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Effectiveness of an Educational Program on Nurses' Performance Regarding Care of Patients Undergoing Coronary Artery Bypass Graft

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ABSTRACT

Background: Coronary artery bypass grafting is a type of surgery called revascularization, used to improve blood flow to the heart in people with severe coronary artery disease. So, nurses should have adequate knowledge and practices to be able to manage patients undergoing Coronary Artery Bypass Graft. ***The study was aimed to*** evaluate the effectiveness of an educational program on nurse' performance regarding care of patients undergoing Coronary Artery Bypass Graft. ***Research design*****:** Quasi experimental research design was utilized to conduct the aim of the study. ***Tool of data collection*****:** two tools were used to collect data: ***Tool I:*** A structured interview questionnaire for nurses ***Tool II:*** Nurses practice observational checklist tool. ***Setting:*** The study was conducted in Cardio-thoracic Intensive Care Unit, at Zagazig University Hospitals. ***Study subjects*****:** All available nurses (40) who provide direct care to patients with coronary artery bypass graft at least one year of experience in intensive care units and accept to participate in the study. ***Result*****:** Two third 65% of studied nurses aged were from 20 to 30 years old, 77.5% of the studied nurses were females and 67.5% were married, 50% of the studied nurses had technician diploma degree and did not have enough income (57.5%), and from rural area (65%). More than half of studied nurses (52.5%) attended training about care of patients. Highest percent of studied nurses had less than twenty years of experience in nursing (90%) and less than ten years of experience in intensive care unit (80%).The total mean post-test knowledge score of staff nurses who received educational program regarding care of patient undergoing coronary artery bypass graft was significantly higher than the mean pre-test knowledge score ($p<0.001$). As well, the nurses' practice towards care of patient undergoing coronary artery bypass graft after an educational program showed greater improvement than before the program ($p<0.001$). Additionally, there was a highly significant correlation between knowledge and practice of studied nurses *(P= 0.001**)*. ***Conclusion***: According to the present study, it can be concluded that there was a statistically significant improvement in the studied nurses' knowledge and practices regarding care of patient undergoing coronary artery bypass graft.

Recommendation: The study recommended conducting training program and workshops periodically for nurses about care of patient undergoing coronary artery bypass graft to improve their performance and enhancing the patient care level and the quality of care provided to this group of patients.

Keywords*:* Nurses' Performance, Knowledge & practice, coronary artery bypass graft, post-operative care

1. INTRODUCTION

Coronary artery disease (CAD) is one among the major causes of mortality in patients all around the globe. It has been reported by the World Health Organization (WHO) that approximately

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80% of cardiovascular diseases could be prevented through lifestyle modifications. Management of CAD involves the prevention and control of cardiovascular risk factors, invasive and non-invasive treatments including coronary revascularizations, adherence to proper medications and regular outpatient follow-ups **(Qiu, 2024).** Coronary artery bypass grafting (CABG) was introduced in the 1960s as the first procedure for direct coronary artery revascularization and rapidly became one of the most common surgical procedures worldwide, with an overall total of more than 20 million operations performed. CABG continues to be the most common cardiac surgical procedure performed and has been one of the most carefully studied therapies **(Mack, Squiers, Lytle, DiMaio, & Mohr, 2021).**

Coronary artery bypass grafting (CABG) is recognized as a more effective intervention than medical therapy for improving survival rates in patients with left main or three-vessel coronary artery disease (CAD). CABG not only alleviates angina symptoms but also plays a crucial role in the treatment of complications arising from unsuccessful postoperative care, such as myocardial infarction (MI), dysrhythmias, and heart failure **(Doenst et al., 2022).**

In coronary artery bypass grafting (CABG), the **greater saphenous vein** is the most commonly used conduit, followed by the **lesser saphenous vein**, **cephalic vein**, and **basilic vein**. Additionally, the **internal mammary arteries** (both right and left) are frequently utilized due to their favorable outcomes. Occasionally, other arterial conduits such as the **radial artery** and **gastroepiploic artery** are also employed **(Lewis et al., 2020).**

While CABG is often life-saving, **Litwinowicz et al. (2022)** highlighted that long-term survival following postoperative MI after CABG is a significant concern, they emphasized the importance of effective postoperative management. This includes addressing complications that may arise, such as renal failure, respiratory failure, perioperative myocardial infarction (MI), vein graft closure, hemorrhage, micro emboli, dysrhythmias, pericarditis, post pericardiotomy syndrome, embolism, pneumonia, atelectasis, hemothorax, stroke, post cardiotomy delirium.

Nursing care in the immediate postoperative period for CABG patients in the ICU is centered around thorough monitoring, maintaining hemodynamic stability, pain management, early detection of complications, and promoting effective recovery strategies. A focus on these objectives helps facilitate a smooth recovery and enhances overall patient outcomes **(Rogers, 2024).** The complexity of care during this phase is largely due to the potential for hemodynamic instability, which requires nurses to be vigilant and responsive to the evolving needs of their patients **(Dutton, & Elliott, 2020).**

Nursing interventions for patients undergoing CABG surgery include preparing patients for surgery, providing care during and after surgery, and providing information and education to

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patients and family members about home care after discharge from the hospital **(Shan, Chen, Zhou, & Wen, 2023,** Prehabilitation has emerged as a proactive approach to prepare patients for surgery, with study by **Steinmetz et al., (2020)** demonstrating its positive impact on functional capacity and quality of life.

Nurses play a critical role in the implementation of these prehabilitation strategies. An educational program could enhance their skills in this area, ultimately improving patient outcomes before and after surgery **(Elendu et al., 2024).**

The integration of simulation-based training in medical education, as highlighted by **Elendu et al. (2024),** can significantly enhance the skills and knowledge of nurses, particularly in the context of post-coronary artery bypass grafting (CABG) care. This training approach provides a safe environment for nurses to practice essential skills, such as medication management and patient education, which are critical for improving patient outcomes. Additionally, **Heitmann, Gudmundsdottir, Jonsdottir, Gudbjartsson, & Sigurdsson, (2022)** emphasized the significance of educational program on cardia patients after CABG. Nurses play a vital role in this process, as they are often t++he primary educators for those patients.

Significance of the study

Improving nursing knowledge and practice regarding care of patients undergoing Coronary Artery Bypass Graft is very essential that can be achieved through developing standards of intraoperative nursing interventions, clear identification of deficiencies in provision of care, and increasing nurses' awareness regarding care of patients undergoing Coronary Artery Bypass Graft through safe practice **(Abd Elaty et al., 2014).** Training has been shown to decrease error and increase the ability to solve problems, particularly for inexperienced professionals, whereas failure of training is often attributed as a major cause of complications and incidents **(Mohamed et al., 2021)**

If the nurse is unable to maintain with recommended postoperative care, these will lead to complications to the patient; increase the patient length of hospital stays, increase patient's morbidity and mortality and raising the costs of treatment and increasing effort of the care providers. **(Ibrahim et al., 2015).**

Aim of the Study:

The aim of the current was to evaluate the effectiveness of an educational program on nurses' performance regarding care of patients undergoing Coronary Artery Bypass Graft.

Subjects and Methods:

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A quasi-experimental research design with pre- post test was conducted to achieve the aim of the study. The study was conducted in Cardio-thoracic Intensive Care Unit, at Zagazig University Hospitals. All available nurses (40) who provide direct care to patients with coronary artery bypass graft at least one year of experience in intensive care units and accept to participate in the study.

Tools of data collection:

- **Tool I**: **An Interviewing question-nnaire:** An Interviewing questionnaire was written in a simple Arabic language to avoid misunderstanding. It was designed by the researcher after reviewing of related literature **(Poser et al., 2024; Alaa et al., 2023; Linton and Matteson, 2023; Lewis et al., 2016)** to assess nurses` knowledge regarding care of patient undergoing coronary artery bypass graft, and **composed of two part as the following :**

Part I: Demographic characteristics of the nurses: It was composed of 8 closed ended questions including age, sex, and marital status, level of education, years of experience, attendance of training program, presence of continuing training centers in hospital for nurses, and presence of open-heart guidelines for nurses **(Amin, et al., 2021).**

Part II: Nurses knowledge about coronary artery bypass graft: It was developed by the researcher to assess nurses' knowledge regarding care of patient undergoing coronary artery bypass graft. It composed of two parts include:

A. N**urses' knowledge about assessments of coronary artery by bass graft:** It was composed of 6 main questions as multiple choice questions MCQ such as (Definition of coronary artery bypasses surgery, Indications for surgery, Common arteries used for grafting, immediate post-operative complications, Causes of bleeding after surgery, Duration antibiotic after surgery).

B. Nurses' of knowledge about postoperative care for patient on mechanical ventilation: It was composed of 62 questions, as multiple choice questions MCQ, yes or no. It concerned with assessment of the following :

- **Nurses' knowledge regarding to: the Care of patients with endotracheal tube.** It was composed of 5 questions (sign of exit of endotracheal tube, Care of patients with endotracheal tube and so on…)
- **Nurses' knowledge regarding to: the care of airway:** It was composed of 4 questions (best methods for keeping patent airway, fixation of airway tube and so on…).
- **Nurses' knowledge regarding to: the Care of patients during suction.** It was composed of 8 questions (to avoid decreasing oxygen level, precaution before suction patient on ventilator and so on…).

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- **Nurses' knowledge regarding to: nursing care of central venous catheter:** It was composed of 5questions (routine change of central venous catheter, advice to use ACVC and so on…).
- **Nurses knowledge regarding to: the Care of patients mouth and airway:** It was composed of 2 questions (routine removal& clean of airway tube, to avoid ventilator associated pneumonia).
- **Nurses' knowledge regarding to: nursing care during analysis of blood gases:** It was composed of 7 questions (evidence of efficient nursing care to patient with failure of gas exchange, nursing role to patient with failure of gas exchange and so on…).
- **Nurses knowledge regarding to: nursing care toward moisture:** It was composed of 3 questions (benefits of ventilators, using lubricants in temperature of fluids putted in lubricant and moisturant filled with)
- **Nurses' knowledge regarding to: nursing care toward respiratory exercise:** It was composed of 8 questions (best position of the patient, change position exercise and so on…).
- **Nurses' knowledge about nursing care as regard diet and fluid:** It is composed of four questions as MCQ. It concerned with to prevent thickness of respiratory discharge, Importance of feeding to patient on ventilator, Measures used at insertion of Ryle and Disadvantage of improper feeding of patients on ventilator.
- **Nurses knowledge regarding to: nursing care toward infection control:** It was composed of 3 questions(time of changing tube of ventilator, time of sterilization of ambo bag and time of change saline used for cleaning tubes)
- **Nurses' knowledge regarding to: the Care of patients with chest tube:** It was composed of 7 questions (indication of using chest tube, usually insertion of chest tube under general anesthesia and so on…).
- **Nurses' knowledge regarding to: nursing care of urinary catheter:** It was composed of 10 questions (small catheter is preferred, urinary catheter used when necessary and removed when patient discharged and so on…).
- **The scoring system for nurses' knowledge regarding the care of patients undergoing coronary artery bypass graft:** For the knowledge items, a correct response was scored 1 and the incorrect zero. For each area of knowledge, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. Knowledge was considered satisfactory if the percent score was 70% or more and unsatisfactory if less than 70%.

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- **Tool II: Observational checklist of nurses' practices for patients with CABG:** It was developed by the researcher to assess nurses' practice during caring of patients undergoing CABG. The tool covered all procedures about nursing for patients with CABG, which was divided into two parts as the following and the answer with done or not done.

1- Check list about primary assessment:-It consists of twelve items.

- **Part 1:** consisted of 4 items about assessment of vital signs.
- **Part 2:** consisted of 4 items about respiratory assessment
- **Part 3:** consisted of 3 items about cardiovascular assessment
- **Part 4:** consisted of 6 items about neurological assessment
- **Part 5:** consisted of 3 items about fluid/electrolyte assessment
- **Part 6:** consisted of 6 items about Circulation
- **Part 7:** consisted of 5 items about Digestive system
- **Part 8:** consisted of 5 items about Urinary system
- **Part 9:** consisted of 6 items about medication administered as ordered
- **Part 10:** consisted of 3 items about Patient position
- **Part 11:** consisted of 6 items about Wound assessment
- **Part 12:** consisted of 5 items about Pain assessment

2- Check list about secondary assessment: it consists of seven items.

- **Part 1:** consisted of 6 items about Maintain patent airway
- **Part 2:** consisted of 42 items about Care of endotracheal tube
- **Part 3:** consisted of 37 items about ABG
- **Part 4:** consisted of 32 items about Ventilator weaning and safe extubation
- **Part 5:** consisted of 25 items about measuring central venous pressure (CVP)
- **Part 6:** consisted of 22 items about Routine care for chest tube.
- **Part 7:** consisted of 14 items about Measuring Intake and Output.

Scoring system for nurses' Practice: In the observation checklists, the items “not done” were scored zero. For each procedure, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into percent scores. The practice was considered satisfactory if the percent score was 80 % or more and unsatisfactory if less than 80% based on data collection.

Ethical consideration

After obtaining of agreement of the Research Ethics Committee (REC) at faculty of nursing, Zagazig University, the agreement for participation of the participants was taken after full

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explanation of the aim of the study. Participants were given the opportunity to refuse the participation. Also, they were assured that the information is confidential and used for the research purpose only.

Content validity and reliability

Content validity was conducted to determine whether the content of the tool cover the aim of the study. This stage developed by a jury of five experts, who reviewed the tool`s content for clarity, relevance, comprehensiveness, understanding and ease for implementation. All recommended modifications were done.

Cronbach alpha coefficient was calculated to assess the reliability of the scales through their internal consistency.

Scale	Cronbach's Alpha
Knowledge	0.832
Practice	0.791

Pilot study

A pilot study for tools of data collection was carried out prior to data collection in order to test the clarity, applicability, feasibility, relevance of the data collection, and to identify any possible obstacles that may hinder the data collection. For this study, the researcher selected 10% of the study subjects (4 nurses) random to participate in the pilot testing of the questionnaire and checklist from CCU. Nurses involved in the pilot study were included in the study sample because of no modifications in the tools.

Field work

The study was implemented in six months started from June 2023 to the end of December 2023. The fieldwork was carried out in four phases, namely assessment, planning, implementation and evaluation.

Assessment phase: After the study protocol has been approved, an official permission was taken from the director of Zagazig university hospital after explanation of the purpose of the study. Once the researcher has gained the approval; the researcher visited the setting and met with the nursing director of cardio-thoracic Intensive Care Unit, at Zagazig University Hospitals for scheduling the fieldwork activities. The researcher explained the aim and nature of the study in order to gain their cooperation during data collection. Eligible ones were recruited after being informed about their ethical rights and after providing their oral informed consent. The

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information obtained served as baseline data or pretest, and guided the researcher in the preparation to instructional module booklet.

The staff nurses` practice was assessed by the researcher using the observational checklist. This was done prior to administration of the questionnaire sheet to ensure the maximal realistic observations of nurses` practice and minimize the possibility of bias. The observation was done at morning and afternoon shifts while the nurse was providing care to patients.

The researcher then collected baseline pretest data by distributing structured interviewing questionnaire to each nurse with clear instructions about its filling. The sheet was completed by each nurse in the presence of the researcher to ensure homogeneity and validity of responses. This was carried out in the clinical area where the nurses were providing the care for patients. It took about thirty-five minutes by each staff nurse to fill the sheet

Planning phase

This phase started with designing Instructional module booklet, based on staff nurses` learning needs identified from assessment data, in addition to most recent related literature to improve nurses` knowledge and practice regarding care of patient undergoing coronary artery bypass graft. The instructional module booklet (Appendix III) was then prepared in simple Arabic language to help nurses assimilate and refresh the information provided to achieve aim of the study. This booklet covered essential aspects of the theoretical and practical related to CABG such as general Knowledge about CABG, nursing management / intervention for patients with CABG, infection control polices/precautions, Health education for patients with CABG and pre-operative and postoperative nursing care of patient undergoing CABG. The booklet was colored printed and served as a guide during the training as a reference staff nurses later.

The general objective of the instructional module was to enhance nurses' performance regarding care of patients undergoing Coronary Artery Bypass Graft. The content of the instructional module sessions was organized as following:

- **Theoretical part:** This started with objectives of the instructional module and an introduction about Coronary Artery Bypass Graft and it is effect on nurses` performance including their knowledge and practice. This covered the following:

- Introduction about heart and its anatomical structures.
- Definition of Coronary Artery Disease.
- Causes and risk factors of Coronary Artery Diseases.
- Prevention of Coronary Artery Disease.
- Diagnosis and treatment of Coronary Artery Disease.

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- Definition of Coronary Artery Bypass Graft (CABG).
- Indication of CABG.
- Equipment, personnel, preparation, and technique regarding CABG.
- Potential complications of CABG.
- Nursing care regarding patients undergoing CABG.
- **Practical part: This included:** This part included nursing role regarding Coronary Artery Bypass Graft:
- Demonstration and re-demonstration of general care of patients undergoing Coronary Artery Bypass Graft.
- Demonstration and re-demonstration of endotracheal tube care.
- Demonstration and re-demonstration of chest tube care.
- Demonstration and re-demonstration of suctioning.
- Demonstration and re-demonstration of central venous catheter care.
- Demonstration and re-demonstration of cardiopulmonary resuscitation.
- Demonstration and re-demonstration of ECG.

Implementation phase

The instructional module was implemented for staff nurses in the study setting in small group sessions with integration of the theory into practice. The content of the instructional module was divided into (8) sessions. The duration of each session was 30-45 minutes. At the beginning of the first session the researcher provided the attendants with an orientation of the instructional module and its purpose and the staff nurses were informed about time and place of the sessions. The instructional module implementa-tion took a period of one month for each small group. The instructional module consisted of (8) sessions (3 theoretical and 5 practical sessions). The sessions were conducted during the morning shifts. The morning shifts session lasted from 11:00 AM to 1:00 PM.

Each session was started by a summary of the objectives of session and a summary of what was given in the previous session. The researcher used simple scientific terms and language to suit the level of understanding of the attended staff nurses, with the use of the attractive media and methods. This included small group discussions, teaching and correction on the spot, real objects, posters and learning videos were also used to clarify some items during training. Motivation and reinforcement techniques as praise and recognition during instructional module sessions were used to enhance learning. The instructional module booklet was distributed to all attendants from the first day of instructional module implement-ation.

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The number of staff nurses was about 12 nurses in each shift according to their work schedule. Since it was difficult to gather all shift nurses at one time, they were divided into three groups, each group consisting of four nurses. This was done with the aim of giving an equal chance for each nurse to attend the sessions of instructional module without influence of work stress as the work schedule allows. The instructional module was implemented for each group separately to ensure exposure of all nurses to the same instructional module content using the same teaching strategies and media.

Evaluation phase:

After receiving the instruction module, the studied subjects were evaluated for their knowledge and practice regarding care for patient undergoing CABG. It was done immediate at the end of instruction module sessions by utilizing tool I and tool II as a posttest assessment, follow up after 3 months and comparing with pretest assessment regarding the nurses' knowledge and practice about care for patient undergoing CABG.

Statistical Analysis:

All data were collected, tabulated and statistically analyzed using **SPSS** 20.0 for windows (SPSS Inc., Chicago, IL, USA 2011)). Quantitative data were expressed as the mean ± SD and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). **Mc nemar** test was used to compare between two dependent groups of categorical data. **Paired t-test** was used to compare between two dependent groups of normally distributed variables. Wilcoxon Signed Ranks Test was used to compare between two dependent groups of not normally distributed variables. Percent of categorical variables were compared using Chi-square test or **Fisher's exact** test when appropriate. **Spearman correlation coefficient** was calculated to assess relationship between study variables, (+) sign indicate direct correlation & (-) sign indicate inverse correlation. Multiple linear regression (step-wise) was also used to predict factors which affect practice score. Cronbach alpha coefficient was calculated to assess the reliability of the scales through their internal consistency. P-value < 0.05 was considered statistically significant, p-value < 0.001 was considered highly statistically significant, and p-value ≥ 0.05 was considered statistically non-significant (NS).

RESULTS:

Table (1) represents frequency and percent distribution of demographic characteristics of studied nurses. It was found that about two third of studied nurses (65%) were from 20 to 30 years old with mean of age (31.22± 8.05). Furthermore, most of them were females (77.5%),

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married (67.5%), had technician diploma (50%), did not have enough income (57.5%), and from rural area (65%). More than half of studied nurses (52.5%) attended training about care of patients. Highest percent of studied nurses had less than twenty years of experience in nursing (90%) and less than ten years of experience in intensive care unit (80%).

Table (2) demonstrates total mean scores of knowledges and its domains about post-operative care of patient with coronary artery bypass as reported by the studied nurses throughout study phases. It was found that there was a highly significant ($p<0.001$) improvement in total mean scores of knowledges and its domains in post phase in comparison with pre phase.

Figure (1) shows that total satisfactory level of knowledge about post-operative care of patient with coronary artery bypass highly statistically ($p<0.001$) increased from 22.5% in pre phase to 90% in post phase.

Table (3) represents distribution of total score of satisfactory practice and its domains about post-operative care of patient with coronary artery bypass. It was observed that 62.5 % and 70 % of studied nurses had satisfactory practice scores about primary and secondary assessments respectively in pre phase. These percentages highly significantly($p<0.001$) improved to 90% and 97.5% respectively in post phase. Also, total satisfactory practice of studied nurses increased from 62.5% in pre phase to 95% in post phase

Table (4) demonstrates Relation between demographic characteristics of studied nurses and their satisfactory knowledge score throughout study phases is revealed in table 4. It was found that there is no a significant relation between socio-demographic characteristics of studied nurses and their satisfactory knowledge score in pre-phase. While, there is a highly significant ($p<0.001$) relation between age, experience years in nursing & ICU and satisfactory knowledge score of studied in post phase. Where, high percent of studied nurses who had satisfactory knowledge score in post phase, aged from 20 to 30 years, and had experience less than 20 years in nursing and less than 10 years in ICU..

Table (5) displays relation between demographic characteristics of studied nurses and their satisfactory practice score throughout study phases. It was found that there is no a significant relation between demographic characteristics of studied nurses and their satisfactory practice score in pre-phase. While, there is a significant relation between gender ($p<0.001$), marital status ($p<0.001$) & attending training about care of patients ($p<0.05$) and satisfactory practice score of studied nurses in post phase. Where, high percent of studied nurses who had satisfactory practice score in post phase, were female, married and attended training about care of patients.

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Table (6) declares the correlation between knowledge and practice of studied nurses throughout study phases. It was observed that there was no a significant correlation between knowledge and practice of studied nurses in pre phase. However, there was a highly significant ($p<0.001$) correlation between knowledge and practice of studied nurses in post phase.

Table 1: Frequency and Percent distribution of Demographic Characteristics of studied nurses (n=40).

Demographic Characteristics	Frequency	Percent (%)
Age:		
20-<30	**26**	**65.0**
30-<40	**8**	**20.0**
40-50	**6**	**15.0**
Range	**21-50**	
Mean± SD	**31.22± 8.05**	
Gender		
Male	**9**	**22.5**
Female	**31**	**77.5**
Nursing qualification:		
Diploma	**20**	**50.0**
Technician diploma	**20**	**50.0**
Bachelor	**0**	**0.0**
Marital status:		
Single	**11**	**27.5**
Married	**27**	**67.5**
Widow	**2**	**5.0**
Income		
Not enough	**23**	**57.5**
Enough	**17**	**42.5**
Residence		
Rural	**26**	**65.0**
Urban	**14**	**35.0**
Attended training about care of patients:		
Yes	**21**	**52.5**
No	**19**	**47.5**
Experience years in nursing		
<20	**36**	**90.0**
≥ 20	**4**	**10.0**
Range	**1-30**	
Mean± SD	**9.42 ± 8.54**	
Experience years (ICU)		
<10	**32**	**80.0**
≥10	**8**	**20.0**
Range	**1-20**	
Mean± SD	**6.72± 5.81**	

Table 2: Total mean scores of knowledges and its domains about post-operative care of patient with coronary artery bypass as reported by the studied nurses throughout study phases (n=40)

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Nurse knowledge	Satisfactory knowledge		W	p. value
	Pre	Post		
	Mean± SD			
Nurses' knowledge about CABG operation	2.82±1.29	5.07±0.88	-5.199	0.001**
Nurses' knowledge about nursing care after operation:	1.70±0.88	4.22±0.86	-5.498	0.001**
Care of patients with endotracheal tube				
Care of airway	0.32±0.57	4.05±0.93	-5.558	0.001**
Care of patients during suction	3.32±1.71	6.95±1.03	-5.470	0.001**
Nursing care of central venous catheter	1.65±1.05	4.20±0.85	-5.335	0.001**
Care of patients mouth and airway	0.87±0.64	1.72±0.45	-4.537	0.001**
Nursing care during analysis of blood gases	2.67±1.07	6.10±0.90	-5.542	0.001**
Nursing care toward moisture	0.25±0.54	2.32±0.85	-5.395	0.001**
Nursing care toward respiratory exercise	1.70±1.50	6.92±1.04	-5.462	0.001**
Nursing care as regard diet and fluids	2.85±0.36	3.27±0.90	-2.518	0.012*
Nursing care toward infection control	0.95±0.59	1.87±0.33	-5.069	0.001**
Care of patients with chest tube	4.35±1.23	6.07±0.88	-4.958	0.001**
Nurses' knowledge about nursing care of urinary catheter	7.82±0.74	9.57±0.78	-5.176	0.001**
Total knowledge	28.85±3.27	62.37±9.22	-5.515	0.001**

W: Wilcoxon Signed Ranks Test, *: statistically significant (p<0.05), **: statistically highly significant (p<0.001)

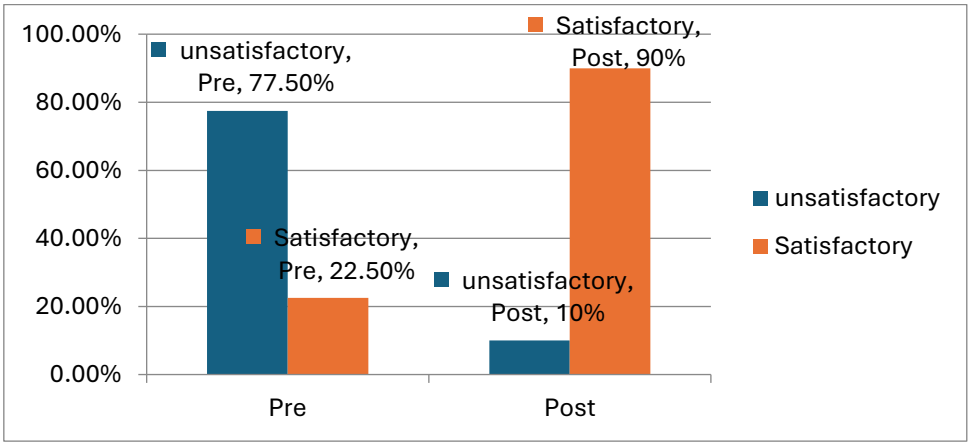

Figure 1: Bar chart showing total satisfactory level of knowledge about post-operative care of patient with coronary artery bypass throughout study phases.

Table 3: Distribution of total score of satisfactory practice and its domains about post-operative care of patient with coronary artery bypass.

Nurse practice about post-operative care	Satisfactory practice				MCp-value
	Pre		Post		
	No.	%	No.	%	

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A - Primary assessment:					
Vital signs	**30**	**75.0**	**40**	**100.0**	**0.001****
Respiratory assessment	**34**	**85.0**	**40**	**100.0**	**0.049***
Cardiovascular assessment	**14**	**35.0**	**36**	**90.0**	**0.001****
Neurological assessment	**22**	**55.0**	**34**	**85.0**	**0.001****
Fluid/electrolyte assessment	**15**	**37.5**	**34**	**85.0**	**0.001****
Circulation	**33**	**82.5**	**38**	**95.0**	**0.059**
Digestive system	**12**	**30.0**	**34**	**85.0**	**0.001****
Urinary system	**28**	**70.0**	**37**	**92.5**	**0.001****
Medication administered as ordered	**26**	**65.0**	**40**	**100.0**	**0.001****
Patient position	**21**	**52.5**	**36**	**90.0**	**0.001****
Wound assessment	**25**	**62.5**	**38**	**95.0**	**0.001****
Pain assessment	**20**	**50.0**	**30**	**75.0**	**0.001****
Total Primary assessment	**25**	**62.5**	**36**	**90.0**	**0.001****
B-Secondary assessment					
Maintain patent airway	**27**	**67.5**	**40**	**100.0**	**0.001****
Care of endotracheal tube	**25**	**62.5**	**40**	**100.0**	**0.001****
ABG	**23**	**57.5**	**38**	**95.0**	**0.001****
Ventilator weaning and safe extubation	**31**	**77.5**	**38**	**95.0**	**0.023***
Measuring central venous pressure (CVP)	**23**	**57.5**	**38**	**95.0**	**0.001****
Routine care for chest tube	**30**	**75.0**	**39**	**97.5**	**0.001****
Measuring Intake and Output	**31**	**77.5**	**38**	**95.0**	**0.023***
Total secondary assessment	**28**	**70.0**	**39**	**97.5**	**0.001****
Total Satisfactory practice≥70%	**25**	**62.5**	**38**	**95.0**	**0.001****

MC: Mcnemar test, non-significant (p>0.05), *: statistically significant (p<0.05), **: statistically highly significant (p<0.001)

Table (4): Relation between Demographic Characteristics of Studied Nurses and Their Satisfactory Knowledge Score throughout study phases.

Demographic Characteristics	Total satisfactory knowledge≥70				÷ 2 ([1]p-value)	÷ 2 (2p-value)
	Pre=9		Post=36			
	No.	%	No.	%		
Age:						
30≥20	**4**	**44.4**	**24**	**66.7**	**2.191 (0.334)**	**25.11 (0.001**)**
40≥30	**3**	**33.3**	**7**	**19.4**		
40-50	**2**	**22.2**	**5**	**13.9**		
Gender						
Male	**2**	**22.2**	**9**	**25.0**	**FET (0.99)**	**FET (0.557)**
Female	**7**	**77.8**	**27**	**75.0**		
Nursing qualification:						
Diploma	**3**	**33.3**	**19**	**52.8**	**FET (0.451)**	**FET (0.605)**
Technician diploma	**6**	**66.7**	**17**	**47.2**		
Marital status:						
Single	**3**	**33.3**	**10**	**27.8**	**1.257 (0.534)**	**0.269 (0.874)**
Married	**5**	**55.6**	**24**	**66.7**		
Widow	**1**	**11.1**	**2**	**5.6**		
Income						
Not enough	**5**	**55.6**	**22**	**61.1**	**FET (0.99)**	**FET (0.294)**
Enough	**4**	**44.4**	**14**	**38.9**		
Residence						
Rural	**4**	**44.4**	**24**	**66.7**	**FET (0.234)**	**FET (0.602)**
Urban	**5**	**55.6**	**12**	**33.3**		
Attended training about care of patients:						
Yes	**6**	**66.7**	**19**	**52.8**	**FET (0.457)**	**FET (0.99)**
No	**3**	**33.3**	**17**	**47.2**		
Experience years in nursing						
<20	**8**	**88.9**	**33**	**91.7**	**FET (0.99)**	**FET (0.001**)**
≥ 20	**1**	**11.1**	**3**	**8.3**		
Experience years (ICU)						
<10	**7**	**77.8**	**30**	**83.3**	**FET (0.99)**	**FET (0.001**)**
≥10	**2**	**22.2**	**6**	**16.7**		

÷ 2 : Chi square test FET: Fisher exact test non-significant (p>0.05), **: statistically highly significant (p<0.01), p[1]: for pre-intervention, p[2]: for post-intervention

Table (5): Relation between Demographic Characteristics of Studied Nurses and Their Satisfactory practice Score throughout study phases

	Total satisfactory practice≥70	÷ 2	÷ 2

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Demographic Characteristics	Pre=25 No.	%	Post=38 No.	%	(^{1}p-value)	(2p-value)
Age:						
30≥20	18	72.0	25	65.8	1.436	2.213
40≥30	4	16.0	8	21.1	(0.488)	(0.331)
40-50	3	12.0	5	13.2		
Gender						
Male	6	24.0	9	23.7	FET (0.99)	FET (0.001**)
Female	19	76.0	29	76.3		
Nursing qualification:						
Diploma	13	52.0	20	52.6	FET (0.99)	FET (0.487)
Technician diploma	12	48.0	18	47.4		
Marital status:						
Single	7	28.0	10	26.3	3.539	11.231
Married	18	72.0	26	68.4	(0.170)	(0.001**)
Widow	0	0.0	2	5.3		
Income						
Not enough	16	64.0	22	57.9	FET (0.336)	FET (0.99)
Enough	9	36.0	16	42.1		
Residence						
Rural	18	72.0	25	65.8	FET (0.310)	FET (0.99)
Urban	7	28.0	13	34.2		
Attended training about care of patients:						
Yes	13	52.0	21	55.3	FET (0.99)	FET (0.023*)
No	12	48.0	17	44.7		
Experience years in nursing						
<20	23	92.0	35	92.1	FET (0.622)	FET (0.192)
≥ 20	2	8.0	3	7.9		
Experience years (ICU)						
<10	20	80.0	31	81.6	FET (0.99)	FET (0.364)
≥10	5	20.0	7	18.4		

÷ 2 : Chi square test FET: Fisher exact test non-significant (p>0.05), *: statistically significant (p<0.05), **: statistically highly significant (p<0.01), p^1: for pre-intervention, p^2: for post-intervention

Table 6: Correlation between knowledge and practice of studied nurses throughout study phases.

Pre	Practice		Post	Practice	
knowledge	r 0.077	P 0.635	knowledge	r 0.688	p 0.001**

Non-significant (p>0.05), **: statistically highly significant (p<0.001), r: correlation coefficient

DISCUSSION:

Coronary artery bypass grafting (CABG) is a well-established procedure to treat coronary artery stenosis. Since the introduction of percutaneous coronary intervention, CABG is now more common among patients with advanced coronary disease and comorbid conditions **(Billard, Wells, Farrell, Curran, & Sheppard, 2024).**

The performance of nurses in intensive care units (ICUs) significantly impacts patient outcomes, particularly for those undergoing complex medical procedures such as CABG. This surgical intervention is associated with various postoperative complications and requires specialized nursing care to ensure patient safety and promote recovery **(Lee et al., 2020).** So, cardiothoracic surgery nurses should be qualified enough to care for patients because those patients need special nursing care; standard nursing care to improve their conditions and to help in preventing or reducing potential postoperative compli-cations. They should develop their standards of care and the profession should agree on acceptable levels of excellence. Nurses are planned, systematic, and focused on mutually agreed goals in which standards of care influence nursing practice, education, and management **(Qiu, 2024).**

With the current study, four main areas will be covered; firstly the **demographic data of the studied nurses,** secondly, **nurses' knowledge regarding care of patients undergoing CABG,** third is the **nurses' practice regarding care of patients undergoing CABG,** and lastly is **the correlation between the nurses' demographic data and their knowledge and practice**. The current study aimed to the effectiveness of an educational program on nurses' performance regarding care of patients undergoing coronary artery bypass graft in intensive care units at Zagazig University Hospital. The utilized sample constituted 40 nurses who applied care of patients who undergoing CABG in the Intensive Care Unit at Zagazig University Hospital.

Regarding the age of the studied nurses, the result of the present study showed that the majority of the studied sample was aged between 20 to 30 years old and were females. This may be due to that in Egypt, nursing was exclusive for females only till a few years ago. In addition, all the nurses had diploma and technician diploma degrees, and more than half of them were married. Most of them had less than 10 years of experience in the ICU, and more than half had attended training about the care of patients.

That's in agreement with the finding of the study by **Ragheb and Metwally, (2016)** who revealed that three-quarter of their studied nurses aged less than 30 years. Also, this finding was congruent with an Egyptian study by **Abusaad and Etawy (2015),** who revealed that the majority of nursing staff were female, and more than half of them aged between 25-35 years old.

On the other hand, **Abukhader, and Abukhader, (2020)** found that the majority 53.8% of the studied samples were male. Additionally, in the study by **Masibo, Kibusi, and Masika, (2024)** in Tanzania,

they found that most of their participants aged 26-44 years old, half of them were males, and more than two-thirds of them had education levels of diploma and below level.

Regarding previous training and years of experience, more than half of studied nurses attended training about care of patients This may refers to the continuous training that the hospital offers to the healthcare providers. Also, the highest percent of these nurses had less than twenty years of experience in nursing and less than ten years of experience in intensive care units. This may be due to the need for experienced, qualified nurses in providing care for the critically ill patients in ICUs in order to provide quality and effective care for better patients' outcome and satisfaction. From the researcher's point of view the continuous training sessions for nurses and increased years of experience are fully important to improve their performance, and affect positively the quality of care.

This goes on line with **Alsadaan et al., (2023)** who studied "impact of nurse leaders' behaviors on nursing staff performance" and found that the majority of the participants in most of the studies were females and aged above 30 years with high work experience. They explained that nurses are the primary healthcare providers who spend a significant amount of time with patients delivering care and services, and experienced nurses are highly recommended.

However, **Sulosaari et al. (2015),** studied "factors associated with nursing students' medication competence at the beginning and end of their education" in Finland and found that their participant nurses had had neither adequate training nor working experience, so they confirmed that training and education were identified as major drivers for the safe, competent and punctual provision of care and it was crucial for nurses to undertake the necessary training to keep the level of their knowledge and technical skills up to date.

In this study, regarding the total mean score of knowledge, it was found that there was a highly significant improvement in the total mean score of knowledge and its domains in post-phase in comparison with pre-phase which means that the educational program was meaningfully crucial to be widely applied for preparing nurses for promoting, understanding and of information and thus improve outcomes to deliver high-quality, patient-centered care.

This is in agreement with **Jabr, Taha, & Metwally, (2022)** in Egypt who depicted an improvement in nurses' total knowledge level after applying an educational program. They stated that applying an educational program for nurses is fully important in enhancing their levels of knowledge and recommended continuous evaluation of nurses' knowledge and practice to identify their needs, encourage and help nurses to attend national and international conferences, workshops, and training courses related to nursing care for patients undergoing cardiac catheterization, and also an educational program for cardiac catheterization unit nurses to improve knowledge and avoid complications after cardiac catheterization.

Also, **Elateif, (2017)** studied the "effect of training programs regarding care of patients undergoing open heart surgery on nurses' performance approach" and found that there was a significant improvement in nurses' knowledge concerning open heart surgery after the implementation of open-heart surgery nursing care training program. They recommended that training programs should be organized for the nurses to improve their knowledge and practice regarding open heart surgery nursing care, feedback should be done as well and booklets about open heart surgery should be available in the cardiothoracic department in the hospital. From their point of view, continuous education, evaluation, and the presence of posters, and guidelines in different open heart surgery units it was very important to increase the knowledge and performance of the nurses about heart surgeries.

This also agrees with **Suliman, Aloush, & Al-Awamreh, (2017)** who applied a convenience sample of 400 nurses working in three Jordanian hospitals and reported that there was a positive significant improvement in nurses' practices after program intervention. They highlighted the need to provide short-term in-service education programs for nurses to improve their knowledge.

Moreover, **Hussein et al., (2021)** conducted a quasi-experimental study to assess the effectiveness of educational programs on nurses' knowledge regarding CABG and pointed out that the educational program was significantly effective on emerging and enhancing nurses' knowledge regarding CABG.

Furthermore, **Fadol, Nodzon, & Lee, (2024)** stated that nurses are the "heart of patient care" and at the forefront of the health care delivery for cardiac patients so, they must be able to expand their knowledge of CABG through ongoing education, Journal, and seminars.

In this study, regarding total mean score of practice and its domains as reported by the studied nurses throughout the study phases, it was found that there was a highly significant improvement in total mean score of practice and its domains (primary and secondary assessment) in the post-phase in comparison to pre-phase. This may be due to the increased knowledge and skills educational programs enhance nurses' knowledge and skills in post-operative care, cardiac rehabilitation, and patient education. Also, nurses who participate in these programs are better equipped to manage CABG patients' needs, including monitoring for complications, providing appropriate interventions, and educating patients on self-care1. From the researcher's point of view, high-level evidenced educational programs help standardize care practices, ensuring that all nurses follow evidence-based guidelines for CABG patient care.

This matches with **Chhaba, (2024)** who studied a quasi-experimental pretest and posttest study titled "Impact of awareness educational program on knowledge and practice regarding cardiac rehabilitation of patients with CABG among staff nurses working in the post-operative cardiac care units" and depicted that a significant improvement in nurses' practice after implementing the educational program. Also, they concluded that cardiac rehabilitation teaching is the most effective intervention for staff nurses as the post-intervention groups have a large influence on their confidence and skills in

caring for post-operative CABG patients. This indicated that there was an insufficient learning resource available in the cardiac unit. Furthermore, a continuous supply of instructional materials and training from medical experts is recommended on a timely basis.

Furthermore, **Toulabi, & Mohamm-adipour, (2022)** studied "Effects of HIS-based intervention on patient education process and patient satisfaction with nurses' education" and revealed that the existence of editable standards programs allowed nurses to acquire professional knowledge to improve the level of their practice, ran it on a patient-specific basis and thus gained better patient outcome.

Consistent with these findings, **Louis, (2019)** in India conducted a study on the "Effect of planned teaching on knowledge and practices among staff nurses working in a selected hospital regarding the prevention of selected cardiopulmonary complications in post-operative CABG patients" and revealed that the planned teaching program successfully increased staff nurses' understanding and skills related to preventing specific complications in patients who have undergone CABG surgery. As a result, the quality of care provided to these patients improved.

Additionally, **Mlambo, Silén, & Mc Grath, (2021)** contributed that nurses must be able to expand their knowledge of this area through ongoing education, journals, and seminars. Consequently, teaching programs for nursing staff constitute an important part. These programs are urgently designed to assess nursing staff in developing and enhancing the skills needed to provide high standards of care to their patients.

In the present study, concerning the relation between demographic characteristics of studied nurses and their satisfactory knowledge, it was found that there was no significant relation between demographic characteristics of studied nurses and their satisfactory knowledge score in pre-phase except in those who aged from 20 to 30 years and who had experienced less than 20 years in nursing and less than 10 years in ICU, this aligns well with the idea that younger nurses and those with less experience are newly graduated with recent information and also might be more eager to learn and adapt to new information and skills. This suggests a targeted educational program for different nurse demographics.

Correspondingly, this result agrees with **Chukwunonso et al., (2018)** who revealed that there was a significant association between level of education with staff nurses and knowledge and practice scores. The highest scores were reported where staff nurses' education is within the registered nurses and MSc nursing groups.

Our finding isn't in concordance with the Egyptian study by **Khalil, (2019)** who studied the "Effectiveness of the educational program on prevention and control of MRSA" and declared no correlations between nurses' demographic characteristics and knowledge regarding MRSA. Moreover, **Al Salmi, & Kadium, (2015)** conducted a study in a hemodialysis unit in Oman about an education intervention to improve nurses' knowledge to reduce catheter-related bloodstream infection showing

no statistically significant association between years of experience of their nursing staff and the pre-test scores.

On completing the present study, our findings clarified that a high percentage of studied nurses who had satisfactory practice scores in the post-phase were female, married, and attended training about the care of patients. The relationship between years of experience and good practice level might be expected to be positive because the practice presumably derives from new information and skills offered through training which is often assumed to increase the awareness of mistakes.

Accordingly, **Majeed, (2017)** portrayed that there was no significant association between nurses' practices and their socio-demographic characteristics except training courses. They referred that working experience increases; knowledge and practice level also increase practice performance depending on the training course to improve nurses' skills and knowledge about endotracheal tube suctioning.

Similar to this, our findings follow **Hesham, (2016)** in Egypt, who depicted that there was a statistically significant relationship between nurses' practice and their demographic characteristics such as being females, highly educated, and well-trained. Their point of view is attributed to the fact that the nurses' practice depends more on attending training and imitation of obstacles that may hinder the males from acquiring new skills or attending educational courses. Moreover, in Malaysia, **Afandi, and Ludin, (2020)** found that a significant relationship was declared between the nurses' socio-demographic characteristics such as gender, attending training about the care of patients, and their level of practice. They expounded that attending training sessions increases the level of information and practice increases from repeated procedures and training programs. So recurrent education and guidelines among nurses help them to improve their knowledge and reflect on practice in patient care.

Conversely, **Zainib et al., (2017)** found a statistically significant relationship between total experience and practices of ICU nurses, but no relationship was determined between these nurses' qualifications and level of practice. Also, an Egyptian study at Menoufia University by **Aboalizm, & Elhy, (2019)** illustrated that there were significant relationships between the nurses' level of education, years of experience, and their baseline practice before and after the educational program. Also, **Said, (2012)** found that the practice of ICU nurses was found to be statistically associated with their educational level but not statistically associated with ICU training and years of working experience. Together with **Mwakanyanga et al., (2018)** who illustrated that there was no association between the practice and the nurses' gender, level of education, work experience, and ICU training.

In this study, testing the correlation between the knowledge and practice of studied nurses throughout the study phases illustrated that there was no significant correlation between them in the pre-education phase. However, there was a highly significant correlation in the post-education phase. This may be explained as in the pre-education phase, the lack of significant correlation between knowledge and

practice could indicate that nurses' practical experience did not fully align with theoretical knowledge. This could be due to varied levels of formal education, differing on-the-job experiences, or gaps in continuing education. But, in the post-education phase, a highly significant correlation implies that the educational program effectively bridged the gap between knowledge and practice. The program likely provided updated evidenced knowledge, with practical application which directly translated theoretical knowledge into practical skills, reinforcing how to apply what they learned in real-world settings.

Similarly, in Egypt, **Elsayed, Shebl, Ali, & Omran, (2022)** found that no statistically significant correlations were found between total knowledge and total practice of the nurses neither in the pre- nor the post-educational program. They interpreted it as a lack of knowledge that may affect nurses' practices. Additionally, a Chinese study by **Bali, Peer, Kour, Ahmad, and Koul, (2019)** reported that there was no correlation between knowledge and practice. As well, **Alhumaid et al., (2021)** added that more confounding variables of good practice other than knowledge or experience exist. Nonavailability of resources, high workload, and time limitations have been reported as the main factors influencing their compliance with practice.

Opposite to these findings, **Ayed, (2015)** reported that there was a statistically significant association between nurses' knowledge, practice, and degree of education. In addition, the study by **Mohamed, Mohamed, & ELmetwaly, (2021)** revealed that there was a positive relationship between pre-education and post-education knowledge. They explained that the practice is independent of knowledge. This does not mean that knowledge does not play a role in practice and this could be most likely because of the attitude of nurses towards the practice.

Further, a study by **Gaheen, et al., (2021)** about the "knowledge and compliance of nursing students regarding infection control standard precautions during their clinical training in Egypt", and **Ajani, Elikwu, Anaedobe, Okangba, and Tayo, (2020)** in Nigeria, demonstrated a statistically significant positive correlation between knowledge and practice of universal precautions**.**

Conclusively, improving nursing performance regarding care of patients undergoing Coronary Artery Bypass Graft is crucial. The educational program was found to significantly improve the knowledge, and practice skills of nurses. The post-intervention groups have a large influence on their information and skills in caring for post-operative CABG patients. The current study indicated that there appears to be an insufficient learning resource available in the cardiac unit. Furthermore, a continuous supply of instructional materials and training from medical experts is recommended on a timely basis.

Conclusion:

According to the present study, it can be concluded that there was a statistically significant improvement in the studied nurses' knowledge and practices regarding care of patient undergoing coronary artery bypass graft.

Based upon the findings of the present study and answer of hypothesis

Recommendations:

1. **Targeted Training Programs**: Develop and implement continuous educational programs focusing on post-operative care for CABG patients. Emphasize areas like suction, central venous catheter care, mouth care, arterial blood gas analysis, moisture management, respiratory exercises, diet, fluid management, infection control, chest tube care, and urinary catheter care.
2. **Intervention Studies:** Design intervention studies to test different types of educational strategies (e.g., e-learning, simulation-based training) and their impact on nurses' knowledge and practice.
3. **Patient Outcomes:** Link nurses' improved knowledge and practice to patient outcomes, providing a more comprehensive understanding of the benefits of educational programs.
4. **Standardization of Training Programs**: Push for the standardization of training programs across hospitals to ensure consistent and high-quality care.
5. **Performance Evaluation**: Implement regular performance evaluations to ensure that nurses maintain high standards of knowledge and practice, linked to continued professional development opportunities.

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