

Nurses' Performance Regarding Electrocardiography Application and Its Interpretation: Suggested nursing Guideline

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Abstract

Background: Electrocardiography is the most commonly used diagnostic test in cardiology. It contributes significantly to the diagnosis and management of patients with cardiac disorders. **Aim:** Assess nurses' performance regarding electrocardiography application and its interpretation and develop suggested guideline based on nurses need assessment. **Design:** A descriptive exploratory research design was utilized for the conduction of this study. Setting the study was carried out in coronary care unit of Assiut University heart hospital. **Study subject:** A convenient sample of all available nurses (40) working within the coronary care unit at Assiut university heart hospital from both gender and agreed to participate in the study. **Data Collection Tools:** I - self – administration questionnaire form which composed of nurses demographic characteristics' and nurses' knowledge questionnaire regarding ECG application and its interpretation, II - Nurses practice observational checklist. **Results:** Revealed that, 80% of the studied nurses had unsatisfactory level of total knowledge regarding ECG application and its interpretation and 92.5% the studied nurses had unsatisfactory level of total practice regarding ECG application and its interpretation. **Conclusion:** More than three quarters of the studied nurses had got unsatisfactory level of knowledge regarding ECG application and interpretation and the majority of the studied nurses had got unsatisfactory level of practice regarding ECG application and its interpretation. **Recommendations:** Training program including the suggested guidelines toward ECG application and interpretation must be implemented for nurses based on their need assessment and evaluate its effectiveness on performance.

Key words: Electrocardiography interpretation, Nurses' performance, suggested guideline.

Introduction:

Electrocardiogram is a major tool that is routinely used non-invasively to assess the electrical and muscular functions of the heart. It also provide information about diagnosing acute coronary syndrome and cardiac arrhythmia. ECG can be implemented to various clinical scenarios, including patients with chest pain, dyspnea, syncope, and poisonous ingestions, in addition to people with electrolyte abnormalities and pacemakers (Tahboub & Yilmaz, 2019; Kessen & Williamson, 2020).

Nurses are the most members of health workers in the hospital and most interact with patients, so the ability of nurses who are professional in applying and interpreting electrocardiogram is very much needed due to their role as the emergency services team. Furthermore, upgrading the competency of ECG interpretation among healthcare professionals who work in emergency areas is a potential patient safety issue and would possibly

diminish interpretation errors during emergency situations. It is important for nurses in critical care settings to carry out a more accurate assessment, which can help to identify dysrhythmias quickly and accurately to ensure prompt interventions and lifesaving measures when necessary (Mobrad, 2020; Vand et al, 2020).

Regarding ECG guidelines, the nurse should have a good skill and knowledge to be proficient in using ECG machine, recording ECG, recognizing of and responding appropriately to significant and life threatening arrhythmias. The nurse should ensure that the ECG machine is safe and ready to use, confirm that the date and time are correct on the machine, wash hands, obtain verbal or written consent once the procedure has been explained to the patient, maintain patient privacy, place patient in supine position, and prepare patient's skin appropriately. The nurse also should maintain correct placement of both limb and pericardial leads and obtain good quality ECG

recording (European society for cardiology, 2019).

Significance of the study

Among the healthcare providers in a hospital setting, especially in intensive and cardiac care units where round the clock monitoring of critical patients is required, nurses play a very crucial role in cardiac monitoring. It is the responsibility of the nurse to assess the patient's clinical condition, monitor and make sure that an excellent quality of care is delivered. The nurses' should monitor the continuous ECG monitoring very carefully and have competency in initial interpretation. Their knowledge about correct ECG leads placement, analysis, and providing adequate management in critical patients have significant implications in reducing morbidity and mortality (Sattar & Chhabra, 2021).

Cardiovascular disease (CVD) has been the leading cause of premature death in Egypt since the 1990s. In 2020, coronary heart disease deaths reached 173,871 or 32.40% of total deaths. Meanwhile, more than 70% of intensive care unit patients experience heart rhythm disturbances and these patients have correspondingly higher mortality rates (World health organization, 2020; Fekry et al., 2020; Haristiani & Tanrewali, 2021).

Critical-care nursing is that sub-specialty of nursing sciences that deals, particularly, with human responses to life-threatening issues. Nurses working in critical care units, where patients usually are monitored continuously at the bedside or through intermittent monitoring a 12-lead ECG, are responsible for monitoring and interpreting ECGs (Linton, 2016; Qalawa & Hassan, 2017; Aspry & Dhen, 2019).

Aim of the study

This study aims to assess nurses' performance regarding ECG application and its interpretation through the following:

- 1-Assess nurses' level of knowledge regarding ECG.
- 2-Assess nurses' level of practice regarding ECG.

- 3-Develop suggested guideline for ECG application and interpretation.

Subject and Methodology

Research question:

This study is based on answering the following questions:

- 1-What is the level of nurses' performance regarding electrocardiogram application and interpretation?
- 2-What is suggested nursing guideline regarding ECG application and interpretation based on needs of studied nurses?

Research Design: A descriptive exploratory research design was utilized for the conduction of this study.

Setting: The study was conducted at coronary care unit of Assiut University heart hospital. The setting is located in the second floor of the hospital. It consists of five rooms one of them is isolation room for suspected patients and each room contains six beds, manager offices, one room for resident physician, one room for head nurses, one staff nurse room with bathroom, two large sinks for hand washing, one counter, a room for supplies and three bathrooms. The number of nurses in the unit was six head nurses and 34 nurses in coronary care unit.

Subject

A convenient sample of all available nurses (40) working within the coronary care unit at Assiut university heart hospital from both gender and agreed to participate in the study.

Tools of data collection: Two tools were used in the current study as the following:

I. Tool I: Nurses self – administered Questionnaire:

This tool was used to assess nurse's level of knowledge regarding electrocardiogram application and its interpretation in coronary care unit, it was developed by the investigator based on the current literature Williams and Wilkins (2016); Luthra (2017), Silvestri (2017) and Goldberger and Shivilkin (2018). It was

written in an Arabic language and consists of two parts:-

A-The first part: It was concerned with demographic characteristics of the nurses under the study including; age, gender, marital status, level of education, years of experience in coronary care unit, presence of manual guide/ book regarding ECG application and its interpretation and previous attendance of training courses regarding ECG application and its interpretation.

B-The second Part: This part was concerned with assessment of the level of nurses' knowledge regarding the electrocardiography application and its interpretation. It consisted of 82 questions; 47 of them were multiple choice questions, 2 of them were complete questions and they included 10 items and 33 of them were true or false questions. The nurses self-administered questionnaire consisted of 6 items including; structure and function of the heart and its conductive system (15 items), ECG machine and its application (12 items), ECG interpretation (23 items), characteristics of normal sinus rhythm (7 items), characteristics of abnormal sinus rhythm and cardiac arrhythmias (18 items) and nursing role regarding ECG procedure (15 items).

❖ **The scoring system:**

Each correct answer was given of one grade and zero for incorrect answer with total score of 90, classified as the following according to statistical report:

- Level of knowledge $\geq 85\%$ (≥ 77 degree) was considered satisfactory level.
- Level of knowledge $< 85\%$ (< 77 degree) was considered unsatisfactory level.

II. Tool II: Nurses practice observational Checklist:

It was concerned with assessment of nurses' level of practice regarding electrocardiogram application and its interpretation in coronary care unit. It was developed by the investigator based on the current literature **Williams and Wilkins (2016); Eckman (2016) and Lynn (2019)**. It was consisted of two parts:

The first part: obtaining an electrocardiogram checklist. It was concerned with evaluating nurses' practice regarding electrocardiogram application. It comprises three phases covering the following items; pre procedure care of ECG application (19 steps), during procedure care of ECG application (19 steps) and post procedure care of ECG application (14 steps).

The second part: It was concerned with evaluating nurses' practice regarding ECG interpretation. It comprises twenty rhythm strips of case scenario covering the following; interpretation of normal ECG characteristics (10 steps) and abnormal ECG interpretation including:-

- Sinus arrhythmias (30 steps).
- Atrial arrhythmias (30 steps).
- Junctional arrhythmias (40 steps).
- Heart blocks (40 steps).
- Ventricular arrhythmias (40 steps).
- Normal sinus rhythm with ST-segment elevation (10 steps).

❖ **The scoring system:**

Each step that was not done was scored zero, while one grade was given for correctly done step. Total score was 252 grades, classified according to statistical report as following:

- Total level of practice $\geq 85\%$ (≥ 214 degree) was considered satisfactory level.
- Total level of practice $< 85\%$ (< 214 degree) was considered unsatisfactory level.

Suggested guideline for ECG application and its interpretation:

The guidelines developed and translated into Arabic in a booklet developed by the investigator after reviewing recent relevant literatures (**European society for cardiology, 2019 & Lynn, 2019 & European society for cardiology, 2020 & Coveiello, 2020 & Thaler, 2019 & Goldberger and Shvilkin, 2018 & and Knechtel 2017**) which fulfill two components; ECG application and interpretation guidelines that should be fulfilled by nurses in coronary care unit.

Content validity: testing validity of the proposed tools by using face and content validity. Face validity aimed at inspecting the items to determine whether the tools measure what supposed to measure. Content validity was conducted to determine whether the content of the tool cover the aim of the study. It measured by a jury of seven expertise, four of them professors and two assistant professors of Faculty of Nursing at Ain Shams and one assistant professor of cardiology department from faculty of medicine at Ain Shams university.

Reliability: Cronbach's alpha test was developed to measure internal consistency of the 2 tools used in current study as follows; nurses self-administered questionnaire was (0.927) and nurses practice observational checklist was (0.990).

Field work: data collection started and was completed within 6 months from January 2021 to June 2021. The purpose of the study was simply explained to the nurses who agreed to participate in the study prior to any data collection. The selected setting was visited by the investigator three days per week during morning and afternoon shifts.

The nurses' observational checklist included obtaining an electrocardiogram procedure checklist and the ECG rhythm strip interpretation checklist. The investigator checked the electro-cardiogram procedure checklist by observing each nurse three times while performing electrocardiography to patients using indirect observation in coronary care unit, however in ECG rhythm strip interpretation checklist, which took 20-45 min, the investigator told each nurse to observe ECG rhythm strips and asked them to (identify) check answer according to her observation to each ECG rhythm strip.

The investigator assessed nurses' knowledge regarding ECG application and its interpretation at coronary care unit of heart hospital of Assiut university hospital by using nurses self-administered questionnaire which took 15-20 minutes to be filled by each nurse. The nurses' observational checklist was used prior to administration of the self-administered

questionnaire to ensure the maximal realistic observations of the nurse's performance and minimize the possibility of bias.

Data were collected during period of spread of pandemic covid-19 (corona virus) and there were cases suspected to and also infected with covid-19 (corona virus) admitted to coronary care unit. The investigator adhered to infection control measures that designed to encounter the spread of covid-19 (corona virus) in coronary care unit which includes face mask, face shield, gown, overshoes and disposable gloves.

Ethical considerations:

The ethical research considerations in this study included the following; the research approval of protocol was obtained from Scientific Research Ethical Committee in Faculty of Nursing at Ain Shams University before starting the study, the investigator clarified the objective and aim of the study to the nurse's included in the study, the investigator also assured maintaining anonymity and confidentiality of the subject's data, nurses were informed that they allowed choosing to participate or not in the study and that they had the right to withdraw from the study at any time without giving any reasons and ethics, values, culture, and beliefs were respected.

Statistical Design: the data were collected and coded. Then the collected data were organized, analyzed using appropriate statistical significance tests using the Computer Statistical Package for Social Science (SPSS), version 20. Data were presented using descriptive statistics in the form of frequencies and percentages. T- test, ANOVA test, mean, standard deviation and range were used to compare the frequencies and the correlation between study variables. Cronbach's alpha was used to assess the reliability of internal consistency of the developed tools. Pearson correlation coefficient was used for the assessment of relationships among qualitative variables.

Degrees of significance of results were considered as follow:

- P value > 0.05 insignificant. (NS).
- P value ≤ 0.05 significant. (S).
- P Value ≤ 0.001 highly significant. (HS).

Results:

Table (1): demonstrates that 57.5 % of the nurses under study their age ranged between 25 to < 30 with mean and standard deviation value of age were 27.08 ± 3.26 . Regarding their gender, 100 % of the nurses under study were females. Regarding their marital status, 77.5 % of studied nurses were married. Regarding their educational level, 67.5% were graduated from technical institute of nursing. Regarding their years of experience, 62.5% of them had general years of experience were ≥ 5 years with mean and standard deviation value of years of experience were 7.25 ± 4.47 . Concerning attendance of training course regarding ECG application and its interpretation, 67.5 % of nurses under study attended training course regarding ECG application and its interpretation. Regarding presence of ECG manual in CCU, 100% of the studied nurses exhibited unavailability of manual regarding ECG application and its interpretation.

Nurses' level of knowledge regarding ECG application and its interpretation:

Table (2): shows that 92.5% and 85% of the studied nurses had got satisfactory level of knowledge about nursing role regarding ECG procedure and ECG machine and its application. Meanwhile, 90% of the studied nurses had got unsatisfactory level of knowledge regarding criteria of abnormal sinus rhythm and cardiac arrhythmias. It was found that 82.5% of the studied nurses had got unsatisfactory level of knowledge regarding ECG interpretation and criteria of normal sinus rhythm. Also, 57.5% of the studied nurses had got unsatisfactory level

of knowledge regarding structure and function of the heart and its conductive system.

Nurses' level of practice regarding ECG application and its interpretation:

Table (6): demonstrates results of studied nurses' level of practice regarding obtaining an electrocardiogram. The results show that, 100 %, 50 % and 37.5 % of studied nurses had got satisfactory level of practice regarding during procedure care of ECG application, pre procedure care of ECG application and post procedure care of ECG application respectively with total satisfactory level of practice regarding this procedure was 70 %.

Figure (2): illustrates that 37.5 % of the studied nurses had got satisfactory level of practice regarding ECG interpretation of ventricular arrhythmia. Also 12.5 % of the studied nurses had got satisfactory level of practice regarding ECG interpretation related to normal sinus rhythm, sinus arrhythmia and sinus rhythm with ST-segment deviation.

Figure (3): illustrates that 80.0% of the studied nurses had got unsatisfactory level of total knowledge regarding ECG application and its interpretation and 92.5% of the studied nurses had got unsatisfactory level of total practice regarding ECG application and its interpretation.

Correlation between studied nurses' demographic characteristics and their total level of knowledge and practice regarding ECG application and its interpretation.

Table (4): shows that there is statistically high significant positive correlation between total level of knowledge among nurses under the study and their total level of practice at ($r = 0.910$) at P value < 0.001.

Table (1): Frequency and percentage distribution of studied nurses according to their demographic data (No=40).

Items	Frequency No.	Percent %
Age Group		
20 - < 25 years	12	30.0
25 - < 30 years	23	57.5
≥ 30 years	5	12.5
Mean ± SD years.	27.08 ± 3.26	
Range	21 - 35	
Gender		
Female	40	100.00
Marital status		
Single	9	22.5
Married	31	77.5
Educational level		
Nursing diploma	7	17.5
Technical institute	27	67.5
Bachelor nursing	4	10.0
Master degree of nursing	2	5.0
Years of experience		
< 1 year	4	10.0
1 - < 5 years	11	27.5
≥ 5 years	25	62.5
Mean ± SD years.	7.25 ± 4.47	
Range	1 - 17	
Attendance of training course regarding ECG application and its interpretation		
Yes	27	67.5
No	13	32.5
Availability of ECG manual		
No	40	100.00

Table (2): Frequency and percentage distribution of studied nurses according to their total level of knowledge regarding ECG application and its interpretation (n= 40).

Knowledge regarding ECG application and its interpretation	Satisfactory		Unsatisfactory	
	No	%	No	%
- Structure and function of the heart and its conductive system.	17	42.5	23	57.5
- ECG machine and its application.	34	85.0	6	15.0
- ECG interpretation.	7	17.5	33	82.5
- Criteria of normal sinus rhythm	7	17.5	33	82.5
- Criteria abnormal sinus rhythm and cardiac arrhythmias.	4	10.0	36	90.0
- Nursing role regarding ECG procedure.	37	92.5	3	7.5

Table (3): Frequency and percentage distribution of studied nurses according to their level of practice regarding obtaining an electrocardiogram (n= 40).

Practice regarding obtaining an electrocardiogram	Satisfactory		Unsatisfactory	
	No	%	No	%
- Pre procedure care of ECG application.	20	50.0	20	50.0
- During procedure care of ECG application.	40	100.0	0	0.0
- Post procedure care of ECG application.	15	37.5	25	62.5
Total	28	70.0	12	30.0

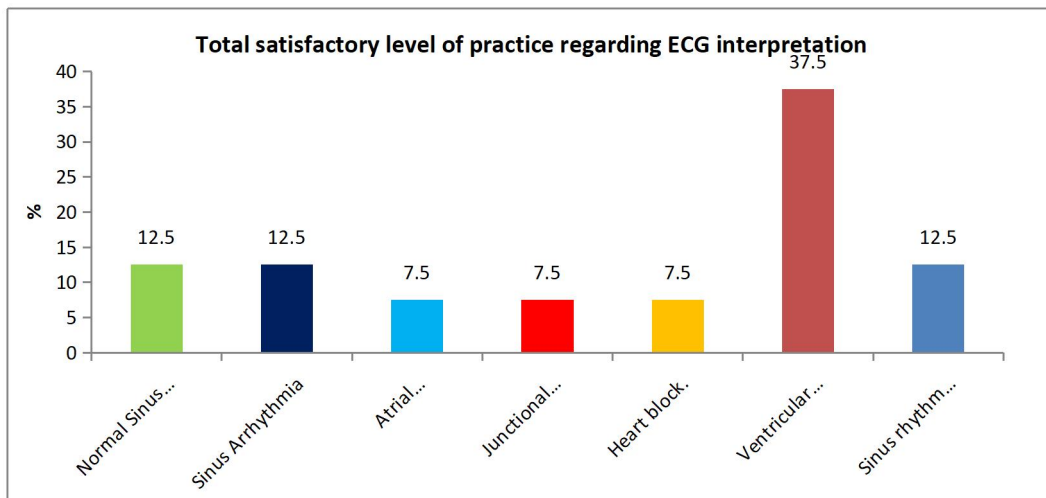


Figure (1): - Frequency and Percentage distribution of studied nurses according to their total satisfactory level of practice regarding ECG interpretation (n= 40).

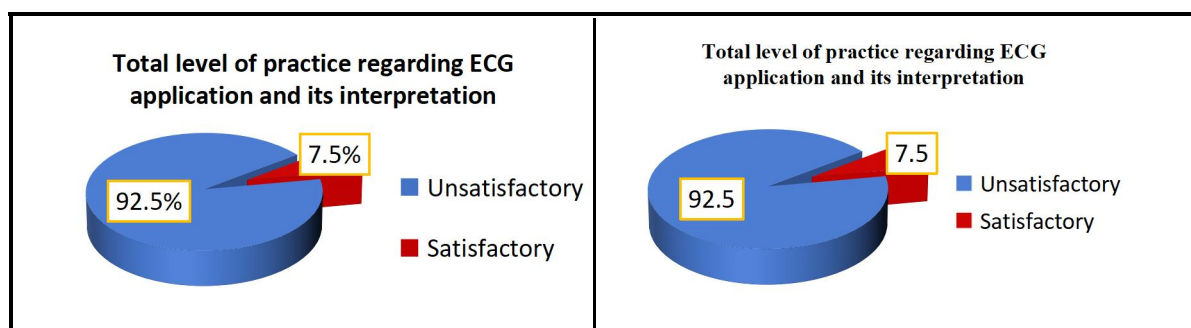


Figure (2): - Frequency and Percentage distribution of studied nurses according to their total level of knowledge and total level of practice regarding ECG application and interpretation (n= 40).

Table (4): Correlation between studied nurses' total level of knowledge and their total level of practice regarding ECG application and its interpretation (n= 40).

Items	Total level of knowledge	
Total level of practice	r-	0.910
	P-value	<0.001**

Discussion:

Electrocardiogram (ECG) is one of the most commonly performed investigations in emergency departments (EDs), and is an extremely useful adjunct that guides diagnosis, professional to assess patients and record an ECG, yet anecdotal evidence suggests that few emergency nurses review prognosis and

treatment. In most cases nurses are the first healthcare, interpret and act on ECG findings. Research findings suggest lack of confidence in, or knowledge about, interpretation of results, often because of inadequate training (McGrath & Sampson, 2018).

Regarding the demographic characteristics of studied nurses, the results of

the present study revealed that more than half of nurses under study were between 25 to < 30 years old with mean and standard deviation value of age were 27.5 ± 4.47 years. This finding may be due to most of nurses under study were newly graduated, and employed in the coronary care unit at early age which is necessary to tolerate the nature of CCU work as an area of specialty requires a young qualified nurse for better quality of nursing care offered and ability to tolerate the working in the coronary care unit. This finding was consistent with what was reported by **Mohammed et al. (2020)**, in a study titled *"Assessment of Nurses Knowledge and Practices Regarding Care of Patients with Cardiogenic Shock"* who stated that about half of study nurses were less than thirty years old.

In relation to gender, the present study showed that, all of the studied nurses were females. This finding could be interpreted in the light of the fact that the majority of nurses in Egypt are females because of that nurses' school graduate large number of females than males. These findings were consistent with **Ibrahim, et al. (2016)** in a study titled *"Effect of nursing care standards on nurses' performance regarding caring for patients with cardiac arrhythmias"* which found that the majority of the nurses under study were female.

Regarding educational level, the present study results indicated that, about two third of the studied nurses were technical institute nursing graduates, which may be due to the fact that they are young and tolerate the nature of the work in CCU. This result agreed with **Ahmed, et al. (2019)** in a study titled *"Effect of an Educational Program on Nurses' Knowledge and Practice Regarding Defibrillation and Cardioversion"* who stated that most of nurses had technical nursing education.

Concerning years of experience, the current study showed that nearly two third of the nurses under study had experience ≥ 5 years. In investigator point of view this finding may be due to working in CCU require highly experienced nursing personnel who have the ability to tolerate the working load and work

stress, severity of patients conditions, hours of work and occupational hazards that facing them in CCU.

The above findings were consistent with **Hassan and Hassan (2014)** in a study titled *"Effectiveness of an Education Program on Nurses practice toward arrhythmia in Kirkuk's teaching hospital"* who stated that about half of the studied nurses had work experience more than 10 years. Also, this finding agreed with **Omran, et al. (2010)** in a study titled *"A study of nurses performance management and prevention of complication for patient undergoing cardiac catheterization"* who stated that majority of the nurses under study had years of experience sex to ten years.

The present study showed that, two third of the studied nurses had attended training courses related to electrocardiogram. This may be due to that the hospital under the study held many courses related to ECG and commit nurses to attend this course. This finding is consistent with **Tahboub, (2018)** in the study titled *"Knowledge and Practices of Electrocardiogram Interpretation of Nurses"* who stated that more than half of the nurses had attended training courses related to electrocardiogram.

Regarding presence of guide manual related to electrocardiogram application and its interpretation, the present study results indicated that all of the studied nurses exhibited unavailability of guide manual related to electrocardiogram application and its interpretation. This may be due to lack of hospital policy and concern regarding availability of guided manual or checklist for nurses regarding ECG application and its interpretation. This finding is consistent with **Elbakry, et al. (2020)** in the study titled *"Nurses' Performance toward Quality Documentation for Patients in ICU: Suggested Guidelines"* who stated the same results.

Concerning to nurses' knowledge regarding electrocardiography application and its interpretation, the results of the current study reflect that more than half of nurses under study had unsatisfactory knowledge regarding nurses'

knowledge about structure and function of the heart and its conductive system; this may be due to difficulty of heart anatomy, physiology and its conductive system and this sophisticated and complex heart construction is difficult to be understood from nurses.

Also, this finding is consistent with **Verma (2019)** in a study titled *"A Study to Evaluate the Effectiveness of Planned Teaching Program (PTP) on the Knowledge of Recording and Interpretation of Electrocardiogram (ECG Units) Among Staff Nurses Working in Selected Intensive Care (I.C.Us)"* who stated that majority of nurses under study had unsatisfactory knowledge regarding nurses' knowledge about structure and function of the heart and its conductive system pre educational program.

Also, the present study findings showed that majority of the nurses under the study had satisfactory level of knowledge regarding ECG machine and its application. This may be due to easiness of ECG machine usage and recurrence of its application on patient in CCU. This finding goes in the same line with **Das et al. (2014)** in the study titled *"An Integrated Review of Nurses' Knowledge on Therapeutic & Diagnostic Equipment with a View to Develop Guidelines"* who stated that the majority of nurses had satisfactory level of knowledge regarding ECG machine and its application.

The finding of the current study showed that more than three quarter of nurses under study had unsatisfactory level of knowledge regarding ECG interpretation. This might be due to the misconception that these items of knowledge are pure medical role and nurses were not interested to know about it. This result is supported with **Ali et al. (2012)** in the study titled *"Effect of self-learning modules on nurses' performance regarding electrocardiography. Thesis submitted for partial fulfillment of doctorate degree. Faculty of nursing, Ain Shams University"* who found that most of the nurses had poor level of knowledge regarding ECG interpretation before implementation of self-learning modules.

Also, the present study finding showed that more three quarter the nurses under the study had unsatisfactory level of knowledge regarding criteria of normal sinus rhythm. This might be due to lack knowledge regarding all criteria of normal sinus rhythm. Also, these criteria are more complicated and need highly qualified nurses and more practice. This finding is supported by **Abd Elzaher (2017)** in a study titled *"Impact of educational program on nurses knowledge and practices about arrhythmias for congestive heart failure patients"* who demonstrated that majority of nurses had unsatisfactory level of knowledge regarding reading of normal electrocardiogram before implementation of educational program.

Concerning nurses' knowledge regarding criteria of abnormal sinus rhythm and cardiac arrhythmias, the current study revealed that majority of the nurses under the study had unsatisfactory level of knowledge regarding criteria of abnormal sinus rhythm and cardiac arrhythmias. This may be due to lack of nurses training courses on criteria of abnormal sinus rhythm and cardiac arrhythmias. This finding was in agreement with **Mohammed (2018)** in the study titled *"Nurses' Performance Regarding Patients with Cardiac Arrhythmias"* who stated that more than two thirds of the studied nurses had unsatisfactory level of knowledge regarding cardiac arrhythmias.

Concerning nurses' knowledge related to nursing role regarding ECG procedure, our study showed that majority of studied nurses had satisfactory level related to nursing role regarding ECG procedure. This may be due to that all newly graduated nurses should undergo an orientation program regarding ECG application. This finding agreed with **Ali et al. (2012)** who stated that majority of studied nurses had satisfactory level of knowledge related to nursing role regarding ECG procedure post-program.

In relation to nurses' total level of knowledge regarding ECG application and its interpretation, the current study showed that more than three quarters of the studied nurses had got unsatisfactory level of knowledge regarding ECG application and interpretation.

This obligation of nurses' knowledge at this critical area might be as a result of lack of refreshment courses about ECG application and its interpretation and nurses' exhaustion due to increased work load which may hinder their ability to read and update their knowledge.

The above finding goes in the same line with **Malk et al. (2018)** in a study titled *"Effect of an Education Program on Nurses Performance Regarding Electrocardiography"* who stated the same results. However, our study results come incongruent with **Tahboub and Yilmaz (2019)** in a study titled *"Nurses' Knowledge and Practices of Electrocardiogram Interpretation"* who stated that nurses showed high level of knowledge and practice regarding ECG.

Regarding nurses' practice of electrocardiogram application, the current study revealed that more than two thirds of studied nurses had satisfactory level of practice regarding ECG application as a whole. This due to hospital regular courses provided to nurses on applying ECG procedure also, ECG procedure is the most practiced procedure in CCU. This finding is agreed with **AL-Husaunawy (2015)**, in a study titled *"Evaluation of Nurses Knowledge and Practical of Electrocardiogram toward Adolescent Patient"* who reported high practical level of nurses regarding ECG application.

Concerning nurses' practice at pre-procedure care of ECG application, the study revealed that half of nurses had unsatisfactory level regarding care provided prior to electrocardiography application. This is due to the fact that nurses in general neglect preparatory steps of many procedures as; explaining procedural steps to the patient and patient's skin preparation that includes cleansing sites for electrode placement and clipping excessive hair. This finding agreed with **Malk and Hassan (2018)** in the study titled *"Evaluation of Nurses Practice Regarding Electrocardiogram Procedure"* who stated that most of nurses neglect explaining procedure and skin preparation for electrode placement.

As regards to nurses' practice at during procedure care of ECG application, the study revealed that all of nurses had satisfactory level regarding care provided during to electrocardiography application. This may be due to that nurses urge to do these steps correctly to get ECG strips. This finding is supported by **Purran et al. (2019)** in the study titled *"An evaluation of Electrocardiogram (ECG) lead placement training in an Integrated Care Organisation"* who stated that there was a positive feedback received from the evaluation of the ECG lead placement training plan that substantiates how training and development can sustain the trust in accomplishing its planned goals by making sure staffs are provided with the right expertise, educations and proficiencies to supply excellence in care.

In relation to nurses' practice at post-procedure care of ECG application, the study revealed that nearly two thirds of nurses had unsatisfactory level of practice regarding care provided after electrocardiography application. This might be due to most of studied nurses neglect post-procedure steps as; reading and reporting rhythm, rate, conduction intervals and ECG waves. This finding agreed with **Sheilini and Devi (2014)** in a study titled *"Effectiveness of educational intervention on ECG monitoring and interpretation among nursing students"* who stated that majority of studied nurses had poor skill regarding ECG performance.

Regarding nurses' practice related to interpretation of normal ECG characteristics, the study revealed that minority of studied nurses had got satisfactory level of practice regarding interpretation of normal ECG characteristics. This may be due to most of nurses under study lack skills regarding identifying normal ECG characteristics including; P- wave, PR-interval, QRS complex, QT-interval and ST-segment, also this may be due to poor qualification of studied nurses and misconception regarding their role about ECG interpretation.

The above finding is agreed with **Abd Elzاهر (2017)** who reported that majority of

nurses had unsatisfactory level of practice regarding interpretation of normal ECG pre-educational program. Also this finding was congruent with **Khalil et al. (2018)** in a study titled *"Critical care nurses' knowledge and practice regarding life-threatening ventricular dysrhythmias"* who reported that majority of nurses had unsatisfactory level of practice regarding interpretation of normal ECG.

Regarding nurses' practice related to interpretation of sinus arrhythmias, the study revealed that minority of studied nurses had got satisfactory level of practice regarding interpretation of sinus arrhythmias, This may be due to lack of in-service educational courses regarding identifying abnormal ECG characteristic about sinus arrhythmias. This finding agreed with **Shehab et al. (2019)** in a study titled *"Effect of an Educational Program of Electrocardiogram Interpretation on Medical and Maternity Nurses' Knowledge and Skills"* who found that majority of nurses had unsatisfactory level of practice regarding interpretation of sinus arrhythmias.

With respect to nurses' practice related to interpretation of atrial arrhythmias, the study denoted that only low percentage of studied nurses had got satisfactory level of practice regarding interpretation of atrial arrhythmias. This can be explained by that the commonest types of atrial arrhythmias are atrial flutter and atrial fibrillation more than premature atrial contraction so it is more difficult to be easily identified by studied nurses. This finding agreed with **Preston et al. (2015)** in a study titled *"Atrial electrogram interpretation improves after an innovative education program"* who found that majority of nurses had unsatisfactory level of practice regarding interpretation of atrial arrhythmias pre-educational program.

Regarding nurses' practice related to interpretation of junctional arrhythmias. The study explored that minority of studied nurses had got satisfactory level of practice regarding interpretation of junctional arrhythmias. This may be due to complexity of this type of arrhythmia to be identified by nurses under the study. This result was congruent with **Kellera and Raines (2005)** in a study titled "Arrhythmia knowledge: A qualitative study" who reported

that nurses categorized of junctional rhythms, premature junctional contraction and accelerated junctional rhythms as intermediate and advanced type of arrhythmias to be recognized. Also **Kerbage (2016)** in a study titled *"Critical Care Nurses' Knowledge and Confidence in Arrhythmia Interpretation"* found that nurses had unsatisfactory level regarding interpretation of junctional rhythms and premature junctional contraction.

In relation to nurses' practice about interpretation of heart block, the study revealed that also minority of studied nurses had got satisfactory level of practice regarding interpretation of heart block. This may be due to poor nurses' recognition of all degrees of heart blocks. This finding was consistent with **Weheida 2016), et al.** (in a study titled *"Effect of Application of Training Program about Electrocardiogram on Nurses Competency Level and Expected Clinical Outcome of Cardiac Patients"* who stated that almost all nurses had poor recognition of all degree of heart blocks before application of training program.

With regards to nurses' practice related to interpretation of ventricular arrhythmias, the study revealed that more than one third of studied nurses had got satisfactory level of practice regarding interpretation of ventricular arrhythmias. This may be due to the fact that nurses to somewhat should be able to recognize this type of fatal arrhythmias which confronts nurses on the practice at CCU and requires immediate intervention to save patients live. This result was agreed with **Mohammed (2018)** who reported that more than half of nurses under study had satisfactory level of practice regarding interpretation of ventricular arrhythmias. Also, this finding was concordant with **Santos et al. (2017)** in a study titled *"Ability of Nurses Interpret a 12- Lead Electrocardiography"*. Who found that majority of the studied nurses had satisfactory level of practice regarding patients with ventricular arrhythmias.

With reference to nurses' total practice related to ECG application and its interpretation. Our study revealed that majority of nurses under study had got unsatisfactory level of total practice regarding ECG application and its

interpretation. This might be due to lack of training program and refreshment courses that focus on ECG interpretation and its importance for nurses in saving patients in critical case. The drawback of this is fairly conclusive; ECG interpretation was problematic for a large percentage of the respondent. Also in Egypt, ECG rhythm interpretation is not a common role for nurses rather it is more assigned to physicians. This result agreed with **Shehab et al. (2019)** who stated that total practice of nurses regarding ECG at the pretest was unsatisfactory. Also, this finding is confirmed with **Malk et al. (2018)** who stated the same results.

With respect to correlation between knowledge and practice, the current study displayed that, there is a positive correlation between studied nurses' level of knowledge and their level of practice regarding ECG application and its interpretation. This is due to majority of studied nurses had got unsatisfactory level of knowledge which consequently led to unsatisfactory level of practice among majority of studied nurses. This result agreed with **Malk et al (2018)** who stated that there was a positive correlation between total nurses' knowledge and practice at pre, post and follow up program implementation.

Also, this result agreed with **Hassan and Issa, (2014)** in a study titled "*Knowledge evaluation theoretical and practical nurses in the electrocardiogram.*" who stated that there is a significant relationship between studied nurses' knowledge and practice and this is a positive side to connect the practical and theoretical. However, the current study results were incongruent with **Fekry et al. (2020)** who found that there was no statistically significant relation between total nurse's level of knowledge and their practice.

Conclusion:

Based on finding of the current study, it can be concluded that: more than three quarter of the studied nurses had got unsatisfactory level of knowledge regarding ECG application and its interpretation. Meanwhile, majority of nurses under study had got unsatisfactory level of total practice regarding ECG application and its interpretation. Based on the study results, the

investigator suggested guidelines for ECG application and its interpretation.

Recommendation:

Based on finding of the current study, the following items are recommended:

Further researches are needed with larger sample sizes to evaluate the application of structure and outcome standards in addition to process standards and evaluate its impact on nurses' performance regarding ECG interpretation and its interpretation.

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Conflict of interest

No

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