ORIGINAL ARTICLE

Improvement in Semiconductivity On The Measurement Of Blood Pressure After An Educational Intervention In Health Professionals

Cynthia Kallás Bachur,[1] Sarah Silva Candido,[1] Gerlia Bernardes Silveira,[1] Samantha Gurgel Oliveira Sousa,[1] Joao Hercos Neto,[1] Eugenia Velludo Veiga[2]

Universidade de Franca,[1] São Paulo, SP – Brazil
Escola de Enfermagem da USP/Ribeirão Preto,[2] Ribeirão Preto, SP – Brazil

Abstract

Background: Measuring blood pressure is a simple method, but it is subject to errors.

Objective: to evaluate the theoretical and practical knowledge of the steps of blood pressure measurement in health professionals, before and after the educational intervention.

Methods: The theoretical knowledge questionnaire on indirect blood pressure measurement was used to assess theoretical knowledge; to assess practical knowledge, the simulation strategy was applied in a standardized clinical setting and environment. The assessments were reapplied after one month. For data analysis, descriptive statistics were used.

Results: 30 health professionals from different categories; 19 of whom were males aged 41 ± 9.4 years and 11 were females aged 35 ± 9.5 years. Improvement was observed in most stages of theoretical and practical knowledge when compared to pre-and post-intervention, with an emphasis on the theoretical stages: "Position of the lower limbs" 2 (6.6%) x 16 (53.3%) and "Forceps with adequate position" 1 (3.3%) x 6 (20%). In the assessment of practical knowledge, it should be highlighted: "Do not speak during the measurement" 6 (20%) x 28 (93.3%) and in the "ideal size clamp" stage 0 (0%) x 5 (16.6 %).

Conclusion: The theoretical and practical knowledge on the stages of BP measurement by health professionals in this sample was insufficient. However, after the educational intervention, there was an improvement in the technique in most stages. (International Journal of Cardiovascular Sciences. 2020; [online].ahead print, PP.0-0)

Keywords: Blood Pressure; Measument Equipment; Sphygmomanometers; Stethoscppes; Hypertension; Knowledge; Questionnaires; Health Personal; Inservice Training.

Introduction

Systemic Arterial Hypertension (SAH) is characterized by high and sustained levels of blood pressure (BP), being a multifactorial clinical condition, as well as one of the most important risk factors for the development of renal, cardiovascular and cerebrovascular diseases.[1] There are about 17 million hypertensive Brazilians, 35% of the population aged 40 years or older. The number is growing and the disease manifests itself early. It is estimated that about 4% of children and adolescents are also carriers. The burden of disease represented by morbidity and mortality is very high and, for all this, it is a serious public health problem in Brazil and worldwide.[2] Approximately 49% of the Brazilian population is made up of adults and deserves an effective approach to cardiovascular risk assessment and primary preventive measures. Thus, it is essential to implement continuing education for health professionals regarding the appropriate BP measurement and care for patients with SAH.

Although the indirect method for measuring BP is simple, it is subject to errors that may be related to those who perform the measurement, the equipment

Mailing Address: Cynthia Bachur
Rua Alberto de Azevedo, 2020. Postal Code: 14405-281, Franca, São Paulo, SP - Brazil
E-mail: kabachur@gmail.com

DOI: https://doi.org/10.36660/ijcs.20190129

Manuscript received July 31, 2019; revised manuscript March 30, 2020; accepted April 17, 2020.

used, the sphygmomanometer and the stethoscope, the patient, the place (the doctor's office or outside it) and the technique itself.[3]

To assess theoretical knowledge on BP measurement, Machado et al.,[4] developed and validated a Theoretical Knowledge Questionnaire on Indirect Blood Pressure Measurement (Q-CTMIPA) for the population of nursing professionals in a Coronary Unit, contributing to the construction of evidence of this knowledge among different health professionals. This study evidenced the importance of training and promoting intervention on direct measurement of BP by health professionals, so that they can identify, evaluate and define assertive behaviors.

Given the above, the objective of this study was to evaluate the effects arising before and after an educational intervention on indirect BP measurement, with a single group of health professionals, in relation to their theoretical and practical knowledge.

Methods

This is a quasi-experimental study, developed at the Mobile Emergency Service (SAMU) located in a city in the interior of the state of São Paulo, in 2017.

The eligible population was SAMU health professionals and the sample was for convenience, regardless of gender or ethnicity. Professionals who expressed interest in participating in the pre-and post-educational intervention assessment were included.

The instrument used to assess theoretical knowledge on the steps of indirect BP measurement was the Q-CTMIPA,[4] composed by 7 questions related to the profile of the research participants (age, sex, time elapsed from the last training on BP measurement) and 20 questions related to the steps of indirect BP measurement, based on the 7th Brazilian Hypertension Guideline[2], with 15 open and 5 closed questions concerning patient preparation before BP measurement, conditions of the device for BP measurement and care with its accessories; care with patient positioning (arm height and position of legs); rigorous recording of values obtained and recommendations on calibration of the BP measuring device.

To evaluate the participants' practical knowledge on the indirect BP measurement procedure, the simulation strategy was applied, in a standardized clinical setting and environment. Realistic simulation, in an educational context, is an educational plot based previously on a created situation that allows people to experience the representation of a real event in order to practice, learn, test and understand systems or human actions.[5] To apply the instruments, three medical students participated in this study: an actor, an observer of the activities, and an analyst responsible for transferring the consultation data to the information system.

The actor waited for the participant in a room always sitting with his arms on his lap and with his legs crossed. The consultation started and the actor referred to a standardized history in which he/she denied symptoms of full bladder, food intake and consumption of alcohol, smoking or coffee. In addition, the patient denied long walks before the consultation and the use of continuous medication. The observer recorded performance aspects based on a checklist that followed the recommendations of the 7th Brazilian Hypertension Guideline,[2] divided into 4 stages: patient preparation and environment (9 items), patient position (8 items), measurement steps (4 items) and registration of values (8 items), totaling 31 items. The analyst (medical student) was able to identify, using the checklist, if the participant did not execute (0), performed incompletely (1), performed incorrectly (2) or performed (3) and, for each option, a value was considered using the Likert scale.

The practical evaluation was carried out in an isolated room, which became a realistic simulation of a doctor's office. The participant, the actor, the observer, the analyst, who fed the information system, in which he detailed the entire procedure using a checklist spreadsheet and could compare the results before and after the intervention, were in the room. After the first theoretical and practical evaluation, an educational intervention was carried out. During this intervention, the students of the medical course intervened actively in the mistakes evidenced by each participant regarding the steps of BP measurement, in addition to allowing the participant to clear their doubts on semiology. In addition, immediately after the intervention, each participant was given an educational booklet with information on the semi-technique of indirect BP measurement. The educational intervention continued with safe practical experience, based on scientific evidence and critical and reflective knowledge, aware of the reasons that underlie each of these stages. During the educational activity, the following topics were addressed:

Preparation of the patient and the environment: for the measurement, the environment must be calm and quiet, with the patient relaxed for 5 minutes before checking the BP, not talking during the procedure; check on bladder emptying, not having performed physical exercises, eating food, coffee or alcoholic beverages, and smoking.

Patient positioning: sitting position, legs uncrossed, feet flat on the floor, relaxed. The arm is always at heart level, free of clothes and supported, with the palm of the hand facing up and the elbow slightly flexed.

BP measurement steps: obtaining the brachial circumference and selecting the corresponding cuff; cuff over the brachial artery; Osler's maneuver to estimate systolic pressure by palpation of the radial artery; stethoscope positioning; insufflation of the cuff to obtain systolic BP 20 to 30 mmHg above the estimated; determination of systolic BP in the first Korotkoff sound; determination of diastolic BP to the disappearance of sounds.

Record of values: Record of values in millimeters of mercury (mmHg) without rounding and record of the arm used.

One month after the educational intervention was carried out, the same Q-CTMIPA instrument and the same methodology for assessing practical knowledge were reapplied in all participants, so it was possible to compare whether there was a change in relation to knowledge before and after the intervention.

This study was approved by the Human Research Ethics Committee, CAAE: 41876615.5.0000.5495, and all participants signed an informed consent form, in accordance with Resolution 466/12.

Statistical analysis

All information obtained during data collection was entered twice in a database using Microsoft Excel Software. Next, they were transferred to the statistical program STATA 9.0 for calculations of absolute and relative frequency. Descriptive statistics were used to synthesize the information and characterize the sample, with measures of central tendency (mean) and variability (standard deviation).

Results

Thirty health professionals from the Mobile Emergency Care Service (SAMU) participated in the study, 19 (63.3%) men and 11 (36.6%) women, with a mean age of 41 ± 9.4 and 35 ± 9.5 years, respectively. Among these health professionals were: Doctors, Nurses, Nursing Technicians, First Aid and Medical Regulation Assistant Technicians (TARM).

Regarding the level of education of the participants, only 1 (3.3%) had incomplete high school and 11 (36.6%) completed high school; 1 (3.3%) incomplete higher education and 14 (46.6%) had complete higher education; only 3 participants reported having a degree at the post-graduate level, of whom 2 participants (6.6%) had completed a lato sensu postgraduate course and 1 participant (3.3%) had a postgraduate master's degree.

Table 1 shows the frequency distribution of the responses referred to in relation to the last formal training on indirect BP measurement.

The assessment of theoretical knowledge before and after the educational intervention, in health professionals, using the Q-CTMIPA instrument, are shown in Table 2, with the percentage of correct answers according to each step of the procedure.

According to the answers pointed out in each step of the procedure, some of them expressed a lack of theoretical knowledge of the participants, with emphasis on "Recommended position for the upper limb", "Calibration conditions of the device" and "Ideal clamp size in relation to the patient's upper limb". The other items in question presented a remarkable improvement in knowledge after the educational intervention.

In order to characterize the practical knowledge on the sequential stages of the indirect measurement of BP before and after the educational intervention, health professionals were evaluated through a simulation exam, using a checklist for verification. Table 3 presents the results pointed out according to each step performed.

The results of the practical evaluation indicated gaps in the "Steps of measurement", since "obtaining the circumference of the patient's arm" and "selection of the clamp of adequate size" presented lower scores compared to all other items, resulting in a small improvement after educational intervention. However, the "Patient position" stage was characterized by better performance in the pre- and post-intervention phases.

Discussion

The study found an improvement in all evaluated items, both in the theoretical and practical questionnaires. However, a limitation of the intervention was observed in the following parameters: "Recommended position

Table 1 – Distribution of the frequency of responses indicated regarding the last formal training on indirect BP measurement, by health professionals (n = 30), in 2017.

Questions	Yes		No	
	n	%	n	%
The training was satisfactory	28	93.3	2	6.6
Received training only during the course	24	80	6	20
Last training time less than 6 months	0	0	30	100

Source: the authors.

Table 2 – Distribution of the frequency of the number of correct answers among the health professionals on the steps of indirect BP measurement, based on the adapted Q-CTMIPA, (n = 30), in the theoretical assessment, performed in 2017.

Steps of the BP measure	Pre-intervention		Post-intervention	
	n	%	n	%
Preparation of patient				
Mentioned asking questions to the patient before measuring their BP	4	13.3	14	46.6
Mentioned resting of at least 5 minutes	4	13.3	14	46.6
Mentioned recommended position for upper limb	0	0	2	6.6
Mentioned recommended position for lower limbs	2	6.6	16	53.3
Preparation of the environment				
Reported the ideal environment to carry out the BP measurement	1	3.3	7	23.3
Care with the device				
Referred to the calibration conditions of the automatic device	0	0	0	0
Agreed that clamp of inappropriate size can influence values	29	96.6	30	100
Considered removing from use armband structure and extensions with any problems/damage	2	6.6	7	23.3
Referred to the calibration period of the automatic device	7	23.3	13	43.3
Values obtaining and recording				
Referred to the ideal size of the cuff according to the patient's upper limb	0	0	1	3.3
Agreed that it is possible to obtain different BP values between the patient's right and left upper limb	28	93.3	29	96.6
Considered different BP values between the right and left upper limbs	9	30	10	33.3
Considered the position of the cuff on the patient's upper limb	1	3.3	6	20
Agreed that it is important to record the limb used to measure BP	28	93.3	28	93.3
Allowed 1 minute interval between two measurements	6	20	16	53,3
Considered the recording of BP values in millimeters of mercury	29	96.6	30	100
Considered the recording of BP values without rounding	13	43.3	20	66.6

n = number of correct answers.
Source: authors.

Table 3 – Distribution of the number of correct answers on the steps of BP indirect measurements, based on the role-play, among health professionals (n = 30), in the practical evaluation, performed in 2017.

Steps of the BP measure	Pre-intervention		Post-intervention	
	n	%	n	%
Patient preparation and environment				
Explained the procedure to the patient	25	83.3	30	100
Allowed the patient to rest for at least 5 minutes in a calm environment	8	26.6	16	53.3
Provided a calm and quiet environment	29	96,6	30	100
Oriented the patient not to talk during the measurement	6	20	28	93.3
Made sure that the patient was not with full bladder	4	13.3	13	43,3
Certified that the patient did NOT exercise in the previous 60 minutes	13	43.3	27	90
Certified that the patient did NOT drink alcohol in the previous 30 minutes	8	26.6	26	86.6
Certified that the patient did NOT drink coffee in the previous 30 minutes	4	13.3	16	53.3
Certified that the patient did NOT smoke in the previous 30 minutes	9	30	21	70
Patient position				
Kept sitting in a relaxed position	30	100	30	100
Kept his/her back on the chair	18	60	30	100
Kept legs uncrossed	16	53.3	29	96.6
Kept feet flat on the floor	15	50	28	93.3
Removed clothes from the arm to put the cuff on	20	66.6	29	96.6
Positioned arm at heart level	26	86.6	30	100
Kept his/her arm supported	26	86.6	30	100
Kept his/her palm upside down	26	86.6	30	100
Kept his/her elbow slightly bent	26	86.6	30	100
Measuring steps				
Obtained the circumference of the patient's arm	0	0	1	3.3
Selected the right size arm cuff	0	0	5	16.6
Placed the cuff without leaving clearances 2 to 3 cm above the cubital fossa	28	93.3	30	100
Centered the middle of the compressive part of the armband over the brachial artery	29	96.6	30	100
Registration of securities				
Recorded systolic / diastolic values	24	80	30	100
Waited 1 to 2 minutes for new measurements	9	30	27	90
Reported the BP values obtained for the patient	29	96.6	30	100
Noted the BP values obtained without rounding	4	13.3	16	53.3
Recorded member on which BP was checked	6	20	20	66.6
Checked whether the time between the recordings was less than 5 min	30	100	30	100
Recorded values in mmHg	18	60	24	80
Kept silent during the procedure.	7	23.3	29	96.6

n = number of correct runs.
Source: authors.

for the upper limb", "Instrument calibration conditions", "Ideal clamp size in relation to the patient's upper limb", being the greatest deficiencies observed in the "obtaining of the circumference of the arm of the patient" and the "selection of the clamp of suitable size" results.

The position of the upper limb during BP measurement is of great value for the veracity and accuracy of the measurement obtained. When the arm is hyperinduced along the axis of the body, the pressure is lower than the intra-arterial pressure measured directly, and that decreases with abduction of the arm. In addition, the same study states that, depending on the type of chair, armchair or patient's own posture, muscle tension can cause changes in BP measurements. F, the patient should be relaxed with his/her back supported on the back of the chair.[6] It is evident, therefore, that the patient's position and the arm supported at the height of the heart with the palm facing upwards are indispensable for a good evaluation of BP by indirect measurement. Thus, it is clear that the approach used for this issue needs to be modified so that more reliable indirect BP measurements can be obtained in the future.

The reference to adequate calibration time of the BP measurement device was correctly made by only 23.3% of the professionals in the pre-intervention stage and, in the post-intervention stage, by 43.3%. These evidences are based on a study on the evaluation of the conditions of the use of sphygmomanometers in health services, which revealed that most respondents (76.6%) did not know how often the aneroid apparatus should be calibrated.[7] It is also worth noting that 0% of the participants knew how to evaluate the calibration of the automatic devices because they were not available in the institution. Therefore, since there is a current tendency to replace aneroid devices by automatic devices, it would be extremely important that trainings are carried out in order to prepare professionals to deal with this novelty.

Inadequately sized sleeves result in incorrect BP measurements. Tiny cuffs used to measure BP in people with a larger than expected waist circumference overestimate the diagnosis of hypertension, whereas larger cuffs underestimate BP readings.[8] One study showed that approximately 97% of practitioners do not check the appropriate measures given by the formula "Correct width cuff = 0.40 x Arm Circumference / Sleeve Width".[9] This same situation was observed in 83.8% of the participants, who did not measure the brachial circumference, and were completely unaware of the purpose of the measurement.[3] Thus, it can be inferred that providing adequate cuffs is essential to achieve BP measurements closer to the theoretical ideal.

Despite the gaps identified during the theoretical and practical evaluation of the BP measurement steps, the number of correct answers was lower during the pre-intervention stage, with a significant improvement in the post-intervention period. A survey conducted at the University of Mississippi compared the measurements acquired by current medical professionals with professionals trained by the American Heart Association and found a difference in SBP of 5.66 mmHg and a decrease in DBP of -2.96 mmHg.[10] The study reinforces our data and suggests that periodic training favors the adequate measurement of BP even though all of these professionals have already been trained.

In Minas Gerais, researchers[11] applied a simulation training strategy for health professionals on the management of patients with acute coronary syndrome and observed an impact on the acquisition of knowledge and confidence of the learners using the training model. This study reinforces evidences of a positive impact of realistic simulations on performance.

In fact, with the educational intervention, we noticed an improvement in the BP measurement technique. Providing specific training after the training of professionals is required for their updating and for the proper functioning of the institution.

The study carried out presented limitations regarding the small sample size, which allows for considering the results found only for the population in question.

Conclusion

Based on the results of this study, it is possible to note that both theoretical and practical knowledge of health professionals on the stages of BP measurement was insufficient. In general, the professionals presented gaps regarding the accomplishment of the "Measurement steps", especially when "obtaining the circumference of the patient's arm" and "selecting the appropriate size cuff" in the pre-intervention assessment. However, the educational intervention had a positive influence and brought improvements in relation to the knowledge gaps presented. Educational strategy plans should be carried out, with institutional actions aimed at the permanent training of all professionals, with an emphasis on detailing the correct and effective performance of each procedure performed in the process of patient care.

Author contributions

Conception and design of the research: Bachur CK. Acquisition of data: Silveira GB, Sousa SGO, Hercos Neto J. Analysis and interpretation of the data: Candido SS. Critical revision of the manuscript for intellectual content: Veiga EV.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the *Universidade de Franca* under the protocol number 41876615.5.0000.5495. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

References

1 Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Hipertensão arterial sistêmica para o Sistema Único de Saúde. Brasilia;2006.p.11.

2. Malachias MVB, Souza WK, Plavnik FL, Rodrigues CIS, Brandão AA, Neves NFT, Sociedade Brasileira de Cardiologia. VII Diretriz Brasileira de Hipertensão Arterial. Arq Bras. Cardiol. 2016; 107(3Suppl 3):7-13.

3. Gusmão JL, Raymundo AC, Campos CL, Mano GP, Alencar NP, Silva JS, et al. Fontes de erro na medida da pressão arterial: papel do esfigmomanômetro e do observador. Rev Hipertens. 2011;14(2):33-44.

4. Machado JP, Veiga EV, Ferreira PC, Martins JCA, Daniel AC, Oliveira AO, et al. Conhecimento teórico e prático dos profissionais de Enfermagem em unidade coronariana sobre a medida indireta da pressão arterial. Einstein, 2014;12(3):330-5.

5. Rabelo L,Garcia VL. Role-Play para o Desenvolvimento de Habilidades de Comunicação e Relacionais. Rev Bras Educ Méd. 2015;39(4):586-96.

6. Araujo TL, Arcuri EAM. Influência de fatores anatomo-fisiológicos na medida indireta da pressão arterial: identificação do conhecimento dos enfermeiros. Rev Latino-Am Enf. 1998;6(4):21-9.

7. Serafim TS, Toma G, Gusmão JL, Colósimo FC, Silva SS, Pierin A. Avaliação das condições de uso de esfigmomanômetros em serviços hospitalares. Acta Paul Enf. 2012; 25(6):940-6.

8. Freitas CCQ, Pantarotto FF, Costa LR. Relação circunferência braquial e tamanho de manguitos utilizados nas Unidades Básicas de Saúde de uma cidade do interior paulista. J Health Sci Inst. 2013; 31(3):48-52.

9. Veiga EV, Arcuri EM, Cloutier L, Santos LF. Medida da pressão arterial: circunferência braquial e disponibilidade de manguitos. Revista Latino-Am Enf. 2009 jul/ago;17(4)

10. Minor DS, Butler Jr K, Artman K, Odair C, Wang W, McNair V, Wofford M, et al. Evaluation of blood pressure measurement and agreement in an academic health sciences center. J Clin Hypertens (Greenwich). 2012;14(4):222-7.

11. Souza-Silva MVR, Fortes P. Implementation of an Acute Coronary Syndrome Simulation Training Strategy for Emergency Health care Professionals. Int J Cardiovasc Si. 2019;32(3):227-37.