www.sciencedirect.com/journal/journal-of-vascular-nursing

Interventional procedures in cardiovascular diseases—Training of nurses to work in a catheterization laboratory

Irinka Atanasova Hristova, PhD, Despina Prodanova Georgieva, PhD, and Greta Velikova Koleva, PhD

Cardiovascular diseases remain the most frequent reason for deaths in the Republic of Bulgaria and also in Europe for 2016. A large number of deaths in Bulgaria could be prevented via an effective health-care system and quality health services. The fast rate at which catheterization laboratories expand throughout the Republic of Bulgaria imposes the necessity of trained nurses in the field of interventional cardiovascular diagnostics and therapy. A postgraduate nursing training was conducted to help nurses acquire competencies for working in a catheterization laboratory. This study involved development and realization of a primary training program for nurses to work in catheterization laboratories, a didactical test for assessing the knowledge of nurses before and after the course, and a questionnaire for understanding nurses' opinion of the necessity of training and their satisfaction from taking part in the training course. An unsatisfactory level of knowledge was determined among nurses before participating in the course. In addition, significantly higher scores were obtained for skills and knowledge in the assessment conducted after the training process. (J Vasc Nurs 2018;37:144-149)

Cardiovascular diseases (CVDs) are the leading reason for death all around the world.[1] According to the "Annual Report of the Citizen's State of Health and the Performing of the National Health Strategy 2020 for 2016", the Republic of Bulgaria remains one of the countries with the highest standardized quotient of death rate (883.86%) in the European Union (EU). (The average standardized quotient of death rate for the EU is 559.85%).[2] The death rate due to CVDs, which remain the most frequent reason for deaths in Europe, was 45% of all deaths in the Republic of Bulgaria in the year 2016, of which 49% were among women and 40% among men. According to the data of the National Center for Public Health and Analyses, Bulgaria stands first in deaths caused by CVDs for the year 2016.[3] A total of 5963 people in Bulgaria were diagnosed with myocardial infarction in the first six months of 2016, and 13.6% of them have died (National Center for Public Health and Analyses). According to the current data of the National Statistics Institute for the year 2017, 110,000 people in Bulgaria have died, and approximately 72,000 of them (65%) were due to blood circulation diseases, which puts this type of mortality in the leading position.[4] The most common reason for mortality in the EU is again heart attack because approximately 180,000 deaths from this category could have potentially been prevented, as suggested by the Eurostat data.[5] Data from a Eurostat analysis, concerning the so-called preventable deaths in the EU for 2016, show that somewhat more than 40% of the deaths in Bulgaria could have been prevented by an optimal health-care service and would not have even occurred if there had been an effective health-care system and quality medical services and technology.[6] The interventional percutaneous procedures are proven to be financially more effective than the well-known surgical methods of treatment for CVDs. For patients with cardiogenic shock and those who need hemodynamic assistance, percutaneous procedures that help the cardiovascular system could be used in an earlier phase, which leads to better results, a shorter stay in the hospital, and lower financial expenses for treatment than the traditional alternative, surgical intervention.[7]

The growing diagnostic and therapeutic value of the interventional procedures for patients with CVD creates challenges for both education and preparation of nurses to work in this highly specialized field. With time, interventional coronary procedures have increased in number and complexity. This trend leads to a greater necessity of economical and human resources, among which nurses are the most needed ones.[8]

From the Chief Assistant Professor, Ruse University "Angel Kanchev", Department of Health Care, Faculty of Public Health and Health Care, Ruse, Bulgaria; Associate Professor, Ruse University "Angel Kanchev", Department of Health Care, Faculty of Public Health and Health Care, Ruse, Bulgaria; Chief Assistant Professor Ruse University "Angel Kanchev", Department of Health Care, Faculty of Public Health and Health Care, Ruse, Bulgaria.

Corresponding author: Irinka Atanasova Hristova, PhD, Department of Health Care, Ruse University, Ruse, Bulgaria (E-mail: ihristova@uni-ruse.bg).

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest: The authors declare that there is no conflict of interest.

1062-0303/$36.00

https://doi.org/10.1016/j.jvn.2018.12.001

In just five years, from the beginning of 2010 to 2014, the number of hospitals in the Republic of Bulgaria that receive finances from the National Health Fund for clinical procedures in invasive cardiology has increased from 33 to 50. Until the beginning of 2016, the total number of clinics for invasive cardiology in Bulgaria was 71.[9,2] In a short time, wards for invasive cardiovascular diagnostics have repeatedly increased in number, which imposes the redirection of medical teams for working in catheterization laboratories (Cath Labs) from cardiologic facilities for noninvasive diagnostics and therapy. The fast rate of expansion of high-tech clinics for invasive cardiology in practice demands an adequate response from universities to provide medical staff. In 2014, a basic European program for continuing professional development in a laboratory of cardiac catheterization for nurses and associated health-care professionals was implemented. The aim of the program is to form a solid educational basis in Europe.[10]

In Bulgaria, in the program *Goals for Health 2020*, measures are offered for the development elaboration of the system for training and qualification, which guarantees the quality of medical help via actualization of the curriculums in the universities, aimed at extending the practical skills of the medical professionals, with priority to the basic health problems and contemporary technologies in health care; elaboration in the process of specialization of the health-care staff; progress of the system for continuing medical training; and increase of control and responsibility of the professional organizations of medical specialists in organizing and conducting the training process. As per regulation 34 (regulation no.: 34, 2006), the doctors in Bulgaria who work in invasive laboratories should acquire specialty and professional qualification in invasive cardiology; however, no such requirement on professional qualification of nurses is provided in this regulation. They obtain the necessary skills and competencies after they start working in that field.

Only two courses for specialized training in invasive diagnostics and treatment of CVDs have been found while analyzing the postgraduate training of nurses in Bulgaria. In a plan for continuing training of nurses, midwives, and associated medical specialists for 2017, only the Ruse University "Angel Kanchev" and the Medical University of Sofia offer a training program on invasive cardiovascular diagnostics.

The increasing number of Cath Labs results in the necessity of training health-care professionals and providing adequate response to the search for well-prepared staff. This trend imposes organization of specialized primary preparation of nurses to work in a Cath Lab, such as continuing training courses, postgraduate training, and free optional discipline, which is studied during the basic education.

The roles and responsibilities of the nurses who work in a Cath Lab are extremely specific and typical for the nature of this work. A lack of a training process, gain of required skills and knowledge only while working in the field, and the nonexistence of related competencies in the regulation for nurses' professional activities were reported in an analysis of educational documentation, curriculum for training of nurses, and regulation no. 1 (Ordinance on the Unified State Requirements for Higher Education in the "Nursing" and "Midwifery" specialties for the Bachelor's degree ", 2016) (Ordinance No 1, 2011).[11,12]

THE STUDY

Aim

The aim of this research is to prove the effectiveness of postgraduate training in providing specific knowledge, skills, and competencies for working in a Cath Lab.

MATERIALS AND METHODS

A plan for postgraduate training titled "Nursing Care and Activities in Interventional Cardiology" was worked out. The course is designed for training nurses. The duration of the training is 31 academic hours in total, spread over 5 consecutive days. Its content is structured in two modules—a theoretical one and a practical one. The theoretical module covers topics such as anatomic features of the cardiovascular system, specific equipment used in different invasive cardiovascular procedures, basic diagnostic and therapeutic methods used in invasive cardiology, and safety in working with X-rays in a Cath Lab. The practical module covers topics such as a practical preparation for performing special nurse care and activities in a Cath Lab, surgical hand preparation and putting on operational attire, preprocedural preparation of the patient and observation of the patient during and after the procedure, and partnership in a multidisciplinary team for invasive cardiovascular diagnostics. To prove the effectiveness of the training program, a didactic test for assessing the level of knowledge at entry and exit points of training was developed. In addition, 5 protocols, which were borrowed from Georgieva D,[13] were worked out for pedagogical observation of skills. A questionnaire for obtaining the nurses' opinion of the necessity of training and their satisfaction in taking part in the training course was also developed.

Methods used

- Documentary method: analysis of literature sources, research of regulations, medical documentation, and educational documentation, which includes curriculums and programs for nursing specialty;
- Sociological method: a survey;
- Pedagogical method: a test and observation;
- Statistical method: mathematical and graphical analysis of the obtained data using the statistical package SPSS, version 16.

Realization of the training process

The course was conducted in association with the Ruse University "Angel Kanchev" and the Bulgarian Association of Healthcare Professionals. The participating nurses are practitioners in the University Hospital for Active Treatment, Medica Ruse, and in a specialized hospital for active treatment in cardiology, Medica Cor Ruse. Fifty nurses took part in the training course, and 9 of whom work in a Cath Lab. The remaining 41 of them work in wards for vascular surgery, cardiology, and neurology. The lecture course was held in Ruse University "Angel Kanchev," and the practical module, in a Cath Lab of the University Hospital for Active Treatment, Medica Ruse.

RESULTS

Professional characteristics

A total of 50 nurses took part in the postgraduate training course titled "Nurse's Care and Activities in Interventional Cardiology." Eighteen percent of the nurses work in a Cath Lab as

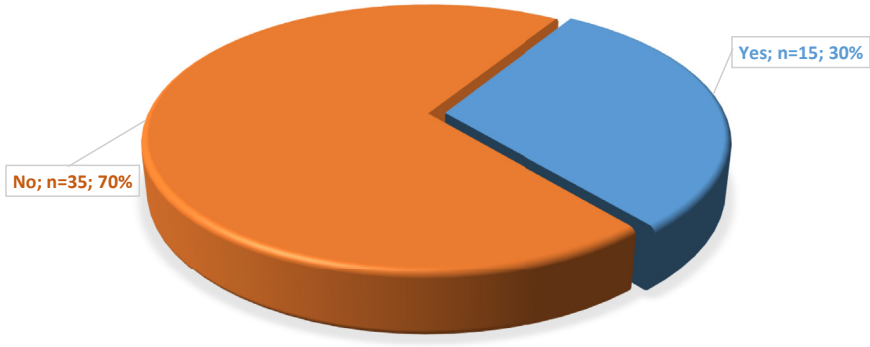

Figure 1. *Intention to work in a Cath Lab. Cath Lab = catheterization laboratory.*

part of invasive cardiology and invasive vascular diagnostics wards. The remaining 82% of nurses work in wards of vascular surgery, cardiology, and neurology. Research interest provokes participants to start working in a Cath Lab (Figure 1).

Most of the respondents (70%) said no, and just 30% responded with a yes when asked whether they have intention to work in a Cath Lab. From this, one may conclude that most participants in the training program do wish to enrich their medical knowledge without intending to work in such a field.

Knowledge before and after the training process

The results concerning the information source for the nurses working in a Cath Lab are graphically described in Figure 2.

Almost half of the respondents (48%) state that they were informed of their work in a Cath Lab mostly by the nurses and doctors working in a Cath Lab, whereas just 7% of them state that they were informed during their basic training. Most respondents (45%) had received no information on the subject before training. It makes an impression that none of the nurses has pointed out the other possible information sources: postgraduate training courses and self-preparation via studying Bulgarian and foreign literature.

There is no specialized literature for nurses in the Bulgarian language, which, therefore, does not allow for self-study. The lack of literature in the Bulgarian language makes it difficult to acquire information in a particular medical field. Results indicate that the main source of information regarding the roles and responsibilities of nurses working in a Cath Lab is the nurses and doctors working in this field.

To assess the level of knowledge at entry before training and baseline knowledge after training, a didactical test was used, with identical content (Figure 3).

The test was given to all participants before and after the training process. The results from the control analysis conducted at entry level show that more than half of the respondents have scored poor (2; 54% of them; n = 27); 12% (n = 6) fair (3); 8% (n = 4) both good (4) and very good (5); and 18% (n = 9) excellent (6). The data show the lack of necessary knowledge and primary skills to work in a Cath Lab. A dissatisfactory level of knowledge was determined in more than half of the nurses.

The analysis of the results from the test for baseline level of knowledge after training shows much higher marks—30% (n = 15) of the trained nurses have scored excellent (6); 28% (n = 14) both very good (5) and good (4); and just 14% (n = 7) fair (3). No nurse with a level of knowledge below the minimal required level of competence was reported in the test for assessment of initial knowledge after training.

The comparative analysis of both entry and baseline tests shows that course participants have increased their knowledge.

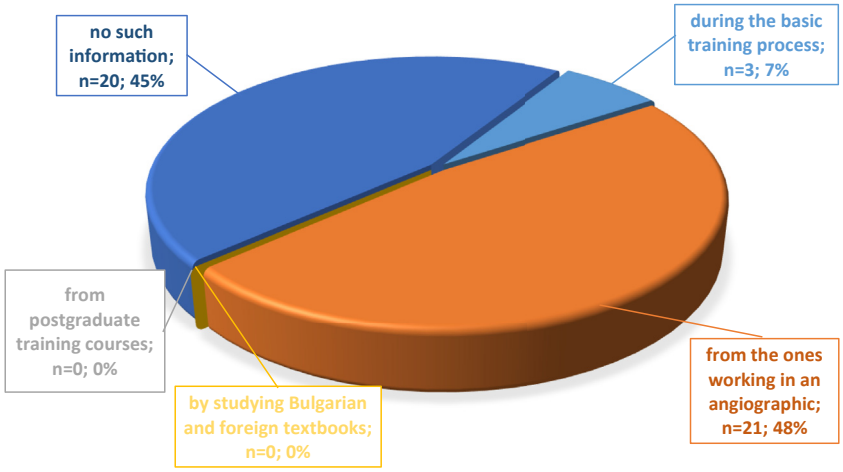

Figure 2. *Information source concerning the nurses' work in a Cath Lab before the postgraduate training course. Cath Lab = catheterization laboratory.*

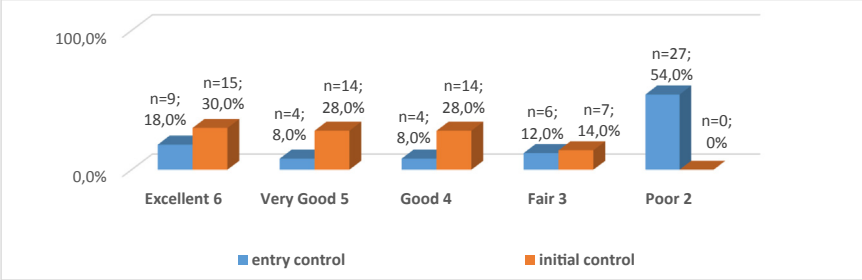

Figure 3. *Test results before and after the course.*

The trustworthiness of this difference was proved using Pearson's criterion. The marks are shown in Table 1.

In this case, we formulated a zero hypothesis that no particular changes have occurred in the participants' knowledge after the postgraduate training course. The hypothesis was tested for acceptance or rejection in accordance with the classical procedure.[14]

As for the empiric characteristics, by using Pearson's formula, we obtained $\chi_e^2 = 39.7$. The theoretical characteristics, $\chi_T^2 = 11.14$, were determined using a data table with the relevant theoretical distribution with a risk of error a = 0.05 (P = 95%), a bilateral critical field (a − 0.025), and degree of freedom $k = (r - 1) \times (c - 1) = (2 - 1) \times (5 - 1) = 4$, where r stands for the number of rows in the data table and n stands for the number of columns in the same table. One can easily see that the χ_e^2 value is high, and therefore, the zero hypothesis is rejected, that is, statistically significant alterations in the nurses' knowledge are apparent at the end of the course.

The respondents claim that the conducted course has definitely contributed to the nurses' higher awareness and skills. The results from the conducted control analysis unambiguously show that the participants in the course have achieved the primary knowledge and competence needed, from which we may conclude that the training process has been effective.

Five protocols were used for pedagogical observation of specific skills obtained from the practical training. Summarized information of the analysis of results is shown in Figure 4.

At the end of the practical module, all participants' skills in the subject were rated. Twenty-four percent of nurses were rated excellent, 22% very good, 40% good, and 14% fair. No nurse was rated below the minimal required level of competence.

Satisfaction from the training process

All respondents (100%; n = 50) gave positive answer when asked about their satisfaction from the conducted postgraduate training course. All of them gave positive opinion regarding their satisfaction from their participation in the conducted postgraduate training course.

The trainee nurses state that they would happily take part in another such course, aiming to update their knowledge and find out about new developments in the subject.

An opportunity for recommendations was provided at the end of the questionnaire. The following suggestions were provided by the participants:

- annual organization of courses for training in this field;
- providing Bulgarian literature that covers the topics in the course;
- more classes in the practical module;
- providing more information on new developments in the subject.

CONCLUSIONS

From the conducted study and the researched opinion on the necessity of conducting continuing training, as well as the participant nurses' satisfaction from the course, the following conclusions can be made:

1. The reported difference in the level of knowledge of the participants before and after the training for working in a Cath Lab shows the effectiveness of the conducted training and its benefit in staff realization and retention.
2. The poor results for some of the questions in the initial evaluation direct the research team to optimize the training

TABLE 1

MARKS FROM THE ENTRY AND BASELINE CONTROL ANALYSES

Control test	*Excellent, 6*	*Very Good, 5*	*Good, 4*	*Fair, 3*	*Poor, 2*	*Total*
Entry test	n = 9 (12)	n = 4 (9)	n = 4 (9)	n = 6 (13.5)	n = 27 (13.5)	50
Initial test	n = 15 (12)	n = 14 (9)	n = 14 (9)	n = 7 (13.5)	n = 0 (13.5)	50
Total	24	18	18	13	27	100

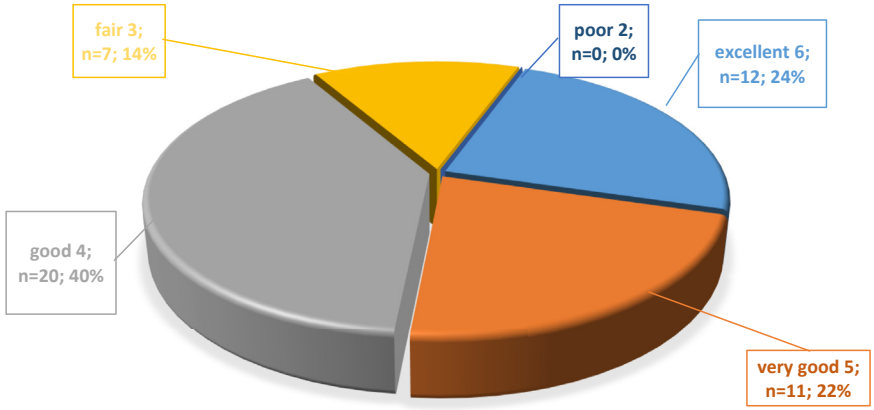

Figure 4. *Marks from the protocols for assessing skills after the training.*

process and upgrade the course modules in future, as well as to increase the number of lessons for practical training.
3. Publication of specialized literature for nurses in the Bulgarian language would ease the training and self-preparation of those who wish to enrich their medical knowledge.
4. Annual organization of postgraduate training courses is welcomed by the medical circle.

Specific knowledge, skills, and competencies required after graduation from the university are acquired and improved by the health-care professionals taking part in postgraduate training. From 2016, postgraduate training has been made compulsory in the Republic of Bulgaria and is being regulated with a change in the law for organizations of health-care professionals. Nonetheless, the motivation for continuing training is still low among most professionals, and this is reported in a research conducted among 403 health-care professionals from Ruse by.[15] Quite a small number of participants are reported (12%) in at least one course for postgraduate training each year.[15]

With this current research, the effectiveness of the conducted course and the necessity of conducting postgraduate training in the field of interventional cardiology are proven. It is proven in a series of other research studies that the average duration of an interventional procedure that is performed with the help of a team of well-trained nurses is significantly shortening and that the postprocedural complications are reducing for patients.

An important issue is safety in the workplace. Trained nurses, among other factors, provide a reduced X-ray overload for the working medical team and the patient.

ACKNOWLEDGMENTS

The authors thank the nurses who took part in this research and also thank the organizations that gave permission to conduct the research in their centers.

REFERENCES

1. WHO. Cardiovascular diseases (CVDs). Retrieved from; 2017. http://www.who.int/mediacentre/factsheets/fs317/en/.
2. Ministry of Health. Annual report on the state of health of citizens and implementation of the National Health Strategy 2020 to 2016. Retrieved from; 2016. http://www.parliament.bg/pub/cW/20180208032448Doklad%20za%20zdraveto%20na%20grajdanite%20chast%201.pdf.
3. Ministry of Labor and Social Policy. REPORT FOR 2016 for implementation of the updated National Strategy for Demographic Development of the Population in the Republic of Bulgaria (2012-2030g). Retrieved from; 2016. www.strategy.bg/FileHandler.ashx?fileId=11435.
4. National Statistical Institute. Deaths by causes, sex and age groups. Retrieved from; 2017. http://www.nsi.bg/bg/content/3351/%D1%83%D0%BC%D0%B8%D1%80%D0%B0%D0%BD%D0%B8%D1%8F-%D0%BF%D0%BE-%D0%BF%D1%80%D0%B8%D1%87%D0%B8%D0%BD%D0%B8-%D0%B7%D0%B0-%D1%81%D0%BC%D1%8A%D1%80%D1%82%D1%82%D0%B0-%D0%BF%D0%BE-%D0%BF%D0%BE%D0%BB-%D0%B8-%D0%B2%D1%8A%D0%B7%D1%80%D0%B0%D1%81%D1%82%D0%BE%D0%B2%D0%B8-%D0%B3%D1%80%D1%83%D0%BF%D0%B8.
5. National Statistical Institute. Causes of death statistics. Retrieved from; 2017. http://ec.europa.eu/eurostat/statistics-explained/index.php?title=Causes_of_death_statistics/bg.
6. OECD/European Observatory on Health Systems and Policies. Bulgaria: Country Health Profile 2017, State of Health in the EU, OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels. Retrieved from; 2017. https://www.oecd-ilibrary.org/social-issues-migration-health/bulgaria-country-health-profile-2017_9789264283305-en.
7. Maini B, Gregory D, Scotti DJ, et al. Percutaneous cardiac assist devices compared with surgical hemodynamic support alternatives: cost-effectiveness in the emergent setting. Catheter Cardiovasc Interv 2014;83(6):E183-92.
8. Hristova I, Koleva G, Georgieva D. The invasive cardiovascular procedures as a factor for economic efficiency in healthcare. Romania: Annals of the "Eftimie Murgu" University of Resita; 2017:127-34. Retrieved from; http://www.analefseauem.ro/upload/arhiva-revista/2017/Volum_2017.pdf.
9. Ministry of Health. Hospitals medical institutions. Retrieved from; 2016. http://www.mh.government.bg/bg/administrativni-uslugi/registri/lechebni-zavedeniya/.

10. Hinterbuchner L, Coelho S, Esteves R, et al. A Cardiac Catheterization Laboratory Core Curriculum for the Continuing Professional Development of Nurses and Allied Health Professions. Retrieved from; 2016. https://www.escardio.org/static_file/Escardio/Subspecialty/EAPCI/Documents/Core%20curriculum%20EAPCI%20NAP_160318%20version%201.4%20final.pdf.
11. ORDINANCE No 1 of 8.02.2011 on the professional activities that nurses, midwives, associate medical specialists and health assistants may undertake by appointment or self. Retrieved from; https://www.lex.bg/laws/ldoc/2135718392.
12. Ordinance on the Unified State Requirements for Higher Education in the "Nursing" and "Midwifery" specialties for the Bachelor's degree ", latest state newspaper amendment number. 32 from 22.04.2016. Retrieved from; https://lex.bg/bg/laws/ldoc/2135513453.
13. Georgieva D. Assessment of the practical skills of students of the nursing specialty. Bulgaria, Pleven: Mediateh; 2015.
14. Pavlov V. Applied Statistics, Publishers Prepres, Sofia; 2013. ISBN 978-954-90443-6-2.
15. Koleva G, Georgieva D, Hristova I. Attitudes and position of health care professionals to continuing education and research. Health Care Magazine 2018;1:28-34.