REVIEW
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The nurse in the prevention of peripherally inserted central catheter infection in neonates

O enfermeiro na prevenção de infecção no cateter central de inserção periférica no neonato

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ABSTRACT

Introduction: As the Peripherally Inserted Central Catheter (PICC) is the first choice of prolonged vascular access in preterm infants, to recognize the risk factors for infection related to its use contributes to the establishment of procedures that qualify care. **Objective:** To evaluate the production of knowledge available in the literature about the work of nurses in the prevention of infection related to PICC. **Method:** An integrative literature review according to Ganong's assumptions, was performed in the SciELO, LILACS, BDENF, MEDLINE and PubMed databases. Data collection took place in October 2017, including original articles made available in full from 2001. Results were organized using Bardin's content analysis. **Results:** Only eleven articles met the inclusion criteria and four thematic categories emerged: 1) Theoretical and practical knowledge assessment of the nurse to prevent infection in the insertion and maintenance of PICC, 2) Permanent education of the nursing team, 3) Implementation and use of protocols, and 4) Constant monitoring of quality indicators. **Conclusions:** The present work, through the analysis of the collected studies, signals the need to create institutional protocols, training and permanent and continuing education, to use de indicators in the prevention of infection, aiming at patient care and safety and, consequently, resulting in lower incidence of bloodstream infections through the use of PICC.

KEYWORDS: Nursing Care; Central Venous Catheter; Newborn Infant

RESUMO

Introdução: Como o cateter central de inserção periférica (PICC) é a primeira escolha de acesso vascular prolongado em neonatos, reconhecer os fatores de risco associados a infecções relacionadas ao seu uso contribui para estabelecer critérios de manuseio e manutenção do dispositivo que qualifiquem a assistência do enfermeiro e de sua equipe. **Objetivo:** Avaliar a produção do conhecimento científico na literatura acerca da atuação do enfermeiro na prevenção de infecção de corrente sanguínea pelo uso do PICC. **Método:** Revisão integrativa da literatura seguindo os pressupostos de Ganong, nas bases de dados SciELO, LILACS, BDENF, MEDLINE e PubMed. A coleta de dados ocorreu em outubro de 2017, incluindo artigos disponibilizados na íntegra a partir de agosto de 2001 a outubro de 2017. Para a organização dos resultados, foi utilizada a análise de conteúdo de Bardin. **Resultados:** Onze artigos preencheram os critérios de inclusão, emergindo quatro categorias temáticas: 1) Conhecimento teórico-prático do enfermeiro para prevenção de infecção na inserção e manutenção do PICC, 2) Educação permanente da equipe de enfermagem, 3) Implantação e utilização de protocolos e 4) Vigilância constante de indicadores de qualidade. **Conclusões:** O presente trabalho observou o despreparo do profissional da enfermagem quanto ao dispositivo PICC e demonstrou a necessidade de elaboração de protocolos institucionais, treinamento e educação continuada permanente e o uso de indicadores, direcionados às medidas preventivas contra a infecção do PICC. Essas medidas visam melhorar a qualidade da assistência e segurança do paciente e consequentemente, resultar em menor incidência de infecções de corrente sanguínea pelo uso do PICC.

PALAVRAS-CHAVE: Cuidados de Enfermagem; Cateter Venoso Central; Recém-nascido

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INTRODUCTION

With the technological progress of neonatal care over the second half of the 20th century, Peripherally Inserted Central Catheters (PICCs) emerged as the first-choice method for prolonged vascular access in neonates. These devices are indicated in cases that need intravenous therapy for more than six days, infusion of irritating or vesicant drugs, hyperosmolar solutions or solutions with non-physiological pH[1,2,3].

PICCs are peripherally inserted vascular devices with central location, with single or multiple lumens, made of polyurethane or silicone. They are bio and hemocompatible and less thrombogenic. They make biofilm formation difficult and can remain in place for up to six months for intravascular therapy in the administration of antibiotics, analgesics, parenteral nutrition, chemotherapy, among others[3,4].

The use of PICCs in Brazil began in the 1990s, however, it was not until 2001 that the Federal Nursing Council defined, with Resolution n. 258, of July 12, the attribution of the technical and legal competence of nurses for handling and inserting PICCs. It also determines that these professionals be qualified through professional training[5,6].

In addition to this support, these professionals must have the theoretical knowledge and the technical ability to support clinical decision making. Nurses must also work to promote effective and positive care results in the insertion of PICCs, according to the particularities of each drug therapy[6].

Despite offering less risk to patients at the time of insertion when compared to surgically placed devices and in large vessels, studies show a number of non-infectious and infectious complications in newborns when a PICC is inserted[7,8,9,10,11,12].

Non-infectious complications include catheter obstruction, thrombus formation, bleeding, mechanical phlebitis, migration, catheter fracture, leakage, cardiac or vessel perforation, among others[7]. Infectious diseases include infectious phlebitis, infection of the insertion site and blood infection (sepsis). If the treatment is not timely or correct, the incidence of infection and the mortality rate can be high[10,11,12].

Brazil's National Health Surveillance Agency (Anvisa) considers primary bloodstream infection (BSI) associated with the use of a central catheter in neonatology to be that in which a patient ≤ 28 days old uses a central catheter for more than two calendar days (D1 is the device installation day) and that on the date of infection the patient was using the device or had it removed on the previous day[13].

Scientific evidence[13,14] points to the need for laboratory tests to confirm the diagnosis of infection related to the central venous catheter. The Center for Disease Control and Prevention (CDC) advises that, in order to diagnose the infection, one must observe the existence of clinical manifestations and obtain positive blood culture collected directly from the PICC or another peripheral access[3].

Nurses play an important role in the care of the central venous catheter. They are responsible for direct maintenance and daily assessment in order to minimize the risks of infection[15]. In addition, Anvisa recommends that the health institution ensure human and infrastructure resources to provide adequate education and training to doctors and other healthcare professionals on guidelines for preventing catheter-related bloodstream infections[16].

To support this study, Evidence-Based Practice (EBP) was selected as the theoretical framework. This approach incorporates evidence from research and associates it with the professional's clinical competence, respecting the patient's autonomy and possibilities, incorporating the best available scientific evidence and encouraging research using these results[17,18].

This study is justified by the relevance of nurses as key professionals responsible for the indication, insertion, maintenance and withdrawal of PICCs. It is believed that, in addition to technical and legal competence, the assistance provided by these professionals must be enhanced by updated concepts and practices, in order to reduce the risks related to the device. These factors also contribute to the establishment of institutional standards and routines that focus on the safety and well-being of patients[19].

The objective of this study was to assess the scientific literature about the role of nurses in preventing infections related to the use of PICCs in neonates.

METHOD

The present study is an integrative review analyzing relevant research that supports decision making and improvement of clinical practice[20]. It enabled the synthesis of a given topic and indicated knowledge gaps that should be filled by further studies[21]. This review was conducted according to the assumptions of Ganong and involved six steps: determining the review problem, sample selection, categorization of studies, analysis of results, presentation and discussion of results, and presentation of review[22].

To guide the study, the following guiding question was formulated: What is available in the scientific literature about the role of nurses in preventing infections caused by the use of peripherally inserted central catheters in neonates?

The sample selection was carried out in October 2017 on the following databases: Scientific Electronic Library Online (SciELO), Nursing Database (BDENF), Latin American and Caribbean Literature in Health Sciences (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE) and United States National Library of Medicine (PubMed).

We used descriptors controlled and combined with Boolean operators as our search strategy: central venous catheterization;

nursing care, nursing assistance, nursing service; newborn, newborn children, newborn infant, newborn infants; neonate and neonates. The search strategy is shown in Chart 1.

The following inclusion criteria were adopted: full articles that addressed the role of nurses in the prevention of PICC-associated infection, in Portuguese, English and Spanish, indexed in the referred databases and with a time frame from August 2001 to October 2017. The reason for this time frame is the issuance of Cofen Resolution n. 258/2001 (articles 1 and 2), which authorizes nurses to insert PICCs as long as these nurses have undergone professional qualification and/or training[5].

Literature-review papers, dissertations, theses or book chapters, studies that did not address the topic, duplicates of articles in the databases and those that were not available in full were excluded.

After reading the articles in full, the data were extracted and entered into an adapted and validated instrument for further analysis[23]. Five relevant aspects were used in the studies we found: the identification of articles, authors, studied intervention, results and recommendations, and conclusions. The country in which the studies were conducted and the proposed objectives were also addressed.

To systematically organize the production of knowledge, Bardin's content analysis was used as a qualitative strategy to organize the results into theme categories[24].

The studies included in this integrative review were analyzed in search for their core meanings, whose presence and frequency were significant for the objective of the study. The main content ideas were identified and turned into theme categories[24].

RESULTS

We found 192 articles, 20 of which in the SciELO database, 37 in LILACS, none in MEDLINE, two in BDENF and 122 in PubMed. After applying the eligibility and exclusion criteria, 11 articles were selected.

Of these articles, one was published in 2006, two in 2010, three in 2011, one in 2012, three in 2013 and one in 2015. Regarding the country where the research was conducted, eight were in Brazil, one in China, one in Iran and one in the United States. Of these, nine were written by nurses and two were written by doctors and nurses. Ten were conducted in hospitals and only one in a research center.

As for the type of research design of the selected articles, seven studies were descriptive with a quantitative approach, one descriptive with a qualitative approach, a cohort study and two case control studies. The synthesis of the 11 articles was organized and presented in Chart 2.

DISCUSSION

Content analysis using Bardin's methodology[24] revealed four categories related to the role of nurses in preventing infection associated with the use of PICCs in newborns:

- theoretical and practical knowledge of nurses to prevent infection in the insertion and maintenance of PICCs;
- continuing education of the nursing team;
- implementation and use of protocols;
- constant monitoring of the indicators presented below.

Theoretical and practical knowledge of nurses to prevent infection in the insertion and maintenance of PICCs

PICCs have been widely used as an option for venous access in neonatal intensive care units (NICU). However, this procedure must be performed by skilled nurses, since theoretical-practical knowledge is required[36].

In view of the analysis of the articles from E1 to E9[25,26,27,28,29,30,31,32,33] and E11[35], for the catheter insertion procedure, nurses and materials must be prepared according to CDC standards on how to maintain the sterility of the materials and ensure compliance with safe techniques, avoiding risks of systemic complications for the patient. Nurses who perform the insertion of PICCs must be aware of the importance of complying with the standards for the prevention of hospital-acquired infections during the procedure.

In 2017, Anvisa revised and published an edition of the Patient Safety and Quality in Health Services series called Prevention Measures for Healthcare-Associated Infection, with basic guidelines for infection prevention and control based on updated technical and scientific grounds[16].

This manual guides healthcare professionals in the insertion, care and maintenance of vascular catheters to prevent bloodstream

Chart 1. Search strategy in the databases.

Database	Search strategy
BDENF LILACS SciELO	"Cateterismo venoso central" AND "Cuidados de enfermagem" OR "Cuidado de enfermagem" OR "Assistência de enfermagem" OR "Atendimento de enfermagem" AND "Recém-nascido" OR "Criança recém-nascida" OR "Crianças recém-nascidas" OR "Lactente recém-nascido" OR "Lactentes recém-nascidos" OR "Neonato" OR "Neonatos"
PubMed MEDLINE	"Central Venous Catheters" OR "Central venous catheter" AND "Nursing care" OR "Nursing care management" AND "Infant, newborn" OR "newborn infant" OR "newborn infants" OR "newborns" OR "newborn" OR "neonate" OR "neonates"

Source: Prepared by the authors, 2019.
BDENF: Nursing Database; LILACS: Latin American and Caribbean Health Sciences Literature Scientific Electronic Library Online; PubMed: United States National Library of Medicine; MEDLINE: Medical Literature Analysis and Retrieval System Online.

Chart 2. Characteristics of the articles included in the integrative review.

ID	Title	Authors	Country	Objective	Intervention studied	Results	Recommendations/ Conclusions
E1 (25)	Reasons for non-elective removal of epicutaneous catheters in neonates	Paiva, ED; Costa, P; Kimura, AF; Castro, TE	Brazil	Describe the incidence and reasons for non-elective removal of the epicutaneous catheter in neonates.	Cohort study with prospective data collection and neonates who received epicutaneous catheters in the NICU of a large hospital.	The most frequent complication that motivated non-elective catheter removal was the suspicion of catheter-related bloodstream infection.	Strategies to reduce this complication include the continuing training of the nursing team.
E2 (26)	Nursing care evaluation: peripherally inserted central catheter dressings in newborns	Johan, DA; Danski, MTR; Pedrolo, E; Lazzari, LSM; Mingorance, P	Brazil	Describe the PICC dressing in newborns and compare it with the available literature on the topic.	Descriptive and comparative methodology through data collection through a form for the systematic observation of trained nurses.	The use of the appropriate dressing, although not significantly contributing to the reduction of catheter-related infection, is essential for maintaining PICCs.	The observed nurses used the basic instruments to make the dressings, but they were based only on the institutional SOP. Ideally, they should use studies with methodological rigor and strong scientific evidence to support professional practice.
E3 (27)	Action of the nurse with peripherally inserted central catheter in the infant newborn	Rodrigues, ZS; Chaves, EMC; Cardoso, MVML	Brazil	Investigate the role of nurses in caring for PICCs in the NICU.	Structured questionnaire for 17 nurses addressing questions about the use, care and maintenance of PICCs.	Nurses play a fundamental role, since they are responsible for carrying out the technical procedure, as well as for continuous surveillance to detect changes related to bloodstream infection.	Gaps were observed in the theoretical-practical knowledge of nurses who provide assistance. Professional training is necessary to guarantee the quality of care.
E4 (28)	Nurses' knowledge about the peripheral central catheter insertion technique in newborns	Lourenço, SA Ohara, CVS	Brazil	Check the theoretical and practical knowledge acquired by nurses in training programs.	Questionnaire with nine questions for 40 nurses working in the ICU.	There are many mismatches between the knowledge accumulated by nurses and the use of the technique. The average of the total number of correct answers was 67.7%.	It was observed that nurses have poor knowledge about the insertion of PICCs, and the professional who performs it must acquire theoretical and practical knowledge in the training programs.
E5 (29)	Peripherally-inserted central catheter use in neonatal clients at a public state hospital: retrospective study	Reis, AT; Santos, SB; Barreto, JM; Silva, GRG	Brazil	Present characteristics of use of the epicutaneous catheter in the NICU.	Access to the information contained in the PICC control form was granted.	The number of catheters removed due to infection is small, totaling 15 cases, compared to the number removed at the end of treatment (65 cases).	Nursing is of vital importance in the care of PICCs and should focus on the handling of central catheters with special attention to adverse events.
E6 (30)	Management practices of peripherally inserted central catheter at a neonatal unit	Dorea, E; Castro, TE; Costa, P; Kimura, AF; Santos, FMG	Brazil	Describe the management of PICCs in hospitalized neonates.	Observations and data collection of medical records of neonates admitted to the NICU.	Although the service adopts a protocol for the management of PICCs, the findings showed the use of different antiseptic solutions in the PICC dressing.	Clinical practice has shown that there is inconsistency in relation to the PICC protocol, which requires investment professional training.
E7 (31)	Neonatology nurses' knowledge about Peripherally Inserted Central Venous Catheter	Belo, MPM; Silva, RAMC; Nogueira, ILM; Mizoguti, DP; Ventura, CMU	Brazil	Describe the knowledge and practice of nurses from five public units.	Instrument with questions prepared by the researchers about PICCs for 52 nurses.	They observed that the nurses' general knowledge about PICCs was predominantly satisfactory.	There is a need for greater encouragement to the training of nurses to use PICCs in order to guarantee constant improvement in the quality of care.
E8 (32)	Nursing care in view of complications regarding the peripherally inserted catheter in newborns	Swerts, CAS; Felipe, AOB; Rocha, KM; Andrade, CUB	Brazil	Evaluate nursing care in view of complications related to PICCs.	Observation of the care provided by the team and application of a questionnaire.	The NICU nursing team acts without standardization of catheter manipulation techniques, not prioritizing scientific and anatomical bases.	To be successful in this practice, professionals must seek knowledge through continuing education.

Continue

Continuation

ID	Title	Authors	Country	Objective	Intervention studied	Results	Recommendations/ Conclusions
E9 (33)	Prevention of peripherally inserted central line-associated blood stream infections in very low-birth-weight infants by using a central line bundle guideline with a standard checklist: a case control study	Wang, W; Zhao, C; Ji, Q; Liu, Y; Shen, G; Wei, L	China	Evaluate the implementation of a central line guide, its safety and the reduction of complications in neonates in need of PICC.	A total of 57 very low-birth-weight babies who received PICC were included in the control group, for whom a guideline of the central line guide and a standard checklist were adopted. In contrast, 53 very low-birth-weight babies underwent PICC insertion, but the criteria of the other group were not adopted.	The incidence of infection showed a statistically significant reduction from 10.0 to 2.20 per 1,000 catheter days in the control group. The incidence of catheter-related blood infections decreased from 3.1 to 0.0 per 1,000 catheter days and colonization infection decreased from 6.9 to 2.2 per 1,000 catheter days.	The use of a central line guide guideline with a standard checklist can be effective and feasible to prevent catheter-related infections in very low-birth-weight babies.
E10 (34)	Discovering the barriers to spread the usage of peripherally inserted central venous catheters in the neonatal intensive care units: Qualitative research	Zargham-Boroujeni, A; Mahdavi-Lenji, Z; Hasanpour, M; Sadeghnia, A	Iran	Discover the barriers to spread the use of PICCs in NICUs.	Interviews with nurses and neonatology interns to discover the barriers to the application of PICCs.	The main topics included barriers related to the procedure and maintenance, barriers related to people who provide care and barriers related to management and planning.	Complete planning is necessary to eliminate barriers and supply the catheters. Staff education is also necessary.
E11 (35)	Effect of a dedicated percutaneously inserted central catheter team on neonatal catheter-related bloodstream infection	Taylor, T; Massaro, A; Willians, L; Doering, J; McCarter, R; He, J; Talley, L; Short, B	USA	To assess whether a team qualified for PICC insertion is associated with a reduced risk of catheter-related blood infection in the NICU.	A pre-versus post-intervention study project was implemented. Participants in the intervention group were admitted when the PICC team was created, dedicating responsibilities for insertion and maintenance of catheters.	The intervention group had a 49.0% lower risk of catheter-related infection in patients who had PICC for more than 30 days.	Standardization of PICC insertion is important, but standardization of maintenance is essential for improving catheter-related infection rates.

Source: Prepared by the authors, 2019.
NICU: neonatal intensive care unit; SOP: standard operating procedure; PICC: peripherally inserted central catheter; ICU: intensive care unit.

infections. When inserting the catheter, it is recommended to use a checklist to ensure compliance with infection prevention practices at the time of insertion[16].

The study by Lourenço and Ohara (E4)[28] verified nurses' knowledge of the PICC insertion technique, and the variable related to the preparation of nurses and materials for catheter insertion achieved 57.5%, which indicates "very poor" knowledge of the topic, an alarming result.

The PICC insertion technique requires nurses' expertise, clinical judgment and conscious, safe and effective decision making. Since it is a specific and highly complex technique, it requires that professionals acquire theoretical and practical knowledge in training programs, so that the insertion process does not harm patients. Training programs provide nurses with basic theoretical-practical support that enables them to carry out the procedure safely and competently, in addition to increasing these professionals' mastery of assistance procedures[35,37,38].

Another aspect discussed in the E4 study was the professional performance regarding skin antisepsis, which needs to comply with the recommendations on the use of antiseptics for the insertion of central catheters, especially in newborns. The correct antisepsis at the insertion site reduces the chances of systemic complications due to the use of the catheter[37,38,39].

According to Anvisa's recommendations, the professional must use the maximum sterile barrier, prepare the skin with an alcoholic solution of chlorhexidine gluconate > 0.5%, with an application time of 30 sec, using back and forth movements, and proceed to puncture after spontaneous drying of the antiseptic[16]. As for the adequate solution for skin preparation, the recommendation is to use aqueous chlorhexidine to prepare the skin of newborns under 1,500 g, since their skin is more fragile and sensitive[40].

Knowledge about the proper dressing that should be used when securing the catheter is very important, and nurses are responsible for observing the integrity of the insertion ostium. This

assessment contributes to the early detection of complications, especially those related to infections.

The purpose of the dressing is suture-free stabilization to reduce the risk of bloodstream infection. It plays two roles: its creates an environment that protects the catheter insertion site and prevents its dislodgement. The first dressing after the insertion should be done using gauze and sterile adhesive tape or sterile semi-permeable transparent cover to cover the area. The cover with gauze and sterile tape should be changed every 48 hours and the transparent sterile cover should be changed every seven days. If the dressing is dirty, loose or damp, it must be changed right away, regardless of the time, since this increases the risk of infection[16].

Some studies corroborate the described procedure when they state that the first dressing made with gauze should be changed every 48 h, handling should be kept to a minimum and aseptic techniques should be followed[41,42].

The use of a transparent dressing is the most suitable for coverage because it enables daily inspection of the insertion site, the catheter path, signs of infiltration, edema, ischemia and infection. It is up to the nurse to choose the appropriate dressing model to enable the visualization of any changes in the catheter insertion site and/or in the limb[3].

Regarding the complications of using the catheter, the study by Swerts et al. (E8)[32] evaluated nursing care in view of the complications of PICCs and described that, in view of the appearance of inflammatory signs, the nurses placed warm compresses on the site and observed it for 24 hours to interrupt the infusion if necessary.

The nurses' theoretical and practical knowledge of this problem is very important to avoid the inappropriate removal of catheters. According to a study by Dias et al., the presence of inflammatory signs at the insertion point of the central venous catheter must be assessed together with other clinical signs, since, in isolation, it is not an indicator of the occurrence of colonization and its absence does not guarantee the absence of bacterial colonization either[43]. For this, nurses and multidisciplinary teams must be trained in the theoretical and practical context for the assessment and correct identification of this situation.

Periodic observation of the limb and site after insertion should also be done preventively, to avoid inadvertent early removal of the catheter by mistaking the edema with an infiltration in the limb[27]. In cases of infiltration, nursing care can include raising the limb for a period of 24 h to 48 h to improve venous return, promote venous absorption and decrease the edema[44].

Nurses are primarily responsible for the management and implementation of care in intravenous therapy. Their work includes the critical assessment of the prescribed therapy, choice of the vascular device that meets the patient's needs, insertion of the device and care during its maintenance, as well as its removal. In addition, it is their role to reflect and implement practices that increase patient safety and contribute to the improvement of their clinical conditions, especially of high-risk newborns[25].

Studies have shown that a way to prevent contamination of the central venous catheter is the implementation of a bundle of measures aimed at its insertion and maintenance, like educating and training health professionals who insert and maintain catheters to: adopt maximum precaution for sterile barriers during the insertion of a central venous catheter, employ skin preparation with alcoholic chlorhexidine for asepsis, avoid routine replacement of central venous catheters, and daily review of the need for catheter maintenance[45,46].

To that end, we have to design and adopt protocols that guide the work of nurses with this type of catheter. With that, we can standardize conducts and improve the quality of care, which is essential for the success of the work with PICCs[47].

Continuing education of the nursing team

The continuing education of the nursing team by nurses, as well as the training of these professionals to use PICCs, was mentioned in six articles (E1; E4, E6 – E8; E10)[25,28,30,31,32,34], which reported flaws in the work done with device.

Anvisa recommends the training of health professionals in the management of vascular access, as well as the monitoring of care, as an integral part of well-organized care improvement programs and well-organized BSI prevention and control programs[16].

To properly do their work, nurses need technical-scientific knowledge from training and education programs that can give them dexterity and skill to increase success rates in the use of PICCs by the nurses themselves and their teams[48].

Members of the nursing team are some of the most active human resources in healthcare institutions and provide direct care to the users. The training of all members according to their technical assignment is very important so that there is significant agreement both in the provision of assistance and in the identification of possible complications caused by infections or due to iatrogenesis. In addition, the design, update and promotion of compliance with internal protocols through the interpersonal communication consolidate the chosen care model and result in more benefits than harm to patients[6].

Two articles (E4; E7)[28,31] evaluated the nurses' knowledge about PICCs and concluded that there are many mismatches between the knowledge acquired by the nurses and the performance of the technique. It is believed that greater encouragement is needed to train these professionals to use PICCs in their institutions. Furthermore, support to this training from updated international standards (from disease control centers and/or health organizations) ensures that professionals will have the required knowledge not only to make the insertion properly, but also to be aware of the complications that can be triggered by wrong techniques.

The study by Zargham et al. (E10)[34] suggested having a harmonious training program to enable the organized education of the teams about the maintenance and care of catheters, with an emphasis on preventing complications, based on international standards.

In addition to this recommendation, another strategy for the reduction of complications is the continuing education of the nursing team about the importance of hand washing, protection of the catheter insertion site during the newborn's bath, use of gloves and antiseptic solutions when handling the catheter, change of semipermeable dressing whenever there is loss of adhesion, dirt and/or weekly, according to the protocol of the internal hospital infection commission. Furthermore, there is the need to learn how to identify the device with the smallest number of lumens to properly meet the needs of a patient's clinical condition[3].

Continuing health education is an essential strategy to enable changes in the sector and turn it into a place of critical, reflective action, with new proposals, with a committed and technically skilled team, which combines theory and practice to identify and analyze problems and prepare proposals for change[49].

With this review, we could notice the importance of health education for nursing professionals involved in handling the PICCs, since the included studies identified flaws in processes using this device. This fact is corroborated by research that has shown that the training of the nursing staff on how to maintain catheters contributes to the reduction of risk factors related to complications[50].

Protocol implementation and use

Of the 11 studies selected in this review, five mentioned the use of standard operating protocols (SOP) (E6 – E9; E11)[30,31,32,33,35]. They addressed the standardization of nursing procedures, training and implementation of routines for the use of PICCs, contributing to the reduction of complications related to the use of catheters. Most of these studies emphasized the importance of the existence and use of protocols that guide the nursing work, avoiding using subjective experience that is subject to errors and standardizing behaviors to improve care.

The PICC insertion protocol should contain information about the characteristics of the chosen catheter (diameter and internal volume of the catheter), insertion site, complications during the procedure and radiography report. In addition to these, information related to maintenance (dressing change, assessment of local conditions and catheter permeability) and removal (reason for withdrawal, length of catheter removed and submission of the tip for microbiological analysis) must be recorded using print or electronic instruments. This data record supports care and standardizes it. Communication with the team also improves the quality of care[51,52].

A study (E6)[30] that observed PICC management demonstrated that, in practice, the maintenance procedures are often different from the institutional protocol, and that this is responsible for the occurrence of some complications. In this context, it is worth emphasizing the importance of using the protocol consistently so as to eliminate the possibility of complications related to the management of PICCs.

Another study (E8)[32], which observed nursing care in the face of PICC complications, noticed that the NICU nursing team acts without standardization of catheter maintenance techniques and without scientific grounds about its correct anatomical location, which often makes cleaning of the insertion site difficult.

The good insertion, maintenance and removal of PICCs prevents infections and losses, reducing the cost to hospital institutions and, consequently, the frequent losses of catheters due to their incorrect handling. It is worth mentioning that, in addition to being invasive, this procedure is also rather new within neonatology[36].

Thus, standardization of the PICC insertion site is important, but standardization of catheter maintenance is essential for improving the rates of catheter-associated bloodstream infection[35].

Nurses are the professionals in charge of maintaining the catheter, so if any portion of the catheter happens to become external when renewing the catheter fixation film, nurses must be careful about the contact of that external portion with other areas outside the dressing, avoiding contamination of this path and, consequently, bloodstream infections[53].

International bodies like the CDC recommend the use of standardized instruments, like checklists and surveillance forms, that fulfill institutional protocols to increase patient safety in relation to the use of intravenous devices[3]. This corroborates a study that reports that, when there are protocols to be followed, the use of forms and checklists can improve the quality of care[54].

That confirms the relevance of well-established protocols of good practices in the team for the reduction of infection rates. These protocols must address the time of insertion of the catheter, vein of choice for insertion, catheter dwell time, asepsis of the skin before puncture, monitoring of dressings and removal as soon as necessary[33].

Constant monitoring of quality indicators

The use of quality indicators by nurses was found in at least three studies (E5 – E7)[29,30,31] in our research.

Specifically, the study by Belo et al. (E7)[31] says that the complications related to the infection are largely the responsibility of the nurse, since signs like hyperthermia, redness and secretion in the ostium of the insertion must be monitored daily and systematically.

Another study (E5)[29] mentioned the importance of constant monitoring of indicators in the collection of data on the device dwell time and the reason for its removal. These are essential for the quality control of the work process around infusion therapy in newborns.

Dórea et al., in turn, (E6)[30] reported that the preparation of an easy-to-use form may be an alternative to solve problems arising from the lack or inadequate registration of procedures performed with PICCs.

Constant monitoring of indicators, such as the device dwell time and reason for withdrawal, is essential for the quality control of the work process around infusion therapy in newborns. National controlled studies in the pediatric population are scarce, but the design of infection indicators and infection monitoring as proposed by Anvisa may encourage the definition of more specific prevention strategies for this population, in addition to allowing the application of recommended preventive measures for these infections[55].

These indicators contribute to reducing the risk of infection related to healthcare and enable professionals to measure the quality of their care. The use of PICCs in neonatology can be considered recent in nursing, therefore, the use of quality indicators by nurses becomes important to assess whether this practice is performed in compliance with the desirable standards or not.

CONCLUSIONS

The present study sought to find scientific literature on the role of nurses in preventing bloodstream infection associated with the use of PICCs in neonates. Based on the analyses carried out in this study, we could identify that the presence of the nurse is fundamental for the reduction of complications with the catheter due to the technical preparation, assessment capacity and decision making. However, there are gaps in the theoretical and practical knowledge about the catheter insertion and maintenance process, as well as a lack of continuing education and training for the teams. There is also scarce use of SOPs and a lack of constant surveillance through quality indicators. All of these strategies are essential and aim at preventing infections, providing high-quality care, increasing patient safety and reducing rates of morbidity and mortality, treatment costs, and other complications.

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Authors' Contributions

Russo NC, Lopes A, Oliveira RAP, Mondelli AL, Corrêa I - Conception, planning (study design), acquisition, analysis, data interpretation and writing of the paper. All authors approved the final version of the paper.

Conflict of Interest

Authors have no potential conflict of interest to declare, related to this study's political or financial peers and institutions.