RESEARCH

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Technological innovation for peripheral venipuncture: ultrasound training

Inovação tecnológica para punção venosa periférica: capacitação para uso da ultrassonografia
La innovación tecnológica para la punción venosa periférica: capacitación para el uso de la ecografía

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ABSTRACT

Objective: to evaluate the training of nurses in the use of ultrasound in peripheral venipuncture. **Method:** descriptive research of quantitative approach performed with nurses as part of an analytical cross-sectional study in two patient care centers: an intensive care unit and an adult emergency center. **Results:** the results showed contributions of training for professional skill and visibility of nurses, requiring, however, more time for complete assimilation of this technological innovation as a safer clinical practice. **Conclusion:** as the use of this technology represents an innovation aimed to facilitate difficult venipuncture and to provide subsidies to the most appropriate clinical decision-making, it is urgent to qualify nurses for its use.
Descriptors: Evidence-based Nursing; Technology; Training; Ultrasound; Peripheral Catheterization.

RESUMO

Objetivo: avaliar a capacitação dos enfermeiros para o uso da tecnologia da ultrassonografia na punção venosa periférica. **Método:** pesquisa descritiva de abordagem quantitativa, realizada com enfermeiros como etapa de um estudo transversal analítico em dois centros de atendimento ao paciente crítico: uma unidade de terapia intensiva e uma unidade de pronto atendimento adulto. **Resultados:** os resultados demonstraram contribuições da capacitação na habilidade e visibilidade profissional dos enfermeiros, com necessidade, entretanto, de maior tempo de vivência e aprendizado dos participantes para o domínio e assimilação desta inovação tecnológica enquanto prática clínica mais segura. **Conclusão:** na medida em que o uso desta tecnologia representa uma inovação destinada a facilitar o procedimento de punção venosa de difícil acesso e prover subsídios à tomada da decisão clínica mais adequada para cada paciente, faz-se premente à enfermagem capacitar-se para o seu uso.
Descritores: Enfermagem Baseada em Evidências; Tecnologia; Capacitação; Ultrassonografia; Cateterismo Periférico.

RESUMEN

Objetivo: evaluar la capacitación de enfermeros para el uso de la tecnología de la ecografía en la punción venosa periférica. **Método:** estudio descriptivo con enfoque cuantitativo realizado con enfermeros como una etapa de un estudio analítico transversal en dos centros de atención a pacientes en estado crítico: una unidad de cuidados intensivos y una unidad de emergencia para adultos. **Resultados:** los resultados mostraron contribuciones de la capacitación en las habilidades y la visibilidad profesional de los enfermeros. Sin embargo, se necesita más tiempo de experiencia y de aprendizaje de los participantes para alcanzar el dominio y asimilar esta innovación tecnológica como una práctica clínica más segura. **Conclusión:** en la medida en que el uso de esta tecnología es una innovación para facilitar el procedimiento de punción venosa de difícil acceso y proporcionar subsidios para tomar la decisión clínica más adecuada para cada paciente, la capacitación de la enfermería es urgente para utilizar tal tecnología.
Descriptores: Enfermería Basada en la Evidencia; Tecnología; Capacitación; Ecografía; Cateterización Periférica.

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INTRODUCTION

Intravenous therapy is present in everyday clinical practice, one of the most used nursing interventions, and 70% of hospitalized patients need, at some point, a venous access for its performance[1-2]. However, the access to the patient's venous network is, usually, a challenge of difficult transposition to the nursing professional, which results in pain and complications for the patient because of multiple puncture attempts[3-4].

In this context, studies suggest that the use of ultrasound during peripheral venipuncture (PVP) favors its performance, bringing many benefits; among them, more successful puncture attempts and reduction of complications[5-6]. This means greater safety for the patient and increase in the quality of the care provided.

Thus, the decision-making process for the adoption of new technologies in health care must be based on scientific evidences. It should be noted that, currently, Evidence-based Practice (EBP) is a strong trend in the field of health care, which governs both research and teaching and practice. Authors conceive EBP as one of the main competencies for decision-making, a fact which led to the reformulation of the undergraduate curriculum in Europe, aiming at training professionals with this competence[7].

In spite of the evidence strength produced on certain technologies available for development of practice, such benefits are only effectively put to use if the nurse responsible learn how to use them. Thereby, training is presented as an important tool for assimilation and implementation of new technologies in clinical practice.

We verify, therefore, that for the use of ultrasonography in peripheral venipuncture, the skill of the professional handling the ultrasound equipment is essential to achieve a satisfactory result[8], considering that professional skill is a factor of vulnerability for vascular trauma[9]. In addition, training and clinical experience are differentials in skill development for its implementation in a safe and effective way[10].

Learning new skills are, at the same time, challenges and stimulus for nurses to fulfill the learning curve and to incorporate innovations from research to practice. With the use of ultrasound, the main change in the procedure is the need to puncture with the eyes focused on the equipment monitor, and no longer on the catheter insertion site, which requires the development of a specific motor skill[11].

From the reflection and decision-making for the best evidence available, training, when nurses are qualified, provides the best conditions to guarantee quality and safety for individual care. Therefore, this study aimed to evaluate the training of nurses in the use of ultrasound in PVP.

METHOD

Ethical aspects

The present research was approved by the Research Ethics Committee of a federal university of southern Brazil and meets the ethical precepts of resolution no. 466/2012.

Study design, location, and period

This is a descriptive research, of quantitative approach, which is characterized as part of an analytical cross-sectional study to evaluate the effectiveness of ultrasonography in PVP, by comparing it to commonly employed traditional puncture procedure. The analysis was conducted in two centers, A and B, located one in the capital and the other in the metropolitan area of a city in southern Brazil. Center A corresponds to the intensive care unit of a private hospital of medium size; and center B corresponds to a serotherapy room of a public emergency center. Training was held in the months of November 2014 and April 2015, respectively.

Population, inclusion and exclusion criteria

The population is composed of nurses. Inclusion criteria were being a nurse with availability to participate in this research; as exclusion criterion, the refusal to participate in the research.

Study protocol

The training of nurses occurred in two stages. Initially, there was a lecture and dialogue, with duration of 60 minutes, in which the principles of ultrasound and theoretical knowledge related to ultrasound-guided PVP were addressed. Next, a specialist has developed a practical activity, in which nurses handled the ultrasound equipment and performed the PVP procedure with the specialist assistance. This stage lasted 4 hours. The puncture procedure was standardized among the participating nurses according to the literature[6].

After the training, each nurse filed a registration with professional and academic information (gender, age, level of education, field of expertise, time since graduation, period of service, professional practice environment, training school) and was rated regarding the competence to perform PVP with ultrasound, using previously established evaluation instrument, adapted from Moore[8]. Furthermore, we employed a training assessment instrument regarding the pedagogical practice, the methodology applied, and the content addressed. We employed a instrument already published and the criteria evaluated were: dissemination, planning, organization, choice of theme, content domain by the facilitator, adequacy of facilities, reproducibility, and applicability of the proposed subject; and periods of performance[12].

The group of nurses participating in the research in center B also participated in data collection of the aforementioned analytical cross-sectional study, when performing punctures according to the procedure indicated in simple randomization: for the group that underwent ultrasound-guided peripheral venipuncture (USPVP) or for the group that underwent peripheral venipuncture with the traditional method (TPVP).

Results and statistics analysis

Data gathered were tabulated with the aid of Microsoft Excel® and analyzed through descriptive statistics, carried out with the aid of Bioestat® program and Comprehensive R Archive Network® (CRAN). Data analysis considered the evaluation of competence of each nurse regarding the use of the technology under study, their training and professional experience, not classifying them, however, by levels of expertise[13]. For quantitative variables, we calculated measures of central

tendency and dispersion; for qualitative variables, frequencies and percentages. For performance analysis among nurses, we applied Chi-square and Williams' G-test on the primary outcome analysis; and Kruskal-Wallis in the secondary outcome analysis.

RESULTS

Fourteen nurses were trained: eight for center A and six for center B. Table 1 shows that both groups of nurses are predominantly female: in A, n = 7 (87.5%), and in B, n = 6 (100%). In both centers, nurses included were young adults: in center A, with a mean age equal to 28.5 ± 2.61 years; 50% with less than five years since graduation (average = 4.75 ± 1.48) and 62.5% with less than five years of professional experience in the hospital area (mean = 3.75 ± 1.83). In center B, the mean age was of 33.33 ± 3.20 years; 50% with more than five years since graduation (mean = 7.17 ± 2.91); and 66.67% with more than five years of professional experience in the hospital area (mean = 6.83 ± 2.91). None of them had experience with the use of ultrasound.

Table 1 – Demographic, academic, and professional profile of nurses participating in the training for the ultrasound-guided venipuncture

Participant (code)	Gender	Age (years)	Higher Education Institution	Period since graduation (years)	Period of hospital experience (years)	Competence evaluation score (USPVP)
A1	F	31	Private	4	1	100
A2	F	28	Private	6	6	100
A3	F	29	Private	3	3	100
A4	F	28	Private	7	2	100
A5	F	28	Private	5	5	92.4
A6	F	35	Public	6	6	96.25
A7	M	27	Private	4	4	100
A8	F	31	Private	3	3	100
B1	F	31	Private	3	3	100
B2	F	29	Public	5	4	100
B3	F	31	Public	5	5	100
B4	F	37	Private	10	10	100
B5	F	35	Private	10	9	100
B6	F	36	Public	10	10	100

Note: F = Female; M = Male; USPVP = Ultrasound-guided Peripheral Venipuncture.

The training of nurses of center A took place, mostly, in private higher education institutions (HEIs) with General Index for Programs (IGC) equal to three, n = 7 (87.5%). In center B, public HEIs were predominant, with IGC equal to four, n = 4 (66.67%). One of the HEIs attended by participants of this research presents IGC equals to four.

Of the eight nurses participating in center A, six (75%) have done a specialization course in the field of critical care. In addition, one of six nurses also have done a specialization course in the field of labor nursing. In center B, five of the six nurses (83.33%) have done a specialization course, of which three in the field of critical care (50%), one (16.67%) in obstetrics, and one (16.67%) in stomatherapy.

The mean of deployment of the groups trained for USPVP, based on the competency evaluation performed after this activity, was of 98.5% in the center and 100% in center B, being the lowest score equivalent to 92.4% (Table 1).

The instrument used for training evaluation was filled anonymously at the end. The total value of the instrument is of 45 points, distributed in nine items that allow assigning an evaluation opinion for each one of them, namely: bad, weak, average, good, and excellent (1, 2, 3, 4, and 5 points respectively).

The results of the training evaluation, as a pedagogical practice, presented a lowest score recorded (three) for items seven (reality reproducibility) and eight (applicability of the issue to the proposed reality). The mean overall score was 44 points, equivalent to 97.77% approval of the training performed, which added to the performance of the evaluators in competence evaluation suggests that this phase of the research achieved the objectives proposed.

In center A, the score for rated item showed little variation, with means between 4.5 and 5 points (maximum value of each item), being the greatest standard deviation equal to 0.75 points. Item seven presented the lowest mean (4.5), and received from one of the evaluators the score three (good). Also for this evaluator, item eight scored three as well. Both items, seven and eight, deal with reproducibility and applicability of the issue to the proposed reality.

In center B, the mean score for each item evaluated also presented variance from 4.50 to 5 points, with global mean of 43.17 ± 2.64 points (95.93% approval); the lowest score was 3 points (good) for item six (adequacy of facilities and training performance prototype), with a mean of 4.50 ± 0.71 points. Unlike group A, group B continued with the practice of USPVP.

From analysis of the data from Table 1, we verified that the period since graduation (up to five years and more than five years, p = 0.4743) and the time of experience working as a nurse (p = 0.4207) showed no association with the values of the scores obtained in the competence evaluation to USPVP. Similarly, we observed that for the education of nurses with more years of study (to held a graduate degree and achieve score 100) (p=1) (Fisher's Exact Test), or the school of origin (IGC 3 X 4) (p=0.2525) showed no statistically significant association with the score obtained in the competence evaluation.

Regarding the performance to execute USPVP, the results of the "nurse who performs the puncture" variable in center B showed that there was no statistically significant difference for the outcomes evaluated in this analytical cross-sectional study, namely, primary outcome: success on the first puncture attempt (p = 0.0427); and secondary outcome: time spent in performing

Table 2 – Distribution of variables related to peripheral venipuncture with success on the first attempt in each random group in center B

Variable	Global (n = 200)		USPVP (n = 97)		TPVP (n = 103)		*p* value
	nº	%	nº	%	nº	%	
Success at the first attempt(*)							0.005944
Yes	148	74.00	63	64.95	85	82.52	
No	52	26.00	34	35.05	18	17.48	
Nurse†							0.0427
B2	74	51.03	37	61.67	37	43.53	
B4	29	20.00	8	13.33	21	24.71	
B6	26	17.93	12	20.00	14	16.47	
B5	16	11.03	3	5.00	13	15.29	

Note: (*) = Fisher's Exact Test; † = Williams' G-Test; USPVP = Ultrasound-guided Peripheral Venipuncture; TPVP = Peripheral Venipuncture with the Traditional Method..

the procedure ($p < 0.0001$). Thus, in view of the different availability of nurses' participation in this research, we observed different amounts of procedures that each of them performed.

In this sense, the nurse B2, with higher frequency of USPVP performance, presented the best performance in the success of first attempts in such procedure (n = 37, 58.73% USPVP; n = 37, 43.53% TPVP) ($p = 0.0605$) (Table 2). On the other hand, nurses B1 and B3, for not often succeeding on the first puncture attempt in some groups, were not considered for the test statistic. The higher variations in success rates between both procedures evaluated were recorded for nurses B4 (n = 8, 12.69% USPVP; n = 21, 24.70% TPVP); and B5 (n = 3, 4.76% USPVP; n = 13, 15.29% TPVP).

Regarding time spent on procedure — considering the sample match between the analyzed groups provided by randomization, sample size, and different frequencies of performance of punctures that each nurse carried out —, we compared the performance of the nurses from center B using Kruskal-Wallis test, which showed statistically significant difference between them ($p < 0.0001$).

Therefore, in USPVP, the minimum time was observed for nurse B6 – 25 seconds; the maximum time for nurse B4 – 354 seconds; the mean was 95 ± 59 seconds and the median was 77 seconds. Therefore, in TPVP, the minimum time was observed for nurse B6 – 16 seconds; the maximum time for nurse B2 – 367 seconds; the mean was 61 ± 48 seconds and the median was 49 seconds.

DISCUSSION

The incorporation of technologies in nursing care must be based on scientific evidence of effectiveness, thus implementing EBP. However, a study points out that Brazilian nurses still have barriers for incorporating EBP in decision-making for individual care, and there is a need to train specific skills for a scientifically appropriate choice of assistance[14].

Furthermore, the incorporation of a new technology for care provision must prioritize the professional's skill in properly using it, in order to achieve the best possible results. In this sense, the training of professionals for the use of a new technology is essential. Authors reiterate that the encouragement of education and training of health professionals is an important strategy for the proper use of technologies[15], as well as point out that training in service and praxis before the incorporation of a technology are factors that influence the safety for health care performance[16].

The adoption of a technology promotes changes in the work process, which requires professional qualification[15]. Thus, the need for training arises at the very work environment, and requires the professional to be open, instrumentalization, and motivation for continuous learning and adaptability to changes[17].

The score achieved by nurses in the competence evaluation shows the suitability of the methodology and contents covered in the training, reiterated by the positive evaluation of the participants on these questions. In addition, it reflects the interests of nurses in training, which creates a favorable environment to the teaching-learning process and can be associated with learning and the effect of long-term training[18].

We highlight that a large number of nurses participated in training and some were outside their working hours. This fact can be related to the interests of professionals in incorporating technologies to care, allowing greater security in the performance of procedures and greater comfort to patients. The motivation to participate in trainings is greater when professionals see suitability and applicability to their work environment, as well as when they identify training as a possibility of professional growth[18].

The participants of this research's interests in evidence-based training for using a new technology can be related to their time of education (between three and 10 years) and to the participation in specialization courses. That is because EBP has been emphatically widespread in recent years. Furthermore, a study shows that the higher the professional education, the more positive the attitudes regarding the implementation of EBP in the clinical practice[19].

The lowest score recorded in the analyzed training evaluation (three) for items seven (reality reproducibility) and eight (applicability of the issue to the proposed reality) may reflect the challenge of assimilating new technology and the possible initial resistance of nurses to its introduction, before all attributions that it already has, especially in critical care environments[20].

Although the levels of expertise and competence acquisition are previously described in the literature[13], in this study we could not observe such relationship with the capacity for PVP with the use of the new technology in question among the participants. Furthermore, the low variability of these scores, along with the monitoring of the performance of the nurses from center B of this research indicates that for a proper evaluation of the development of skills and competencies, the adoption of procedural and continuous methods including the learning curve is necessary.

Thus, the analysis of the two groups of nurses showed that data regarding success on the first puncture attempt ($p = 0.0427$) and data regarding time spent with the procedure (p

< 0.0001) showed statistically significant differences between them, which is corroborated in previous publications[5-6,21].

Thus, we observed that the nurse with more experience in center B (B2) also showed higher rates of success on the first attempt and better performance with the use of ultrasonography in PVP (n = 37, 61.67% USPVP); (37, 43.53% USPVP) (p = 0.0427). Such data corroborate that the more familiar with the technology in use, the greater the benefit achieved by the health professional; therefore, the skill for ultrasound-guided venipuncture comes with practice[22].

In similar studies, authors stated that professionals with more than 20 insertions of ultrasound-guided peripheral catheters had almost twice success rate[18]. Records in the scientific literature considered suitable for the use of this technology nurses with 25 successful punctures[8]. Other authors have applied for a training period of four months to perform this procedure[11]; and there are records that proficiency is achieved after 25 puncture attempts, and one reaches competence after 50 procedures performed[23].

From such data, considering the period of data collection in center B (April 2015) as well as individual needs of each nurse, we verify that the mean number of puncture necessary for achieving skills and competencies related to USPVP is higher than that experienced by the participants of this analysis.

We highlight that EBP in Brazil has occurred more due to the motivation and interest of groups of professionals than due to national or institutional policies established by identified needs[24]. Hence, the use of EBP for incorporating technologies in clinical practice is a challenge to be transposed. An example is the dissemination of ultrasound use for PVP between the nurses, which is still incipient.

As a challenge, there is the elaboration of curricula comprising USPVP for the different levels of practitioners, aiming at minimizing complications related to this procedure[25]. Regarding the teaching of this procedure, search in literature shows that the learning process for the use of this technology has different audiences, mainly physicians and nurses, mostly inexperienced with the use of ultrasound, and who are usually inserted in institutional training programs or other long-term formal courses. It is organized in a fairly diverse way, with the duration of trainings ranging from one hour to one month for the theoretical stage and from 75 minutes to three days for the practical stage[26-27].

It should be noted, however, that is not always feasible to base the training for the use of such technology establishing numerical goals for acquiring such competencies, considering the particularities of each professional in the teaching-learning process[11].

Aiming at the adoption of safe practices to infusion therapy, authors recommend that nurses who perform the puncture use the puncture procedure that is more familiar to them. Thus, before the difficult venous access, inexperienced operators should attempt traditional puncture procedure, the jugular vein puncture, or consider the need of a central venous access, avoiding multiple attempts of ultrasound-guided puncture[21,28].

Limitations

The present research has as a limitation factor the short time of its duration, which did not allow evaluating the acquisition of competence for use of ultrasonography for peripheral venipuncture in the long term, or after a large number of punctures, as recommended in literature.

Contributions to the field of Nursing

As contributions to the Nursing practice, this research brings the disclosure of a new technology for peripheral venipuncture between nurses, which can contribute to increase the success in puncture attempts and also reduce the vascular trauma associated with punctures, considering that the professional has competence to use it. Thus, the training shows itself as an important tool that allows the use of technology in order to achieve the best results and ensure patients' safety. Besides, training for using ultrasound proved to be a way of empowerment of nurses and professionals and it can serve as subsidy for the deployment of this technology in hospital institutions.

CONCLUSION

The training conducted in this research contributed to skill development of the participating nurses, providing them visibility and empowerment within the multidisciplinary team. However, despite the high rate of deployment obtained in the competence evaluation, the results show that the time nurses have available for practicing and learning the procedure was possibly below the time required to achieve all the competencies related to USPVP.

To the extent that the use of this technology represents an innovation aimed to facilitate the venipuncture procedure of difficult access and to provide subsidies to the most appropriate clinical decision-making for each patient, it is urgent to qualify nurses for its use.

Furthermore, the best results in venipuncture attempts, to be achieved by the assimilation of this innovation in the everyday life of the care, contribute to the increased satisfaction of professionals and patients involved, impacting directly on quality and safety in health care. Therefore, in addition to the contributions arising from good Nursing schools and professional experience, curricula and training programs for the USPVP need to be stimulated, standardized, and monitored, aiming at ensuring professionals qualification and adopting best practices.

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