

ORIGINAL ARTICLE

Critical Care Nurses' Competency in Electrocardiogram Interpretation: A Cross-Sectional Study

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ABSTRACT

Introduction: The electrocardiogram is used to assess the heart's condition. Patients who come with symptoms of acute coronary syndrome must have the ECG immediately and the readings interpreted within 10 minutes, since any delays in giving treatment could result in significant tissue damage to the heart muscle. The objective was to determine the level of knowledge and practices regarding electrocardiogram (ECG) interpretation on cardiac arrhythmia among registered nurses working in critical care units. **Method:** A cross-sectional study was conducted among nurses at the critical care unit of Hospital Raja Permaisuri Bainun Ipoh, Perak. 105 respondents were recruited by convenience sampling. Respondents were given questionnaire on Knowledge and Practice on ECG interpretation. **Results:** this study found that 97.1% of the respondents have a good level of knowledge, while 76.2% have a good practice level regarding electrocardiogram interpretation on cardiac dysrhythmia. There were statistically significant differences in the knowledge level of ECG interpretation between the units in the hospital ($\chi^2(3) = 33.962, p = 0.022$) and education level ($\chi^2(3) = 9.608, p < 0.001$). There were statistically significant differences in the practice level of ECG interpretation between the years of working experience as a nurse ($\chi^2(3) = 13.726, p < 0.003$) and working unit ($\chi^2(3) = 21.887, p < 0.001$). **Conclusion:** the level of knowledge regarding ECG interpretation on cardiac arrhythmia is generally good. Level of practice can be improved by the development of continuous education on ECG. Early detection of dysrhythmia is a crucial skill among nurses to give a prompt treatment.

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INTRODUCTION

The electrocardiogram (ECG) shows the human heart's rhythmic contractions, which are caused by the electrical activity of heart muscles that varies over time during each cardiac cycle (1). A normal ECG in one cardiac cycle consists of a P-wave, a QRS-complex, and a T-wave that represent the electrical activity in specific regions of the heart. This wave will show whether the heart activity is normal or irregular by the presence of two important information, firstly, the time intervals that the electrical wave take to pass through the heart and secondly, the amount of electrical activity passing through the heart muscle (2). Arrhythmias are defined as abnormal heart rhythms caused by the distraction in the heart automaticity and/or abnormal heart conduction

due to a change in the heart rate, thus affecting tissue perfusion (3).

The ability to detect early signs of clinical deterioration through the patients' observation is very important to ensure the patients' safety (4). One of the roles of the critical care nurse is to recognise signs of deterioration in patients' condition and institute remedial measures (5). Performing and interpreting the ECG is part of the resuscitation procedure for the credentialing of nurses in emergency medicine and trauma services (6). Arrhythmias have been reported as a common event that occurs in the intensive care unit (ICU) setting (7), as well as the coronary care unit (CCU) (8). Therefore, it is crucial for a critical care nurse to quickly notice possible arrhythmias as patients' observation in critical care is performed by nurses (9). Since critical care nurses are the ones who are most often near the patients, their competency in the detection of any abnormal rhythm of the heartbeat from the ECG is counted as an important duty (10). Good knowledge and skill on ECG interpretation will directly

influence the diagnostic accuracy of the patients and consequently their treatment (11).

However, a study done by Shaaban Khalil et al. found that the participants have an inadequate level of knowledge and practice when it comes to managing life-threatening ventricular arrhythmias, which includes normal ECG, pathophysiology of ventricular dysrhythmias, rhythm interpretation, and cardiopulmonary resuscitation techniques (8). One study reported that only 12.5% of emergency nurses managed to demonstrate a fair level of ECG interpretation by correctly answering all questions (12). Meanwhile, Tahboub and Yılmaz reported that the nurses' ECG interpretation practise was only satisfactory, with 67% of the nurses passing the questionnaire (5). Another study found that the majority of respondents (97.56%) have an inadequate knowledge on ECG interpretation, while 87.8% have an inadequate knowledge regarding the ECG procedure (8). This knowledge deficit among critical care nurses on the interpretation of ECG, especially arrhythmia ECG, was also reported in a study among 110 ICU nurses in Sri Lanka that showed only 23.4% of them have high level of confidence to read an ECG rhythm strip (13). Another study also showed that the knowledge level among nurses is considered low, with an average of 54% correct answers on the ECG test (14). However, a study by Ruhwanya, Tarimo and Ndile reported that majority of the respondent's knowledge level is good, but their skill in handling life threatening arrhythmias was still poor (15).

Patients who come in with symptoms of acute coronary syndrome (ACS) must have the ECG immediately done on them and the ECG strip interpreted within 10 minutes, since delays in treatment could result in significant tissue damage to the heart muscle (16). Inappropriate interpretation of the ECG will cause increased healthcare cost, prolong the admission process due to the late care given or uncertainty over the ECG interpretation (17). It is vital that hospital administrators acknowledge the highlighted deficits in knowledge and practice regarding ECG interpretation and endeavour to improve nursing competencies to improve patient care (15).

In our knowledge there is no study on knowledge and practice of ECG interpretation was conducted among critical care nurse in Malaysia. Thus, this study aims to determine the level of knowledge and practice on the interpretation of arrhythmia ECG among registered nurses working in critical care and the association between their sociodemographic with their level of knowledge and practice on ECG interpretation on cardiac arrhythmia.

MATERIALS AND METHODS

Study design

This study is a descriptive cross-sectional study and

was conducted at the Intensive Care Unit (ICU), High Deficiency Unit (HDU), Coronary Care Unit (CCU) and Acute & Emergency Department (A&E) of Hospital Raja Permaisuri Bainun Ipoh, Perak (HRPB), Malaysia.

Samples

Convenience sampling was used in this study. The inclusion criteria included registered nurses working in general ICU, HDU, A&E and CCU in HRPB, either with or without higher education in critical care settings (e.g., post basic, advanced diploma, degree, or others) and able to understand the Malay and English language. The exclusion criteria were nurses who were on study leave, maternity leave, medical leave during the research's data collection process and nurses with temporary attachment at critical care settings. The sample size was calculated by using Krecjic and Morgan formula (18), with X² value 3.841, a precision level of 5%, the population proportion assumed to be 0.5, and a total population of nurses was 140. Based on the sample size calculation, 103 samples were required. After considering 20% dropout, the total sample needed were 128.

Instrument

A self-administered structured questionnaire was used in this study which consisted of three parts:

Part 1: Socio-demographic information

This part consisted of 11 questions regarding the socio-demographic of the respondents. The variables were age, gender, working experience, working unit, education level, experience in taking ECG, ECG training course, ECG education resource, years since taking the last ECG course, ECG competency level and desire to learn about ECG.

Part 2: Nurses' Knowledge of Electrocardiogram Interpretation

Part two consisted of 15 questions on knowledge of nurses on ECG. This questionnaire was adapted from Tahboub and Yılmaz (5). Questions were assessed with true and false type of answers. The respondents' level of knowledge was determined by totalling the marks obtained, which then was divided into two category levels. For each question answered correctly, one mark was given and zero mark for an incorrect answer. The cut-off point of total marks for the knowledge level is as follows: those with total marks that fall within the range of 0 to 7 were categorized under 'poor knowledge', while those with total marks within the range of 8 to 15 were categorized under the 'good knowledge' level. A pilot study was done to assess the validity and reliability of the questionnaire. The Cronbach's Alpha value for the Nurses' Knowledge of Electrocardiogram Interpretation questionnaire was good ($\alpha = 0.714$).

Part 3: Practice of nurses on ECG

Part 3 consisted of 8 multiple-choice questions adapted

from Tahboub and Yilmaz (5). The respondents' level of practice determined by totalling the marks obtained, which then was divided into two category levels. For each question answered correctly, one mark was given and zero mark for an incorrect answer. The cut-off point of the total marks for practice level is as follows: those with total marks within the range of 0 to 4 were categorized under 'poor practice' and those with total marks within the range of 5 to 8 were categorized under the 'good practice' level. A pilot study was done to assess the validity and reliability of the questionnaire. The Cronbach's Alpha value for the Practice of Nurses on ECG questionnaire was good ($\alpha = 0.762$).

Data Collection

Data collection was started after approval was obtained from the Universiti Teknologi MARA (UiTM) research ethics committee and the National Medical Research and Ethics Committee (NMRR). Nurses from ICU, HDU, CCU and A&E of HRPB were approached at the end of their shift to answer the questionnaire. A brief explanation was given and respondents have the right to refuse from participating in this study. Nurses that fulfilled the inclusion criteria were recruited via convenience sampling. After that, their consent was obtained before allowing them to answer the questionnaire. Respondents were given 30 minutes to complete the questionnaire. The respondents' names were not collected and replaced with a subject ID code number to maintain confidentiality.

Statistical Analysis

The statistical analysis was done by using IBM Statistical Package for Social Sciences version 25.0. Descriptive analysis was used to describe the demographics characteristic of the respondents, knowledge level and the level of practice regarding electrocardiogram (ECG) interpretation on cardiac Arrhythmia among registered nurses working in critical care. The relationship between sociodemographic with level of knowledge and practice on ECG interpretation on cardiac arrhythmia among registered nurses working in critical care was analyze using a suitable inferential analysis (Mann-Whitney U test and Kruskal-Wallis test).

Ethical Approval

Ethical approvals from the UiTM research ethic committee with reference number (REC/09/2020/MR274) and National Medical Research Register (KKM/NIHSEC/P21-348 (4)) were obtained.

RESULTS

Demographic Characteristics

Table I shows the overall demographic characteristics of the 105 nurses who participated in the study. The majority were female nurses (81.9%) with a median age of 32 years old (IQR: 9.0). All respondents have experienced taking ECG for their patients (100%).

Table I: Demographic Characteristics of Respondents (n=105)

Characteristic	Statistic, n (%)	
Age in years, median (IQR)	32.0	9.0
Gender		
• Male	19	18.1
• Female	86	81.9
Years of working experience as registered nurse		
• 1-5 years	22	21.0
• 6-10 years	39	37.1
• 11-20 years	37	35.2
• >20 years	7	6.7
Currently working unit in hospital		
• Emergency department	18	17.1
• Intensive care unit	52	49.5
• Coronary care unit	29	27.6
• High Deficiency unit	6	5.7
Education level		
• Diploma	40	38.1
• Post Basic Certificate	52	49.5
• Bachelor's	11	10.5
• Master	2	1.9
Taking ECG for patients		
• Yes	105	100
• No	0	0.0
Previous ECG training course		
• Yes	64	61.0
• No	41	39.0
ECG Education Resource		
• University	13	12.4
• Courses	53	50.5
• Internet	19	18.1
• Self-learning books	8	7.6
• Congress / conferences	8	7.6
• Class of ECG	3	2.9
• In work place	1	1.0
Years since taking the last ECG course		
• I don't take	38	36.2
• Less than 2 years	19	18.1
• Between 2 to 5 years	19	18.1
• More than 5 years	29	27.6
ECG competency level		
• Beginner	47	44.8
• Intermediate	52	49.5
• Advanced	6	5.7
Desire to learn about ECGs		
• Yes	104	99.0
• No	1	1.0

Level of Knowledge and Practice regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care

Table II shows the level of knowledge regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care. The majority of respondents gave a wrong answer for "The P wave represented right and left atrial repolarization" (n = 76; 72.4%). However, most of the respondents responded correctly for "T wave represents ventricular repolarization" (n = 99; 94.3%), and "Normal PR interval between 0.12 and 0.20 seconds" (n = 100; 95.2%).

Table III shows the level of practice regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care. The result shows that

Table II: Level of knowledge regarding electrocardiogram (ECG) interpretation on cardiac arrhythmia among registered nurses working in critical care (n=105)

Knowledge regarding ECG	Incorrect answer		Correct answer	
	frequency (n)	Percent (%)	frequency (n)	Percent (%)
The P wave represented right and left atrial repolarization	76	72.4	29	27.6
QRS complex represented right and left ventricular depolarization	7	6.7	98	93.3
T wave represents ventricular repolarization	6	5.7	99	94.3
T wave is one of the positive in normal ECG except in leads aVR	20	19.0	85	81.0
Normal PR interval between 0.12 and 0.20 seconds	5	4.8	100	95.2
In normal ECG aVR leads are negative wave	25	23.8	80	76.2
Pathologic Q waves are a sign of previous myocardial infarction	20	19.0	85	81.0
Atrial fibrillation could be regular rhythm	25	23.8	80	76.2
ECG can detect left ventricular hypertrophy (LVH)	15	14.3	90	85.7
ST elevation in inferior myocardial infarction appears in leads: V1-V6	44	41.9	61	58.1
ST elevation in lateral myocardial infarction appears in leads: I, aVL, V5, V6	13	12.4	92	87.6
ST elevation in anterior myocardial infarction appears in leads: II, III, aVF	39	37.1	66	62.9
ST depression in ECG indicated ischemia myocardial	10	9.5	95	90.5
rSr pattern appear in V1, V2 and V3, slurring of S wave in V6 and QRS duration is 120sec for complete right bundle branch block rhythms	16	15.2	89	84.8
Tall tented T and wide QRS complex seen in case hypokalemia	37	35.2	68	64.8

88 of the respondents (83.8%) answered correctly for the second question. However, in question eight, respondents had to choose the correct pathology of the patient’s ECG that was given and unfortunately, 53 of the respondents (50.5%) gave the wrong interpretation.

Table IV shows the distribution of the overall knowledge and practice regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care. 97.1% of the respondents have a good knowledge regarding ECG interpretation on cardiac arrhythmia, while 76.2% of the respondents have a good practice regarding ECG interpretation on cardiac arrhythmia.

The relationship between sociodemographic and level of knowledge on ECG interpretation on cardiac arrhythmia among registered nurses working in critical care

Table V shows the relationship between the respondents’ sociodemographic and the level of knowledge on ECG interpretation. There was a statistically significant difference between the units in HRPB that the respondents were working in ($\chi^2(3) = 33.962, p < 0.001$), education level ($\chi^2(3) = 9.608, p = 0.022$), ECG training course ($z = 961.0, p = 0.020$) and ECG competency level ($\chi^2(2) = 19.766, p < 0.001$) on their knowledge level on ECG interpretation. A post hoc test using Bonferroni correction was done and the result showed that the knowledge level on ECG interpretation among nurses from the coronary care unit was statistically higher compared to those from the emergency department ($U = 134.5, p = 0.004$), intensive care unit ($U = 207.5, p < 0.001$) and high deficiency unit ($U = 24.5, p = 0.005$). For education level, ECG interpretation among nurses with only a diploma was statistically lower compared to nurses with a bachelor’s degree ($U = 95.0, p = 0.004$).

Beginner nurses have a statistically lower knowledge level compared to intermediate ($U = 678.0, p < 0.001$) and advanced nurses ($U = 38.5, p = 0.004$).

The relationship between sociodemographic and level of practice on ECG interpretation on cardiac arrhythmia among registered nurses working in critical care

Table VI shows the relationship between the respondents’ sociodemographic and the level of practice on ECG interpretation. There was a statistically significant difference between the years of working experience among the nurses and their practice level on ECG interpretation ($\chi^2(3) = 13.726, p = 0.003$), units that the respondents were working ($\chi^2(3) = 21.887, p < 0.001$), education level ($\chi^2(3) = 12.426, p = 0.006$), previously taken an ECG training course ($z = 604.5, p < 0.001$), years since the respondents took their last ECG course ($\chi^2(3) = 19.704, p < 0.001$), self-assessment on their competency to interpret the ECG ($\chi^2(2) = 25.933, p < 0.001$). A post hoc test by Bonferroni correction was done and the result showed that the practice level on ECG interpretation among nurses who work between one to five years was significantly lower compared to those who work within six to ten years ($U = 289.0, p = 0.033$) and those who work within 11 to 20 years ($U = 175.5, p < 0.001$). Practice on ECG interpretation among nurses from the coronary care unit was significantly higher compared to those from the emergency department ($U = 128.5, p = 0.003$), intensive care unit ($U = 302, p = 0.001$) and high deficiency unit ($U = 37.5, p = 0.026$). The practice level of ECG interpretation among nurses with only a diploma was significantly lower compared to those with a post basic certificate ($U = 674.0, p = 0.003$) and bachelor’s degree ($U = 102.0, p = 0.006$). Practice level on ECG interpretation among nurses who did not take an ECG course was significantly lower compared to

Table III: Level of Practice Regarding Electrocardiogram (ECG) Interpretation on Cardiac Arrhythmia Among Registered Nurses Working in Critical Care (n=105)

Practice regarding ECG	Incorrect answer		Correct answer	
	frequency (n)	Percent (%)	frequency (n)	Percent (%)
You perform an ECG and observe this rhythm. What do you think it might be?	32	30.5	73	69.5
You perform an ECG and observe this rhythm. How would you act?	17	16.2	88	83.8
A patient comes to the emergency department due to a respiratory distress. He has 140 beats per minute	30	28.6	75	71.4
A hospitalized patient who had percutaneous coronary investigation (PCI) due to an Acute Myocardial Infarction, his vital signs are unstable.	17	16.2	88	83.8
Patient who have chest pain appeared after leaving an important meeting two hours ago. He is 52 years of age and hypertensive and a few months ago he was diagnosed with Diabetes Mellitus Type II.	54	51.4	51	48.6
A 24 years old male comes to the emergency department. He is athletic and slim. He reports feeling a pricking sensation in the left area of his chest since he finished doing exercise (3hour earlier).	28	26.7	77	73.3
A 30-year-old woman comes to the emergency department reporting palpitation, chest tightness and dyspnoea.	26	24.8	79	75.2
What pathology you think the patient with this ECG has?	53	50.5	52	49.5

Table IV: Distribution of the respondents by their overall knowledge and practice regarding electrocardiogram (ECG) interpretation on cardiac arrhythmia (n=105)

Variable	Statistic, n (%)	
	Poor	Good
Knowledge	3 (2.9)	102 (97.1)
Practice	25 (23.8)	80 (76.2)

those who took an ECG course between the last two to five years ($U = 166.5, p = 0.001$), and those who took an ECG course more than five years ago ($U = 260.5, p < 0.001$). Nurses who took their last ECG course less than two years ago have a lower level of practice on ECG interpretation compared to nurses who took an ECG course between the last two to five years ($U = 107.0, p = 0.029$), and nurses who took an ECG course more than five years ago ($U = 169.0, p = 0.022$). The practice level on ECG interpretation among beginner nurses was lower than the practice level of intermediate ($U = 531.0, p < 0.001$) and advanced nurses ($U = 57.0, p = 0.017$).

Table V: The Relationship Between Sociodemographic with Level of Knowledge on ECG Interpretation on Cardiac Arrhythmia Among Registered Nurses Working in Critical Care (n=105)

Characteristic	Knowledge on ECG Median, IQR	z / $\chi^2(df)$	p-value
Gender			
• Male	11.0, 5.0	764.5 ^a	0.659
• Female	12.0, 4.0		
Years of working experience as registered nurse			
• 1-5 years	12.0, 2.5	7.373 (3) ^b	0.061
• 6-10 years	11.0, 4.0		
• 11-20 years	13.0, 3.5		
• >20 years	12.0, 3.0		
Currently working unit in hospital			
• Emergency department	12.0, 2.5	33.962 (3) ^b	<0.001
• Intensive care unit	10.0, 3.0		
• Coronary care unit	14.0, 1.0		
• High Deficiency unit	9.5, 3.75		
Education level			
• Diploma	11.0, 2.75	9.608 (3) ^b	0.022
• Post Basic Certificate	12.5, 4.75		
• Bachelor's	14.0, 2.0		
• Master	10.0, -		
Previous ECG training course			
• Yes	13.0, 4.0	961. ⁰ a	0.020
• No	11.0, 3.0		
ECG Education Resource			
• University	10.0, 4.0	10.240 (6) ^b	0.115
• Courses	13.0, 4.0		
• Internet	12.0, 3.0		
• Self-learning books	11.5, 4.25		
• Congress / conferences	10.5, 3.5		
• Class of ECG	14.0, -		
• In work place	-		
Years since taking the last ECG course			
• I don't take	12.0, 4.0	7.308 (3) ^b	0.063
• Less than 2 years	10.0, 4.0		
• Between 2 to 5 years	12.0, 4.0		
• More than 5 years	13.0, 3.5		
ECG competency level			
• Beginner	10.0, 3.0	19.766 (2) ^b	<0.001
• Intermediate	13.0, 3.0		
• Advanced	14.0, 2.75		
Desire to learn about ECGs			
• Yes	12.0, 4.0	41.5 ^a	0.726
• No	-		

a= Mann-Whitney U test, b= Kruskal-Wallis test, df= degree of freedom

DISCUSSION

Knowledge and Practice regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care

In this study, 97% of the respondents were found to have a good level of knowledge regarding ECG interpretation

Table VI: The Relationship Between Sociodemographic with Level of Practice on ECG Interpretation on Cardiac Arrhythmia Among Registered Nurses Working in Critical Care (n=105)

Characteristic	Practice on ECG, Median, IQR	z / χ^2 (df)	p-value
Gender			
• Male	5.0, 3.0	732. ^{0a}	0.472
• Female	6.0, 2.0		
Years of working experience as registered nurse			
• 1-5 years	4.0, 3.0	13.726 (3) ^b	0.003
• 6-10 years	6.0, 2.0		
• 11-20 years	6.0, 1.5		
• >20 years	6.0, 3.0		
Currently working unit in hospital			
• Emergency department	5.5, 1.5	21.887 (3) ^b	<0.001
• Intensive care unit	5.0, 2.0		
• Coronary care unit	7.0, 2.0		
• High Deficiency unit	4.5, 4.25		
Education level			
• Diploma	5.0, 3.0	12.426 (3) ^b	0.006
• Post Basic Certificate	6.0, 2.0		
• Bachelor's	6.0, 1.0		
• Master	-		
Previous ECG training course			
• Yes	6.0, 1.75	604.5 ^a	<0.001
• No	5.0, 3.0		
ECG Education Resource			
• University	5.0, 4.0	12.492 (6) ^b	0.052
• Courses	6.0, 2.0		
• Internet	5.0, 2.0		
• Self-learning books	5.5, 1.0		
• Congress / conferences	4.0, 5.0		
• Class of ECG	7.0, -		
• In work place	-		
Years since taking the last ECG course			
• I don't take	5.0, 3.0	19.704 (3) ^b	<0.001
• Less than 2 years	5.0, 3.0		
• Between 2 to 5 years	7.0, 3.0		
• More than 5 years	6.0, 1.0		
ECG competency level			
• Beginner	5.0, 3.0	25.933 (2) ^b	<0.001
• Intermediate	6.0, 1.0		
• Advanced	7.0, 1.75		
Desire to learn about ECGs			
• Yes	6.0, 2.0	11.5 ^a	0.174
• No			

a = Mann-Whitney U test, b = Kruskal-Wallis test, df= degree of freedom

on cardiac arrhythmia. In a similar study, Ruhwanya et al. reported that 83% of their respondents answered correctly when identifying life threatening arrhythmias such as ventricular tachycardia, asystole, complete heart block and ventricular fibrillation through reading of the ECG strip (15). The high percentage of nurses with a

good level of knowledge in the present study may be due to the fact that the majority of them have previously taken an ECG training course. However, a study by Werner et al., which involved ambulance staff, reported a lower level of knowledge, since the majority of the respondents did not take any ECG education during the last five years (14). This shows that it is important for nurses to continuously update their knowledge on ECG through ECG training courses. Besides that, nurses also need to have Basic Life Support skills, where they learn to operate the ECG machine and carry out systematic rhythm analysis (19). This approach can be used as one of the methods to help nurses gain a better understanding of ECG. In this study, all respondents had some practical experience in performing the ECG test on patients. This is probably also the reason why they have a good knowledge regarding the ECG. Esparza et al. found that nurses who have practical experience performed ECG before have a good ability in early identification of potential problems among patients through the ECG interpretation, and able to describe patients' condition to other health professionals, thus indirectly leading to earlier discharge times for patients (20). Meanwhile, the present study also found that the majority of the respondents rated themselves to have an intermediate ECG competency. Their confidence appears to be influenced by their level of knowledge.

This study found that 76.2% of the respondents have a good level of practice in ECG interpretation of cardiac arrhythmia. This result is similar with Tahboub and Yilmaz, which also reported that the level of nurses' practice on ECG interpretation was satisfactory (5). However, a study among critical care nurses in Tanzania showed that 84.4% of the respondents scored a low practice level regarding the operation of the ECG machine, such as the skin preparation before the application of electrodes, lead placement, the path of conduction of the ECG and identification of the waves produced by the ECG (15). In the present study, 60% of the respondents reported to have attended an ECG training.

Relationship between sociodemographic and level of knowledge and practice on ECG interpretation on cardiac arrhythmia among registered nurses working in critical care

This study examined the relationship between the sociodemographic of the respondents with the level of knowledge and practice regarding the ECG interpretation on cardiac arrhythmia. The result showed that there were statistically significant differences in both of the nurses' knowledge and practice on ECG interpretation between the different units in the hospital that the respondents were working in. This study found that those from the coronary care unit have significantly higher knowledge compared to those from the emergency department, intensive care unit and high deficiency unit. This result is contrary to the study by Ho et al. who reported

that ECG knowledge was significantly and positively correlated with emergency department experience (12). This discrepancy could be due to the nurses from HRPB's coronary care unit being assigned exclusively to take care of patients with heart problems, compared emergency department nurses who only take care of patients for a short period of time before the patients will be transferred to the other units.

The result from this study also showed that there was statistically significant difference between the level of knowledge on ECG interpretation among respondents who have and have not previously taken an ECG training course. Another study also found that nurses who have not received prior ECG training, displayed significantly less ECG knowledge compared to nurses who had received prior ECG training (12). A basic knowledge on ECG will help nurses to understand and interpret the result more easily. Moreover, having more working experience and attending ECG training courses had a positive impact on nurses' ECG knowledge (5).

This study also found that those from the coronary care unit also have a significantly higher practice level compared to those from the emergency department, intensive care unit and high deficiency unit. Meanwhile, a study by Ahmed demonstrated that those from the coronary care unit, intensive care unit and emergency department have a good knowledge and practice level on ECG towards adolescent patients (21). Zhang and Hsu also reported that those from the cardiology department have the highest percentage of correct answers compared to those working in the emergency department and intensive care unit (22). This can be due to the nurses from the coronary care unit are dealing with patients who have heart problems every day, thus having more competency in identifying any ECG changes to give earlier treatment. The result of the study also revealed that there was a statistically significant difference between the self-assessment by the respondents on their competency to interpret the ECG and the level of knowledge and practice on ECG interpretation. The results showed that nurses who rated their competency as beginners, have a lower level of knowledge and practice on ECG interpretation compared to the nurses who self-rated as intermediate and advanced. It might be as a result of them being new staff or junior nurses.

CONCLUSION

In conclusion, this study found that the level of knowledge and practice regarding ECG interpretation on cardiac arrhythmia among registered nurses working in critical care is generally good. There were statistically significant differences in the knowledge level of ECG interpretation between the units in the hospital and education level. There were statistically significant differences in the practice level of ECG interpretation

between the years of working experience as a nurse and working unit. For future research, the researchers suggest an observational study using a checklist might also be useful to evaluate the actual practice among the nurses during the procedure of taking the ECG. The strength of this study is, to the best of the researcher's knowledge, there was no study on knowledge and practice of ECG interpretation on cardiac arrhythmia was conducted among critical care nurse in Malaysia. The limitation for this study is due to Covid 19 pandemic, it's hard for the researchers to do the random sampling since researchers need to limit the time during data collection at each department. Then, this study only involved nurses from few departments in one hospital, therefore, the data may not reflect the general situation about the level of knowledge and practice among nurse regarding electrocardiogram (ECG) interpretation on cardiac arrhythmia in Malaysia.

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