Nurses' Performance for Patients with Implantable Cardiac Devices

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Abstract

Background: Nurses' knowledge and practice could be beneficial in caring for patients with implantable cardiac devices and preventing any self or environmental interactions which can adversely affect proper device function. **Aim of the Study:** To assess nurses' performance for patients with implantable cardiac devices. **Research Design:** A descriptive exploratory design was utilized. **Setting:** This study was conducted at the cardiac care units and intermediate cardiac care units at Ain Shams University Hospital. **Subjects:** A convenience sample of all available nurses (50) working within the previous mentioned setting was included in the study. **Tools:** Nurses' self-administered questionnaire which composed of nurses' demographic characteristics, nurses' level of knowledge and factors affecting nurses' performance regarding care of patients with implantable cardiac devices. Nurses' practice observational checklist. **Results:** The present study revealed that 66% of nurses under the study had a satisfactory level of total knowledge regarding care of patients with implantable cardiac devices, 62% of studied nurses had agreed that the work environment, nurse and patient related factors affect their performance and 58% of studied nurses had a competent level of total practice. **Conclusion:** This study concluded that there was a highly statistically significant with positive correlation between total nurses' level of knowledge and total nurses' level of practice regarding care of patients with implantable cardiac devices. **Recommendations:** Replication of the current study on a larger probability sample selected from different geographical areas in Egypt to achieve generalization of the results.

Key words: Nurses' Performance, Implantable Cardiac Devices.

Introduction

Although cardiac electrostimulation was recognized centuries ago, the technology of implantable heart rhythm monitoring and therapeutic devices has only been established in the last few decades. From the initial demonstration that the heart could be stimulated by external electrical energy, technological developments over the past 50 years have confirmed reliable and effective cardiac pacing **(Abbas & Sadeq, 2021).**

A reduction in generator size, improved lead reliability, improved batteries and longevity, and the development of implantable cardioverter defibrillators have extended device therapy for many patients. Device therapy is and will continue to remain the mainstay treatment for patients with both tachy and brady arrhythmia **(Almutairi & Bahari, 2022).**

Implantable cardiac devices such as cardiac pacemakers and implantable cardioverter defibrillators (ICDs) are now firmly established as significant therapies for patients with symptomatic bradycardia and for those at risk for sudden death due to ventricular arrhythmias. More recently, implantable cardiac devices that stimulate both the right and left ventricle simultaneously or are used to restore interventricular and intraventricular synchrony (cardiac resynchronization therapy) in patients with systolic dysfunction and left ventricular dyssynchrony **(Humphries & Hawkins, 2020).**

Complications of implantable cardiac devices may be surgical (hardware) or programming (software). Pacemaker specific complications include failure to pace, failure to capture, failure to sense, pulse generator failure, pacemaker mediated tachycardia and pacemaker syndrome**.** Complications specific to the ICD

include ineffective therapy, failure to deliver therapy, multiple shocks and device proarrhythmia **(Albasal, et al., 2022).**

Surgical complications are divided into venous access related complications (hemothorax, pneumothorax and air embolism), lead related complications (perforation, malposition, dislodgement, venous thrombosis, superior vena cava syndrome, conductor fracture, lead insulation failure and exit block), pocket related complications (hematoma and skin erosion) and infection **(O'Connor, et al., 2021).**

Providing nursing care and proper nursing processes for patients with implantable cardiac devices can prevent complications and defects in the CIEDs' performance. Nurses' knowledge is important in communication, education and counseling patients and can facilitate the acceptance of cardiac device, as well as provide fundamental information for patients to prevent cardiac rhythm disorders **(Guan, et al., 2021).**

Since caring of these patients need knowledge about the device, its complications, the related factors and also the patient's hemodynamic condition, nurses' knowledge can be vital and constructive in patient's training and hence the reduction of complications during the patient's life with the cardiac device **(Ruzaini, et al., 2021).**

The major parts of complications (either after surgery or over a patient's life with the cardiac device) are associated with device care during work time and life. All of these complications can be related to improper performance of the medical team, especially nurses in the intensive care unit. The importance of the nurses' performance in taking care of these patients, training the nurses and familiarizing them with the possible complications should be done and involved in the nurses' working principles **(Sternick & Sánchez, 2021).**

The preoperative, intraoperative and postoperative cares are similar for all patients regardless of which type of implantable cardiac device they have. Nurses have the significant role of closely monitoring patient's vital signs and clinical status. This type of close monitoring will allow early detection of abnormalities preoperatively **(Abbas & Sadeq, 2021).**

In addition, nurses should be kept responsible for the meticulous preparation of the patient for the operating or procedure room, inserting the appropriate lines and giving chemoprophylaxis and sedation. Postoperative nurse monitoring is more significant since it will allow early detection of surgical complications like hematoma, dysrhythmias, infection, hemothorax, pneumothorax and perforation. Prophylactic antibiotic for at least 24 hours following device insertion **(White, 2019).**

Significance of the study

In Egypt, the documented medical records and the statistical data of the cardiac care department at Ain Shams University Hospital revealed that the percentage of patients who were admitted for implantable cardiac devices insertion in 2018 were 10.4% of pacemaker insertion, 3.2% of implantable cardioverter defibrillator (ICD) insertion, 2.6% of cardiac resynchronization therapy (CRT) and 4.3% of other cases such as (battery changes, temporary pacemaker lead insertion).

Over a period of 5 years in the critical care units, empirical observation showed that patients' outcomes and self-care abilities were influenced to some extent, and there was readmission of some patients suffering from different complications. Most of these complications were life-threatening yet preventable.

Nurses have a holistic outlook on patient care and can play a key role in the prevention of complications by using an approved protocol of care that is based upon the different educational needs of nurses and considers other relevant factors, as well as addressing the immediate concerns of the patients and helping them cope successfully with their condition **(O'Connor, et al., 2021).**

Furthermore, this research can be beneficial in determining the level of nurses' performance for patients with implantable cardiac devices, the related factors affecting the nurses' performance and highlighting areas of deficiency in nursing performance while caring for patients with these devices.

Aim of the study

The present study was conducted to assess nurses' performance for patients with implantable cardiac devices through the following:

1- Assess level of nurses' knowledge regarding care of patients with implantable cardiac devices.
2- Assess level of nurses' practice regarding care of patients with implantable cardiac devices.
3- Assess factors affecting nurses' performance regarding care of patients with implantable cardiac devices.

Research questions

The current study answered the following questions:

➢ What is the level of nurses' performance for patients with implantable cardiac devices?

➢ What are the factors affecting nurses' performance regarding care of patients with implantable cardiac devices?

Subjects and methods
I-Technical design:

The technical design included research design, setting, subjects and tools for data collection used in this study.

Research design:

A descriptive exploratory research design was utilized to achieve the aim of this study.

Setting:

The study was conducted at the cardiac care units and intermediate cardiac care units at Ain Shams University Hospital.

Subjects:

A convenience sample of all available nurses (fifty nurses) working at the cardiac care units at Ain Shams University Hospital (cardiac care unit and intermediate cardiac care unit) who have a minimum of 1 year's work experience and provide direct nursing care to patients fitted with an implanted cardiac devices and agree to participate in the study. They have been contacted by the investigator during the morning and afternoon shifts for consecutive six months.

Tools of Data Collection:

The following tools were used for data collection:

Tool (I): Nurses' self-administered questionnaire:

It was developed by the investigator in a simple Arabic language after reviewing the recent national and international related literatures. It was filled by nurses. It included the following three parts:

Part 1: Nurses' demographic characteristics:

This part was used to assess nurses' demographic data. It was consisted of eight items such as age, gender, marital status, academic qualifications, work unit, years of experience, training courses and nursing procedures guide books regarding care of patients with implantable cardiac devices.

Part 2: Nurses' level of knowledge:

It was used to assess nurses' level of knowledge regarding care of patients with implantable cardiac devices. This part consisted of questions that covered knowledge related to general information about anatomy and physiology of the heart, implantable cardiac devices, patient preparation, post-implantation care, complications and patients' discharge instructions. It included 37 multiple choice questions (MCQs) and 14 Yes or No questions with equal 51 questions **(Angelidou, 2017; Bavnbek, et al., 2018 and Abdullah & Nusari, 2019).** It covered the following five sections:

Section 1: It was concerned with the assessment of nurses' basic knowledge regarding the anatomy and physiology of the heart. It was composed of 10 MCQs. **Section 2:** It was concerned with the assessment of nurses' knowledge regarding implantable cardiac devices (pacemakers, ICDs and cardiac resynchronization therapy) and its uses. It was composed of 15 MCQs. **Section 3:** It was concerned with the assessment of nurses' knowledge regarding nursing care for patients with implantable cardiac devices (patient preparation, post implantation care). It was composed of 6 MCQs.

Section 4: It was concerned with the assessment of nurses' knowledge regarding possible complications after insertion of implantable cardiac devices and how they deal with it. It was composed of 6 MCQs. **Section 5:** It was concerned with the assessment of nurses' knowledge regarding health education for patients with implantable cardiac devices before discharge. It was composed of 14 Yes or No questions.

❖ **Scoring system**

The score for correct/yes answer for each question took one grade and incorrect/no answer given zero. The total score of nurses' level of knowledge was 51 marks classified as the following:

- < 85% was considered an unsatisfactory level of knowledge (< 44 marks).
- ≥ 85% was considered a satisfactory level of knowledge   (≥ 44 marks).

Part 3: Factors affecting nurses' performance regarding care of patients with implantable cardiac devices:

This part was developed by the investigator in a simple Arabic language after reviewing the recent national and international related literatures as (**Cinar, et al., 2018; Abdullah, et al., 2019 and Micheal & Drateru, 2019**) to assess factors affecting nurses' performance regarding care of patients with implantable cardiac devices. It included three sections: **section 1** work environment related factors (15 Yes or No questions), **section 2** nurse related factors (8 Yes or No questions) and **section 3** patient related factors (7 Yes or No questions) with total equal 30 Yes or No questions.

❖ **Scoring system**

The score for agree/yes answer for each question took one grade and disagree/no answer was zero. The total score of nurses' opinion assessment was 30 marks classified as the following:

- < 85% was considered disagreed level of opinion (< 26 marks).
- ≥ 85% was considered agreed level of opinion (≥ 26 marks).

Tool (II): Nurses' practice observational checklist:

It was developed by the investigator after reviewing relevant and recent literatures as (**Bavnbek, et al., 2018; Ullah, et al., 2018; Prawirodihardjo, et al., 2019 and Singh, et al., 2019**). It was written in the English language. It was used to assess nurses' practice regarding care of patients with implantable cardiac devices during the preparation and post implantation phases. It included patient preparations, post implantation care and procedures of hand washing, performing ECG, performing closed wound care, administration of IV fluids and medications, measuring body temperature, pulse rate, respiration rate and blood pressure as the following ten parts:

Part 1: Observational checklist for patient preparation before implantation of cardiac devices: It was composed of 22 steps. The response of each step was done or not done.

Part 2: Observational checklist for post implantation care of cardiac devices: It was composed of 18 steps. The response of each step was done or not done.

Part 3: Observational checklist for hand washing procedure: It was composed of 26 steps. The response of each step was done or not done.

Part 4: Observational checklist for performing ECG procedure: It was composed of 16 steps. The response of each step was done or not done.

Part 5: Observational checklist for performing closed wound care procedure: It was composed of 21 steps. The response of each step was done or not done.

Part 6: Observational checklist for administration of IV fluids and medications procedure: It was composed of 17 steps. The response of each step was done or not done.

Part 7: Observational checklist for measuring body temperature procedure: It was composed of 16 steps. The response of each step was done or not done.

Part 8: Observational checklist for measuring pulse rate procedure: It was

composed of 11 steps. The response of each step was done or not done.

Part 9: Observational checklist for measuring respiration rate procedure: It was composed of 12 steps. The response of each step was done or not done.

Part 10: Observational checklist for measuring blood pressure procedure: It was composed of 20 steps. The response of each step was done or not done.

❖ **Scoring system**

The response of each step was one grade for done and zero for not done. The total score of nurses' level of practice was 179 marks classified as the following:

- < 85% was considered an incompetent level of practice   (< 153 marks).
- ≥ 85% was considered a competent level of practice   (≥ 153 marks).

Ethical Considerations:

The investigator clarified the aim and sub-objectives of the study to the subjects included in the research study. A written approval was obtained from the Scientific Ethics Research Committee of the Faculty of Nursing-Ain Shams University. The investigator obtained oral consent from the studied nurses. Nurses were assumed that all data was confidential and used only for their benefits and for research purpose. The study subjects were informed that they had the freedom to withdraw from the study at any time without any consequences.

II. Operational design:
- **The preparatory phase:**

It included reviewing the recent national and international related literatures and theoretical knowledge of various aspects of the study using books, articles, periodicals, magazines and the internet to develop tools for data collection.

- **Validity and Reliability:**

Testing validity referred to how well the proposed tools actually measures what it is intended to measure by using face and content validity. Face validity aimed at inspecting the items to determine whether the tools measure

what are supposed to measure. Content validity was conducted to determine whether the content of tools covered the aim of the study (**Ullah, et al., 2018**).

Validity testing was ascertained by a group of seven experts from Medical Surgical Nursing department at Faculty of Nursing, Ain Shams University (four professors and three assistant professors) to test its face and content validity. The jury reviewed the tools for objectivity, comprehensiveness, clarity, relevance and simplicity. Based on the opinion of the jury, some modifications were made to the nurses' self-administered questionnaire and the nurses' practice observational checklist.

Reliability of the study tool: A Cronbach reliability test was carried out to test tool reliability using the internal consistency method. They proved a high degree of reliability test in which (alpha = 0.843 for nurses' knowledge questionnaire, alpha = 0.812 for factors affecting the nurses' performance questionnaire and alpha = 0.835 for nurses' observational checklist).

The reliability was scaled as the following:
- > 0 - 0.25 weak reliability.
- 0.25 - 0.75 moderate reliability.
- 0.75 - < 1 strong reliability.
- 1 is optimum.

- **Pilot study:**

Before performing the actual study, a pilot study was carried out on five nurses (10%) of the total study subjects and chosen from the previously mentioned setting to test the clarity, feasibility and applicability of the tools and the time required to fill them. No modifications were made to the tools. The nurses who participated in the pilot study were included in the main study.

- **Field work:**
- **Data collections**

The study was carried out from the beginning of October 2020 to the end of March 2021. The investigator visited the selected cardiac care units at Ain Shams University Hospital three days per week, during the

morning and afternoon shifts. Firstly, the investigator assessed nurses' practice regarding care of patients with implantable cardiac devices then assessed nurses' knowledge regarding care of patients with implantable cardiac devices and factors affecting their performance till knowledge not affect subjects' practice.

As regards, the observational checklists were filled by the investigator through direct observation of the care was provided for patients planned for implantation of cardiac devices or connected with implantable cardiac devices during patient preparation and post implantation care of cardiac devices during the morning and afternoon shifts.

Each nurse had taken about 30-45 minutes for patient preparation before implantation of cardiac devices and post implantation care of cardiac devices, 2-3 minutes for hand washing procedure, 20-30 minutes for ECG, closed wound care and administrations of IV fluids and medications procedures and 5-10 minutes for vital signs procedures (temperatures, pulse rate, respiration rate and blood pressure). Data collection was obtained from 1-2 nurses per day.

Each nurse was interviewed for 20-30 minutes to fill out the background data sheet, the nurses' knowledge questionnaire schedule about implantable cardiac devices and factors affecting the nurses' performance questionnaire, during which the investigator was accessible to clarify any obscure questions. The proper way of communications was utilized and the purpose of the study was explained before beginning of the answer.

III. Administrative design:
An approval was issued from Faculty of Nursing at Ain Shams University to the director of Medical and Nursing director of the cardiac care units at Ain Shams University Hospital to conduct the study and request permission for data collection from the studied sample.

IV. Statistical design:
All data was collected, tabulated and subjected to statistical analysis. Statistical analysis was performed by the computer Statistical Package for Social Science (SPSS), version 21 was used for data handling and graphical presentation. Quantitative variables were described by mean and stander deviation (SD), while qualitative categorical variables were described by proportions and percentages. A Chi-squared test of independence was used for categorical variables. Test of significance was used and regarding the significance of the results, the observed difference and association were considered as the following:

• Non significant (NS) P > 0.05.
• Significant (S) P ≤ 0.05*.
• Highly significant (HS)   P < 0.001**.

Results:
Table (1): showed that 84% of nurses under the study were females with a mean age **32.6±3.71**, 64% of studied nurses had diploma degree. Also, 70 % of studied nurses had ten years and more of experience. As well as, 90 % of nurses under the study didn't have any training courses and all of studied nurses 100 % said that there were no nursing procedures guide books in the unit.

Figure (1): illustrated that 66% of nurses under the study had a satisfactory level of total knowledge regarding care of patients with implantable cardiac devices, while 34% of studied nurses had an unsatisfactory level of total knowledge.

Figure (2): illustrated that 62% of nurses under the study had agreed that all suggested factors affect their performance regarding care of patients with implantable cardiac devices, while 38% of studied nurses had disagreed about that.

Figure (3): revealed that 58% of nurses under the study had a competent level of total practice regarding care of patients with implantable cardiac devices, while 42% of studied nurses had an incompetent level of total practice.

Table (2): showed that there was a highly statistically significant relation between total nurses' level of practice and their age, gender and years of experience at p-value <0.001 and there was a statistically significant relation between total nurses' level of practice

and their qualification and work unit at p-value ≤0.05. While there was no a statistically significant relation between total nurses' level of practice and their marital status and training courses at p-value >0.05.

Table (3): showed that there was a highly statistically significant with positive correlation between total nurses' level of knowledge score and total nurses' level of practice score at p-value <0.001.

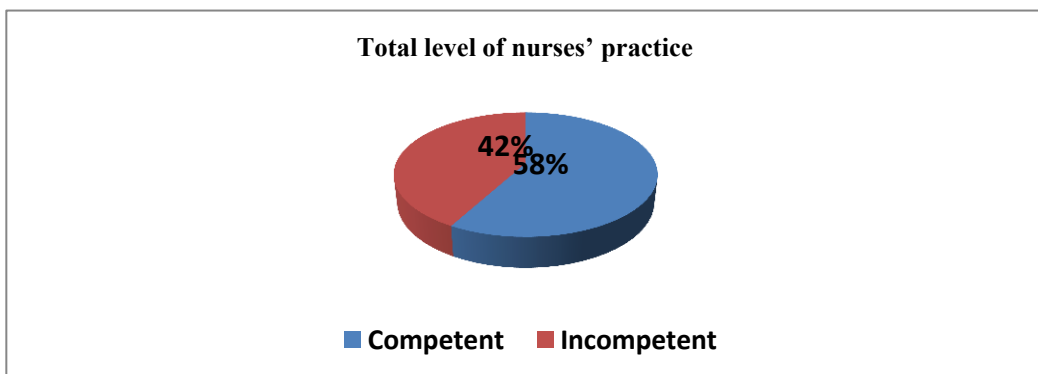**Table (1):** Number and percentage distribution of nurses according to their demographic characteristics (N=50).

Items	N	%
Age		
20 < 30 years old	12	24
30 < 40 years old	17	34
≥ 40 years old	21	42
Mean±SD	**32.6±3.71**	
Gender		
Male	8	16
Female	42	84
Marital status		
Married	46	92
Single	4	8
Academic qualification		
Nursing Diploma	32	64
Technical Nursing Institute	15	30
Bachelor of Nursing	3	6
Postgraduate Studies	0	0
Work unit		
Cardiac care unite	33	66
Intermediate cardiac care unite	17	34
Years of experience		
< 5 years	6	12
5 < 10 years	9	18
≥ 10 years	35	70
Training courses		
Yes	5	10
No	45	90
If yes, how many courses are there		
One	3	6
Two	2	4
Three or more	0	0
Nursing procedures guide books		
Yes	0	0
No	50	100

Total level of nurses' knowledge

34%   66%

■ Satisfactory   ■ Unsatisfactory
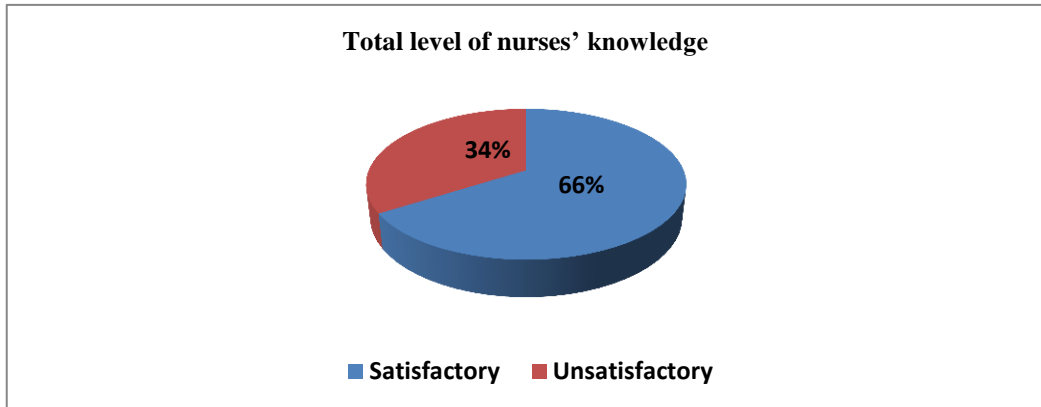
Figure (1): Percentage distribution of nurses according to their total level of knowledge regarding care of patients with implantable cardiac devices (N=50).

Total level of factors

38%
62%

■ Agree   ■ Disagree
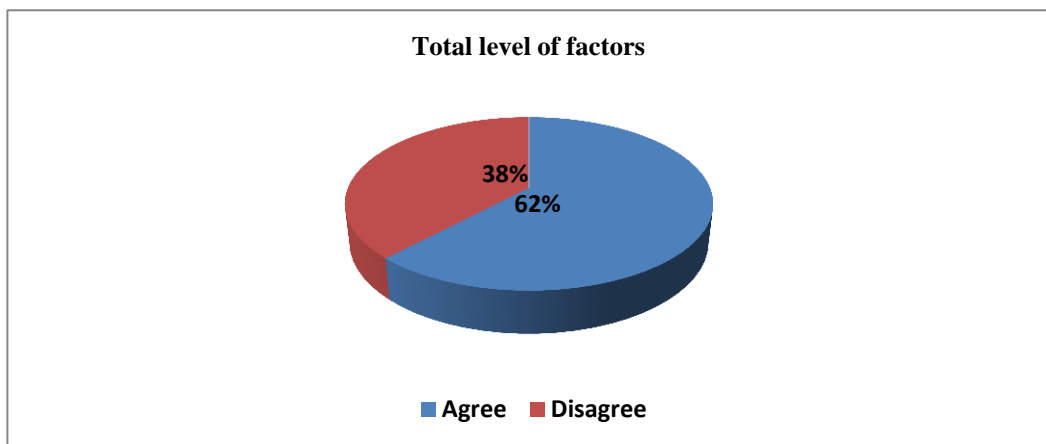
Figure (2): Percentage distribution of nurses according to total level of factors affecting their performance regarding care of patients with implantable cardiac devices (N=50)**.**

Total level of nurses' practice

42%
58%

■ Competent   ■ Incompetent

Figure (3): Percentage distribution of nurses according to their total level of practice regarding care of patients with implantable cardiac devices (N=50).

Table (2): Relation between nurses' demographic characteristics and their total level of practice (N=50).

Items	Done		Not done		Chi-square	
	N	%	N	%	X^2	P-value
Age						
20 < 30 years old	0	0	12	24		
30 < 40 years old	10	20	7	14	25.668	<0.001**
≥ 40 years old	19	38	2	4		
Gender						
Male	0	0	8	16		
Female	29	58	13	26	13.152	<0.001**
Marital status						
Married	27	54	19	38		
Single	2	4	2	4	0.114	0.735
Academic qualification						
Nursing Diploma	13	26	19	38		
Nursing Institute	13	26	2	4	11.198	0.004*
Nursing Bachelor	3	6	0	0		
Work unit						
Cardiac care unit	14	28	19	38		
Intermediate CCU	15	30	2	4	9.666	0.002*
Years of Experience						
< 5 years	0	0	6	12		
5 < 10 years	1	2	8	16	23.363	<0.001**
≥ 10 years	28	56	7	14		
Training courses						
Yes	4	8	1	2		
No	25	50	20	40	1.104	0.293

Non significant at P >0.05   Significant at P ≤0.05*   High significant at P <0.001**

Table (3): Correlation between total nurses' level of knowledge score and total nurses' level of practice score (N=50)

Items	Total nurses' knowledge score	
	r	P-value
Total nurses' practice score	0.332	<0.001**

Non significant at P >0.05   Significant at P ≤0.05*   High significant at P <0.001**

Discussion

Critical care nurses play an important role in caring for patients with implantable cardiac devices. Nursing management for patients after implantable cardiac devices implantation includes monitoring for complications related to insertion and device malfunctions. Postoperative complications include cardiac perforation and tamponade, pneumothorax, hematoma, lead displacement, infection and interference by magnetic fields or an AF signal (**Elgazzar, 2021).**

Regarding nurses' demographic characteristics, the current study findings showed that the majority of nurses under the study were females with a mean age **32.6 ± 3.71**, almost of studied nurses were married and near two thirds of studied nurses had diploma degrees. From the investigator's opinion, the majority of nurses under the study were females may be due to the nursing profession in the past was limited to females only and recently became for both genders, near two thirds of studied nurses had diploma degrees because the graduated nurses from nursing diploma joined them to meet the shortage of nursing staff.

The study is supported by **Ismail, et al., (2020)** who carried out their study about "what do our nurses know about managing patients with permanent pacemakers?" and showed that two thirds of respondents were female, more than half of respondents their age range from 20-34 years. For the level of education, more than two thirds of respondents obtained a diploma while less than half of respondents have a specialization certificate in cardiac nursing.

Also, nearly three quarters of nurses under the study had ten years and more of experience. As well, almost of studied nurses did not have any training course and all of studied nurses said that the unit did not have nursing procedures guide books. From the investigator's point of view, this may be due to lack of educational program plan in the studied setting and lack of awareness about vital role of critical care nurse regarding care of patients with implantable cardiac devices.

In the same line, **Al-Baghdadi and Rajha, (2018)** who conducted their study about "Evaluation of subcutaneous implantable cardioverter-defibrillator performance in patients with ion channelopathies from the EFFORTLESS cohort and comparison with a meta-analysis of transvenous ICD outcomes" and revealed that more than half of studied nurses aged from 18<30 years old with a mean age 28.69 and the majority of them were female. Regarding the level of education, nearly half of studied nurses graduated from technical institute of nursing while more than half of them had less than five years of experience and two thirds of studied nurses didn't attend scientific sessions about caring for patients undergoing pacemaker insertion.

For total nurses' level of knowledge regarding care of patients with implantable cardiac devices, the findings of the current study illustrated that two thirds of nurses under study had a satisfactory level of total knowledge regarding care of patients with implantable cardiac devices. This, from the investigator's point of view, may be due to the studied nurses were working in a critical care unit and acquired ten years of experience and more that helped

them to acquire a satisfactory level of knowledge.

The study findings are incompatible with **Elsebai, et al., (2022)** who conducted their study about ''Effectiveness of an Educational Program for Management of Patients Undergoing Permanent Pacemaker on Nurses' Performance'' and illustrated that nearly two thirds of nurses had a poor total knowledge.

Also, **Ahmed, et al., (2021)** who conducted their study about **"Factors Affecting Nurses' Performance Regarding Care for Patients with Permanent Pacemaker"** and found most of the studied nurses had an unsatisfactory level of total knowledge regarding care of patients with permanent pacemaker. The findings disagree with **Elgazzar, (2021)** who carried out her study about "Efficacy of an Intervention Protocol on Nurse's Knowledge, Practices Regarding Permanent Pacemaker Patient's Care" and showed that most of the studied nurses had inadequate knowledge score related to implantable cardiac devices.

For total level of factors affecting the nurses' performance regarding care of patients with implantable cardiac devices, the findings of this study illustrated that about two thirds of nurses under the study had agreed that the work environment, nurse and patient related factors affecting their performance regarding care of patients with implantable cardiac devices, while more than one third of studied nurses had disagreed about that.

The study findings are congruent with **Ahmed, et al., (2021)** who showed at their study that most of studied nurses agreed that the factors affecting their performance regarding care of patients with pacemaker.

In addition, total nurses' level of practice regarding care of patients with implantable cardiac devices, the current study findings revealed that more than half of nurses under the study had a competent level of practice regarding care of patients with implantable cardiac devices. These results may be due to nearly three quarters of studied nurses had ten years of experience and more in caring for

patients with implantable cardiac devices that help the studied nurses to acquire their competent level of practice.

The study findings are incongruent with **Elsebai, et al., (2022)** who illustrated in their study that the majority of the studied nurses had an incompetent total practice pre-program implementation. Also, **Ahmed, et al., (2021)** demonstrated in their study that most of the studied nurses had an incompetent level of total practice regarding care of patients with permanent pacemakers.

In addition, relation between nurses' demographic characteristics and their total level of practice, the current study findings reported that there was a highly statistically significant relation between total nurses' level of practice and their age, gender and years of experience and there was a statistically significant relation between total nurses' level of practice and their qualification and work unit.

From the investigator's point view, it may be due to increased years of experience, age and academic qualifications that lead to increase level of practice. While there was no statistically significant relation between the total nurses' level of practice and their marital status and training courses.

The study findings agree with **Elhadad, et al., (2020)** who illustrated at their study "Coexistence of deep brain stimulators and cardiac implantable electronic devices" that for items related to age, there was a statistically significant relation with total practice in pre-program implementation. The findings are incompatible with **Elgazzar, (2021)** who viewed in their study that there was a negative correlation between the practice of studied nurses regarding their level of education and year of experience at before the intervention protocol with no statistically significant difference.

For correlation between total nurses' level of knowledge and total nurses' level of practice, the current study findings revealed that there was a highly statistically significant with positive correlation between total nurses' level

of knowledge and total nurses' level of practice. In my opinion, this may be due to the fact that accurate practice should be based on correct knowledge.

The study findings are supported by **Ahmed, et al., (2021)** who show in their study that there was a statistically significant positive correlation between total pre knowledge score regarding pacemakers and their total practice at post and follow-up program implementation whenever there was no statistically significant correlation between total pre knowledge score regarding pacemakers and their total practice at preprogram implementation.

The study results agree with **Mousa, et al., (2018)** who reflected in their study "AN Unprecedented cause of implantable cardioverter defibrillator (ICD)" that total nurses' knowledge score was significantly correlated with total practice pre-intervention protocol. The study findings are incongruent with **Elgazzar, (2021)** who displayed in his study a negative correlation before and after the intervention protocol between total knowledge score and total practice score.

Conclusion

Based upon the current study findings, it can be concluded that two thirds of nurses under the study had a satisfactory level of total knowledge regarding care of patients with implantable cardiac devices, about two thirds of nurses under the study had agreed that the work environment, nurse and patient related factors affecting their performance regarding care of patients with implantable cardiac devices and more than half of nurses under the study had a competent level of total practice regarding care of patients with implantable cardiac devices.

There was a highly statistically significant with positive correlation between total nurses' level of knowledge and total level of factors affecting their performance and between total nurses' level of practice and total level of factors affecting their performance. Also, there was a highly statistically significant with positive correlation between total nurses' level of knowledge and total nurses' level of practice.

Recommendations

Based on the results of the current study, the following recommendations were inferred from the study:

1. Replication of the current study on a larger probability sample selected from different geographical areas in Egypt to achieve generalization of the results.

2. Further researches are recommended to assess factors affecting nurses' performance regarding care of patients with implantable cardiac devices.

3. Provide nurses with periodic training sessions to improve their practice and skills regarding care of patients with implantable cardiac devices.

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