Effect of Application of Training Program about Electrocardiogram on Nurses Competency Level and Expected Clinical Outcome of Cardiac Patients

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Abstract

Electrocardiogram (ECG) monitoring in hospitals has become more complex since it was one of the first importance for nurses who work in medical and critical care units. *Aim to;* evaluate the effect of application of training program about electrocardiogram on nurses competency level and expected clinical outcome of cardiac patients. *Subjects and Methods:* The study was conducted in emergency, and cardiology department and coronary intensive care unit (ICU) at the Aswan University Hospital. A convenience sample of 43 nurses was recruited in this study and 70 adult patients with chronic medical condition at selected setting. *Design:* A quasi-experimental research design was utilized to meet the aim of this study. **Two tools were used**: (observational checklists and patient outcome tool), during 2014-2015. *The results:* findings revealed that staff nurses showed high percentage level of competence in knowledge and practices post application ECG training program than pre application p- value of <0.001. 51.28% of patients had satisfactory outcome with no complications $X^2 = 18.97$ at P<0.0001, high statistical significance deference was existed regarding to length of hospital stay. **In the light of the study finding, it is concluded that,** statistically significant difference was existed between pre- post application for nurses' competence performance, also a statistically significant positive patient's outcome regarding length of hospital stay and complications. **The study recommended that,** Nurse's competence level of knowledge and practice regarding ECG interpretation in emergency department must be considered in periodically evaluation.

Key words: Electrocardiogram, chronic medical condition, competency level.

INTRODUCTION

Electrocardiogram (ECG) monitoring has become a standard of care, not only in intensive care units, but in virtually every patient care area in the hospital *(Huajun RN, &Lily RN, 2012)*. The ECG considered one of the essential to diagnosing cardiac arrhythmias and acute myocardial ischemic syndromes, which account for the majority of cardiac catastrophes *(Lancia et al., 2008)*.

The technology has evolved to be able to detect the heart rate and rhythm, to include paced ones, to monitor rhythm for morphological and ST changes so that changes can be detected in patient's condition and to intervene in a timely manner. By acquiring the best tracings possible and by monitoring in the appropriate leads for the patient, clinicians facilitate improved outcomes during his hospital stay *(Nihon Kohden.2009)*.

Competence can be defined as specific knowledge, specialist skill, attitude and value and experience of intensive and critical care nursing and personal base of ICU nurse. The personal attributes of nurses are also related to good nursing care and they are quality indicators in good care *(Toth 2012)*.

In this study basic competence refers to competence to knowledge and practice in a critical care unit. Further, the concept of competence was divided into the concepts of clinical competence and professional competence. Clinical competence refers to the capability to perform acceptably duties directly related to patient care. It means handling and caring for patient competence. Professional competence refers to the capability to perform the duties generally. Professional competence skills mean general professional competence, which can be transferred between nursing contexts *(Pubmed, 2012)*.

The American Association of Critical-Care Nurses (AACN) has published two practice alerts to define the best practices for monitoring patients for dysrhythmia and ST-segment changes. The potential benefits of monitoring include; detection of a prolonged QT interval response to cardiac problems, assessment and detection of hemodynamic deterioration evaluate the efficacy of the drug to control the ventricular rate in chronic atrial fibrillation or flutter, especially with increasing patient activity. It should be pointed out that for patients who are administered certain antiarrhythmic drugs with a known high risk of pro-arrhythmia, ECG monitoring should be considered importance method of early diagnosis and Detection of Pro-arrhythmia *(American Association.2006)*

The initial orientation and training, a mandatory periodic competency evaluation of all staff should be performed to ensure continued proficiency in critical elements of cardiac monitoring. This evaluation also could include periodic audits of electrode placement and rhythm strip interpretation. If physiological abnormalities are not recognized, corrected quickly or supported sufficiently, the patient's condition may progress further to critical illness or death. However, the nurse is ideally placed to identify patients through nursing observation and assessment in the period preceding critical illness, and to intervene at an early stage preventing further decline *(Higginson & Jones, 2009)*.

Patients who do eventually encounter cardiac events been established that there are frequently clinical signs of deterioration hours before cardiac arrests or urgent transfers to the ICU. The most important predictors for patient adverse events have been shown to be Heart Rate/Pulse Rate (HR/PR) and Respiratory Rate (RR) *(Chaboyer, 208)*. ECG monitors indicate changes in electrical impedance, which can be problematic due to artifacts and false alarms caused by patient movement and poor lead contact *(Schmid et al. 2013)*.

Monitoring technologies provide early recognition of patient deterioration, and the specialized clinical competencies have been identified as the skills and knowledge required for specific areas of acute cardiac nursing. These skills require competence in critical care unit for delivering care, and hence have a focus on the management and integration of skills and knowledge. For example, critical care setting requires competence in ECG monitoring and interpretation, hemodynamic monitoring, auscultation of heart sounds, and resuscitation/ life support *(Brown H, Terrence J, Vasquez P, et al.2014)*.

Important nursing implications that were included in this analysis illustrate how to manage specific arrhythmias, what symptoms to assess, and when to obtain a resting 12-lead ECG e.g. for all patients who were being evaluated for ventricular

arrhythmias. These guidelines may also be found on the National Guideline Clearinghouse website *(Funk et al., 2009; AACN, 2008; Drew & Keller & Raines, 2005).*

Significance of the study:

ECG monitoring requires interpretation by all nursing staff who is working with life threating dysrhythmia patients. Therefore, effective use of ECG monitoring would require training for competence knowledge and practice. Competences of staff nurse on ECG interpretation or cardiac monitoring technician are very importance at each shift. For this reason, determine the best practices for educating staff nurses on ECG or dysrhythmia monitoring is very important. Consequently, formulating level of competence ECG knowledge and practice could help nurses in promoting the quality of nursing care and its reflection on patient outcome.

Aim of the study:

The aim of the study was to evaluate the effect of application of training program about electrocardiogram on nurses competency level and expected clinical outcome of cardiac patients

Research hypothesis:

H_1. Nursing exposed to training program about electrocardiogram exhibit.

H_2. There will be positive differences in patient outcomes post application of training program than pre implementation.

Subjects and Methods

Research design

A quasi-experimental research design was utilized to meet the aim of this study.

Setting:

The study was conducted in three units at the Aswan University Hospital. These units include on emergency department, cardiology department, coronary and intensive care unit (ICU).

The units accept about 2300 newly admitted adult patients with chronic medical conditions and coronary artery diseases per year statistical *hospital recorded (2014)*.

Subjects:

Convenience samples of all available nurses who have been working in the study setting at the time of the data collection were included. Two groups were used to collect data in the study.

Group I:

18 nurses working in emergency department, 8 nurses working in a cardiology department and 17 nurses working in a coronary and intensive care unit (ICU) were recruited for the study.

Group II:

Patients: A total study subject of seventy adult male and female patients were selected from the above mentioned setting, used scoring Epi Info program to detect sample size equal 70 at power study 80% Confidence Interval CI 95% P>5. Then, according to the following inclusion criteria: Adult patients, cardiac problems, able to communicate, willing to participate in the study.

Tools of data collection:

Two tools were used for data collection:

Tool I: Nurses' knowledge: Structure interview questionnaire: it was designed by

the researcher based on current and international literature ref to assess nurses' knowledge regarding ECG monitoring and it consists of two parts:

Part 1: Socio-demographic characteristics of nurses: as age, sex, educational level, years of experience and previous ECG training.

Part II: Assessment of nurses' knowledge: it includes six domains *as a fallow:* Domain 1: Basic theoretical knowledge of ECG. Domain 2: Knowledge of ECGs related to series resuscitation. Domain 3: Theoretical knowledge of abnormal ECGs. Domain 4: Practical of the cardiac arrhythmias which are tachycardia, ventricular fibrillation and ventricular flutter. Domain 5: Recognition of the all degree of heart block. Domain 6: Recognition of other ECG problems. The total scores of questionnaire 27 grades, one grade was given for the correct answer and zero for the incorrect answer. Those who obtained less than (50%) were considered having poor level of knowledge. (50%) were considered having satisfactory level of knowledge and above were considered having good level of knowledge.

Tool II: ECG monitoring Nurses' performance observation checklist tool: This tool was developed to determine the ECG training program applicability by staff nurses at selected setting through nurses' performance observation. The items of this part of the checklist were checked as done or not done this part consisted of 6 domains under main six headings that identify the specific nursing activities for patients with chronic medical conditions *(Jeffries et al., 2003; Jeffries, 2005; Cadden, 2007; Morris et al., 2009).* The total scores of performance checklist 500 grades, those who obtained less than (50%) were considered having inadequate level of practice. Above (50%) were considered having adequate level of practice.

Tool III: *ECG monitoring Nurses' competency level checklist:* this checklist is intended as a method of assessing professional proficiency as: no experience, theory observed only. Moderate experience, >5 times per year, may need minimal resource. Competent, performs on a daily activity. The total scores of questionnaire 30 grades, one grade was given for the Moderate experience and zero for the no experience. Those who obtained less than (50%) were considered having poor competency level. More than (60%) were considered having satisfactory competency level of skills.

Tool II: *ECG monitoring Patients outcome:* this tool was developed and modified by the researcher based on relevant recent literature. This sheet was used to assess the effect of ECG training program on patients' outcome including complications and length of hospital stay *(Luo,. 2013, S. Helgadottir. 2012).* It was divided into two parts:

Part I: This entailed demographic data of the patients' such as: age, gander, marital status, and level of education.

Part II: This part was developed to list of complications developed for patients admitted in selected setting. It consisted of (7) criteria (items) under main five headings that covered all cardiac dysrhythmias of patients with chronic medical conditions, as follows: tachyarrhythmias, bradyarrhythmias, Hypokalemia, ischemic cardiomyopathy, cardiac arrest, heart failure *(Luo,. 2013 and S. Helgadottir. 2012).* The possible complication was present and absent, the score of present = "1" means unsatisfactory outcome and absent score = "0" means satisfactory outcome.

Method:

This study was carried out in three phases:

Assessment and Planning phase: This phase included the following:

Reviewing the available literature and different studies related to research problem, and theoretical knowledge of its various aspects of the study. This period extended from *(April 2014 to Decamped 2014).*

Ethical considerations:

Informed consent was obtained from nurses and patients who are willing to participate in the study after explanation of the nature and purposes of the study. Confidentiality of the subjects was certainly assured.

Implementation phase:

The process of data collection was carried out from middle of Decamped 2014 to March 2015. The implementation phase was achieved through:

Validity was tested through jury of 3 expert in the field of medical surgical nursing and 2 in the field of cardiology. *Reliability* of proposed tools was done by Cronbach alpha test, the developed tools was tested using test retest method within 2 weeks. *A pilot study* it was carried out on 10% of the study subjects, who were excluded from the main study. The pilot study was done to ensure clarity, applicability, feasibility of conduction of the study tools, and time needed for each tool to be filled in. some modifications were done according to the pilot study findings. Some questions and items were omitted, added or rephrased, and then the final forms were developed.

The educational program was based on the PowerPoint Dysrhythmia Monitoring Practices (6 domains) downloaded from AACN's website *(Richards, 2008).* Monitor strips and 12 lead ECGs in the current medical records, analyzing dysrhythmias *(Drew, 2002)* and interpreting 12 lead ECGs displayed on a poster.

Total number of training hours for the staff nurses on the six domains of ECG training program application were (40 hours) 8 hours for theoretical part, 42 hours for practical part plus teaching on spot in addition to 4 sessions (8 hours) 4 hours for orientation at the six domains of ECG training program, and other (4 hours) at the end for revision.

Total number of nurses was 43, they were divided into 8 groups, and each group has 5 nurses, the six domains of ECG training program implementation took 16 weeks for all nurses in the study setting, morning, and afternoon shift. After that, the researcher asked the staff nurses to implement the six domains of ECG training program during their work at selected setting. Then, to assess the nurses competency levels.

Evaluation phase:

After implementation of six domains of ECG educational program, the nurses` competence level in knowledge and practice has been evaluated by the researcher through filling the tool (I, II and III).

Ethical approval:

An official permission to conduct the study was obtained by the researcher from the head of the emergency department, cardiology department and coronary and intensive care unit. Information consent for voluntary participation was obtained from each post explanation of the purpose of the study was described. The researcher emphasized that the participation is voluntary, confidentiality and anonymity of the subjects was assured through coding of all data.

Administrative design:

An official letter was issued from the Dean of the Faculty of Nursing to the Head of emergency department, cardiology department and coronary and intensive care unit at Aswan University Hospital to collect the necessary data, and explain the aim and contents of the study to nursing supervisors and physicians to gain their cooperation and allow the release of nurses to attend the education during minimal workload activities. Also the meetings with the patient to explain the objectives and contents of this study and obtain informed consent.

Statistical Design:

The collected data were coded then transformed into specially designed form so as to be suitable for entering into IBM compatible computer. All entered data were verified for any errors using Statistical Package for Social Sciences (SPSS) version 16 for windows. Descriptive statistics eg: number, percentage, mean and standard deviation. Data were collected, tabulated and statistically analyzed using Chi-square test, t-test, and ANOVA test. Correlation coefficient (r) was calculated between continuous variables. Test of significance were considered as a follows:

No significant (NS) P > 0.05
* Significant P < 0.05
** Moderate significance   P<0.001
*** Highly significance (HS) p<0.000.

Results:

Table (1): Percentage distribution of nurses according to socio demographic characteristics.

%	No. (n= 43)	Characteristic
Age: (years)		
37.2	16	< 30
40.1	20	30
15.9	7	≥ 40
	Mean ± SD = 33.20 ± 9.26	
Sex:		
18.2	7	- Male
81.8	36	- Female
Marital status:		
18.2	9	- Single
81.8	31	- Married
2.3	3	- Divorced
Qualification:		
100.00	43	- Nursing diploma
Years of experience:		
38.6	17	< 10 years
34.1	15	10 - < 20
27.3	12	≥ 20
-100	-43	**Previously attended to ECG training programs:** **Yes** **No**
95.34	41	**Nursing compliance**

This table shows that mean of age of nurses was (33.20 ± 9.26), more than half of nurses were in the age group of <30 years old, female, married, had nursing diploma, and <10 years of experience. It also illustrate that all of nurses (100%) had not attending any previous training program about ECG.
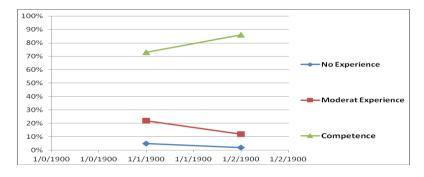
Table (2): Comparison between nurses performance in relation to pre post application of six domains of ECG training program (No= 43nurses).

Items	Pre- application				Post- applications				T- Test	
	Done		Not done		Done		Not done		T	P-Value
	No.	%	No.	%	No.	%	No.	%		
ECG monitoring immediate resuscitation.	00.00	00.00	43	100	15	34.88	28	65.11	-----	-----
Monitoring abnormal ECGs.	00.00	100	43	100	37	86	6	13.95	-----	-----
Assess tachyarrhythmia	2	4.65	41	95.34	39	90.6	4	9.30	41.43	0.001**
Assess ventricular fibrillation	00.00	100	43	100	30	69.7	13	30.23	-----	-----
Assess ventricular flutter.	00.00	100	43	100	29	62.7	14	32.55	-----	-----
Assess all degree of heart blocks.	1	2.32	42	97.67	28	65.11	15	34.88	47.25	0.001**

* Statistical significant difference (P< 0.05)

This table illustrate that, staff nurse's performance as regarding pre- post application of six domains the ECG training program for patients with chronic medical conditions. It can be noted that, most of the staff nurses showed high percentage in post application ECG training program than pre application p- value of <0.001.

Fig (1): Distribution of nurses related to level of competence in knowledge and practice post application of six domains (n= 43).

(Fig: 1) illustrate that, about (5%) of the studied sample had no knowledge experience while (2%) had no practice experience. Approximately (22%) were moderate experience in knowledge and (12%) in practice. The majority of the studied sample competences were (73%) knowledge and (86%) practice.

Table (3): Distribution of nurses competence level of knowledge mean score of pre-post application of six domains (n= 43).

P-value	Post application X + S.D	Pre application X + S.D	level of Competence Nurses` knowledge
00.10*	18.86 ± 2.34	7.57 ± 2.73	

This table illustrate a significant difference between nurses pre- post application according to level of competence score with p- value of <0.001.

Table (4): Distribution of nurses according to competence level of practice mean score of pre-post application of six domains (n= 43).

P-value	Mean + SD		level of Competence Nurses` practice
	Post application	Pre application	
0.001*	331.95 ± 25.87	133.07 ± 30.60	

This table emphasise a highly significant difference between nurses` in pre and post application in competence level of practice, total score with p- value of P <0.001.

Table (4): Distribution of study sample according to the level of competence in practice of pre-post application of six domains (n= 43).

P-value	Post application (n= 43)		Pre application (n= 43)		competence practices
	%	No.	%	No.	
	86.4	37	0.0	0	Adequate
0.001*	13.6	6	100.0	43	Inadequate

This table shows that, significant difference (P<0.001) between competence practice of pre-post application. It has been observed that all pre application (100%) has inadequate level of practice and (86.4%) of post application has adequate level of competence practice.

Table (5): Distribution of study sample according to the competence knowledge level for pre and Post application (n= 43).

Competence knowledge level	Pre application (n= 43)		Post application (n= 43)	
	No.	%	No.	%
Good	-	-	30	68.2
Satisfactory	2	6.8	12	29.5
Poor	41	93.2	1	2.3
P-value	0.001*			

Chi-square test   * Statistical significant difference (P< 0.05)

This table shows that the 6.8 % of pre application had satisfactory competence knowledge level, 93.2 % were poor. For the post application competence knowledge were 68.2 % had good competence knowledge, while 29.5 had level, 2.3 % had poor competence knowledge.

Table (6): Relation between nursing outcome and patients complications in the study group (n=70).

Outcome Indicators	Unsatisfactory (n=31)		Satisfactory (n=39)	
Patients Complication	No	%	No	%
	29	83.33	19	48.17
P-value	$X^2 = 18.97$		P< 0.001**	

Table 6, shows the relation between nursing outcome ECG training program for patients with chronic medical conditions and complications. It can noted from this table that, 83.33 % of patients with unsatisfactory outcome had complications, in comparison to 48.17% of patients with satisfactory outcome had no complications $X^2 = 18.97$ at P<0.0001.

Table (7): Relation between length of hospital stay and patient complications in the study patients (n=70).

Length of hospital stay	Complications No = 33		No complications No= 37	
	No	%	No	%
	22	57.90	----	91.89
Test	$X^2 =$ 26.41			
	P-value P<0.000**			

Table 7, shows the relation between patients hospital stay and complications, it can be observed from this table that, 57.90 % of patients who had complications stayed at hospital for long period. In addition, 91.89% of patients who had no complications, with highly statistically significance difference $X^2= 26.42$ at P-value P<0.00.

Discussion

Nurses caring for critical ill patients need to be prepared in the event of arrhythmia a deadly heart rhythm. The patient who suffers from arrhythmia needs nurses to be able to make the quick decisions necessary to save his life. Although patients with known cardiac disease suffer the greatest number of arrhythmias, these rhythms can occur with any patient on any department *ACLS. (2005).*

The aim of the study was to evaluate the effect of application of training program about electrocardiogram on nurses competency level and expected clinical outcome of cardiac patients.

The results of the present study showed that more than half of nurses were married, middle age adult. Nursing diploma was the highest proportion, more than half of them have an experience less than ten years and all of them have no in service training courses related to ECG. *Bahza, (2013)*; agree with the current study finding , also; confirm that the majority of the nurses their ages were ranged from 20- < 30 years, married, female, had diploma on nursing their experiences range from 5 to 10 years.

The present study induct a significant difference between nurses pre and post application ECG training program six domains, this result is agreed with *Schultz, (2010)* found that the educational program used in his study was found to be effective in increasing nurses 'knowledge of dysrhythmias and monitoring practices for patients at risk for wide QRS complex tachycardias. While the results of the current study was disagreed with the findings of other research studies that Chickering and Gamson's 1987 seven principles provided an effective framework for online programs to nursing staff or students *(Jeffries, 2005; Jeffries et al., 2003).*

In the present study post application of ECG training program, more than half of nurse's knowledge and practice were improved. This improvement might be related to the fact that all nurses have a strong compliance to learn new knowledge and practice. *Ahmed, (2011)*; found that a great improvement in knowledge occur post implementation of designed program. Other studies found that it was effective to require return demonstration of skills with competency assessment checklists and/or human patient simulation *(Morris et al., 2009; Cadden, 2007; Jeffries, 2005; Jeffries et al., 2003).*

However, the test scores for the domains given pre-post booklet of ECG interpretation distribution were significantly different with regard to the total score of all domains except Domain 1 on the topic of immediate resuscitation, where one question in particular was difficult for the participants to answer, thus demonstrating that the self-learning booklet was effective.

Moreover the current study revealed that, majority of patients with had outcome with no complications post training. *Rauen, 2008, Martinez, (2009)* emphasize that, ECG training program is a significant improving patient outcomes and contributes to reducing risks associated with critical care, particularly when implemented in conjunction with other patient safety initiatives This is in the same line with. *Schultz, 2010)* in a comparative study found that there had a validating competency on the entire staff at the same time this may result in a significant difference in patient outcomes of electrode placement and lead selection.

The present study illustrate significant change in length of hospital stay for patients with chronic medical condition post application of ECG training program in six domains. This is in agreement with *Johnson,*

et al., (2010) they found that the care provided by specialist nurses has been shown to improve outcomes for patients with CHF, significantly reducing the number of unplanned readmissions, length of hospital stay, mortality, and hospital costs.

Finally, nurses play important role in caring for patients with chronic medical condition, if they received proper training on ECG interpretation and emergency cardiac competence level of care. So this program has proved to professional competency in ECG interpretation and safe practice for these patients.

Conclusion

Nurses knowledge and practice differed with respect to the mean score. The lecture-based education program and self-learning booklet material were effective in improving the nurses' competence knowledge level of ECG interpretation, and patients satisfactory post application. Future research is needed to develop more proficient teaching strategies.

Recommendations:

1. Nurse's level of competence regarding knowledge and practice to ECG interpretation in emergency department must be considered in periodically evaluation of the nursing staff. Reward and punishment must be available based on the result of evaluation.

2. All opportunities available for improving staff nurses' competence knowledge regarding caring of patients with chronic medical condition as workshops, seminars, conference, and in-service education program regarding ECG interpretation should be utilized.

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تأثير برنامج تدريبي عن رسم القلب الكهربائي على مستوى كفاءة التمريض لمرضى القلب

يعتبر رسم القلب الكهربائي (ECG) في المستشفيات من العلوم الاكثر تعقيدا، ومع ذلك لابد وان يعتبر من الاهتمامات الاولى للممرضين والممرضات الذين يعملون في وحدات العناية الحرجة والطوارئ. **الهدف من الدراسة**: تقييم تأثير برنامج تدريبي عن رسم القلب الكهربائي على مستوى كفاءة التمريض لمرضى القلب. **مواد وطرق البحث**: أجريت الدراسة في قسم الطوارئ، قسم أمراض القلب ووحدة العناية المركزة للقلب (ICU) في مستشفى جامعة أسوان وقد اشتملت العينة على 43 من الممرضات في هذه الدراسة و 70 مريض بالغ في حالة حرجة يحتاج الى رعاية مركزة خلال الفترة 2014-2015. **ادوات القياس**: تم استخدام أداتين للقياس في المراحل المختلفة من هذه الدراسة وتنقسم الى: الجزء الاول: 1. استبيان لقياس البيانات الجغرافية للممرضات 2. استبيان لقياس معلومات الممرضات عن رسم القلب الكهربائي. الجزء الثاني: . استبيان لقياس البيانات الجغرافية للمرضى ـ استبيان خاص بتقييم المضاعفات للمرض في حاله حرجة ومدة الإقامة بالمستشفى. **اسفرت النتائج عن**: بالنسبة للممرضات أظهرت الدراسة نسبة تحسن عالية في برنامج التدريب على رسم القلب الكهربائى ECG قبل وبعد التطبيق بقيمة P- <0.001 بالنسبة للمرضى كانت النتائج تحسن في حدوث المضاعفات للمرضى مع تقليل نسبة البقاء بالمستشفى الى حدا ماء بنسبة 51.28٪ من المرضى الذين يعانون نتيجة مرضية أي مضاعفات 18.97 = X2 في P <0.0001، **فى ضوء هذا الدراسة**، وجدت فروق ذات دلالة احصائية بين ما قبل التطبيق والتطبيق البعدي بالنسبة لأداء الممرضات، يوجد تأثير ايجابى ودلالة احصائية واضحة تشير الى تحسن المضاعفات بالنسبة للمرضى بما في ذلك طول مدة الإقامة في المستشفى. **وأوصت الدراسة**: دورات مستمرة عن رسم القلب الكهربائى وتقييم دورى للممرضات العاملين بوحدة الطوارئ والحالات الحرجة. لايقتصر رسم القلب فقط على تمريض العنايات المركزة وانماء على كل الممرضات فى بعض الاقسام التى يوجد بها مرضى تحتاج الى متابعة لرسم القلب الكهربائى.

كلمات البحث: رسم القلب الكهربائى، الحالة الطبية المزمنة، ومستوى الكفاءة.