Effect of a Structured Simulation-Based Training on Oncology Nurses' Performance Regarding Port A Catheter Devices

Huda Rady Sobh [(1)], Heba Abubakr M.Salama*[(2)], Eman R.El- Refaay [(3)], Ola Ebrahim Elsherbiny[(4)]

(1,4) Lecturer of Medical-Surgical Nursing, Faculty of Nursing, Mansoura University, Egypt.
(2) Assist professor of Medical-Surgical Nursing, Faculty of Nursing, Mansoura University, Egypt.
(3) Lecturer of Community Health Nursing, Faculty of Nursing, Mansoura University, Egypt.
(*) Corresponding author: hebasalama@mans.edu.eg.

Abstract

Background: The Port-A-Catheter is a reliable vascular access device used for long-term chemotherapy treatment at oncology centers. Recent research has shown that oncology nurses have inadequate knowledge and practice regarding Port-A-Catheter care. Therefore, improving nurses' knowledge and practice is crucial for compliance and minimizing complications. Using a simulation-based approach is one of the most effective methods of teaching because it enhances learning outcomes and nurses' performance. **Aim:** to evaluate the effect of a structured simulation-based training on oncology nurses' performance regarding Port-A-Catheter devices. **Methods:** A quasi-experimental design with one group pretest-posttest was utilized. A convenience sample was composed of 50 nurses in the oncology center at Mansoura University in Egypt. **Tools**: Port-A-Catheter Nurses' Knowledge Questionnaire and Accessing and De-Accessing Implanted Venous Port Checklist were used for data collection. **Results:** The total mean scores of nurses' knowledge regarding port-a-catheter were improved significantly immediately post- training and at follow-up, from 21.07 ±7.51 to 42.67 ±9.54 and 38.51 ±10.17, respectively. Moreover, the total mean practice scores post-training and at follow-up (141.57 ±17.09 and 136.51 ±23.99), respectively, were significantly higher than pre-training (76.92 ±29.35) ($P < 0.001$). **Conclusion:** The findings of the present study concluded that simulation-based training was an effective approach, improving nurses' knowledge and practice regarding Port-A-Catheter care. **Recommendations:** In-service training programs and continuing education are recommended for all staff nurses in different specialties, using simulation-based training to improve their attitude, knowledge, and performance regarding Port-A-Cath care.

Keywords: Port-A-Cath device, Oncology nurses, Performance, Structured simulation based-training.
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Introduction

Chemotherapy is the most common treatment modality used to improve cancer patients' survival rates. Long-term chemotherapy treatment often requires vascular access devices (VADs) for the infusion of drugs **(Shih, Hsu, & Hsieh, 2023).** Today, medical therapy advancements have reinforced the need for reliable VADs and have become the keystone of modern medical therapy. Vascular access devices are commonly used in patients' treatment and are classified into three types: external central venous catheters, peripherally inserted central venous catheters, and subcutaneous central venous port catheter (**Öztaş, Alkan & Öztaş, 2020).**

In cancer treatment centers, implantable central venous port access is commonly used for patients who require chemotherapy for an extended period and need to receive prolonged intravenous infusions, antibiotics, nutrition, blood transfusions, and laboratory specimens (**Alban, Espin, Fontanez, & Fulwood, 2020; Taxbro, 2019**). Port-A-Catheter (Port A Cath) is a type of central venous device that includes a catheter that connects to a container called a reservoir, which is surgically placed under the skin, either near the ribcage or upper arm. Accessing the reservoir is achieved by inserting a needle through the port's septum. The catheter can be valid for use for an average of 2–6 years (**Ghmaird, et al., 2021; Hoa, 2019)**.

The advantages of Port-A-Cath include easy access to the patient's vein, particularly for patients with small or damaged veins or patients who are anxious about needles. Also, it maintains patient comfort, permits engagement in daily

living activities (including bathing, dressing, and exercising), has minimal infection rates, and is long-term. Furthermore, individuals with bleeding difficulties have a lower chance of skin, tissue, muscle, and vein damage, as well as a lower rate of bruising or bleeding. In conclusion, Port-A-Cath devices have several benefits for patients undertaking long-term chemotherapy. They can reduce complications, improve quality of life, and enable safe delivery of chemotherapeutic agents **(Öztaş et al., 2020; D'souza et al., 2021)**.

Although Port-A-Cath is a useful tool for cancer treatment, it has numerous risks and complications including; puncture failure, infection, catheter fracture, and extravasation can occur, which may result in fatal consequences for the patient. Proper puncture technique and care are essential for maintaining the catheter. Injection through a Port-A-Cath is an invasive procedure, and a good puncture can significantly reduce the risk of damage to the catheter path **(Shih, Hsu, & Hsieh, 2023).**

Oncology nurses have a crucial role in the management of patients with port catheters. They are responsible for carrying out interventions safely, early detecting and preventing complications, and educating patients and their families about proper port catheter care. Nursing care and maintenance of implanted ports require continuous caution and attention to maintain their patency and prevent complications, which includes flushing, heparin locking, dressing, changing needles, and minimizing the risk of contamination by scrubbing the access with an appropriate antiseptic solution. In addition, staff nurses must demonstrate proficiency when caring for patients who have implanted devices in order to ensure their safety and well-being. Nursing staff must possess professional knowledge in the management of Port-A-Cath to enhance the quality of cancer care provided to patients **(Lang et al., 2022; Mohamed, Mohamed, Abdelaziz, & Mohammed, 2023)**.

Unfortunately, recent studies confirmed that oncology nurses had poor knowledge and practice regarding Port-A-Cath care. However, inadequate Port-A-Cath education and training can lead to clinical errors that endanger patient lives and decrease the quality of care (**Hassanien, Mohamed & Marzouk, 2019; Mohamed, Mohamed, Abdelaziz, & Mohammed, 2023**). Therefore, oncology nurses desperately need to have adequate knowledge through standardized procedure guidelines, continuous education and training regarding different types of Port-A-Cath, techniques of insertion and maintenance, and methods of identifying and managing complications. Recent research confirmed that integrating virtual teaching strategies into nursing staff education can improve their attitude, knowledge, and practice regarding implantable catheter care **(Sok, Kim, Lee, & Cho, 2020; Shih, Hsu, & Hsieh, 2023)**.

The simulation-based approach is one of the most effective teaching strategies that enhances learning outcomes and improves nurses' performance (**Elshama, 2020)**. In the context of nursing science, simulation serves as a valuable tool for instructional purposes, enabling the development of both theoretical and practical skills among learners. Simulation offers a unique opportunity for trainees to develop their clinical skills within a realistic, interactive, and communicative healthcare environment without compromising patient safety or risking errors. By replicating training, trainees can gain hands-on experience and hone their abilities in a controlled and low-stakes setting, free from the pressure of actual patient care (**Koukourikos et al., 2021; Pun, 2023)**.

Incorporating simulation based training into nurses' education, can help trainee nurses to apply theoretical knowledge in a realistic setting and develop important skills such as critical thinking, decision-making, and communication. This approach can also help bridge the gap between classroom learning and real-world clinical situations, ensuring that trainee nurses are well-prepared to provide high-quality patient care (**Pun, 2023)**. Since limited studies were addressed Port-A-Cath care and maintenance among nurses in Egypt. Therefore, the current study is proposed as a preliminary to assess the level of nurses' knowledge and practice regarding Port-A-Cath care, design proper training through a structured simulation-based approach and evaluate its effect on nurses' performance.

Significance of the study

The induction of Port-A-Cath devices in the oncology center at Mansoura University, Egypt is new, and the number of patients using this device is increasing, so nurses are more likely to be

responsible for the care and maintenance of the Port-a-cath. While Port-A-Cath offers numerous advantages for cancer treatment, complications such as infection, mechanical failure, catheter breakage, and tearing of the Port-A-Cath are still prevalent. To minimize these risks and enhance compliance with Port-A-Cath care processes, it is crucial for nurses to increase their knowledge and skills related to Port-A-Cath management **(Hoa, 2019).**

Aim of the study:

This study was designed to:

1. Evaluate the effect of a structured simulation-based training on oncology nurses' knowledge regarding port-A-catheter devices.
2. Evaluate the effect of a structured simulation-based training on oncology nurses' practice regarding port-A-catheter devices.

Research Hypotheses:

H1: The oncology nurses will exhibit higher knowledge scores related to Port-A-Cath device care post-simulation-based training compared to the pre-training knowledge scores**.**

H2: The oncology nurses will exhibit higher practice levels related to Port-A-Cath device care post-simulation-based training compared to the pre-training practice levels.

Methods:

Research design:

A quasi-experimental research with one group pretest-posttest design was utilized in this study.

The setting of the study:

The current study was conducted at the inpatient departments of the Oncology Center, affiliated to Mansoura University Hospitals, Egypt. The inpatient departments were five wards. These wards included a female's medical ward, a men's medical ward, a pediatric ward, a chemotherapy ward, and a chemotherapy insurance ward.

Subjects:

A convenience sample was composed of 50 nurses who are working in and providing direct care for all patients with Port-A-Cath device in the previously mentioned setting; all available nurses were 60 nurses, 5 refused participation in the study, 10% (5) nurses included in the pilot study, and 50 nurses accepted to participate in the study.

- **Participants' inclusion criteria:** All oncology nurses working in and providing direct care for patients with Port-A-Cath devices who agreed to participate in the study with varying ages, genders, years of experience, and levels of education were suitable for participation.
- **Participants' exclusion criteria**: Excluded participants were those who were unable to complete the questionnaire.

Tools of data collection

Data was collected by using the following two tools:

Tool I: Port a-Catheter Nurses' Knowledge Questionnaire:

This tool was developed by the researchers based on reviewing related literature **(Alkan, et al.,2017; Khalil, Youssef, Shalaby & Moustafa, 2017; Hoa, 2019; Öztaş, et al., 2020; D'souza, et al., 2021),** it consisted of two parts; it took about 35 minutes to fill them out.

The first part was concerned with nurses' demographic characteristics. It consisted of seven items. It is introduced in Arabic and includes the nurse's age, gender, level of education, years of experience, number of times she has given care to the patient with Port-A-Cath and the training needs related the topic.

The second part aimed to explore nurses' knowledge regarding Port-A-Cath. This questionnaire consisted of 45 closed-ended questions, which represent two main sections as follows:

- **1st Section:** Port-A-Cath general knowledge composed of 27 closed-ended questions to elicit nurses' knowledge about the Port-A-Cath device. It covered (definition of Port-A-Cath (**3 items**), indications of the Port-A-Cath device (**7 items**), advantages of Port-A-Cath (**12 items**), and precautions before and after insertion of the device (**5 items**), the scores of the 1st section ranged from 0 to 27.
- **2nd Section:** Port-A-Cath complications, involves 18 closed-ended questions about nurses' knowledge regarding Port-A-Cath complications. It covered several questions about the most common complications, causes, signs, symptoms, treatment, and prevention, the scores of the 2nd section ranged from 0 to 18.

The scoring system of the Port-A-Cath Nurses Knowledge Questionnaire was graded according to the items of interviewing questionnaire sheet; the answers of respondents (nurses) were evaluated using key answers prepared by the researchers. Each correct answer was scored one grade, while the unknown, incorrect, or missed answer was given zero. The scores obtained for each question were summed up to get the total score for the nurse's knowledge. The total score of the knowledge was 45 (100%). A higher score indicated better knowledge and vice versa. All scores were transformed into score percent as follows; score % = (the observed score / the maximum score) x 100. Then the total scores were transferred into the following categories: "Satisfactory" level equal to or more than 34 (≥ 75%)." Unsatisfactory" level less than 34 (≤ 75%) **((Khalil, et al., 2017; Elateif, 2017).**

Tool II: Accessing and De-accessing an Implanted Venous Port Checklist:

The researchers adapted this tool from Omnicare checklist (**Omnicare, 2016**). This checklist covered the demonstrated nursing skills in accessing, using, and de-accessing implanted ports. It was used as a monitoring and evaluative tool for the nurse's practice pre- and post-training. It consisted of **73** steps covering four well-defined main skills: 1st skill related accessing an implanted Port-A-Cath which includes **40 items,** the 2nd skill concerning De-accessing an implanted Port-A-Cath which includes **19 items,** the 3rd skill regarding drawing the blood for testing which includes **12 items** and 4th skills related to pump maintenance **(2 items).**

***Scoring system* of tool II** was made using 3-Point Likert scale ranging from '0' to '2', where '0' indicates that the skill was not done, '1' incorrect, and '2' reflects that the skill was done correctly. The steps' distinct scores for each skill were added together, and then the overall scores were calculated and computed out of 146. All scores were transformed into percent as follows; percent = (the observed score / the maximum score) x 100. The percent was classified into the following categories: percent of < 80 % was considered as "Incompetent." - Percent of 80% and more was considered as "competent practices" **(Saltah & Abusaad, 2022).**

Validity and reliability:

Five experts, including two professors of medical-surgical nursing, two professors of oncology, and one lecturer of bio-statistics, evaluated the study tools for content validity, feasibility, clarity, relevance, and applicability, making necessary modifications. Cranach's Coefficient Alpha was used to assess the internal consistency of the research tools, tool I (r = 0.896) and tool II (r = 0.901).

Pilot study:

A pilot study was conducted to ascertain the developed tools' relevance, objectivity, and applicability; it involved 10% (5) of the study sample. They were selected randomly and excluded from the actual study. After minor modifications, the final form of the tools was developed, and the time needed to complete them was determined.

Ethical consideration:

Written approval was obtained from the Ethics and Research Committee of the Faculty of Nursing, Mansoura University, Egypt (Ref. No. P. 0388). Informed written consent was obtained from each nurse after clarification of the purpose and nature of the study. The study took into account the nurse's privacy, data confidentiality, and the right to withdraw at any time. In addition, the study was carried out in compliance with the Helsinki Declaration.

Administrative preparation:

An official letter was obtained with approval from the hospital responsible authorities of the oncology center after an explanation of the study purpose and schedule of data collection.

Fieldwork and data collection:

Data collection was started and continued for a period of 5 months from the beginning of March 2023 to the end of July 2023. The work plan for data collection has followed the phases of the nursing process and it consists of the following phases:

1- Assessment phase:

- The researcher started by introducing herself to nurses giving them a brief idea about the aim and nature of the study. Each nurse was interviewed according to their work schedule by the researchers individually in the clinical

department at the oncology center to accomplish demographic data for nurses using **tool I, first part**.

- Participants were instructed to complete all of the items on the knowledge questionnaire sheet within the allotted 30 minutes (**tool I, second part)**. The questionnaires were then gathered to be evaluated before the training as a knowledge pretest.
- As for**,** the researchers observe the nurses' practice before implementing the training as a practice pretest using **tool II.**

2- Planning phase:

A recent literatures review (**Alban, et al., 2020; Öztaş, et al., 2020 D'souza, et al., 2021; Ghmaird, et al., 2021; Raghuraman., 2021)** used in addition to the pretest results of nurses' performance level to design the appropriate training content. The training content covers two core area of Port-A-Cath devices include the basic theoretical knowledge such as: general knowledge about Port-A-Cath devices, complications, and its management, while the basic nurses' practices include: practice-related accessing an implementable Port-A-Cath device, practice-related de-accessing an implementable Port-A-Cath, practice-related to drawing blood for testing and finally practice related to pump maintenance.

3- Implementation phase:

- The training designed for this study has been carried out in the oncology center, at Mansoura University, Egypt. It was implemented according to the nurse's scheduled working hours at the lecture hall.
- Participant nurses were divided into small groups, each group ranging from (5-7) nurses.
- Each group of nurses completed the training within three weeks (one week cover the theoretical part in two sessions and two weeks for the practical part using the interactive simulation-based training.
- In the theoretical 1st session, nurses were provided with general theoretical knowledge which include a brief description of Port-A-Cath such as definition, indications, advantages, and precautions before and after insertion, in the 2nd session, discuss port-a-catheter complications, causes, treatment, and prevention.
- In the practical part sessions, nurses were demonstrated the procedure in two sessions: the first covers accessing and de-accessing an implantable port-a-catheter with a needle, and the second covers pump maintenance and drawing blood for testing from the port-a-cath. Each nurse demonstrates each skill individually using special manikin for port a catheter.
- During training sessions, the researchers used simple, brief, and clear words and each session started with a summary of the previous session in addition to the objectives of the new session, using very simple language that suits the level of nurses without ignoring motivation and reinforcement techniques. In addition, different teaching and learning methods was used during the sessions which included interactive lectures, demonstration, and instructional media including pictures and printed handouts which were presented in a clear and concise form to be used as memorial reference.
- At the end of each session, a brief summary was given by the researchers, nurses will be allowed to ask for any interpretation, elaboration, or explanation of any item included in the sessions.

4- Evaluation phase:

- After the training was completed for each group, the researcher administered the questionnaire **tools I (part 2)** to study nurses. Following that, questionnaires were gathered for evaluation as knowledge post-test.
- The researcher observes the nurses' practice after implementing training using **tool II** to evaluate their practice on the provided manikin as a practice post-test.
- The researcher assesses nurses' knowledge and practice three times by using **tools I (part 2)** &tool **II** according to their working schedule and compares the result before and after the applied training as follows:
  - The first (pre-test) was conducted before implementing the training.
  - The second (post-test) was done immediately after implementing the training.
  - The third (follow-up) was conducted after three months of training.

Statistical Analysis:

SPSS for Windows version 20.0 (SPSS, Chicago, IL) was used to conduct all statistical analyses. Continuous data were normally distributed and were expressed in mean ±standard

deviation (SD). Categorical data were expressed in numbers and percentage. One-way analysis of variance (ANOVA) test was used for comparison among more than two variables with continuous data. Chi-square test was used for comparison of variables with categorical data. Correlation co-efficient test was used to test for correlations between two variables with continuous data. The reliability (internal consistency) test for the questionnaires used in the study was calculated. Statistical significance was set at p<0.05.

Results:

Table 1: Illustrates that the majority of the oncology nurses (84.0%) were female. Additionally, less than half (44.0%) were between 18 and less than 30 years old, and nearly two-thirds (60%) graduated from the technical institute of nursing. 42.0% of nurses had experience spanning more than 10 years. Moreover, 52.0% of participants gave care to patients with Port-A-Cath 10 times or more. Regarding their need for training, 88% report a need for training about port-a-cath.

Table 2: Shows that around three quarters of nurses (78.0%, 76.0%, 72.0%, 72.0%, and 74.0%) had unsatisfactory pre-training knowledge regarding definition, indications, advantages, precautions, and complications of Port-A-Cath, respectively. Their overall unsatisfactory knowledge score was 76.0% pre-training compared to 30.0% immediately post-training and 38.0% at follow-up. Overall, total knowledge mean scores were improved immediately post training and at follow-up, respectively (42.67 ±9.54, and 38.51 ±10.17) compared to pre-training (21.07 ±7.51), with highly statistically significant differences (p< 0.001***).

Table (3): Reveals that there was a statistically significant difference (P < 0.001) in practice subtitles levels related to accessing, de-accessing the implanted port, drawing blood, and pump maintenance between pre training, immediately post, and at follow up. Moreover, the post -training and follow up total mean practice level (141.57 ±17.09 and 136.51 ±23.99) respectively was significantly higher than pre-training (76.92 ±29.35) (P < 0.001**).

Figure (1): Illustrates that there were a positive statistically significant correlations between nurses' knowledge and practice immediately post training (r =0.399).

Figure (2): Clarifies that there were a positive statistically significant correlations between nurses' knowledge and practice at follow up (r =0.297).

Table 1. Nurses' demographic and occupational characteristic (n=50).

Demographic and occupational characteristics	N	%
Gender		
Female	42	84.0
Male	8	16.0
Age (years)		
18 – <30	22	44.0
30 – <40	16	32.0
40 – < 50	7	14.0
50 – <60	5	10.0
Educational Level		
Secondary Nursing School	14	28.0
Technical Institute of Nursing	30	60.0
Faculty of Nursing	3	6.0
Post - Graduate	3	6.0
Experience (Years)		
Less than 1	9	18.0
1 – 5	16	32.0
6 – 10	4	8.0
> 10	21	42.0
Number of times of Port-A-Cath Care		
None	4	8.0
1 – <5 times	9	18.0
5 – <10 times	11	22.0
10 times or more	26	52.0
Need of training		
No	6	12.0
Yes	44	88.0

Table (2): Comparison of nurses' mean knowledge scores pre and post implementing Port-A-Cath simulation-based training (n=50).

Time	Pre				Immediately post				Follow – Up				Test of significance			
Knowledge level	Unsatisfactory Knowledge		Satisfactory Knowledge		Unsatisfactory Knowledge		Satisfactory Knowledge		Unsatisfactory Knowledge		Satisfactory Knowledge		Pre / Post training		Pre / Follow – Up	
Definition	39	78.0	11	22.0	16	32.0	34	68.0	20	40.0	30	60.0	21.374	<0.001***	14.924	<0.001***
Mean ±SD	1.60 ±0.69				2.89 ±0.52				2.48 ±1.02				F=36.468	P <0.001**		
Indications	38	76.0	12	24.0	12	24.0	38	76.0	17	34.0	33	66.0	27.040	<0.001***	17.818	<0.001***
Mean ±SD	2.98 ±0.97				6.46 ±1.77				5.55 ±1.25				F=86.685	P<0.001**		
Advantages	36	72.0	14	28.0	16	32.0	34	68.0	20	40.0	30	60.0	16.026	<0.001***	10.390	<0.001***
Mean ±SD	5.84 ±2.13				11.14 ±3.01				9.86 ±2.78				F=53.795	P<0.001**		
Precautions	36	72.0	14	28.0	16	32.0	34	68.0	19	38.0	31	62.0	16.026	<0.001***	11.677	<0.001***
Mean ±SD	2.64 ±0.79				4.82 ±0.89				4.28 ±0.64				F=105.893	P<0.001**		
Complications &its management	37	74.0	13	26.0	16	32.0	34	68.0	19	38.0	31	62.0	17.704	<0.001***	13.149	<0.001***
Mean ±SD	8.01 ±2.93				17.36 ±3.35				16.33 ±4.48				F=98.868	P<0.001**		
Total Knowledge Score	38	76.0	12	24.0	15	30.0	35	70.0	19	38.0	31	62.0	21.236	<0.001***	14.729	<0.001***
Mean ±SD	21.07 ±7.51				42.67 ±9.54				38.51 ±10.17				F=78.537	P<0.001**		

X^2: Chi-Square F: Repeated measure ANOVA ***:** p<0.05

Table (3): Comparison of nurses' mean practice scores pre and post implementing Port-A-Cath simulation-based training (n=50).

Time	Pre				Immediately post				Follow – Up				Test of significance			
Practice level	Incompetent Practice		Competent Practice		Incompetent Practice		Competent Practice		Incompetent Practice		Competent Practice		Pre/ Post traning		Pre / Follow – Up	
	N	%	N	%	N	%	N	%	N	%	N	%	X^2	P	X^2	P
Accessing an implanted venous port	37	74.0	13	26.0	12	24.0	38	76.0	18	36.0	32	64.0	25.010	<0.001**	14.586	<0.001**
Mean ±SD	42.98 ±17.68				77.75 ±9.17				74.85 ±12.18				F=102.429	P<0.001**		
De-accessing an implanted venous port	38	76.0	12	24.0	9	18.0	41	82.0	15	30.0	35	70.0	33.762	<0.001**	21.236	<0.001**
Mean ±SD	19.63 ±6.92				36.85±4.73				35.45±7.13				F=113.290	P<0.001**		
Drawing blood for testing	37	74.0	13	26.0	14	28.0	36	72.0	18	36.0	32	64.0	21.168	<0.001**	14.586	<0.001**
Mean ±SD	12.21 ±3.83				23.42 ±2.81				21.45 ±3.98				F=139.9039		P<0.001**	
Pump maintenance	40	80.0	10	20.0	15	30.0	35	70.0	16	32.0	34	68.0	25.253	<0.001**	23.377	<0.001**
Mean ±SD	2.09±0.95				3.85 ±0.43				3.76±0.70				F=93.422	P<0.001**		
Total Practice Score	38	76.0	12	24.0	13	26.0	37	74.0	17	34.0	33	66.0	25.010	<0.001**	17.818	<0.001**
Mean ±SD	76.92 ±29.35				141.57 ±17.09				136.51 ±23.99				F=112.147	P<0.001**		

X^2: Chi-Square F: Repeated measure ANOVA. ***:** p<0.05

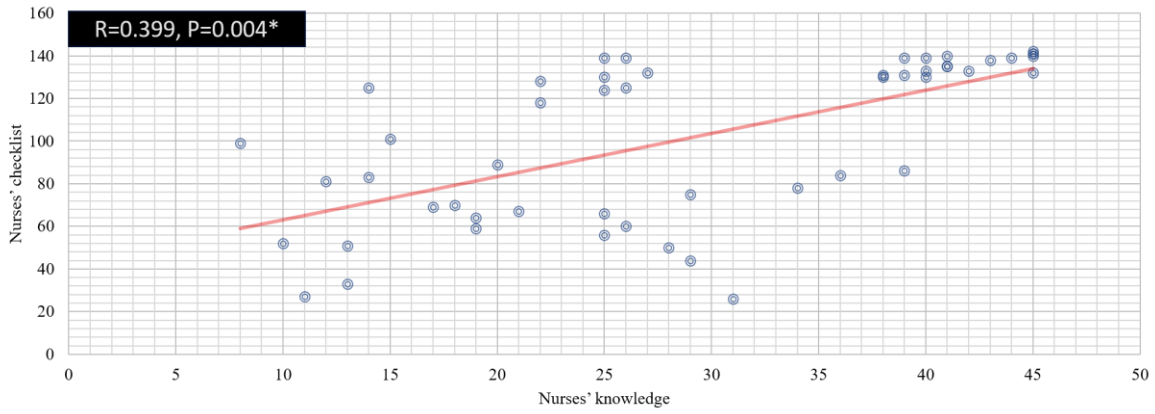

Figure 1. Correlation between nurses' knowledge and practice scores immediately post-training

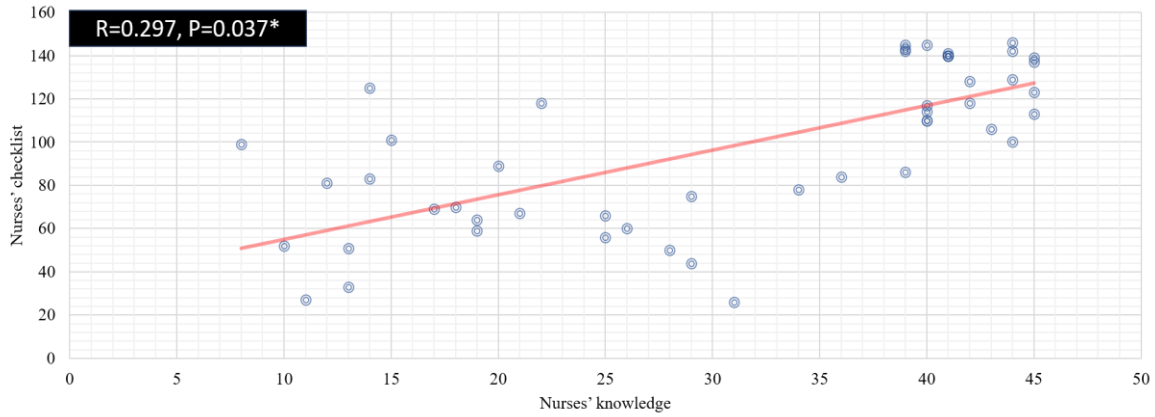

Figure 2. Correlation between nurses' knowledge and practice scores at follow – up

Discussion

Port-A-Catheter is a widely used device in patients with long-term venous access demand such as frequent or continuous administration of medications such as, chemotherapy delivery, blood transfusions, blood products, and fluids **(McLoughlin et al., 2017)**. Vulnerability is worsened by the risk of adverse events associated with the insertion and management of this device. The proper care and use of the Port-A-Cath require the nurse to be knowledgeable and skilled to prevent any complications related to the Port-A-Cath and to ensure safe and high- quality care for patients (**El-Metwaly, & Abd-El Salam, 2020)**. Therefore, there is a necessity to provide in-service training for nurses to improve their knowledge and skills. Therefore, the aim of this study was to evaluate the effect of a structured simulation-based training on oncology nurses' performance regarding Port-A-Cath devices.

Regarding the demographics characteristics of the studied nurses, the present study illustrated that majority of the oncology nurses were females. This finding was similar to previous studies done by **Khalil et al., (2017)** and **Barbosa et al., (2017)** who showed that the majority of the studied nurses were females. The female majority in the findings can be attributed to that females in Eastern communities prefer to work in nursing proficiency as it is suitable for their nature. Moreover, the current study reported that less than half were between 18 to less than 30 years old, younger ages in the sample may indicate that these nurses are more likely to be involved in direct patient care compared to older nurses who may be engaged in administrative tasks. This finding is supported by **Ahmed & Kafl, (2019)** who found that nearly two- thirds of the studied nurses were in the age group from 20 to less than 30 years.

Concerning the level of nurse's education and years of experience, the current study found that nearly two-thirds of the participants held degrees from technical institutes of nursing. This is because academic programs at technical institutes typically last for two years, while bachelor's degree programs in nursing take four years to complete. Given the economic conditions in the region, families often prefer technical institutes as they offer a shorter duration and lower costs. These results align with earlier study done by **Mamdouh Zakaria et al. (2022)**, who found that over half of oncology nurses held degrees from technical institutes of nursing. However, it differs from another study findings (**Hoa, 2019)**, that reported that two-thirds of the studied sample held bachelor's degrees, with the remaining one-third holding technical institute degrees. Such discrepancies between the current study and other studies on the impact of variables such as education may be due to cultural or social differences between the Egyptian community and other communities. Moreover, the current study demonstrated that less than half of nurses had more than 10 years of experience. This finding is in the same line with **Kapucu et al. (2017)**, who mentioned that less than half of studied nurses had 11 years of experience or more.

When it comes to the studied nurses' needs for Port-A-Cath training, the present study represented that mostly of the studied nurses required training on Port-A-Cath maintenance and care as no opportunity for training on Port-A-Cath devices in the oncology center, which may be related to lack of experienced staff who have adequate knowledge about this new devices, and may be also related to nurses workload. This finding is similar to the findings of, **Hoa (2019)**, who found that the majority of studied nurses needed training on Port-A-Cath care.

The preliminary assessment of the studied nurses level of knowledge of port-cath care before applying simulation based training indicated that nearly three quarters of nurses had unsatisfactory pre-training knowledge regarding definition, indications, advantages, precautions, and complications of Port-A-Cath. These findings are in harmony with **Alkan (2017)**, who reported poor knowledge levels of the studied nurses in pretest. Additionally, it was noted that the studied nurses had difficulty relating complications of Port-A-Cath and managing them. While these findings differ from **Khalil, et al. (2017)**, who revealed that most of the studied subjects had satisfactory responses related to indications of Port-A-Cath, local and general complications, and the contraindications of Port-A-Cath. This disparity may be due to the fact that these studied nurses received prior training courses on port-a-catheter care.

It is worthy noted that, after applying the simulated training, the included nurses level of

knowledge was improved significantly post-training and later at follow-up, which indicates that the structured simulation-based training was effective in increasing nurses' knowledge score. In line with our results, a study conducted by **Khalil et al. (2017)**, showed that significant differences between nurses' levels of knowledge related to Port-A-Cath before and after the training. Nurses are knowledge- dependent workers, and knowledge plays an important role in the quality of health care today as they should be able to create a match between each patient and the advanced treatment modalities. It appears that nurses do actively look for information related the provided topic.

As for, the level of the included nurses' practices before applying port-cath simulation bases-training, the present study reported that around three -quarters of nurses had incompetent practice related to accessing and de-accessing an implanted port, drawing blood for testing and pump maintenance pre training. These findings align with previous research by **Elsayed et al. (2019)**, who found that over three-quarters of nurses had an unsatisfactory level of practice when it came to caring for implanted ports.

Competent practice is essential for the oncology nurses to improve the care provided in the oncology center and the maintenance of implanted Port-A-Cath devices. In this context, the results of the presented study illustrated that after the implementation of the simulation-based training, the mean practice scores of the studied nurses (immediate post-test and follow-up) were significantly increased to high levels compared to pre-training scores. These findings suggest that the training that have implemented using simulation-based approach enables nurses to demonstrate and re-demonstrate port-cath care according to standardized guidelines, which empower nurses with essential skills to be competent in Port-A-Cath care and maintenance. This finding is supported by **Sharour, Subih, Yehia, Suleiman, Salameh, & Al Kaladeh, (2018)** who confirmed that the structured education is effective in improving the practice levels of staff nurses regarding venous access device care. In the same line, **Aloush, (2019)** found that there is an improvement in the majority of items in his study post using simulation training, which aimed to compare the effectiveness of lecture-based education versus simulation in educating student nurses and reported that the simulation approach is widely recognized to improve practical abilities compared to theoretical knowledge. Additionally, the study done by **Sok et.al, 2020** was similar to the present study in terms of using simulation-based approach but differed in the type of training course implemented. It reveals that the simulation-based training program significantly increase nurses' knowledge and skills and decreased stress in clinical setting.

The present study revealed that the studied nurses' knowledge significantly correlated with their practice. This is in agreement with **Feroze, Afzal, Sarwar, Galani, and Afsha (2017)**, who showed a statistical correlation between knowledge and practice. The authors suggest that a strong connection exists between nurses' knowledge and their ability to develop new skills and put them into practice based on that good practice is the result of theoretical understanding. Nurse trainees can gain hands-on experience in a controlled and supportive environment through simulations, allowing them to build confidence and readiness for the practical aspects of their training.

Conclusion:

The findings have important implications for clinical practice, education, and future research, highlighting the importance of ongoing education and training for oncology nurses and the value of simulation-based training in enhancing the quality of care provided to patients with cancer. The findings of the present study indicated that simulation -based training approach has increased nurses' knowledge of Port-A-Cath care. Moreover, the results demonstrated an improvement in the practice levels in all sub-items. Hence, the simulation -based training is an effective approach to improve nurses' performance in relation to Port-A-Cath care.

Recommendations:

- Incorporating simulation-based training into in-service nursing training to enhance the quality of care provided to patients with cancer is highly recommended.
- In-service training programs and continuing education are recommended for all staff nurses in different specialties, using simulation-based

training to improve their attitude, knowledge, and performance regarding Port A Cath care.

- The study emphasizes the need for further research to compare the effect of different teaching and traning methods on oncology nurses' knowledge and practice.

Limitation of the study:

The small sample sizes of the current study may limit the generalization to larger populatio ns or other settings.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Conflicts of interest

The authors declare that there was no conflict of interest regarding the study.

Disclosure

We do not have any financial interests or commercial associations to disclose.

Corresponding author

Correspondence to Heba Abubakr M. Salama

References

Ahmed, S. A. E. M. & Kafl, R. H. (2019). Knowledge and practice of the critical care nurses on vascular access devices related infection, *Journal of Nursing and Health Science,* (2), 13-22.

Alban, J., Espin, S., Fontanez, G. Y., & Fulwood, A. (2020). Establishing a Vascular Access Device Program in the Outpatient Clinic Setting. AAACN Viewpoint, 42(3), 11-13.

Alkan, A., Kaçan, T., Avcı, N., Türker, İ., Kaçan, S. B., Ergen, A., Yaşar, A., Tanrıverdi, Ö., Turhal, S., & Şenler, F. Ç. (2017). Nurses' Knowledge Levels About Port Catheter Care (POCATH Study): a study of the palliative care working committee of the Turkish Oncology Group (TOG). *Journal of Clinical and Experimental Investigations, 8*(2), 66-70. https://doi.org/10.5799/jcei.333384.

Aloush S. (2019). Lecture-based education versus simulation in educating student nurses about central line–associated bloodstream infection–prevention guidelines, Journal of Vascular Nursing, 37(2), 125-131. https://doi.org/10.1016/j.jvn.2018.11.006.

Barbosa, C. V., Canhestro, M. R., de Lima Guimaraes, G., Couto, B. R. G. M., Mendoza, I. Y. Q., & Goveia, V. R. (2017). Knowledge of the nursing team on care with central venous catheter, *Journal of Nursing UFPE* on line, 11(11), 4343-435.

D'souza, P. C., Kumar, S., Kakaria, A., Al-Sukaiti, R., Al-Baimani, K., Hamid, R. S., ... & Al-Moundhri, M. S. (2021). Complications and management of totally implantable central venous access ports in cancer patients at a university hospital in Oman. Sultan Qaboos University Medical Journal, 21(1), e103.

Elateif, Z. G. M. (2017). Effect of Training Program Regarding Care of Patients Undergoing Open Heart Surgery on Nurses' Performance Approach. *Port Said Scientific Journal of Nursing*, *4*(2), 219-240.

El-Metwaly, R. M., & Abd-El Salam, S. N. (2020). Effect of Educational Program on Nurses knowledge & Practice towards Patients with Implantable Port Catheter. https://www.researchgate.net/publication/341057087.

Elsayed, S. M., Mohamed, E. T., & Marzouk, S. F. (2019). Assess Nurses' Performance Regarding Care of Patient with Implanted Port Undergoing Chemotherapy. *Egyptian Nursing Journal*, *10*, 166-178. https://ejhc.journals.ekb.eg/article_36803_de19eeee6ae5bbda4d1b7fb3069e6877.

Elshama, S. S. (2020). How to apply simulation-based learning in medical education?. Iberoamerican Journal of Medicine, 2(2), 79-86. https:// doi. org/ 10. 5281/ zenodo.3685233.

Feroze, M., Afzal, M., Sarwar, H., Galani, A., & Afshan, S. (2017). Knowledge and Practice of Registered Nurses about Patient Safety after Cardiac Catheterization in Punjab Institute of Cardiology Hospital in Lahore, Pakistan. *International Journal of Musculoskeletal Pain Prevention*, *2*(2), 233-238.

Ghmaird, A. S., Alnoaiji, M. S. M., Alalawi, Y. S., Alrashidi, T. N., Al Blewi, S. M., Gad, N. G., ... & Gad, N. (2021). Port-A-Cath Insertion in Pediatric Patients With Malignancy in Tabuk. Cureus, 13(8).

Hassanien, S. E. M., Mohamed, E. T., &Marzouk, S. F. (2019). Assess nurses'performance regarding care of patient with implanted port undergoing chemotherapy. Egyptian Journal of Health Care, 10(2), 166-178. https://doi.org/10.21608/ejhc.2019.36803.

Hoa, N. T. (2019). Improving the Knowledge of Port-A-Cath Care For Nurses. https://digscholarship.unco.edu/theses/120.

Kapucu S, Özkaraman AÖ, Uysal N, Bagcivan G, Şeref FÇ, Elöz A. (2017). Knowledge level on administration of chemotherapy through peripheral and central venous catheter among oncologynurses. *Asia Pac J Oncol Nurs*; 4:61-8.

Khalil, N. S., Youssef, W., & Moustafa, Z. (2017). Oncology critical care nurse's knowledge about insertion, care and complications of venous port catheters in Egypt. *Advanced Practices in Nursing*, *2*, 137. doi: https://doi.10.4172/2573-0347.1000137.

Koukourikos, K., Tsaloglidou, A., Kourkouta, L., Papathanasiou, I. V., Iliadis, C., Fratzana, A., & Panagiotou, A. (2021). Simulation in Clinical Nursing Education. *Acta Informatica Medica*, *29*(1), 15-20. https://doi.org/10.5455/aim.2021.29.15-20.

Lang, T., Jaboury, S., West, A., O'Sullivan, J., Seletto, K., Wilson, L., ... & Richardson, G. (2022). Is there a relationship between frequency of port-care maintenance and related complications in patients with cancer?. JCO Oncology Practice, 18(9), e1438-e1446. https://doi.org/10.1200/OP.22.00060.

Mamdouh Zakaria, M., Mohamed Alaa, S., & Mohamed Desoky, G. (2022). Oncology Nurses' Knowledge and Practices regarding Safe Administration of Intravenous Chemotherapy. *Egyptian Journal of Health Care*, *13*(1), 1218-1231.

McLoughlin, M., Stepien, K. M., McNelly, B., Thompson, L., Gorton, J., & Hendriksz, C. J. (2017). The use of port-a-caths in adult patients with Lysosomal Storage Disorders receiving Enzyme Replacement Therapy-one centre experience. *Molecular genetics and metabolism reports*, *13*, 111–114. https://doi.org/10.1016/j.ymgmr.2017.10.003.

Mohamed, H. H., Mohamed, M. A. F., Abdelaziz, T. M., & Mohammed, N. M. (2023). Assessment of Nurses' Knowledge and Practice Regarding Implanted Port-A-Catheter Care for Patients Undergoing Chemotherapy. *Alexandria Scientific Nursing Journal*, *25*(3), 1-12.

Omnicare, 2016. Available at: https://www.mmlearn. org/hubfs/docs/Skills-Checklist-18-Accessing-and-De-Accessing-an-Implanted-Port.pdf. Accessed on:5 Marsh 2023.

Öztaş, M., ALKAN, İ., & ÖZTAŞ, B. (2020). Determination of nursing practices regarding port catheter care. Journal of Medicine and Palliative Care, 3(1), 33-38.

Pun, J. (2023). Using a simulation-based approach to promote structured and interactive nursing clinical handover: a pre- and post-evaluation pilot study in bilingual Hong Kong. *BMC Nurs*, 22, 38. https://doi.org/10.1186/s12912-023-01189.

Raghuraman, M. M. (2021). Port-a Cath-A friendly partner in the care of child with cancer A Case presentation.

Saltah, O. Y., & Abusaad, F. (2022). The Effect of Implementing Peripherally Inserted Central Catheter Educational Program on Nurses 'Knowledge, Practice, and Neonatal Outcomes. *International Egyptian Journal of Nursing Sciences and Research*, *2*(2), 212-226. https://doi.10.21608/EJNSR.2022.212447.

Sharour, L. A., Subih, M., Yehia, D., Suleiman, K., Salameh, A. B., & Al Kaladeh, M. (2018). Teaching module for improving oncology nurses' knowledge and self-confidence about central line catheters caring, complications, and application: A pretest- posttest quasi-experimental design. Journal of Vascular Nursing, 36(4), 203-207.

Shih, S. F., Hsu, L. L., & Hsieh, S. I. (2023). Effects of Digital Learning and Virtual Reality in Port-A Catheter Training Course for Oncology Nurses: A Mixed-Methods Study. In Healthcare (Vol. 11, No. 7, p. 1017). MDPI.

Sok, S. R., Kim, J. A., Lee, Y., & Cho, Y. (2020). Effects of a simulation-based CPR training program on knowledge, performance, and stress in clinical nurses. *Journal of Continuing Education in Nursing*, *51*(5),225232. https://doi.org/10.3928/00220124-20200415-07.

Taxbro, K. (2019). *Vascular access in cancer patients–clinical implications* (Vol. 1693). Linköping University Electronic Press.