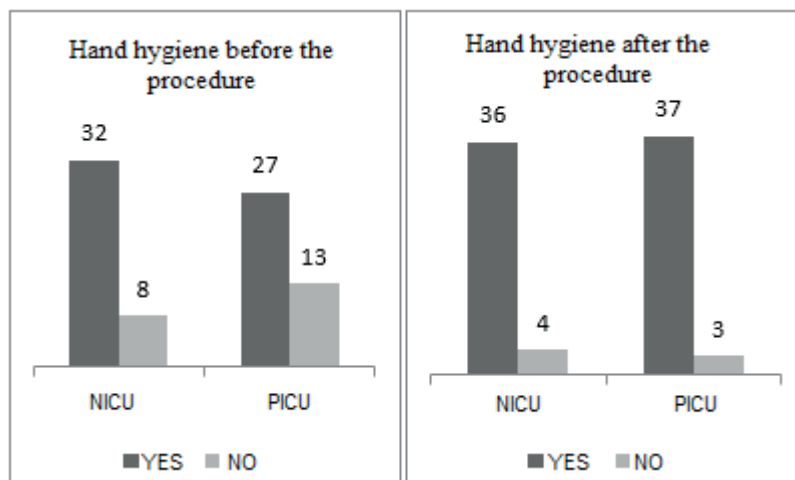
Stage II, “Catheter handling”, exposes the actions of the nursing team in the proper handling of the catheter. This item discusses issues such as wearing gloves during handling, sanitizing connections (disinfection of connectors with alcohol at 70% of 5-15 seconds), flushing in the circuit before infusion and positive pressure after infusion.

And the last step, the III, “Droppers and Connectors”, provides data on the validity of the infusion system, absence of dirt on the extenders and connectors and the non-reuse of the connectors.

### *Step I: Moments of hand hygiene*

Regarding the performance of the NICU and PICU teams of this study, concerning hand hygiene before the procedure (Graph 1), 80% and 67.5% were observed, respectively. Regarding hand hygiene after venous catheter management, the two sectors obtained 90% and 92.5% of the following respectively.

**Graph 1** – Step I: Hygiene of the hands before and after the handling of the central venous catheter in the neonatal intensive care unit and pediatric intensive care unit. Rio de Janeiro, Rio de Janeiro, Brazil - 2020



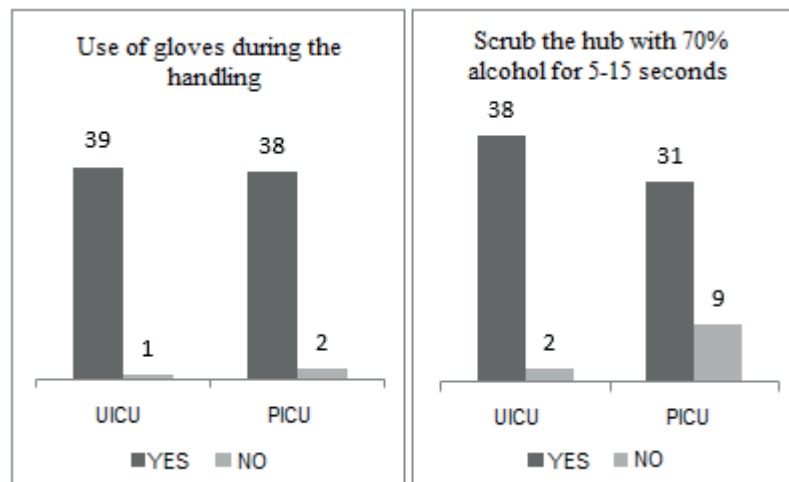
Source: Created by the authors.

### Stage I: Central catheter handling and techniques used

Regarding the techniques implemented for handling central catheters in the NICU and PICU, the use of procedure gloves during catheter

handling was 97% in the NICU and 95% in the PICU. Regarding the completion of the scrub the hub with alcohol at 70% of 5-15 seconds, 95% of the NICU professionals performed the disinfection of the connector against 77.5% of the PICU (Graph 2).

**Graph 2** – Use of gloves and scrub the hub before the handling of profound catheter in the Neonatal Intensive Care Unit and Pediatric Intensive Care Unit. Rio de Janeiro, Rio de Janeiro, Brazil - 2020

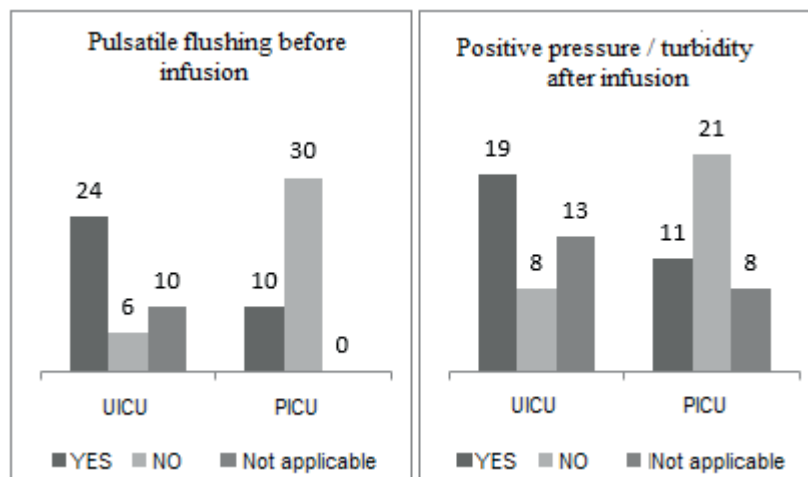


Source: Created by the authors.

Moreover, it was also possible to observe flushing with saline solution before drug infusion in 80% of NICU observations and 25% in PICU. Of the 25% who performed flushing before the PICU infusion, 65% were nurses and 35%

were nursing technicians. After administration of the drug, the technique of positive pressure or turbidity with saline solution was performed, respectively, in 70.3% and 34.3% (Graph 3).

**Graph 3** – Execution of pulsatile flushing with saline before infusion and achievement of positive pressure technique after infusion of deep catheter solutions in the Neonatal Intensive Care Unit and Pediatric Intensive Care Unit. Rio de Janeiro, Rio de Janeiro, Brazil - 2020



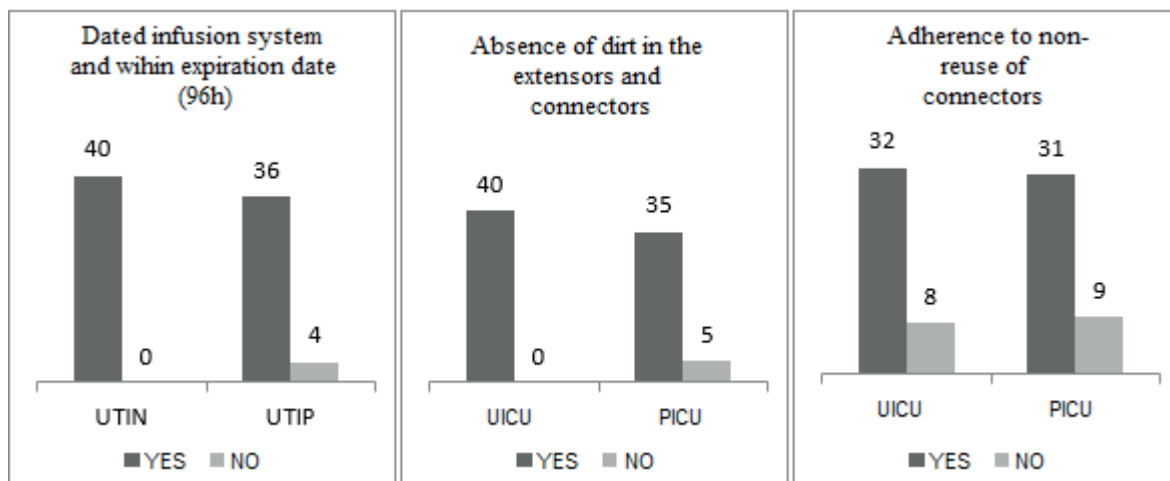
Source: Created by the authors.

### Stage III: droppers and connectors

Concerning the support in the identification of the date and the time of exchange of continuous infusion systems, such as infusion pump droppers, according to the institutional protocol and based on the solution infused, in the NICU, the professionals adhered 100%, and in the PICU, 90%.

As for the absence of dirt on the extenders and connectors, in the NICU no device presented dirt, representing 100% of the desired conformity. In the PICU, the absence of dirt on the extenders and connectors was observed in 87.5%. Regarding the reuse of the connectors, 80% adhered to non-reuse in the NICU, while in the PICU, 77.5% were not reused (Graph 4).

**Graph 4** – Infusion systems dated and within validity according to an institutional protocol, absence of dirt in the extenders and connections of infusion and adherence systems to non-reuse of the connectors in the Neonatal Intensive Care Unit and Pediatric Intensive Care Unit. Rio de Janeiro, Rio de Janeiro, Brazil - 2020



Source: Created by the authors.

## Discussion

The data analysis allowed observing that the care strategies in the handling of central catheters adopted by nursing team professionals in the NICU and PICU were organized in stages.

### Stage I: Moments of hand hygiene

Hand hygiene is pointed out as the simplest and most effective way to prevent healthcare-related infections and its correct execution. Its adherence by health professionals has been seen by institutions as a priority, considering that the dissemination of microorganisms, including multidrug-resistant ones, can be conveyed by the hands of the health professional<sup>(12)</sup>.

The act of sanitizing the hands is a basic measure to reduce the transmission of healthcare-related infections (HCRI), in addition to a basic measure of care. Therefore, in its most recent handbook, Anvisa<sup>(13)</sup> reaffirms the importance of hand hygiene before and after direct or indirect contact with the patient as a key point in reducing primary infections of the bloodstream related to central catheters, considering that these infections are related to important unfavorable health outcomes.

In the reality studied, the access to hand hygiene by nursing professionals of the NICU is satisfactory, being always higher than 80%. In the PICU, the hand hygiene rate before the procedure is 67.5% against a post-procedure hygiene rate of 92.5%.



The data obtained in the present study contrast with the findings of a research<sup>(14)</sup> that, in its observational study, which occurred in the period 2013-2017, in an Austrian university hospital, pointed out the Pediatric ICU as one of the few services that maintained the rate of hand hygiene support above 80% during the entire period observed, especially before the performance of procedures. The authors correlate this finding to a better general attitude of care of professionals working in pediatric areas.

At the end of stage I, according to Technical Note 01/2018, from Anvisa, the 5<sup>th</sup> moment among the five moments for hand hygiene is immediate hand hygiene after contact with the patient by the health professional<sup>(13)</sup>.

Considering the professional category of nurses, a study conducted in Minas Gerais showed that the hand hygiene rate before manipulation was 40%, while those who sanitized them after contact with the patient was higher, 73.3%<sup>(15)</sup>.

Another study corroborates that hygiene after contact with the patient was higher than the treatment before contact, 71%. It shows that hygiene based on alcohol stood out in 70%, because they performed all stages of the technique and correctly. Similarly, the results of these studies reinforce the greater importance given in hygiene after catheter management<sup>(16)</sup>.

### *Stage II: Catheter handling and techniques used*

Regarding Graph 2, the use of gloves during the manipulation of deep catheters, the observed reality has a significant support (97% in the NICU and 95% in the PICU). The use of gloves during catheter handling is extremely important, considering that the professional's hand is a potential route for contamination and transmission of microorganisms. The Pan American Health Organization (PAHO) widely recommends the use of gloves for two reasons: to prevent the professional from transmitting to the patient colonizing microorganisms or that are transitively in his/her hands and to protect the professional from acquiring infections from the patient<sup>(17)</sup>.

The efficacy of the use of gloves has been confirmed in several clinical studies. However, it is worth mentioning that the use of gloves does not confer complete protection for the professional, because it does not replace the hygiene of the hands, mainly due to the occurrence of contamination during its removal or through defects (microholes)<sup>(12,17)</sup>.

In relation to Graph 2, entitled "scrub the hub with 70% alcohol for 5-15 seconds" (before catheter handling), disinfection of the three-way tap and connections to each handling with 70% alcohol, through strict friction for 5-15 seconds, provides a significant reduction of the catheter-related PBI<sup>(18)</sup>.

In pediatric and neonatal intensive care, intravenous medications are routinely administered, which increases the possibility of extraluminal catheter contamination. The disinfection technique of the connections is considered an efficient strategy to prevent the colonization of microorganisms, considering that the opening of the three-way tap and connections constitutes an entrance port of the infusion circuit<sup>(12)</sup>.

The systematic review that colonization of the catheter hub and the subsequent migration of microorganisms to the intraluminal medium is considered the cause of 50% of catheter-related infections after insertion. For this reason, they reinforce the need for disinfection of the outside of the catheter before manipulation to avoid contamination and formation of intraluminal biofilm<sup>(19)</sup>.

In view of the above and observing the reality studied, the NICU has a satisfactory 95% disinfection of three-way tap and connectors against 77.5% in the PICU. The need for permanent education with the nursing team on the subject is emphasized, aiming at improving this indicator, besides enabling quality and safe nursing care.

Another highlight is flushing with 0.9% saline before infusion, as shown in Graph 3. This action is considered fundamental in maintaining central accesses to test catheter permeability and minimize the risk of drug interaction. According to the Infusion Nurses Society<sup>(20)</sup> and Anvisa<sup>(12)</sup>,

the appropriate volume is at least twice the prime (or internal volume) of the catheter added to twice the internal volume of the connections.

The technique of positive pressure or turbidity with pulsatile flushing (“push and stop”) prevents the return of blood to the catheter when its tip is opened. It consists of maintaining the pressure of the syringe inside the catheter, clamping immediately and disconnecting the syringe, preventing reflux<sup>(12)</sup>.

In drug therapy, pulsatile flush turbidity is an indispensable care for maintaining catheter permeability. It should be performed after the administration of medications and blood components, as well as in cases where the interval between medications is longer than six or eight hours. To perform the technique, the volume is considered consistent with the size of the patient, the catheter and its restrictions, using 0.9% sodium chloride in a 10 or 20 ml syringe to perform the turbulent flush<sup>(21-22)</sup>.

A study with the objective of evaluating the effect of an educational intervention for the nursing team on the prevention of non-elective removal of PICC showed that the greatest difference in means of knowledge before and after educational action occurred in questions related to the technique for flushing, indicating a lack of knowledge on the subject<sup>(23)</sup>. Another relevant data was the previous low flushing in the performance and turbidity after intravenous infusions. This finding is similar to that of the PICU researched, because the aforementioned care was below 50%.

### *Stage III: droppers and connectors*

According to Anvisa, in its notebook on healthcare-related infection prevention measures, the exchange of infusion systems must comply with the following criteria: continuous infusion – every 96 hours; intermittent infusions – every 24 hours; parenteral nutrition and administration of blood and blood components - exchange with each bag; lipid emulsions – changes every 12 hours. Under any suspicion or confirmation of PBI, the system must be exchanged<sup>(12)</sup>.

A study<sup>(24)</sup> evaluated the compliance of the nursing team in the handling of the central vascular catheter in the exchange of equipment in an ICU and observed that, of the eight actions evaluated in each dropper exchange, only 25% achieved the desired conformity, among them “keeping the place of connection protected” and “using procedure gloves”, with a positivity rate between 90% and 99%. Differently, in this study, respectively, the NICU and PICU obtained 100% and 90% aptitude for these same care analyzed.

Moreover, it is important to identify with information on the date of installation and the exchange of intravenous infusion systems, so that there is a scheduled monitoring and replacement of the systems, as recommended by Anvisa; in this article, there was an adherence greater than 90% in both units.

The physical characteristics of valved connectors and their designs should be thought, in order to minimize the dead space, necessary for the closing mechanism, between the fluid pathway and the connector wall, as they increase the chance of blood and dirt accumulation and cannot be cleaned during flush<sup>(25)</sup>. Therefore, it is possible to score more than 85% of the desired conformity regarding the absence of dirt in the connectors and extenders in the two sectors observed.

According to Anvisa, the connectors should be changed immediately in case of disconnection of the catheter or infusion system, presence of blood or other dirt. However, in cases where this does not happen, they should be changed every 96 hours, preferably together with the exchange of droppers and extenders<sup>(12)</sup>.

It is noteworthy that the exchange of connectors should be specifically declared by the manufacturer, since “following the usual hospital policy” can potentiate human error, since divergent steps for care increase the risk of non-compliance<sup>(25)</sup>. It can correlate with the investigated, in which 80% did not reuse in the NICU and 77.5% in the PICU.

This study was limited by the difficulty in large-scale observation, due to the reduced number of hospitalizations, resulting from the



reduction of elective surgical procedures and the low turnover of patients, correlated with the Covid-19 pandemic.

## Conclusion

The findings of this study allowed identifying the care strategies adopted in the handling of central catheters, and they include hand hygiene before and after handling, use of procedure gloves, scrub the rub, identification with date and exchange of intravenous infusion equipment according to institutional protocol, not reusing connectors or dirty extenders in the central accesses and previous flushing with saline solution and pulsatile flushing after administration of medicines. All these actions are routinely performed by the nursing team.

It was possible to affirm that, in the NICU and PICU, the observed professionals present a satisfactory support to the items considered essential in the care and prevention of catheter-related bloodstream infections. These data indicate the quality of care provided.

Regarding the weaknesses in the actions developed, a discrepancy in the rates of hygiene of the hands pre-procedure, flushing with saline solution before infusion and scrub the hub between NICU and PICU was noticed. Therefore, the role of the nursing team in the NICU for greater adherence to care actions related to the handling of central catheters stands out.

In view of the above, it is essential that the nursing team has a differentiated view of intravenous therapy, especially the manipulation of central catheters in children and newborns in intensive care units, considering that the weaknesses observed can negatively impact therapy, increasing not only the costs of hospitalization, but endangering the lives of patients.

The recognition of the importance of recommendations and scientific support by professionals, including the supervision of nurses during infusion therapy assistance performed during the shift, especially concerning the handling of central catheters, should be seen as necessary for safe and undamaged care.

There should be debates about the issues observed, in the elaboration of checklist instruments, applicable in the daily life of pediatric and neonatal intensive care units, periodic training and interventional studies as measures to prevent infection of the bloodstream and in order to enrich the knowledge of the team, thus improving the quality of nursing care.

The present study shall provide support for the next reflections and the strengthening on the theme of infusion therapy, besides producing new evidence for health care, in order to impact on the training of future pediatric nurses and neonatologists.

## Collaborations:

1 – conception, design, analysis and interpretation of data: Laís Martins Santos de Souza;

2 – writing of the article and relevant critical review of the intellectual content:: Mariana de Carvalho Santa Rita da Silva;

3 – final approval of the version to be published: Juliana Maria Rêgo Maciel Cardoso.

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