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Direct cost of Peripherally Inserted Central Venous Catheter insertion by nurses in hospitalized adults

Custo direto da inserção do Cateter Central de Inserção Periférica por enfermeiros em adultos hospitalizados

Costo directo de la inserción del Catéter Central de Inserción Periférica por enfermeras en adultos hospitalizados

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ABSTRACT

Objectives: to analyze the average direct cost of PICC insertion by nurses. **Methods:** this is a unique case study with a quantitative approach. The observation took place in a public hospital, collecting information on inputs used and procedure length. For the calculation of costs, time was multiplied by nurses' costs plus supplies. The US dollar was used to present the calculations. In the analysis, descriptive statistics of measures of central tendency and variability were used. **Results:** the sample corresponded to 139 observations. The average cost of PICC insertion totaled US$286.04, with 90.8% of materials, mainly catheter, and 9.2% of the labor. The procedure took an average of 50 minutes, at US$0.26 per minute for nurses. **Conclusions:** the average direct cost of PICC insertion was US$286.04, with emphasis on the catheter. The results can support management decisions for adequate material and professional sizing.

Descriptors: Nursing; Health Care Costs; Costs and Cost Analysis; Catheterization, Peripheral; Catheterization, Central Venous.

RESUMO

Objetivos: analisar o custo direto médio do procedimento de inserção do PICC por enfermeiros. **Métodos:** trata-se de um estudo de caso único de abordagem quantitativa. A observação ocorreu em hospital público, coletando-se informações sobre insumos utilizados e tempo do procedimento. Para o cálculo dos custos, multiplicou-se o tempo pelo custo do enfermeiro somado aos insumos. Utilizou-se o dólar americano para apresentação dos cálculos. Na análise, utilizou-se a estatística descritiva de medidas de tendência central e de variabilidade. **Resultados:** a amostra correspondeu a 139 observações. O custo médio do procedimento de inserção do PICC totalizou US$286,04, sendo 90,8% dos materiais, principalmente cateter, e 9,2% da mão de obra. O procedimento durou em média 50 minutos, a US$0,26 o minuto do enfermeiro. **Conclusões:** o custo direto médio do procedimento de inserção do PICC foi US$286,04, com destaque para o cateter. Os resultados podem fundamentar decisões gerenciais para adequado dimensionamento material e profissional.

Descritores: Enfermagem; Custos de Cuidados de Saúde; Custos e Análise de Custo; Cateterismo Periférico; Cateterismo Venoso Central.

RESUMEN

Objetivos: analizar el costo directo promedio del procedimiento de inserción de PICC por enfermeras. **Métodos:** se trata de un estudio de caso único con enfoque cuantitativo. La observación se realizó en un hospital público, recolectando información sobre insumos utilizados y tiempo del procedimiento. Para el cálculo de los costos, el tiempo se multiplicó por el costo de la enfermera más los insumos. Se utilizó el dólar estadounidense para presentar los cálculos. En el análisis se utilizó estadística descriptiva de medidas de tendencia central y variabilidad. **Resultados:** la muestra correspondió a 139 observaciones. El costo promedio del procedimiento de inserción de PICC fue de US$286,04, con el 90,8% de los materiales, principalmente catéter, y el 9,2% de la mano de obra. El procedimiento tomó un promedio de 50 minutos, a US$0,26 por minuto para la enfermera. **Conclusiones:** el costo directo promedio del procedimiento de inserción de PICC fue de US$286,04, con énfasis en el catéter. Los resultados pueden apoyar las decisiones de gestión para un adecuado dimensionamiento material y profesional.

Descriptores: Enfermería; Costos de la Atención en Salud; Costos y Análisis de Costo; Cateterismo Periférico; Cateterismo Venoso Central.

INTRODUCTION

Intravenous Therapy (IVT) is widely used in several care scenarios and serves different patient profiles[1]. The nurses' role in IVT was initially secondary, with the objective of assisting physicians in venipuncture and fluid administration. However, due to the high demand for procedures generated with the Second World War, direct action in IVT was assigned to nurses as administering solutions and performing transfusions[2].

Currently, IVT continues to expand and has developed as a specialty. The mastery of different technologies and the greater training of nurses have contributed so that this professional can recommend the type of vascular access device according to the venous network of each patient. Moreover, nurses, through better evidence, can seek best practices for the care and maintenance of IVT devices[3].

Vascular catheters can be classified as peripheral or central, depending on the device's distal tip site. Each has a specific indication and length of stay[4]. In the case of central vessels, the tip must be located in the superior or inferior vena cava. Due to the high blood flow in the vena cava, the central devices are highlighted in clinical practice, as they allow the rapid administration of large volumes of fluids, the possibility of monitoring central venous pressure, as well as safety in the infusion of drugs and vesicating solutions with high osmolarity[5].

Central venous catheters can be inserted through central veins, most commonly the internal jugular, subclavian or femoral vein, or through peripheral veins, being termed as Peripherally Inserted Central Venous Catheter (PICC). It is empirically realized that using PICC in adults has increased in Brazil. In the United States of America (USA), approximately three million PICCs are inserted per year[6], being one of the most non-tunneled central catheters used in Intensive Care Units (ICUs)[7]. In Brazil, PICC insertion can be performed by a nurse, as determined by Resolution 258/2001 of the Federal Nursing Council (COFEN - *Conselho Federal de Enfermagem*), or by a physician, both trained and qualified for the procedure[8].

Inserting catheter through peripheral vessels, when compared to puncture in central vessels, promotes greater patient safety and minimizes complications such as pneumothorax and hemorrhage[9]. As for the use of these vascular devices, several studies report different rates of complications between PICC and Central Venous Catheter (CVC) in both the pediatric and adult population[10-12].

In adults, PICC can be inserted through venous puncture performed in the basilic, cephalic, brachial, medial cubital veins, or as a last alternative in the external jugular vein, as it is associated with greater complications. In neonates, there is also the possibility of insertion in the metacarpal, temporal, posterior auricular, axillary, saphenous and popliteal veins[13].

Like any type of central device, during the insertion procedure, maximum barrier precautions should be used[4-5]. Additionally, it is recommended to use microintroduction and ultrasound (US) technique, which provides greater assertiveness and lower complication rates[5,14-16]. Different methods for confirming tip positioning are currently available, such as US and the electrocardiogram-guided method (ECG), considered the best but with restrictions for patients with cardiac arrhythmia[5]. However, after insertion, chest X-ray is the gold standard for assessing PICC positioning before releasing it for use[5].

Inserting PICC is a procedure that demands care for good practices and patient safety, the use of constantly evolving technologies, specialized nursing care and, consequently, generates significant costs. Since PICC is a technology with increasing use and the analysis of hospital costs promotes the optimization of health actions, it is essential to understand the costs associated with insertion of this catheter.

Despite the widespread use of PICC in Brazil, especially among the neonatal and pediatric population[17], no national studies have been found in adults that clarify the costs involved in the insertion procedure that are based on direct observations.

OBJECTIVES

To analyze the average direct cost of *Peripherally Inserted Central Venous Catheter* insertion by nurses.

METHODS

Ethical aspects

The study was analyzed and approved by the Ethics Committee for Analysis of Research Projects of the institution (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration). The nurses responsible for insertions signed the Informed Consent Term (ICF) in two copies, agreeing with the observation of the procedure by the researcher.

Study design

This is a unique case study with a quantitative approach, which allows full investigation of a phenomenon[18]. This type of study is used in management activities as a support for decision-making. In this study, the case is the average direct cost of PICC insertion procedure by nurses. The methodological structure followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations[19].

The research was conducted in inpatient and intensive care units of a teaching hospital, mostly public, specialized in cardiopneumology and composed of 535 beds, which meets, on average, the demand for 13 thousand hospitalizations per year. Considering 2017, there were, on average, 39 PICC insertions in adults per month at the institution.

Sample

The sample of procedures was convenient and the observations were made during the day (7:00 a.m. - 4:00 p.m.) from December 2016 to September 2017, according to the data collector's availability. It is noteworthy that catheter insertion is usually concentrated in this period due to nurses' availability in the infusion therapy group and the programmed sizing of assistance nurses. The inclusion of the procedure in the sample corresponded to the observation opportunities during the collection period and procedures interrupted for any reason during observation and those performed on patients under the age of 18 were excluded.

All trained and certified nurses for PICC insertion, according to COFEN Resolution 258/2001[8], were considered eligible to have the procedure observed. During the data collection period, the hospital had 54 nurses qualified to insert PICC, with similar expertise and experience; therefore, the length of professional experience was not considered an inclusion variable. It is noteworthy that, due to institutional norms, nurses are considered qualified after performing five PICC insertions under the supervision of a qualified reference nurse (member of the institution's infusion therapy group).

Peripherally Inserted Central Venous Catheter insertion protocol

The institution has a protocol for insertion, maintenance and removal of PICC for uniformity of care about the catheter, followed by all nurses certified and qualified for this procedure and which recommends the participation of two nurses in the procedure, in order to promote greater patient safety. The procedure is carried out at the bedside and nurses has the autonomy to choose using the US device to assist or guide puncture using the modified Seldinger technique and micropuncture[13], as both are listed in the protocol. For choosing properly the insertion site, the Zone Insertion Method (ZIM) was used, which divides the arm into 3 zones: the first, starting with the epicondyle, is the red zone, contraindicated for insertion due to the increased risk of thrombosis and bleeding; the middle third corresponds to the green zone, being the place indicated for the puncture with less risk of complications; and the third, yellow zone, covers the end of the green zone to the axillary line, where the concentration of hair and greater humidity creates a potential risk for the occurrence of infection and must be avoided[20].

Before the vessel catheterization, nurses apply a tourniquet to the upper limb chosen to promote dilation of the veins and inspect the venous network with the aid of US, as the catheter diameter must occupy up to 45% of the vein diameter to prevent venous thrombosis[21]. After vessel selection, the catheter is measured to prevent malposition as follows: for insertions in the upper limb, the measurement starts from the puncture site to the right clavicle-sternal junction and from this point up to the third intercostal space; for left side punctures, 2 cm is added to this measurement[21]. The initial brachial circumference is also measured, using the reference measurement 10 cm above the antecubital fossa for early identification of edema during the catheter's stay[13]. Antisepsis of catheter insertion site is done with 2% chlorhexidine using an antiseptic brush, followed by disinfection with alcoholic chlorhexidine> 0.5%, according to institutional bundle and infection prevention measures[14]. At the end of catheter insertion, the site is covered with sterile gauze and transparent film. After completion of the procedure, all patients undergo chest X-rays to confirm the proper catheter tip site, which can be performed at the bedside or patients are referred to a Diagnostic and Therapeutic Support Service.

Observation protocol

Data collection was performed by a researcher who did not participate in the PICC insertion procedure. The beginning of the observation was considered from a tourniquet placement to assess patients' venous network (ti) until the completion of occlusive dressing (tf) at the end of the procedure. For data collection and material counting, one developed by the researchers was used, containing information related to the characterization of patients (sex, age, diagnosis), catheterization (insertion or reinsertion, reason for catheter insertion, catheter material, presence and position of the catheter valve, supplies used, duration of the procedure) and nurses (sex and number of professionals observed).

Cost measurement

The costs accounted for were the direct costs, defined as an expense that is applied in the production of a product or service in which there is the possibility of identification, that is, it is everything that can be measured, identified and clearly quantified[22]. It consists of labor and supplies used directly in the assistance process[23].

To measure the procedure's direct cost, the following data were included: quantity of materials consumed (cap, surgical mask, surgical glove, brush for antisepsis, antiseptic solution, gauze, syringes, needles, occlusive connector, saline solution ampoules, lidocaine, transparent film, catheter and puncture kit for US use) and direct labor cost (DL). The unit values of supplies were obtained from the Hospital's Costs Center, based on the value of the last purchase.

No costs related to equipment use (X-ray and US) and reprocessed materials were accounted for, as these calculations also involve indirect costs.

To calculate the DL's unit cost, nurses' average salary was used, in addition to social charges, provisions for vacation and 13th wage, values provided by the Human Resources Department of the Hospital for the year 2017, so that: DL unit cost=Σ labor costs of nurses observed/number of nurses observed[23].

The workload corresponding to 40 hours per week, representing the contractual relationship of all nurses participating in the study, was used to calculate the hourly value of nurses, such that: hourly value of nurse=unit cost of DL/160 hours. Subsequently, the nurse's minute value was calculated by dividing the hour/nurse value by 60 minutes.

The average direct cost per inserted catheter was calculated by multiplying the time spent by professionals in performing the procedure by the DL's unit cost, plus the cost of supplies used, i.e., average direct cost=Σ [(nurse minute value x procedure duration) + supplies used in the procedure]/total procedures observed[23].

Due to instability of the Brazilian currency (*real*), the values were converted into dollars, considering the average exchange rate for the months of data collection (US$1=R$3.20)[24].

Data analysis

The collected data were stored in an electronic spreadsheet prepared using Microsoft Excel® and analyzed in the Statistical Package for Social Sciences® (SPSS), version 22.0. The results were presented in absolute and relative frequencies. For quantitative variables, descriptive measures of central tendency and position (means, medians, quartiles, mode) and variability (standard deviation, Pearson's coefficient of variation, minimum and maximum

values, interquartile range) were used). Pearson's coefficient of variation is the percentage deviation of standard deviation and the interquartile range is the distance between 25% quartile and 75% quartile. The shorter this distance, the smaller the dispersion of 50% of the values observed around the median.

Table 1 - Distribution of types of catheters used, unit costs and total and average cost of the catheter, São Paulo, São Paulo, Brazil, December 2016 to September 2017

Catheter used in the procedure	Observations n (%)	Unit cost US$	Total cost US$
Proximal single lumen valve 4 French (Fr) polyurethane	53 (38.1)	193.75	10268.75
Distal valve single lumen 4 French (Fr) silicone	48 (34.5)	193.75	9300.00
Open tip double lumen high flow 5 French (Fr) polyurethane	18 (13.0)	278.13	5006.34
High-flow double lumen proximal valve 5 French (Fr) Endexo	17 (12.2)	278.13	4728.21
Proximal single lumen 3 French (Fr) polyurethane valve	3 (2.2)	265.63	796.89
Total	139 (100.0)		Mean 216.55

RESULTS

Of the 120 patients who underwent PICC insertion, 52% (n=62) were female and 48% (n=58), male, aged 18 to 93 years, with a mean of 54.4 years (SD ± 19.7) and 59-year-old mode. All procedures were performed by qualified nurses, totaling 25 professionals, of which 76% (n=19) were female.

As the main diagnosis, cardiac disorders stood out, being responsible for 47.5% (n=57) of hospitalizations, 25% (n=30) of pulmonary disorders and 27.5% (n=33) of other disorders.

Also, 139 observations were made for 120 patients due to the need to exchange the PICC for suspected infection, catheter obstruction or worsening of the clinical condition of patients in need of new therapy. The average number of catheterizations observed per month was 15.4 procedures.

Thus, 86.7% (n=104) of patients had the procedure performed only once. Among the reinsertions, the observation of the same patient ranged from two to four times, with two (86.7%) times the most frequent occurrence.

Table 2 – Average consumption per procedure, variation in the amount of supplies used in Peripherally Inserted Central Venous Catheter insertion, with respective average and total unit cost, São Paulo, São Paulo, Brazil, December 2016 to September 2017

Materials used	Average consumption	Consumption variation	Average unit cost in US$	Total cost in US$
Cap	2	2	0.013	0.03
Surgical mask	2	2	0.034	0.07
Antisepsis brush	3	3	0.38	1.14
Powder surgical glove	3	3 - 5	0.55	1.65
Antiseptic solution				
Degerming chlorhexidine*	1	1	0.61	0.61
Alcoholic chlorhexidine *	1	1	0.32	0.32
Gauze pack (10 units)	4	2 - 7	0.20	0.80
10mL syringe	4	2 - 8	0.04	0.16
5mL syringe	1	1	0.04	0.04
1.2x40mm needle	1	1 - 2	0.08	0.08
0.4x13mm needle	1	1	0.08	0.08
SF0.9% ampoule - 10mL	5	3 -7	0.04	0.20
Lidocaine 2% - 5mL	1	1	0.28	0.28
Transparent film	1	1	0.53	0.53
Occlusive connector	1	1	0.93	0.93

*Note: *100mL bottle.*

Considering the total number of PICC insertions (n=139), the main justifications were 39.6% (n=55) for administration of antimicrobials and 34.5% (n=48) for administration of antiretrovirals, followed by 24, 5% (n=34) for vasoactive drugs and other solutions, such as electrolyte replacement, in two cases, or 1.4%.

The catheter was the most significant item for composition of costs. Five different types of catheters were used in insertions (Table 1), with variations in material (Endexo®, silicone or polyurethane), number of lumens (one or two), presence and position of the valve (proximal valve, distal valve or tip open) or additional function (simple or high flow). The average cost, using the sum of the values of each catheter used, was US$216.55.

The US device was used in all insertions, with 91.4% (n=127) guided by the US with the microintroduction technique, while 8.6% (n=12) used the US as a puncture aid, no need for angulators and puncture kit.

Puncture kits for US use had the highest unit cost (US$39.78), after catheters. The other materials were used in all procedures (Table 2). As the procedure in the institution is carried out by two nurses, there was a duplicate amount of materials for surgical dressing, in addition to using an antiseptic brush to clean patients' skin at the puncture site. Similarly, the variation in the use of sterile gloves is due to the occasional glove change during the procedure in case of accidental contamination.

The average cost of supplies used in the catheter insertion process for average consumption was US$6.92. In this value, the costs of the catheter and puncture kit by US are not included, as the objective was to show that the cost of the procedure is due to the technology used.

The only drug used during insertion was 2% lidocaine to perform the anesthetic button. Of the procedures, in 96.4% (n=134), the anesthetic was used, because its use depends on a medical prescription at the study institution and is not used if patients are hypersensitive to the drug.

The insertion procedure length was from 25 to 125 minutes, with an average of 50 minutes (SD ± 17.4) and a median of 45 minutes. Pearson's coefficient of variation for the mean PICC insertion length was 34.8% and the interquartile interval was 8 minutes (range 42 - 50).

The monthly cost, per nurse, of DL was US$2,479.12 for a 40-hour week, the average hourly cost was US$15.49, with a minute cost of US$0.26 per nurse. Since the procedure involves two nurses, the cost of DL varied between US$12.97 and US$64.84 (Table 3), with an average of US$26.22 (SD ± 9.01) and a median of US$23.34. The interquartile range was US$4.15 (US$25.94 - US$21.79), corresponding to a Pearson's coefficient of variation of 34.4%.

Considering the DL's average costs, the catheter, the puncture kit by US and the other supplies, an average direct cost of US$286.04 was obtained for inserting PICC in adult patients (Table 3), and the resources materials corresponded to 90.8% of the value.

Table 3 - Central tendency and cost variability measures (US$) related to Peripherally Inserted Central Venous Catheter insertion according to the cost of human and material resources, São Paulo, São Paulo, Brazil, December 2016 to September 2017

COSTS (US$)	Mean	Standard deviation	Q1	Q2	Q3	Interquartile range	Minimum	Maximum
Direct labor (DL)	26.22	9.01	21.79	23.34	25.94	4.15	12.97	64.84
Material resources – Total	259.81	36.94	239.81	240.39	285.12	45.31	199.95	327.25
Catheter	216.55	37.34	193.75	193.75	278.13	84.38	193.75	278.13
Ultrasound puncture kit	36.35	11.21	39.78	39.78	39.78	-	-	39.78
Other consumables	6.92	0.82	6.28	6.75	7.45	1.16	4.70	9.34
Total	286.04	39.49	262.44	265.69	311.06	48.62	219.66	389.48

Note: Q1 - First Quartile or 25 Percentile; Q2 - Second Quartile, 50 Percentile or median; Q3 - Third Quartile or 75 Percentile.

It was observed, through the analysis of the interquartile range, that the largest range was attributed to the catheters (US$84.38), as they present high costs and variations depending on the model and the material that makes up their physical structure.

DISCUSSION

Among the justifications for PICC insertion, it was observed, in this study, that the prolonged use of antimicrobials was the main indication for PICC insertion due to long period of treatment and the characteristics of these drugs, often irritating, vesicating or high osmolarity[5]. In addition to antimicrobials, it is worth mentioning the routine administration of antiretrovirals, since the present institution is a reference in performing heart and lung transplants, and the use of these drugs is common in this population.

Using US as a guide for PICC insertion is frequent in the institution, demonstrating the qualification of nurses and the wide access to this technology. Literature shows that US-guided catheterization has provided better results when compared to blind puncture insertion. Its use promotes greater assertiveness of insertion[15], as it allows viewing the depth of the vein and identification of adjacent vessels and structures, reducing the procedure length[16]. Its use is recommended by national and international bodies and societies such as the Infusion Nurses Society (INS)[5], the National Sanitary Surveillance Agency (ANVISA - *Agência Nacional de Vigilância Sanitária*)[14], the National Institute for Clinical Excellence (NICE)[25] and the Agency for Healthcare Research and Quality (AHRQ)[26].

A Chinese study, which compared the costs of US-guided PICC insertion with insertion without US, found that in the first months the costs of using US were higher, but considering the costs of treating complications, the cost benefit for insertion with US it was better. Furthermore, there was a significant difference favorable to PICC insertion with US in relation to the comfort rate (76.6% x 44.7%), success rate in the first puncture (94.4% x 75.4%) and rate of non-complication (97.2% x 61.7%), with p value <0.001 for all rates[27]. Given the objective of this study, comfort rates, success in the first puncture or absence of complications were not assessed.

In the current investigation, puncture kits, followed by catheters for US-guided insertion, were the supplies with the highest unit cost, with a value of US$39.78. The kits have three options of disposable angles that can be attached to US clamp, which allow the ideal angle of the needle according to the depth of the vessel. As noted in literature, guided puncture promotes greater assertiveness, less vascular injury and less chance of infection[5,14].

As for the catheters used, preference was given to single lumen silicone valve catheters due to the higher frequency of intermittent therapies and less demand for medications or high flow infusions. Moreover, the silicone catheter is highly biocompatible and flexible, with less chance of damage to the vessel wall, having low thrombogenicity and less capacity for bacterial adhesion[28].

In relation to the catheters used, it was observed that the catheters with larger diameter and some type of associated technology presented a higher unit cost. The catheter with Endexo® technology has an integral and permanent polymer throughout the catheter body that provides greater resistance to thrombus accumulation[29]. The high-flow double-lumen catheter is a pressure-resistant polyurethane device up to 325 psi (pounds per square inch or pound per square inch), also known as power injection, especially indicated for use with injection pumps in contrast tests[28].

According to the Table Management System of Procedures, Medical Drugs, Orthotics, Prosthetics and Special Materials (OPM) (SIGTAP - *Sistema de Gerenciamento da Tabela de Procedimentos, Medicamentos*) of the Unified Health System (SUS – *Sistema Único de Saúde*)[30], consulted in July 2019, PICC is considered special material; therefore, it only presents the value of the discriminated catheter, assigning zero value to professionals' service. Even considering only the catheter's value, transfer value to the institution is US$61.88, well below the average value observed in the present study, i.e., a difference of US$154.67. Thus, for the purchase of PICC, it is necessary to allocate resources from other sources, and part of the Medium and High Complexity Financial Ceiling received by the institution is commonly used for bidding for the purchase of the catheter.

It is important to emphasize that the success of therapy is closely associated with using well-established criteria[13] of insertion to prevent future complications and, consequently, lower costs, such as choosing the appropriate device according to the characteristics of patients and therapy to be used, professionals' expertise, resources for insertion and maintenance and preferences of patient and family.

During insertion procedures, the only drug used was 2% lidocaine without vasoconstrictor, a local anesthetic, to provide a less painful procedure. Since 2014, COFEN has allowed subcutaneous local anesthesia with 1% or 2% lidocaine without vasoconstrictor by nurses trained to insert PICC, through the existence of an institutional protocol, professional training and medical prescription[31]. Due to the low unit cost of the anesthetic, as well as the other materials, except catheters, there was little impact of their use on the total cost of the procedure.

As for time spent inserting PICC, it was found that there was a wide variation from 25 minutes to two hours and five minutes, with an average of 50 minutes. A North American study shows an average insertion time of 29 minutes, disregarding confirmation of tip site[32]. The prolonged time seen in the present study is closely related to patients' characteristics, mainly referring to the markedly weakened venous network, severe clinical conditions and the use of multiple invasive devices by patients, often making the insertion process difficult and long. Given that the cost of DL was based on nurses' minute value, the cost also varied widely.

Depending on the institutional protocol, PICC insertion can be performed by nurses or physicians. Some institutions recommend that the procedure be performed by a medical professional and in a surgical center, with the possibility of sedation and greater control over the risk of infection[9]. The value of the procedure performed by a physician has its value defined by a standard table, which varies according to the paying source, SUS or supplementary health companies, and it is not the focus of this study to make a comparative analysis of these cost differences. But it is a fact that using operating rooms causes an exponential increase in costs involved in the procedure. Literature is controversial regarding the superiority of the procedure performed in the operating room as a strategy to reduce infection rates; several national and international guidelines[4-5,14] recommend only precautions of maximum barrier during insertion and adequate skin antisepsis.

A comparison of PICC insertion costs by nurses at the bedside and of central venous catheter (CVC) by physicians in a surgical center showed that PICC insertion had a 40% lower cost, although the value of CVC was R$32.00 and PICC, R$610.00. The basis for calculating the cost of inserting PICC was similar to that of this study, and the authors obtained a direct cost of R$686.12, with 91.2% of the cost being related to supplies[33].

A cohort study on costs of US guided PICC insertion or blind puncture showed lower costs for US guided insertion (US$318.41 x US$381.44), due to the assertiveness in puncture and catheter insertion. The total cost was higher than that observed in this study, as they included in the cost calculation assessment of the catheter positioning by X-ray or fluoroscopy, coordination of the catheter repositioning procedure by nurses and whether the catheter was inserted or repositioned by physicians, who has a hour more expensive than nurses[34]. The calculations presented in the publication were analyzed considering the cost of supplies and DL, obtaining a value of US$274.20 in PICC insertion with US, US$11.84 less than that of this study.

Introducing teams for PICC insertion can influence the total costs of the procedure and the team may have different assignments to be defined according to the demand and resources of each institution. In general, the team is responsible for carrying out PICC insertions, updating and continuing education of professionals and contributing to developing protocols using the best evidence and lowest costs. Insertions performed by specialized teams have a shorter procedure length, greater assertiveness and optimization of resources, in addition to contributing to quality and comfort assistance for patients. More than 60% of hospitals in the USA over 50 beds have a PICC team composed of nurses[35]. Knowing data related to the costs and logistics of PICC insertion by nurses can assist in decision-making for the implementation of these teams and greater investment in professional training.

Study limitations

Despite the planning to make it possible to observe the largest number of insertions, the study limitation is logistics for data collection, given the wide variability in the procedure length, the non-inclusion of reprocessed permanent materials and X-ray examination for composition of costs. It is worth mentioning that the results are just a parameter that does not allow generalization, as the costs vary according to the company that supplies the material and type of catheter as well as remuneration of the human resources of the institution involved.

Contributions to nursing

It was found that estimating the costs of procedures is vital to identify the real demands, make feasible estimates and support the development of protocols with minimization of costs, always focusing on patient safety. Also, it is important that nursing professionals develop knowledge about the costs of care provided to optimize resources and support negotiations in different deliberative instances, from managers to funding sources, ensuring quality of care.

CONCLUSIONS

The average direct cost for PICC insertion in adult inpatients corresponded to US$286.04 (100%), US$259.81 (90.8%) with material and US$26.22 (9.2%) with hand constructions. Moreover, the average care time spent by nurses was 50 minutes per procedure, with great variation due to the specificity and severity of patients assisted by the institution.

PICC has been widely used as the central venous access of choice worldwide and in several specialties. Knowledge about the time spent, the amount and costs of resources involved in their insertion are essential in foundation of care, educational and managerial actions, such as elaboration of protocols and adequate sizing of materials and professionals.

Thus, it is essential to produce new studies about the entire process, in order to expand the knowledge obtained, provide patients with quality evidence-based care and collaborate to recognize nursing care costs throughout the health system.

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