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Influence of nurses' working time on epicutaneous catheter knowledge: a cross-sectional study

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ABSTRACT

OBJECTIVE: To analyze the influence of nurses' working time in a neonatal or pediatric intensive care unit on the knowledge about insertion and handling of the peripheral insertion central catheter. **METHOD:** A cross-sectional study conducted with 22 neonatal and pediatric intensive care nurses. A structured instrument was used, produced based on the Practice Guidelines for Infusional Therapy. **RESULTS:** The median of training time was 9 years and that of working time in neonatology or pediatrics was 8 years. The length of practice showed a significant difference regarding knowledge about "patient positioning for catheter length measurement" (p=0.010) and "Personal Protective Equipment recommended for dressing changes" (p=0.004), the largest proportion of correct answers being by nurses with shorter working time. **CONCLUSION:** Time of work showed little influence on the knowledge of the professionals. It is important to invest in continuing education for a safer care.

KEYWORDS: Nursing; Catheters; Intensive care units; Knowledge; Time.

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INTRODUCTION

The peripherally inserted central catheter - either epicutaneous catheter or *Peripherally Inserted Central Catheter* (PICC) - is indicated to meet the therapeutic demands of critically ill patients, becoming substantial for their recovery [1-3]. The PICC, as it is more commonly known in the care practice, is increasingly used in neonatal and pediatric intensive care units because of its ease of insertion, prolonged length of stay, less traumatic insertion and reduced risk of complications[4].

Despite being a stable and effective venous access alternative for critically ill neonates and children, the PICC is not free of complications, the most common being poor positioning, occlusion, thrombosis, phlebitis and sepsis[5-6].

In Brazil, this catheter has been used in pediatric and neonatology for approximately two decades. Resolution 258/2001[7], of the Federal Council of Nursing, considers the insertion of the PICC lawful to nurses, but emphasizes that everyone must undergo a properly regulated qualification course.

It is well known that several factors can influence professionals' knowledge and behavior, such as work overload and poor nurse recognition[2-6]. These factors also influence the quality of care and favor the occurrence of errors[1,2,5,6]. In addition, the length of time these professionals work in neonatology or pediatrics may also influence daily practices[1-2,8-10].

Assessing the relationship between working time and peripherally inserted central catheter care knowledge can help guide nurses' qualification, aiming at safe care for newborns and children using this device

Given the challenges presented, this study aimed to analyze the influence of nurses' length of work in a neonatal or pediatric intensive care unit on the knowledge about insertion and handling of the peripheral insertion central catheter.

METHOD

This is a cross-sectional study conducted in two units of a general hospital of high complexity in the public network of Minas Gerais: Neonatal Intensive Care Unit and Pediatric Intensive Care Unit. The units total 30 beds, 10 from pediatrics and 20 from neonatology. The care procedures related to the management of the PICC are based on the protocols established and approved by the hospital.

The population consisted of 30 nurses. As inclusion criteria the following were considered: proceeding with insertion and maintenance of the PICC device in neonates or children and working for more than six months in the units. Professionals who were on vacation, leave or who refused to sign the consent form were excluded. Following these criteria, the sample totaled 22 nurses, as five refused to participate in the study and three were on leave at the data collection time.

The form was applied from September to October 2015, in shifts and times according to the work schedule of each participant (all work shifts were contemplated), with the presence of one of the researchers. For data collection a structured instrument with closed questions was used, produced based on the Practice Guidelines for Infusional Therapy[9]. It was evaluated by three specialists from the areas that considered the form and content, relevant to the study proposal. It is notewor-

thy that there are no validated instruments on this theme so far.

To assess nurses' knowledge, 20 questions were addressed, with five answer alternatives each (always, sometimes, rarely, never, I don't know), which included aspects related to the PICC insertion and maintenance technique, namely: orientation and clarification to family members about the procedure; patient's, nurse's and materials preparation for the technique; PICC preparation for insertion; antisepsis performed on the skin; catheter insertion mode; daily care with PICC; guidelines for preventing infection and catheter removal.

The data were processed and analyzed using the *Statistical Software* program, version 14.0 (Stata Corp, Texas, USA). The sample was described using absolute, relative, median and interquartile range frequencies. Frequency distribution tables of the variables were presented according to the nurses' time in the units, which was categorized as less than eight years and greater than or equal to eight years, considering the median of the variable.

The Fisher's exact test was used to compare the proportions and to verify the associations. To compare the medians of the two independent samples, the Mann-Whitney test was used. A significance level of 0.05 was adopted for the analytical procedures.

For data on nurses' knowledge presentation, in addition to tables by theme (insertion and maintenance of PICC) according to the time of practice in neonatology or pediatrics, a conceptual classification of the variables established by previous study was established[11]. Thus, if the professional obtained 100% accuracy, his knowledge was rated excellent; 90 to 99%, very good; 80 to 89%, good; 70 to 79%, regular; 60 to 69% poor and 50 to 59% extremely bad[11]. For each question, the number of correct answers in the total forms was evaluated, obtaining the correct answer percentage in each one.

The study met the formal requirements of the national and international regulations governing research with human beings.

RESULTS

Of the 22 nurses, the majority (80.9%) was from the Neonatal Intensive Care Unit and all were female. Of these, 21 (95.45%) completed the PICC course.

The median of age was 36 years old (IQ=33-39), of the professional training time was nine years (IQ=8-12) and of the working time in neonatology or pediatrics was eight years (IQ=4-9).

The sample characterization according to the time worked in the units is presented in Table 1. It is noteworthy that the total number of professionals may vary for some of the studied variables due to the lack of information. In the variables in which statistically significant differences were found, a higher median was observed among professionals who worked longer (≥ 8 years) in the units. Table 2 presents nurses' knowledge, by the thematic of insertion of the PICC, according to the time of practice in neonatology or pediatrics.

There was a statistically significant difference between working time and knowledge about "patient positioning to measure the length of the catheter to be inserted". The highest

proportion of correct answers (72.7%) was by professionals who worked in the units for less than 8 years.

Table 3 presents the nurses' knowledge, by the thematic of maintenance of the PICC, according to the time of practice in neonatology or pediatrics.

There was a statistically significant difference between working time and knowledge related to the question about "Personal Protective Equipment recommended for bandage changes". There was a higher proportion of correct answers (55.6%) among professionals who worked less recently in neonatology or pediatrics.

Still regarding the nurses' knowledge, it was observed that no professional had 100% of correct answers (excellent). Only 1 (4.55%) got between 90 to 99% of correct answers (very good knowledge). Four (18.2%) had 80 to 89% of correct answers (good knowledge) and eight (36.4%) obtained 70 to 79% of correct answers (regular knowledge). The highest percentage was 12 to 13 questions (60 to 69%), showing bad knowledge in 9 participants (40.9%). This score was also evaluated according to the time worked in neonatology or pediatrics and no statistically significant differences were found.

Table 1. Characterization of the sample according to time of practice in neonatology or pediatrics. Belo Horizonte, MG, Brazil, 2015.

Characteristics	< 8 years (n=10) n (%) or Median (IQ†)	≥ 8 years (n=12) n (%) or Median (IQ†)	Total (n=22) n (%) or Median (IQ†)	p-value
Age	33 (32-38)	37 (34-39)	36 (33-39)	0.20 §
Time of training §	6 (6-8)	10 (9.5-13)	9 (8-12)	**<0.001**†
Sector				0.25§
Neonatal Intensive Care Unit	7 (41.2)	10 (58.8)	17 (100.0)	
Pediatric Intensive Care Unit	3 (75.0)	1 (25.0)	4 (100.0)	
Time of performance in the institution	3 (1-4)	8 (7-8.5)	7 (1-8)	
Time of performance in the unit	2 (1-4)	8 (4-8.5)	6 (1-8)	**<0.001**§
Yes	9 (42.9)	12 (57.1)	21 (100.0)	**<0.001** §
No	1 (100.0)	-	1 (100.0)	
Employment contract				0.33 †
One	4 (36.4)	7 (63.6)	11 (100.0)	
More than one	6 (54.5)	5 (45.5)	11 (100.0)	
PICC Training*				0.61 ††
Yes	7 (46.6)	8 (53.3)	15 (100.0)	
No	3 (42.9)	4 (57.1)	7 (100.0)	

Notes: †IQ: Interquartile range; ‡Fisher's exact test; §Mann-Whitney test; *PICC: *Peripherally Inserted Central Catheter*

Table 2. Nurses' knowledge, by the thematic of insertion of the PICC, according to time of practice in neonatology or pediatrics. Belo Horizonte, MG, Brazil, 2015.

Theme	< 8 years (n=10) n (%)	≥ 8 years (n=12) n (%)	Total (n=22) n (%)	p-value
PICC insertion indication§				0.45†
Correct answer	9 (42.9)	12 (57.1)	21 (100.0)	
Error	1 (100.0)	-	1 (100.0)	
PICC insertion contraindication§				
				0.33†
Correct answer	6 (54.6)	5 (45.4)	11 (100.0)	
Error	4 (36.4)	7 (63.6)	11 (100.0)	
PICC insertion first choice vein§				0.48 †
Correct answer	4 (40.0)	6 (60.0)	10 (100.0)	
Error	6 (50.0)	6 (50.0)	12 (100.0)	
Positioning for catheter length measurement				**0.01**†
Correct answer	8 (72.7)	3 (27.3)	11 (100.0)	
Error	2 (18.2)	9 (81.8)	11 (100.0)	
PICC length measurement§ **for upper limb insertion**				0.21†
Correct answer	9 (52.9)	8 (47.1)	17 (100.0)	
Error	1 (20.0)	4 (80.0)	5 (100.0)	
PICC distal end§ **with proper placement**				0.58†
Correct answer	7 (43.8)	9 (56.2)	16 (100.0)	
Error	3 (50.0)	3 (50.0)	6 (100.0)	
Prevention of infection related to PICC insertion§				0.11†
Correct answer	9 (56.2)	7 (43.8)	16 (100.0)	
Error	1 (16.7)	5 (83.3)	6 (100.0)	
Correct measure to insert PICC§ **on lower limbs**				0.59†
Correct answer	2 (40.0)	3 (60.0)	5 (100.0)	
Error	8 (47.1)	9 (52.9)	17 (100.0)	
Advantages of PICC Insertion§ **in the veins of the upper limbs**				0.45†
Correct answer	7 (50.0)	7 (50.0)	14 (100.0)	
Error	3 (37.5)	5 (62.5)	8 (100.00)	0.38†
Advantages of PICC§				
Correct answer	4 (57.1)	3 (42.9)	7 (100.0)	
Error	6 (40.0)	9 (60.0)	15 (100.0)	

Notes: †Fisher's exact test; §PICC: *Peripherally Inserted Central Catheter*.

Table 3. Nurses' knowledge, by the thematic of maintenance of the PICC, according to time of practice in neonatology or pediatrics. Belo Horizonte, MG, Brazil, 2015.

Theme	< 8 years (n=10) n (%)	≥ 8 years (n=12) n (%)	Total (n=22) n (%)	p-value
Most frequent complication after PICC insertion§				0.22†
Correct answer	7 (38.9)	11 (61.1)	18 (100.0)	
Error	3 (75.0)	1 (25.0)	4 (100.0)	
Frequency for transparent film bandage change				
Correct answer	10 (45.4)	12 (54.6)	22 (100.0)	
Error	-	-	-	
Solution recommended for antisepsis of skin in bandage change				**0.40†**
Correct answer	7 (41.2)	10 (58.8)	17 (100.0)	
Error	3 (60.0)	2 (40.0)	5 (100.0)	
PPEs††† recommended for bandage changes				**0.04†**
Correct answer	10 (55.6)	8 (44.4)	18 (100.0)	
Error	-	4 (100.0)	4 (100.0)	
Actions favoring PICC permeability§				0.45†
Correct answer	9 (42.9)	12 (57.14)	21 (100.0)	
Error	1 (100.0)	-	1 (100.0)	0.45†
Indications for PICC removal§				
Correct answer	9 (42.9)	12 (57.1)	21 (100.0)	
Error	1 (100.0)	-	1 (100.0)	0.54†
PICC complications§				
Correct answer	6 (42.9)	8 (57.1)	14 (100.0)	
Error	4 (50.0)	4 (50.0)	8 (100.0)	
Care for phlebitis risk reduction				**0.61†**
Correct answer	7 (46.7)	8 (53.3)	15 (100.0)	
Error	3 (42.9)	4 (57.1)	7 (100.0)	

Notes: †Fisher's exact test; p-value in bold ≤0.05; §PICC: *Peripherally Inserted Central Catheter*; †††Personal protective equipment.

DISCUSSION

Was starting with the main given initial hypothesis confirmed? What is the hypothesis of the study?

Regarding nurses' knowledge of PICC insertion and maintenance, the highest percentage of correct answers was 60 to 69%, denoting bad knowledge, according to the classification adopted in the study[11]. It is important to highlight that, in the case of an invasive procedure that is the insertion of the PICC, bad knowledge may influence the breach of the procedure safety and, consequently, may generate adverse events on the child. A study conducted with 32 neonatal and pediatric intensive care nurses from 26

hospitals in the city of São Paulo[8] showed a similar result and concluded that there are many mismatches between the knowledge accumulated by nurses and the performance of this practice[8]. This finding may be justified by the lack of scientific evidence in the nursing area, which leads nurses to use empirical practices derived from their experience.

Another noteworthy point in the results was that among the professionals who had the best knowledge were those who had worked less recently in neonatology or pediatrics. A study suggests that advanced beginners feel very responsible for patient care, follow the rules and are guided by the tasks they must perform, unlike expert professionals.

The use of the PICC in pediatrics and neonatology is a specialized and highly complex practice. For the nurse to be able to develop such a procedure, she needs specific training. However, this study has shown that these courses alone may not be enough to keep nurses updated on new scientific evidence and institutional protocols.[1]. Thus, it is suggested that a certification on the PICC insertion course by the scientific society in the field of pediatrics and neonatology is needed, which currently does not happen. Furthermore, it is emphasized that graduate courses related to neonatological nursing should include in their *curriculum* a nurse qualification course in this field of practice in order to improve the professionals' ability in this usual procedure in neonatology and pediatrics[8].

The variables of "indication and contraindications for epicutaneous insertion" showed correct answers rates of 95.5 and 50%, respectively. Several studies conducted in Neonatal Intensive Care Units in Recife and Minas Gerais showed that most of the participants correctly indicated the use of PICC, considering the need to maintain venous access for more than six days, administration of parenteral nutrition, amines and infusion of vesicant or irritants solutions[11-12].

Regarding the items "first choice vein" and "upper limb positioning angle for puncture", there was insufficient knowledge of the professionals. According to the terminology adopted in the evaluation scale, the literature points out that the choice of the vein to be punctured is extremely relevant to the success of catheter insertion, the most suitable being basilica and cephalic.[1,11,13-15].

In the present study, almost all nurses stated that they performed "catheter length measurement" before starting the procedure. However, for the "upper limb measurement" and "lower limb measurement" variables, knowledge was assessed, respectively, as fair and very bad. In a similar study conducted in the city of São Paulo[8], the mean of the correct answer ratio for these two variables was 53.7%, also denoting insufficient knowledge. Nurses' lack of knowledge about the correct measurement of the catheter is considered a risk factor, as erroneous measures can lead to the emergence of serious complications, such as edema, arrhythmias, tamponade and others, and often make it impossible to use the catheter as a central access[8].

Regarding waiting for the "drying of the skin antisepsis solution" before the puncture, more than 90% of the nurses stated that they always perform this practice. However, when asked about the frequency of "connector antisepsis" prior to manipulating the catheter,

less than half responded to perform such activity at all times. In addition to performing the insertion of the PICC, the nurse is also responsible for maintaining this device. Thus, they should be aware of the importance of adherence to hospital infection prevention rules and apply them in the procedure to reduce the risk of adverse events[8,12].

Catheter-related bloodstream infection increase is related, among other things, to the lack of training of the nursing staff in daily catheter care[16]. Therefore, the Centers for Disease Control and Prevention recommend that all professionals handling the devices have high level training, continuing education on international and national guidelines for the prevention of catheter-related infection[1].

Regarding the "catheter tip location" variable, the respondents had fair knowledge, indicating significant difficulty in identifying proper catheter tip placement, especially when insertion occurs through the lower limbs. About the frequency that certifies "catheter positioning by radiography" before starting the infusion solutions, less than half of the nurses answered they performed this practice. A poorly positioned catheter tip can lead to serious complications and may result in a lethal condition of pericardial effusion, tamponade secondary to myocardial perforation, and cardiac arrhythmia.[16].

The main advantages of using the PICC are access reliability, lower risk of infection compared to other central vascular devices, preservation of other venous accesses, reduction of stress resulting from multiple punctures, less traumatic insertion, lower risk of chemical phlebitis and extravasation fluids, longer residence time and reduced costs[11]. The authors of a study conducted at a university hospital in Brazil pointed out that, when asked about the advantages of this catheter, the nurses' mean level of correct answers was 87.5%, indicating good knowledge[13]. This finding is not consistent with the present study, in which the variables of "general advantages of epicutaneous use" showed a very bad knowledge. However, it is noteworthy that the questionnaires used in both studies were different, which may hinder their comparison.

The good permeability of the PICC until the end of the therapy is one of the pillars in patient care and in the nursing work process, avoiding early catheter removal[1]. In this research, for the "permeability" variable, knowledge was very good, with a mean rate of correct answers above 90%.

The "need for dressing change" variable obtained a mean rate of correct answers of over 80%, which indicates good knowledge. In the study, all nurses reported performing bandage changes whenever necessary. It is emphasized that dressing change should be performed with aseptic technique, when the transparent film loses its adherence or integrity does not offer patient safety or within seven days[14].

In the present study, the "complications due to epicutaneous" variable showed bad knowledge. A study conducted in Recife found that 79.8% of the nurses demonstrated to know the main complications of the PICC, which corresponds to fair knowledge, comprised between 70 to 79% of correct answers[11]. The potential complications that may lead to a non-elective removal of this catheter are infiltration, leakage, phlebitis, obstruction,

catheter-related bloodstream infection, insertion site infection, embolism, tip migration, accidental traction, arrhythmias, tamponade catheter rupture, thrombosis and swelling of the members[15-16].

In this study, over 70% of the nurses reported performing analgesia with hypertonic glucose before PICC insertion. However, this is a painful event, as observed in a study conducted at the Neonatal Intensive Care Unit of a large teaching hospital in São Paulo that evaluated 28 neonates undergoing PICC insertion and showed that 71.4% of the neonates presented scores on the *Premature Infant Pain Profile* pain assessment scale indicative of moderate to severe pain in response to venous puncture and less intense during catheter tip progression. However, the results showed that the care practices of analgesia and sedation during the PICC insertion procedure occurred in less than half of the insertions in neonates[11].

In the training courses, guidance is provided for the elaboration of a formal and written consent form, with simple language, which should be applied accompanied by a verbal explanation from the nurse and, at the end, it should be signed. However, in this study, only 9.1% of the nurses reported requesting parental consent before PICC insertion and 40.9% reported never requesting such consent. A similar study, conducted in neonatal and pediatric intensive care units in the city of São Paulo, showed that knowledge of the importance of obtaining the term before the beginning of the technique obtained a 77.5% accuracy rate, denoting fair knowledge[8].

The authors found that, of 156nurses, 5.8% used the written informed consent; a result similar to that found in the present study. The participating nurses work in ICUs and, often, in this work scenario, many interventions are performed without knowledge of the family members, which are communicated only later. The PICC should not be inserted in emergency situations due to the numerous risks presented, and thus, the nurse has the possibility of performing the orientations before the insertion[8].

Finally, it is noteworthy that this research presented the relatively small sample number as a limiting factor. That is, there is no sample with proven representativeness of the population of nurses in the pediatric and neonatal intensive care units. However, it is noteworthy that all work shifts were contemplated in order to avoid potential bias.

It is extremely important that the nursing professionals have knowledge about the aspects that involve the use of the PICC, in addition to the risks to which neonates undergoing this procedure are exposed, in order to use prevention, control and detection of possible complications. The existence and use of protocols that guide the nursing practice in the use of this catheter aims to standardize conducts and improve the quality of care, which is fundamental for the success of the practice with the PICC[11,13].

In intensive care units, it is essential that there is constant encouragement from the professionals to maintain enthusiasm within a highly complex sector, so that the practice of technicisms does not overlap with the human. Continuing education is an alternative for filling gaps in scientific and practical technical knowledge, as it provides the opportunity to discuss nursing care for patients with the

PICC, providing reflection and updating of the practice[1,13].

CONCLUSION

The present study points out the weaknesses of the nurses' knowledge about the insertion and handling of the PICC. The results showed that the nurses' working time in neonatal and pediatric units showed a statistically significant difference in knowledge about "patient positioning for catheter length measurement" and "Personal Protective Equipment recommended for dressing changes", the largest proportion of correct answers being by nurses with shorter working time.

The use of the PICC requires knowledge, dexterity and skill in its handling by the nursing staff. For better performance and safety in catheter insertion and maintenance, training and continuing education of the professionals are required, strategies aimed at qualifying care. It is hoped that this study can contribute to guide the training of nurses, aiming at safe care for children and newborns who use this device.

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