

Effect of Implementing Educational Guidelines on Cardiac Nurses ' Performance regarding Patient Safety Post Cardiac Catheterization

¹Aida Faried Abdelwanees Ali, ²Eman Fadel Abdelkhalik, ³Bedour Adel Mohamed Ibrahim, ⁴Elsayed Mahmoud Sabek, ⁵Fatma Abdelaziz Mohammed

1 Lecturer of Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University, Egypt

2 Assistant professor at Medical Surgical Nursing Department, Faculty of Nursing, Minia University, Egypt

3 Lecturer of Medical-Surgical Nursing, Faculty of Nursing, Minia University

4 Lecturer, Critical Care and Emergency Nursing, Faculty of Nursing, Beni-Suef University, Egypt, and Coordinator of Faculty of Nursing, Beni Suef National University, Egypt

5 Lecturer of Critical Care and Emergency Nursing, Faculty of Nursing, Cairo University

Abstract

Background: The most effective method for identifying and treating coronary artery disease is cardiac catheterization. One of the most important components of providing healthcare in all contexts is ensuring patient safety. Patients' lives can be saved by spotting any shortcomings in care and raising nurses' understanding of their crucial role. **Aim:** To evaluate the effect of implementing educational guidelines on cardiac nurses' performance regarding patient safety post-cardiac catheterization. **Design:** A quasi-experimental research design was used. **Setting:** The study was conducted in the cardiac catheterization unit, and cardiac care unit at Mania University Hospital. **Sample:** A purposive sample of all available nurses and 50 nurses who are working in the selected setting. **Tools:** Four tools were used for data collection: nurses' personal demographic data, nurses' knowledge concerning safety measures, a safety measures observational checklist and A safety attitude questionnaire. **Results:** There was a highly statistically significant improvement in nurses' total knowledge, attitude, and practices mean score in post post-educational guidelines implementation phase than the pre-educational guidelines phase concerning safety measures. A statistically significant correlation was found between total practices, total knowledge, and attitude among the studied nurses ($p \leq 0.05$). **Conclusion:** The study's findings conclude that educational guidelines implementation has a positive effect on improving cardiac nurses' performance regarding patient safety post-cardiac catheterization. **Recommendations:** The study recommends that nurses working in cardiac catheterization units continuously engage in educational programs to improve their nurses' knowledge and practical skills regarding safety measures concepts.

Key words: Patient Safety, Cardiac Catheterization, Nurses, Performance

Introduction

A cardiologist can discover more about the circulation and blood pressure patterns inside the heart by performing a technique known as cardiac catheterization. The gold standard for diagnosing, evaluating, and treating heart diseases is cardiac catheterization (CC) (Shaik, et al., 2020). Cardiovascular catheterization allows surgeons to see the heart's arteries up close. Cardiac catheterization is the most efficient way to diagnose and treat coronary artery disease. Surgeons can get a close-up view of the arteries that lead to the heart by putting catheters into the body. Additionally, they enable the correction of structural issues that result in erratic heartbeats, tiredness, and other potentially fatal symptoms (Hansmann et al., 2020).

Cardiac catheterization is an invasive procedure that could result in several serious and minor issues that could increase morbidity and

death. It makes sense that taking steps to receive prompt care and receiving the proper therapy are related, to preventing further issues. Although the catheter procedure's noninvasive technique has improved over time, it still carries a risk of both major and minor complications, including temporary pain, nausea/vomiting, bleeding, hematomas, contrast allergy, and myocardial infarction, major embolic events, and death (Wankhede & Biradar, 2019).

The most common and frequent of these problems are the vascular ones that arise from compressing the femoral vasculature, which greatly varies after sheath removal after treatment depending on the compression technique employed to achieve femoral artery hemostasis. They consist of infections with a 1.5–9% overall incidence, hematomas, pseudoaneurysms, arteriovenous fistulae, acute arterial occlusions, cholesterol emboli, and more (H). Peripheral vascular disease, repeated percutaneous transluminal coronary

angioplasty, being female and advanced age are significant predictors of these issues after coronary interventional procedures. Low platelet counts, prolonged anticoagulation periods, usage of bigger sheaths, use of thrombolytics, elevated creatinine levels, and degree of anticoagulation are marginal indicators (**Kern et al., 2021**).

Patient safety, which is defined as the avoidance of injuring patients while providing healthcare services, is the foundation of high-quality care and requires knowledge and skills in several domains. Patient safety is a major issue for public health globally. Medical errors can occasionally result in substantial harm to patients, including death, incapacity, or prolonged further treatments (**El-Hosany et al., 2019**).

Nurses play a vital role in maintaining patient safety because of the very nature of their job, requiring continual monitoring of patients and care coordination. By following established infection control recommendations and upholding aseptic practices during the installation of cardiac catheters, nurses play a critical role in the prevention of cardiac catheterization problems (**Rahman et al., 2020**). During CC, safety procedures must be upheld to allow for the early detection and management of difficulties. The nurses who can spot issues early are best positioned to take decisive action and enhance patient outcomes. Therefore, lowering the mortality and morbidity rates for patients undergoing this operation in the cardiac catheterization unit may be possible for nurses with experience in patient care during CC (**Coomes et al., 2004**).

When providing nursing management to patients having cardiac catheterization, improved nurse knowledge leads to higher levels of self-efficacy in nurses (**Neupane, Thapa, & 2018**). Particularly in critical care environments like cardiac catheterization units, adherence to safety procedures is essential. The nurse in this unit is required to follow safety protocols to protect patients from risks associated with healthcare and to protect themselves from occupational hazards (**Ebekozien et al., 2020**). This makes it empirical to design nursing care standards for patients undergoing cardiac catheterization.

In the practice of coronary care units, patient safety in reducing repercussions is widely acknowledged as crucial. In many acute and critical care settings, nurses are largely in charge of removing femoral sheaths and managing any complications that may arise as a result of the treatment, such as highlighting hemostasis as a crucial concern. Being safeguarded from

unintentional injury as a result of a medical interaction is what is meant by this (**Rajesh, 2018**).

After cardiac catheterization procedures, cardiac nurses are in charge of ensuring patient safety and minimizing vascular problems. The rules for ensuring the patient's safety should be known to them. Every nurse should be familiar with handling high-risk patients safely and maintaining homeostasis. In addition, nurses must design standardized, secure, and evidence-based protocols of care for patients following percutaneous coronary intervention and cardiac catheterization. Therefore, if there is a higher level or amount of nursing care, patient outcomes can be improved (**Elgazzar & Keshk, 2018**).

Maintaining proper hydration in addition to promoting patient comfort and psychological readiness to receive therapy are the primary goals of nursing care before the procedure. Nursing guidelines advised assessing the patient's physical and mental well-being before the procedure, looking for any conditions that would raise procedural risk, getting a baseline electrocardiogram (ECG), and taking blood for lab tests. Patients should be given oral antiplatelet drugs to reduce thrombotic issues before, during, and after surgery. The nurse should also advise the patient to fast after midnight the day before, shave the treatment region, and deliver intravenous fluids as instructed. (**Abd El-Aty et al., 2018**).

The nurse's role during the intervention is to promote the comfort and security of the patient while working with the interventional cardiologist to ensure the treatment's success. The ECG, arterial pressure, signs and symptoms of contrast sensitivity, symptoms of ischemia or chest discomfort, and any noteworthy changes that may take place during medicine delivery are all noted by nurses. They are prepared for any situation and alert the doctor to any changes in the patient's health (**Morton & Fontaine, 2018**).

Following the procedure, nursing care included monitoring the patient's vital signs, the affected extremity's peripheral circulation frequently and the catheter insertion site (by examining the capillary refill, peripheral skin temperature, color, and the existence of peripheral pulses), as well as observing and managing chest pain episodes, maintaining appropriate rest periods with the affected extremity straight, giving the patient the necessary medications, monitoring their fluid intake and output, and performing other tasks as needed. Patients feel more comfortable managing their health when information is provided to them at the time of discharge. Patients need to be given the right advice regarding how to

manage the catheter insertion site, potential problems, medication, nutrition, and activity guidelines during the healing time (Kern & Kirtane, 2020).

Significance of the study

Cardiovascular illnesses have had the highest rates of morbidity and mortality worldwide since the 1960s, and One of the most often used diagnostic techniques for these problems is cardiac catheterization. (Susan & Erikas, 2019). In Egypt, medical mistakes are the third biggest cause of death. Unsafe care causes 134 million adverse events in hospitals each year, leading to 2.6 million fatalities (World Health Organisation, 2019). Nursing care for patients having cardiac catheterization necessitates experience in these circumstances as well as knowledge of the common worries observed. Before, during, and after cardiac catheterization, nurses should employ their knowledge and skills to offer safe and appropriate care and to improve both physical and emotional health (Abo El-Ata et al., 2020).

Nursing care for patients undergoing cardiac catheterization is one of the main responsibilities of nurses who work in cardiac catheterization units. These nurses have a specialized function and are highly skilled cardiovascular nurses. The first stage of duties starts with preadmission and concludes with discharge and consists of screening for health issues, preparing patients for surgery, helping the surgeon during the procedure, and watching over patients till release (Abo El-ata et al., 2020). To determine how instructional guidelines affect cardiac nurses' performance in terms of patient safety during cardiac catheterization, this study was conducted.

Aims of the study:

For evaluating the effects of educational guidelines implementation on cardiac nurses' performance in regard to patient safety during cardiac catheterization

Research Hypothesis

To fulfill the goals of this study the three research hypotheses were formulated:

H1: Nurses' performance score will be higher in post implementing educational guidelines than pre-implementing educational guidelines..

H2: There will be differences in nurse-patient safety practices between pre-implementing and post-implementing educational guidelines.

H3: There will be a highly statistically significant correlation between cardiac nurses' general

knowledge, behaviors, and attitudes.

Design of the study:

It was conducted using a quasi-experimental study design.

Setting:

At Mania University Hospital, this study was conducted in the cardiac catheterization and cardiac care units. The cardiac care unit has two large rooms with a total of 12 beds and one room for cardiac catheterization with just 5 beds. There was room for meetings for nurses' education.

Sample:

A purposive sample of (50) nurses working in the cardiac catheterization and cardiac care units at Mania University Hospital were chosen. The nurses were over the age of 25 and had varying levels of nursing education. They also had five or more years of work experience.

Data collection tools:

In order to gather information relevant to the current study, the following four tools were used:

Tool I: Nurses' demographic data:

It consisted of questions about data related to nurse's age, marital status, gender, years of experience, qualification, and attendance of training programmers

Tool II: Nurses' knowledge concerning safety measures:

The researchers created it to gauge the level of nurses' knowledge regarding patient safety (before, during, and after cardiac catheterization).The nursing care for patients undergoing cardiac catheterization includes questions regarding coronary artery disease, cardiac catheterization, and the anatomy and physiology of the heart, to name a few. Nursing treatment of cardiac catheterization (before and post), vascular complications following the procedure, and patient pre-discharge instructions. For knowledge items, incorrect or don't know the answer responses received a score of 0, a correct but incomplete response received a score of 1, and a correct but complete response received a score of 2. Following that,. The percentage was then calculated by adding up all the scores. The amount of nursing knowledge was deemed satisfactory if the percentage was $\geq 70\%$. Nursing knowledge was deemed to be at an unsatisfactory level if the percentage was lower than 70%.

Tool III: A safety measures observational checklist:

After reviewing the literature, researchers developed it to compare nurses' performance in terms of patient safety for patients undergoing cardiac catheterization before and after using the teaching program (Elgazzar & Keshk, 2018). There were three sections:

Part one:

Technique is done before a heart catheterization. It includes the following: informed consent, a description of post-catheterization care, a complete family and medical history, a systematic assessment, a record of allergies and adverse reactions, an ECG and complete lab tests, a history of the use of anticoagulants and other medications, and a check and recording of the peripheral pulse.

Part two:

Checklist for intracardiac catheterization: It involved setting up the necessary tools, according to infection control procedures such as the principles of aseptic technique, surgical hand washing, donning a sterile glove, and donning a mask and gown, as well as nursing care and close observation of the patient's vital signs and the procedure site.

Part three:

Checklist for cardiac catheterization after procedure: The skills covered included transferring patients to beds, reclining patients, checking distal pulses, frequency of checking pulses, determining the color or temperature of the affected extremity, checking vital signs every 15 to 30 minutes for the first two hours, determining the stability of pain, checking for ECG and SPO₂, giving IV fluids, and immobilizing the affected limb after surgery.

Scoring system for nurses' performance items in the checklist

For correctly completed performances, there were two scores, one for incorrectly completed performances, and zero for performances that weren't completed at all. The results of all scores were then added up and compared pre and post the educational program was implemented. The performance level of the nurses was deemed incompetent if the scores were below 80% and competent if the scores were above 80%.

Tool IV: A safety attitude questionnaire:

An investigation of safety attitudes. This section was extracted from a study by Saberi et al. (2017) that established the safety attitude questionnaire (SAQ), which is most widely used to

evaluate attitudes about the patient safety culture in hospitals. The questionnaire was composed of five factors: the management perspective (5 items), teamwork (6 items), the safety climate (7 items), job satisfaction (5 items), and the working conditions (4 items).

Scoring system:

On a Likert scale, there were 54 possible outcomes (Disagree=0, Neutral=1, Agree=2). The average score for the portion was calculated by dividing the total of the item scores by the number of things. These scores were converted to a percentage rating. A negative attitude was defined as having a total score of less than 60% (32score), while a positive attitude was defined as having a total score of more than 60% (32score).

Administrative and ethical considerations:

Firstly, the Research Ethics Committee (REC) and Postgraduate Committee of the Faculty of Nursing at Mania University gave their approval to the study proposal (REC202155). The administrative plan was then put into action by submitting an official letter from the Postgraduate department of the Faculty of Nursing at Mania University to the cardiac catheterization unit and cardiac care unit at Mania University Hospital, stating the purpose of the study. All nurses were made aware of the study's objectives and provided guarantees that their data would be protected and utilized only for appropriate research without putting them at danger. The trial's nurses were also made aware that they might choose not to participate and that they were free to leave the study at any time without giving a reason.

Tools validity:

Five nursing faculty members who are specialists in the fields of medical-surgical nursing and critical care nursing evaluated the suggested tools' content validity to see if the included items were clear and appropriate for achieving the study's objectives. They were asked for feedback on the structure, style, uniformity, correctness, and application of the tools.

Reliability:

The Alpha Cronbach's coefficient test was used to evaluate the tools' reliability, and the results showed that each of the three instruments had generally homogenous items, as seen by high reliability for each tool. How the tools were internally consistent is described as follows: The reliability of the knowledge questionnaire was evaluated using the 0.972 Cronbach's alpha coefficient. The tool practice and attitude both

have 0.897 reliability. This just serves to show how useful these technologies are in their current capacities.

Pilot Study:

Before the actual data collection began and after the tools had been constructed, a pilot study was carried out to evaluate the tools' clarity, applicability, and fill-time needs, as well as to determine whether the research technique was practical. Ten percent of the sample (n=5), which was used for the pilot study since no changes were made to the study tools, was used for the main study sample.

Fieldwork:

After receiving permission to continue with the study, the researcher set about organizing a schedule for gathering data. From the start of January 2023 through the end of June 2023, the fieldwork was completed over a six-month period. The unit conducted individual interviews with each nurse while also considering the COVID-19 prevention and safety procedures. 20 to 30 minutes were needed to complete the interview questionnaire. Three days a week (Monday, Tuesday, and Wednesday) from 12 p.m. to 2 p.m. were set aside by the researchers.

Preparatory phase:

To gain an understanding of the research problem and theoretical underpinnings, a thorough literature review that included text edition, online periodic, evidence-based articles and scholarly journals was done.

Assessment Phase:

An explorative visit was made to the cardiac catheterization facility at Mania University Hospital to assess the best way to collect data. An initial interview with the nurses was undertaken to build rapport before the study's start. After being informed of the study's goals and its nature, each participating nurse verbally agreed to participate. Two days a week were dedicated to data collection, which included both morning and afternoon shifts (long-day shifts).

Data Collection Methods:

The structured interviewing questionnaire was distributed to each nurse prior to the implementation of the instructional guidelines. (Tool II) to assess their understanding. This inquiry took between 10 and 15 minutes to

complete. Furthermore, an observational checklist (Tool III) was used to evaluate nurses' practical abilities before receiving educational guidelines, during preparation, during the cardiac catheterization technique, and following the procedure. The researcher saw that environmental and infection control precautions were followed. The observational checklist took each nurse between 15 and 25 minutes to complete. The attitude evaluation form that was given to nurses took between five and ten minutes to complete.

Planning Phase (Development of Safety Measures educational guidelines):

Based on the most recent relevant literature and the recognized needs of nurses paying attention safety measures in the cardiac catheterization unit, the educational guidelines' objectives were developed. Based on advice from experts, these goals were evaluated and improved. The instructional instructions were created with simplicity in mind, and they included both theoretical and practical elements. The main tool for implementation was a pamphlet with plain Arabic writing that was supported by pictures.

Implementation Phase:

The researchers delivered a single daily session between 9:30 AM and 12:30 PM, carrying out the safety measures teaching recommendations. Nurses were placed into groups of three to five for the training sessions, which served as the actual implementation. The pre-educational guidelines baseline assessment and the post-educational guidelines evaluation each took one month throughout this three-month phase. The educational requirements were made to correspond with the Arabic language competency of the nurses. Three information sessions and four practice sessions, each lasting 30 to 45 minutes and containing a 10-minute discussion and feedback section, were conducted for each nurse group.

The objectives of the current session were outlined and a recap of previous topics was given at the start of each session. After gathering input from nurses to ensure the greatest possible benefit, a summary of the session's contents was also supplied. While practicing required repetition and demonstration, knowledge was spread through lectures and group discussions. There were several visual aids used, including pamphlets, videos, and pictures. A brochure was given to each nurse, emphasizing the information covered in the workshops.

Evaluation phase:

Using the same data collection instruments (tools II, III, and IV), it was possible to compare

the results before and right after the implementation of the educational guidelines to determine the effect of those recommendations on cardiac nurses' performance in patient safety post cardiac catheterization. One month was the period of this stage.

Statistical Analysis:

The acquired data were tabulated and statistically analyzed using an IBM computer and the Statistical Program for Social Science (SPSS) Advanced Statistics, version 25 (SPSS Inc., Chicago, IL). To ascertain whether quantitative variables had a normal distribution, the Kolmogorov-Smirnov test was performed. Numerical data were represented using the mean and standard deviation. The qualitative data were expressed using frequency and percentage. McNemar was used to evaluate the differences between qualitative variables. Chi-square tests were run to examine the association between the qualitative variables. When the frequency count for more than 20% of the cells was 5, Fisher's exact test was used as an alternative to the chi-square test for smaller sample sizes. The Spearman method was used to analyze the correlation between numerical variables. A p -value < 0.05 was considered significant and a p -value < 0.001 was considered highly significant.

Results:

The study's nurses' personal information is shown in **Table 1**, which reveals that 52% of them were between the ages of 25 and 35, with a mean age of 35.45 ± 1.67 . 62% of them were female when it came to sex. 54% of them were married, according to their marital status. In terms of education, 36% of them had graduated from the Technical Institute of Nursing, and 52% had work experience ranging from five to ten years. Additionally, it was noted that 52% of the nurses who participated in the study had never taken a course on safety precautions in a cardiac catheterization facility.

Table 2 reveals that there was a highly statistically significant difference in the overall knowledge level of the investigated nurses on cardiac catheterization and safety measures before

and immediately after obtaining instructional instructions, with a p -value of < 0.001 .

Table 2 demonstrates that there was a highly statistically significant difference in the total knowledge level of the examined nurses on cardiac catheterization and safety measures before and right after receiving educational guidelines, with a p -value of ≤ 0.001 .

Figure 1 shows the marked increase in nurses' overall knowledge of cardiac catheterization and safety precautions, which went from 30% of them having a satisfactory level of knowledge prior to educational guidelines to 90% of them having a satisfactory level after guidelines.

According to **Table 3**, there was a highly statistically significant improvement in nurses' overall practices related to cardiac catheterization procedures in the post-implementation phase of educational guidelines with a mean SD of 160.6 and 1.4 as opposed to the overall practice mean score in the pre-implementation phase of educational guidelines with a mean SD of 95.8 and 11.3, which is shown in **Table 3**.

Figure (2) shows that there was a highly statistically significant difference ($p = 0.001$) between total practice level, total safety measures practices, and environmental safety measures practices among the tested nurses with regard to cardiac catheterization before and after the educational guidelines. The study's sample of nurses saw a change in their practice level from 55% prior to the recommendations to 95% after they were implemented.

Figure 3 shows how, as evidenced by the study nurses' respective pre- and post-educational guidelines positive attitude scores of 30% and 70%, their overall attitudes toward patients' safety have greatly improved.

Table 4 shows that, shortly after the implementation of instructional standards, there was a highly statistically significant association between total knowledge and attitude among the evaluated nurses ($p = 0.001$, $r = .74$). Following the establishment of educational guidelines, there was a statistically significant link between total practice, total knowledge, and attitude among the evaluated nurses ($p < 0.05$).

Table (1): Nurses personal data of the studied nurses (n = 50)

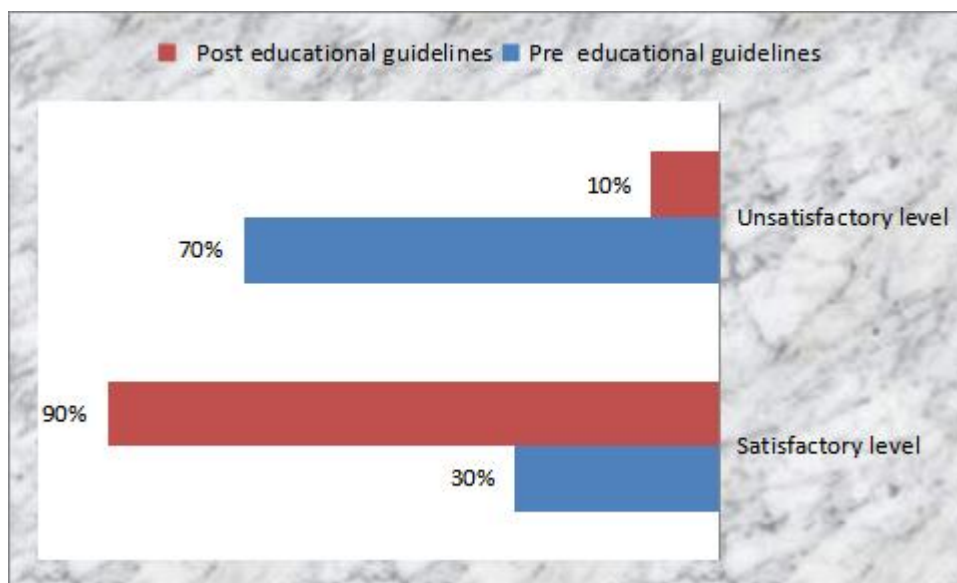
Nurses' personal data	(n = 50)	
	No	%
Age/years		
<25	8	16.0
25 - < 35	26	52.0
35- <45	11	22.0
≥ 45	5	10.0
Mean ± SD	35.45 ± 1.67	
Sex		
Male	19	38.0
Female	31	62.0
Marital status		
Single	12	24.0
Married	27	54.0
Divorced	6	12.0
Widowed	5	10.0
Educational level		
Nursing Diploma	12	24.0
Technical Institute of Nursing	18	36.0
Bachelor's Degree in Nursing	14	28.0
Postgraduate	6	12.0
Years of Experience		
< 5	7	14.0
5-< 10	26	52.0
10-< 15	12	24.0
≥ 15	5	10.0
Attending previous training courses related to safety measures		
Yes	24	48.0
No	26	52.0

Table (2): Knowledge score about cardiaccatheterization and safety measures among the studied nurses pre and immediately post-educational guidelines (n=50)

Knowledge of cardiac catheterization and safety precautions among nurses	Knowledge level	Knowledge (pre-educational guidelines)		Knowledge (immediately post educational guidelines)		X ² test P- value
		(No.)	%	(No.)	%	
Nursing role before cardiac catheterization	Satisfactory ≥ 80%	12	24.0	42	84.0	25.04 <0.001**
	Unsatisfactory < 80%	38	76.0	8	16.0	
Nursing role during cardiac catheterization	Satisfactory ≥ 80%	18	36.0	47	94.0	20.06 <0.001**
	Unsatisfactory < 80%	32	64.0	3	6.0	
Patient safety measures	Satisfactory ≥ 80%	22	44.0	43	86.0	14.15 <0.001**
	Unsatisfactory < 80%	28	56.0	7	14.0	
Environmentalsafety measures	Satisfactory ≥ 80%	17	34.0	37	74.0	16.07 <0.001**
	Unsatisfactory < 80%	33	66.0	13	26.0	
Infection control measures	Satisfactory ≥ 80%	20	40.0	38	76.0	17.86 <0.001**
	Unsatisfactory < 80%	30	60.0	12	24.0	

(*) Statistically Significant at ≤0.05

(**) Highly statistically significant at ≤0.001



(**) Highly statistically significant at ≤ 0.001

Figure (1): Total knowledge level among the studied nurses about cardiac catheterization and safety measures pre and immediately post-educational guidelines (n=50)

Table 3: Nurses Practice mean scores regarding cardiac catheterization procedure among the studied nurses pre, immediately, and post educational guidelines implementation

Total practice score		Mean	± SD	P value
Total practice pre-catheterization procedure	Pre	34.2	5.7	F =208.2 P<0.0001
	Post	52.2	1.3	
Total practice during a catheterization procedure	Pre	29.4	4.0	F =403.5 P<0.0001
	Post	46.7	0.7	
Total practice after the catheterization procedure	Pre	33.4	1.5	F =494.5 P<0.0001
	Post	62.6	1.06	
Total practice	Pre	95.8	11.3	F =686.1 P<0.0001
	Post	160.6	1.4	

F = Analysis of variance test

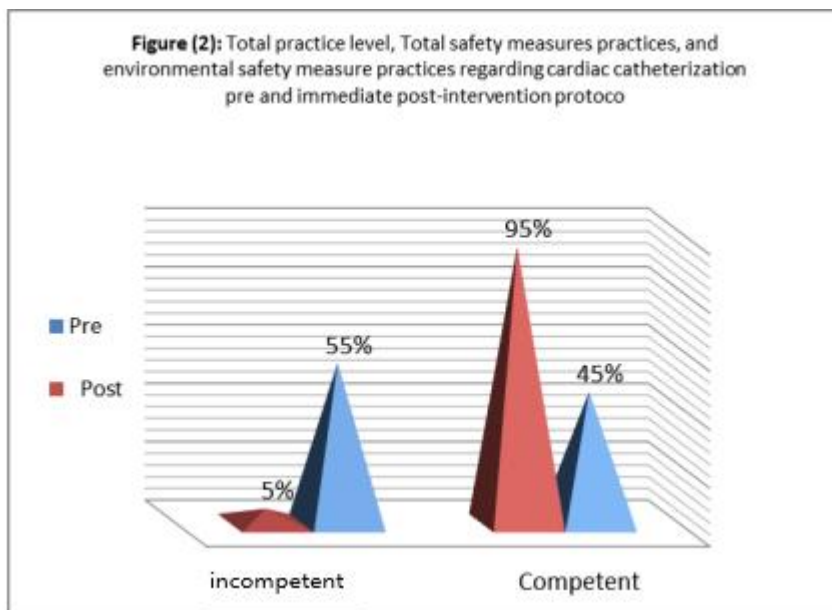


Figure (2): Total practice level, Total safety measures practices, and environmental safety measure practices regarding cardiaccatheterization pre and immediate post-intervention protocol (n=50).

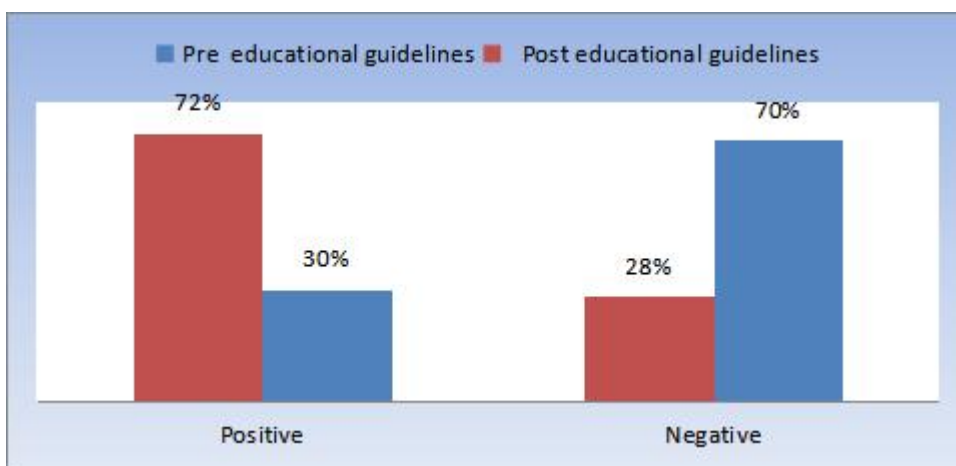


Figure (3): Total attitude level among the studied nurses toward patients' safety pre and post-educational guidelines (n=50)

Table (4) Correlation between total knowledge, practice, and attitude among the studied nurses immediately post-educational guidelines implementation (n=50)

Variables	Total knowledge		Total attitude	
	r	p	r	P
Total practice	0.387	0.015*	0.307	0.052*
Total attitude	0.875	<0.001**	-	-

(*) Statistically Significant at ≤ 0.05

(**) Highly statistically significant at ≤ 0.001

Discussion:

Globally, patient safety is becoming more crucial, and national focus has recently been drawn to improving patient safety (Findlay et al., 2016). Cardiac catheterization, the gold standard for

the diagnosis and treatment of heart conditions, is still the best way to detect the presence of coronary artery disease. Patient safety in reducing difficulties is increasingly recognized as being important in the practice of coronary care units (Fekry & Abd Elwahab, 2020).

A number of health disorders that need to be diagnosed and treated following the test may have it as a contributing cause. In cardiac catheterization units, nurses play a critical role by considering potential negative effects in order to deliver high-quality nursing care and ensure patient safety. The key to being a competent and successful nurse is having knowledge of and adherence to evidence-based practice (**Keshk & Elgazzar, 2018**). Because they provide crucial, high-quality nursing care that considerably improves patient safety, nurses are necessary in the cardiac catheterization unit. The idea of safety culture is crucial here, as it reflects one's or an organization's capacity to control risks and avoid harm to accomplish goals (**Fekry & El Wahab, 2020**).

The study's findings showed that the average age of the nurses was 35.45 ± 1.67 , with more than half of them being between 25 and 35. The researcher hypothesizes that the presence of recently graduated nurses in the cardiac catheterization units may be responsible for this distribution. This finding is consistent with a prior **Bayan, (2018)** study that looked into "Nurses' Knowledge Regarding Cardiac Catheterization at a General Hospital in Rania City." According to Bayan's study, the majority of the nurses she looked at were young people, with a mean age of 31.5 ± 7.58 with the majority of them being between the ages of 26 and 30. This age distribution agreement between the two studies supports the idea that many cardiac catheterization units include a sizable proportion of younger nurses, probably as a result of recent graduates entering the sector.

The results of research by **Mamdouh et al., (2020)** entitled "Assessment of Nurses' Performance Regarding the Implementation of Patient Safety Measures in Intensive Care Units," which discovered that about three-quarters of respondents were between the ages of 20 and 30, are consistent with this finding.

According to the results of the current study's marital status and gender analyses, more than three-fifths of the nurses were female and more than half of them were married. This validates the results of **Hassan's (2017)** study, which looked at nurses' understanding of patient safety following cardiac catheterization for adult patients at the Baghdad University's Ibn Al-Biter Specialist Centre for Cardiac Surgery. Additionally, it backs up **Younus (2018)**, who also noted that most nurses were female. Researchers speculate that this may be due to a lack of male nurses working in hospitals. After all, the nursing program has only begun to enroll female students. The majority of the study nurses were married, according to **Sharif et al.'s**

(2018) research, and our finding supports that conclusion.

More than one-third of them had a degree from the Technical Institute of Nursing, according to the findings of the current study. The current study and **Renato, (2018)** discovered that about one-third of the nurses had a background in a technical nursing institute. This consistency in results points to a potential pattern in the distribution of nursing staff with this type of educational background, which may be caused by factors like the accessibility of technical nursing institutes, the particular geographic region, or other factors influencing nurses' decision-making regarding their educational pathways.

On the other hand, the study's findings by **Fekry and Abd el Wahab (2020)**, a substantial majority of nurses have completed their secondary education.

This result runs counter to the findings of both **Renato, (2018)** and the current study. The researcher hypothesizes that this gap may be due to variations in the institution's policies and practices or the particular populations under examination. The findings of studies by **Feroze et al. (2017)**, **Keshk & Elgazzar (2018)**, and **Ali & Ali (2019)**, which discovered that more than half of nurses earned general nursing diplomas, are in disagreement with one another.

When analyzing and contrasting research findings, it is crucial to take the context and local circumstances into account because there are differences in the educational backgrounds of the nurses in these studies. The various profiles of nurses in various studies may be influenced by institutional rules, geographic regions, and the range of educational alternatives. Researchers should exercise caution when extrapolating their findings to larger groups since the investigated samples' unique characteristics might not be an accurate reflection of the nursing profession as a whole.

According to the study's findings regarding experience years, more than half of the nurses had between five and ten years of experience. Contrary to this result, **Bayan's (2018)** research revealed that more than two-thirds of the study individuals had work experience of between one and four years. These findings are different from those made public by (**Feroze, et al., 2017**), (**Rushdy, et al., 2016**), and (**Hassan, 2017**), who discovered that 58% of the research samples were cardiac catheterization unit personnel between the ages of 1 and 5. The (**Keshk & Elgazzar, 2018**) study, which claimed that the majority of the investigated nurses had worked for at least ten years, was consistent with this finding.

More than half of the nurses in the survey had not previously participated in any training sessions related to safety measures, according to the study's conclusions on this topic. This is in line with **Ali & Ali, (2019)** assertion that not all nurses participated in in-service education programs. The absence of opportunities for suitable training opportunities offered by nursing authorities may be the cause, according to researchers.

The current study's results supported the hypotheses and shown that there was a highly statistically significant difference between the evaluated nurses' overall knowledge of cardiac catheterization and safety precautions before and right away after educational guidelines implementation. When instructional standards were put into place, the general level of awareness among nurses on cardiac catheterization and safety measures significantly rose.

This result was that of **ElGazzar & Keshk (2018)**, who discovered that most nurses had a highly satisfactory level of patient safety knowledge regarding cardiac catheterization following educational guidelines implementation. According to the researcher, this outcome showed that patient safety teaching guidelines were successful in raising nurses' level of understanding.

These findings were consistent with **Rajesh (2018)**, who studied the effectiveness of a structured teaching program on knowledge and practice regarding patient safety after cardiac catheterization among cardiac nurses, according to which the mean improvement was determined to be at a statistically highly significant level. The pretest mean score of knowledge was 17.57, and the posttest mean score was 32.23. This large increase in knowledge suggests that the intervention had a beneficial effect on the participants' comprehension of cardiac catheterization and safety precautions, supporting the first hypothesis.

Overall, the study shows how the intervention improved nurses' understanding of cardiac catheterization and safety precautions while also highlighting a particular area of infection control expertise that could use more focus. These findings have implications for nursing education and training approaches, highlighting the necessity of continual professional development to make sure that nurses remain knowledgeable and skilled in delivering safe and effective care. Additionally, **Pandit et al., (2019)** study to measure cardiac nurses' knowledge and practice respect patient safety following cardiac catheterization found that the satisfactory level of post-intervention protocol indicates the effectiveness of the intervention protocol.

This is supported by a study to evaluate

the effect of training on nurses' knowledge and abilities conducted by **Abdelmoaty et al., (2020)**, which discovered a highly statistically significant difference in levels of acquired nurses' practices before and after the mutual training.

A highly statistically significant difference between total practice level, total safety measure practices, and environmental safety measure practices among the studied nurses after receiving educational guidelines was revealed by the current study ($p < 0.001$). These results were consistent with those of **ElGazzar & Keshk, (2018)** study, which focused on developing learning guidelines for nurses who are responsible for patients' safety before, during, or following cardiac catheterization in post-implementation educational protocol across all domains of care. Additionally, **Ali & Ali (2019)** revealed a statistically significant difference in the practices of nurses before, during, and after the program's implementation, indicating that all of them had insufficient levels of practice prior to the program and that more than half had acceptable levels of practice after its implementation.

Rajesh, (2018) found that the pretest mean practice score was 8.07 and the posttest mean score was 15.77, supporting this finding. According to the researcher, the improvement in nurses' practices following the implementation of educational guidelines may be attributable to those guidelines' effects. It was also related to how willing the nursing staff was to adapt their practices and accept any new performance guidelines. This outcome is also related to nurses' perceptions that environmental safety measures are not part of their responsibilities but rather the responsibilities of health and safety workers.

Ali and Ali, (2019) study on the "Effect of Designed Teaching Protocol Regarding Patients' Safety after Cardiac Catheterization on Nurses' Performance and Patients' Incidence of Vascular Complications" found a significant difference in nurses' practices before, during, and after program implementation. This finding was supported by their research. The majority of nurses do not follow environmental safety protocols, according to the **National Institute for Occupational Safety and Health, (2018)** study that examined workplace risk factors and prevention strategies for nurses in hospitals. This finding supports this point of view.

However, these results were at odds with those of **Abo El-ata et al., (2020)**, who claimed that more than half of the nurses in the study had satisfactory practices for caring for cardiac catheterization patients both before and after the procedure. Additionally, more than 75 percent of

them had adequate practice performing cardiac catheterizations.

In the current study, it was discovered that there was a statistically significant difference between the nurses' general attitudes toward patient safety before and after they received instruction. This observation lends credence to the third theory. This demonstrates the potency of the instructional techniques.

The results of a study by **Kaynar et al., (2019)** titled "Attitudes of Respiratory and Cardiac Therapists and Nurses about Measures to Prevent Post Cardiac Catheterization Complication" revealed that more than half of cardiac nurses had a favorable attitude toward safety culture to maintain patient safety after cardiac catheterizations, which supports these findings.

This study found a positive correlation between nurses' knowledge and practice total scores, suggesting that if nurses have enough knowledge, their practice will advance. This result supports the fourth theory. These results are supported by **Jabr et al., (2022)**, which found a statistically significant positive correlation between knowledge score and practice score. This result was in line with research by **Ali & Ali (2019)**, which showed a positive and significant correlation between nurses' knowledge and practice after program implementation. According to **El-Sol and Badawy, (2017)** research, participants' performance is significantly impacted by instructional programs for infection control precautions.

Conclusion:

The study's conclusions confirm its hypothesis, according to which implementing instructional standards will enhance the performance of cardiac nurses in terms of patient safety after cardiac catheterization. The investigated nurses' general knowledge, practice, and attitude toward cardiac catheterization and safety precautions improved noticeably after the intervention program. Following the implementation of educational guidelines, total knowledge and attitude among the studied nurses showed a highly statistically significant correlation, whereas total practice and total knowledge and attitude among the studied nurses showed a statistically significant correlation.

Recommendations:

Based upon the findings of the current study, the following are recommended:

- To increase the understanding of safety measures principles and practical abilities for cardiac nurses.
- Patient safety-related standard nursing procedure manuals must be written up and

made available in both Arabic and English.

- Each critical care unit needs posters outlining the patient safety precautions.
- Apply this research once more to a larger probability sample that was gathered from various Egypt-based places to make generalizations.
- Cardiac catheterization units should have clearly illustrated guidance data regarding cardiac catheterization technique performance and knowledge pre/post cardiac catheterization.

Acknowledgments

The authors appreciate all nurses who participated in the study and helped to facilitate the research process.

Authors' contributions:

Each author contributed significantly to the writing of the paper draft. The ideation, planning, and execution of the program, methodology, examination of formal and administrative procedures, data input and analysis, initial draft and manuscript writing, editing, and revision were all equally contributed to by all of the authors. All authors read and approved the final manuscript.

Funding: no Funding

Conflict of interest:

No conflicts of interest exist, according to the authors, with the publishing of this paper.

Availability of supporting data:

The corresponding author will provide the datasets used and/or analyzed during the current work upon reasonable request.

References

- Abdelmoaty A., Sabry H., ElSebaie E. & Kenawy A. (2020): Indwelling Urinary Catheter: Effect of Training on Nurses Knowledge and Skills. *The Egyptian Family Medicine Journal* Vol 4, No. 1, May 2020. DOI:10.21608/efmj.2020.90206
- Abo El-ata,A., Shehab,M., El- Zayat,R.(2020): Assessment of nurses performance regarding

- care of patients undergoing cardiac catheterization. *Port Said scientific Journal of nursing*; 7(2):57-77.
- Ali H. & Ali M. (2019): Effect of Designed Teaching Protocol Regarding Patients' Safety after Cardiac Catheterization on Nurses' Performance and Patients' Incidence of Vascular Complications, *International Journal of Studies in Nursing*, Vol. (4), No.(1), Pp.107-120. DOI: [https:// doi. org/ 10. 20849/ ijsn.v4i1.555](https://doi.org/10.20849/ijns.v4i1.555)
 - Coomes A., Haghbayan H. & Cheema N. (2020): Distal Trans radial Access for Cardiac Catheterization: a systematic scoping review. *Catheterization and Cardiovascular Interventions*, 96(7):1381-1389. DOI: 10.1002/ccd.28623.
 - Ebekozen A., Aigbavboa C., Ayo-Odifiri S. & Salim N. (2020): An Assessment of Fire Safety Measures in Healthcare Facilities in Nigeria. *Property Management* 6 (3): 21-39. DOI: 10.1108/PM-07-2020-0043
 - Elgazar W, Raghep M., Mohamed H. & Mohamed R. (2020): Effects of an Educational Program on the Nurses' performance regarding Vascular Access Infection Prevention. Thesis for a doctorate in nursing science, Medical-Surgical Nursing, Faculty of Nursing, Benha University.
 - El Solan, A., & Badawy, A. (2017): The effect of a designed teaching module regarding prevention of cardiac catheter-associated bloodstream infection on nurses' knowledge and practice. *American journal of nursing science*; 6(1):11-18.
 - Elgazar W, Raghep M., Mohamed H. & Mohamed R. (2020): Effects of an Educational Program on the Nurses' performance regarding Vascular Access Infection Prevention. Thesis for a doctorate in nursing science, Medical-Surgical Nursing, Faculty of Nursing, Benha University.
 - Elgazzar, S, E., & Keshk, L, I. (2018): Creating learning guidelines for nurses caring for patient's safety undergoing cardiac catheterization. *Research journal of education*; 4 (7): 101- 109.
 - El-Hosany W., Habashy A., Abd El-Wahab E. & Ali H., (2019): Developing a Proposed Plan for Patients' Safety Management System in Cardiac Catheterization Units at Suez Canal University Hospitals, International Scientific Conference of Faculty of Nursing, Suez Canal University, In collaboration with Edith Cowen University- Australia, 21-22. [https:// www. researchgate. net/ publication/ 331311530](https://www.researchgate.net/publication/331311530).
 - Fekry E. & Elwahab A. (2020): Effect of a Construction Educational Protocol on Nurses' Knowledge, Performance and its Effect on Patient Satisfaction undergoing Cardiac Catheterization. Available: [http:// www. sciencepub. net/ researcher](http://www.sciencepub.net/researcher), 4(7): 29-
 - Feroze M., Afzal M., Sarwar H., Galani A.& Afshan S., (2017): Assess Knowledge and Practice of Registered Nurses about Patient Safety after Cardiac Catheterization in Punjab Institute of Cardiology Hospital, Lahore. *International Journal of Musculoskeletal Pain Prevention*, Vol. (2),No. (2), Pp. (233-238).
 - Findlay Ú., Best H., Ottrey M., (2016): Improving patient safety in radiotherapy through error reporting and analysis, *Elsevier Ltd on behalf of the college of radiographers*, Vol. (22), Supplement December 2016, Pp. (S3- S11).
 - Hansmann G., Rich S. & Maron A. (2020): Cardiac Catheterization in Pulmonary Hypertension: Doing it right, with a catheter on the left. *Cardiovascular Diagnosis and Therapy*, Cardiovasc Diagn Ther. 2020 Oct; 10(5): 1718–1724. Doi: 10.21037/cdt-20-483.
 - Hassan A., (2017): Assessment of Nurses Knowledge about Patient Safety after Cardiac Catheterization for Adult Patients in Ibn Al - Biter Specialist Center Cardiac Surgery, *International Journal of Science and Research (IJSR)*, Vol. (6), No.(5), Pp.(2763-2766).
 - Henedy, W., & El-Sayad, H. (2019). Nurses' knowledge and practice regarding patient safety post cardiac catheterization. *IOSR Journal of nursing and health science*; 8(3):43-52.
 - Jabr, E., Taha, N., & Metwaly, E. (2022): Nurses' Knowledge and Practice Regarding Care for Patients Undergoing Cardiac Catheterization. *Zagazig Nursing Journal*; 18 (1): 1-15.
 - Kaynar M., Mathew, J. & Hudlin, M. et al. (2019): Attitudes of Respiratory and Cardiac Therapists and Nurses about Measures to Prevent Post Cardiac Catheterization Complication: A Multicenter, Cross-Sectional Survey Study. *Cardio Respiratory Care*, 52(12): pp. 1687 – 1694.
 - Kern, M, J., & Kirtane, A, J. (2020): Catheterization and angiography. *Goldman-Cecil Medicine*. 26th ed., Philadelphia, Elsevier: pp 50- 53.
 - Kern, M, J., Lim, M, J., & Sorajja, P. (2021): *Cardiac Catheterization Handbook E-Book*, 7th Edition, Philadelphia, Elsevier: pp 1-79.
 - Keshk L., Elgazzar S., (2018): Creating Learning Guideline for Nurses Caring for Patients Safety Undergoing Cardiac Catheterization, *Research Journal of Education*, Vol. (4), Issue. (7), Pp.101-109.
 - Mamdouh E. A., Mohamed H. S. & Abdelatif D. A. (2020): Assessment of Nurses' Performance Regarding the Implementation of Patient Safety Measures in Intensive Care Units. *Egyptian*

- Journal of Health Care, 11(1), 82-100. doi: 10.21608/ejhc.72596
- Morton P., & Fontaine, D. (2018). Patient management: cardiovascular system, critical care nursing: a holistic approach, 11th ed. Lippincott Williams and Wilkins, pp.269- 277.
 - National Institute for Occupational Safety and Health (NIOSH). (2018): Workplace risk factors and prevention strategies for nurses in hospitals Assessment Annual Meeting. SageCA: Los Angeles, CA: *SAGE Publications*. 62, (1): pp. 838-842
 - Pandit P., Garg M. & Matwankar P. (2019): A study to assess the Knowledge and Practice among Cardiac Nurses about Patient Safety after Cardiac Catheterization. *Med J Armed Forces India*; 5(4):115-20
 - Rahman H., Demir O. M., Ryan M., McConkey H., Scannell C., Ellis H. & Perera D. (2020): Optimal use of Vasodilators for Diagnosis of Microvascular Angina in the Cardiac Catheterization laboratory. *Circulation: Cardiovascular Interventions*. 2020; 13:e009019
<https://doi.org/10.1161/CIRCINTERVENTIONS.120.009019>.
 - Rajesh, B. (2018): Effectiveness of structured teaching program on knowledge and practice regarding patient safety after cardiac catheterization among cardiac nurses. Master's thesis at Arvinth College of Nursing Namakkal. Available at <https://www.semanticscholar.org/>
 - Rajesh, B. (2018): Effectiveness of structured teaching program on knowledge and practice regarding patient safety after cardiac catheterization among cardiac nurses. Master's thesis at arvinth college of Nursing Namakkal. Available at <https://www.semanticscholar.org/>
 - Renato H. (2018): Complications Associated with Cardiac Catheterization. American College of Cardiology: American Heart Association, chronic angina
 - Rushdy, T., Youssef, W., Elfeky, H., (2016): Nurses' knowledge and performance regarding the care of patients connected to intra-aortic balloon pump at Cairo University hospitals *Egyptian Nursing Journal*: Available: www.elmagla.egy2010@yahoo.com
 - Shaik F. A., Slotwiner D. J., Gustafson G. M. & Dai, X. (2020): Intra-procedural arrhythmia during Cardiac Catheterization: A systematic review of the literature. *World Journal of Cardiology*, 12(6): 269 -284 DOI: 10.4330/wjc.v12.i6.269
 - Sharif B., Salih S., Sailh N. & Salim B. (2018): Nurses' Knowledge Regarding Cardiac Catheterization at General Hospital in RaniaCity, *Kurdistan Journal of Applied Research (KJAR)* Print-ISSN: 2411-7684 | Electronic-ISSN: 2411-7706 Special Issue: 2nd International Conference on the Health & Medical Sciences | DOI: 10.24017/science.2018.2.31.
 - Susan L. W. & Erikas S. F. (2019): Cardiac Nursing, 7th Ed., Copyright by Lippincott Williams and Wilkins, pp. 409-424.
 - Thapa R. & Neupane G. (2018): Intra-Aortic Balloon Pump Implantation Therapy. *International Journal of Recent Scientific Research*, 9(2): 459-462 DOI: <http://dx.doi.org/10.24327/ijrsr.2018.0902.1666>.
 - Wankhede A. & Biradar S., (2019): A study to assess the Knowledge and Practices among Cardiac Nurses about Patient Safety after Cardiac Catheterization, *International Journal of Science and Research (IJSR)*, Vol. (8), No. (6), Pp.916-920. Wiley Blackwell, 1st ed, UK, p39.
 - World Health Organization (WHO) (2019): Patient Safety- Global Action on Patient Safety. Report by the Director-General. Geneva: ([https:// apps. who. int/ gb/ ebwha/ pdf_ files/ WHA72/A72_26-en.pdf](https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_26-en.pdf)).
 - Younus, F., S. (2018): Nurses' knowledge regarding patients' safety after diagnostic cardiac catheterization in Azadi Teaching Hospital in Kirkuk City. *Kirkuk University Journal Scientific Studies*; 13(4): 45-56.