KNOWLEDGE AND PRACTICE ON ELECTROCARDIOGRAM INTERPRETATION AMONG NURSES AT NATIONAL HEART INSTITUTE

Jamahari NA[1, 2], Sh Abdullah SS[1], Hussain A[3], and Liang F[4].
[1]Centre for Nursing Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia
[2]HDU Department National Heart Institute, 145 Jalan Tun Razak, 54000 Kuala Lumpur, Malaysia
[3]Pediatric Unit, Hospital Sultanah Bahiyah, KM6, Jalan Langgar, Alor Setar, Kedah, Malaysia
[4]School of Nursing, Huzhou University, China

Correspondence:
Sharifah Shafinaz binti Sh Abdullah,
Centre for Nursing Studies, Faculty of Health Sciences,
Universiti Teknologi MARA, Puncak Alam Campus,
42300 Puncak Alam, Selangor, Malaysia
Email: shasya@uitm.edu.my

Abstract

Coronary heart disease (CHD) is the top killer globally, including in Malaysia. Patients with symptoms of chest pain are recommended to get an electrocardiogram immediately, in less than 10 minutes, to detect necrosis of heart tissue due to acute myocardial infarction (AMI). This cross-sectional study conducted among nurses at the National Heart Institute (NHI), Kuala Lumpur, Malaysia was aimed to identify the level of knowledge and practice of ECG interpretation among nurses at NHI. This current study used convenient sampling and involved 255 participants. Overall, 239 participants (93.7%) have good ECG interpretation knowledge and 88.2% (n = 225) have good practice on ECG. There was an association between the level of knowledge and practice regarding ECG readings (p = 0.01). In conclusion, the level of knowledge and practice among nurses in NIH was considered good.

Keywords: Knowledge, Competency, Assessment Electrocardiogram, Nurses

Introduction

Cardiovascular disease (CVD) is known to cause 17.9 million deaths per year, contributing to 31% of the world population (1). In Malaysia, ischemic heart disease remained the principal cause of death, accounting for 17.0% of the 109 155 medically verified deaths in 2020 (2). Ischemic heart diseases can narrow and cut off blood supply to the heart muscle. An electrocardiogram (ECG) is a device that can detect changes in the heart's electrical activity over time. The device is a cost-effective, straightforward, and non-invasive procedure for detecting cardiac abnormalities such as tachycardia and infarction (3).

Nurses are responsible for basic resuscitation and are the first medical professionals to respond to an in-hospital cardiac arrest (4). The responsibilities of the nurses as the first liner to the interpretation of ECG are crucial to decrease mortality rates and increasing patient survival rates. Correctly interpreting ECG, such as myocardial infarction with and without ST-segment elevation, T-wave tenting or inversion, and abnormal Q waves within 10 minutes of a patient complaining of chest pain, is beneficial as a diagnostic tool in emergency department triage (5). Nurses with good knowledge and practice interpreting the

ECG can help the doctor build trust and collaborate with other healthcare professionals to save the patient's life. However, several previous studies reveal poor levels of knowledge and poor practice in ECG interpretation (5-7). Thus, this study aimed to evaluate the level of knowledge and practice in ECG interpretation among nurses working at Kuala Lumpur's National Heart Institute (NHI).

Materials and Methods

Sample collection

A descriptive cross-sectional design was conducted among nurses who worked in various departments such as the cardiac ward, Invasive Cardiac Laboratory (ICL), observation and emergency department and critical care area include Intensive Care Unit (ICU), Coronary Care Unit (CCU), Cardiothoracic High Dependency Unit (HDU CT), High Dependency Unit Renal (HDU RENAL), Coronary High Dependency Unit (HDU CD), and Pediatric Intensive Care Unit (PC ICU), at the National Heart Institute, in Kuala Lumpur. All registered nurses working at National Heart Institute were recruited from September 2022 till December 2022. Through a convenient sampling method

and participants had to meet two requirements to be included: they had to be registered nurses with a minimum age of 21 and a maximum age of 45, including both male and female nurses, and they had to have completed at least six months of employment in the study location to ensure all the participants were practicing ECG in the study area. The exclusion criteria for this study were administration nurses, nurses on long leave, such as maternity or unpaid leave, nurses involved in hospital attachment in the NHI, such as student nurses, and attachment nurses from other hospitals.

A survey questionnaire was adapted and modified from a study by Tahboub & Yilmaz (8). Written permission was obtained from the original authors to use the questionnaire. The first section of the questionnaire was the socio-demographic background of the participants, the second section was regarding questions related to the level of knowledge of ECG interpretation. There were 15 true/false questions included. One point was awarded for the correct answer, while zero points were awarded for the wrong one. The cut-off points for total marks used to determine knowledge level is as follows: those with total marks between 0 and 7 were classified as having "poor knowledge," while those with full marks between 8 and 15 were classified as having "good knowledge" level (9).

The third section was regarding inquiries related to the level of ECG interpretation practice. The questionnaire consists of 8 multiple-choice questions with four answer options each regarding the nurse's practice on ECG interpretation. One mark was given for each correct answer, and zero marks were given for the wrong answer. Following is the cut-off criterion for total marks for practice level: those with full marks between 0 and 4 were classified as having "poor practice," and those with full marks between 5 to 8 were classified as having "good practice (9).

A Content Validity Index (CVI) was conducted with a score of 0.97 for part of the knowledge and practice of ECG interpretation. The validity of the content was validated by six panels (two cardiologists, two senior medical officers, one nursing lecturer, and one nurse from the Cardiopulmonary Resuscitation (CPR) coordinator. A reliability test was performed to ensure the consistency of the tools, and it was found that Cronbach's alpha was 0.69. A participant information sheet provided explains the purpose of the study, the intended inclusion criteria as stated, and that participation was voluntary. Consent was implied upon completion of the online questionnaire. Questionnaires were also distributed by the researcher through an online platform by emailing them to the participants.

Data collection was done through Google Forms because the rate of transmission of COVID-19 was still relatively high during the study period. An appointment with the nurse manager was accompanied by the study's ethical approval letter and the selection of participants based on the inclusion criteria. The nurse manager disseminated the link to the participants, and an allocation time to answer was advised for 20 minutes to maintain the validity of the survey. Participants had the right to refuse the study at any time. The details of participants remained anonymous and were substituted with the subject ID code to preserve privacy and to prevent repetitive of answering the questionnaire. All the participants were advised to keep the link to the Google form in a suitable manner of private and confidential. Data entry, including coding, organizing, and cleaning, was performed using Microsoft Excel, and data processing was conducted using IBM SPSS version 26.0.

Data analysis

Using IBM SPSS version 26.0 to analyze all data because this software is more reliable and provides an accurate result for this study. Descriptive statistics were calculated to measure the central tendency of the participant's demographic characteristics, knowledge level, and practice toward ECG interpretation in the study area. Pearson chi-square inferential statistics and the Fisher exact test were performed to determine the relationship of demographic participants with practice and knowledge of ECG interpretation in the study area.

Results

Demographic characteristics of participants

The surveys were completed by 255 participants, yielding a 90% response rate overall. Most participants were female nurses 89.8% (n = 229); male nurses only contributed 10.2% (n = 26). It was found that 47.5% (n = 121) of the participants were under 30, and 35.3% (n = 90) had working experience of 1 to 5 years - about 65.1% (n = 166) of the participants who had attended the course regarding ECG interpretation. Table 1 shows the demographic characteristics of the participants at the NHI (n = 255).

Table 1: Demographic characteristics of the participants at the NHI (n = 255)

Characteristic	Statistics n (%)	
Age		
< 30	121	47.5
30 – 40	119	46.7
41 – 45	15	5.9
Gender		
Female	229	89.8
Male	26	10.2
Race		
Malay	237	92.9
Chinese	4	1.6
India	13	5.1
Others	1	0.4
Years of working		
< 1	27	10.6
1 – 5	90	35.3
6 – 10	67	26.3
11 – 20	58	22.7
> 20	14	5.1

Table 1: Demographic characteristics of the participants at the NHI (n = 255)

Characteristic	Statistics n (%)	
Currently, at Unit of		
Ward	91	35.7
CCA	87	34.1
O&E	38	14.9
ICL	39	15.3
Education background		
Diploma	123	48.2
Degree	104	40.8
Advance diploma	26	10.2
Master	2	0.8
Last ECG course taken		
Never	65	25.5
< 2 years	73	28.6
2 – 5 years	68	26.7
> 5 years	49	19.2
Source of ECG Education		
University	67	26.3
College	101	39.6
Internet	15	5.9
Self-learning from books	15	5.9
Congress / conference	23	9.0
Others	34	13.3
Competency level of handling ECG		
Beginner	123	48.2
Intermediate	123	48.2
Advance	9	3.5
Desire to learn about ECG		
Yes	254	99.6
No	1	0.4

Level of knowledge on ECG interpretation among nurses at National Heart Institute

Table 2 displays the level of knowledge of ECG readings among the participants at the NHI. The majority of the nurses had a good level of understanding of ECG interpretation, with a score of 93.7% (n = 239).

Table 2: The level of knowledge on ECG interpretation among nurses at the NHI

Level of Knowledge	Level of Knowledge	Percentage (%)
Good	239	93.7%
Poor	16	6.3%

*Descriptive analysis

It was found that almost half of the participants answered incorrectly about the question "The P wave represented right and left atrial repolarization" 49.4% (n = 126). More

than 30% of the participants answered wrongly: "In normal ECG V1 and aVR leads are the negative wave, ST elevation in inferior myocardial infarction appear in leads: V1-V6 and ST elevation in anterior myocardial infarction appear in leads: II, III, aVF". For other questions, most participants had a correct answer with a score of more than 50% (Table 3).

Table 3: Knowledge item regarding ECG interpretation

Knowledge towards ECG interpretation	Correct answer		Incorrect answer	
	n	%	n	%
1. The p wave represented right and left atrial repolarization	129	50.6	126	49.4
2. QRS complex represented right and left ventricular depolarization	229	89.8	26	10.2
3. T wave represents ventricular repolarization	236	92.5	19	7.5
4. Normal PR interval between 0.12 and 0.20 seconds	246	96.5	9	3.5
5. In normal ECG V1 and aVR leads are negative wave	172	67.5	83	32.5
6. Pathologic Q waves are a sign of previous myocardial infarction	208	81.6	47	18.4
7. Atrial fibrillation could be regular rhythm	223	87.5	32	12.5
8. ECG can detect left ventricular hypertrophy (LVH)	232	91.0	23	9.0
9. ST elevation in inferior myocardial infarction appear in leads: V1-V6	167	65.5	88	34.5
10. ST elevation in lateral myocardial infarction appear in leads: I, aVL, V5, V6	223	87.5	32	12.5
11. ST elevation in anterior myocardial infarction appear in leads: II, III, aVF	164	64.3	91	35.7
12. ST depression in ECG indicated ischemia myocardial	235	92.2	20	7.8
13. RSR pattern appear in V1, V2 and V3 in right bundle branch block rhythms	220	86.3	35	13.7

The level of practice on ECG interpretation among nurses at National Heart Institute

Table 4 represents the level of practice toward ECG interpretation among nurses at the NHI. It was noticed that most participants had a high degree of practice in interpreting ECG 88.2%, (n = 225).

Table 4: Level of practice regarding ECG interpretation

Level Of Practice	Frequency (n)	Percentage (%)
Good	225	88.2%
Poor	30	11.8%

From table 5, the most incorrect answer was the Sinus rhythm strip, in which 37% (n = 95) of participants wrongly interpreted the rhythm, and Atrial Tachycardia 26.3% (n = 67). However, majority of participants showed good practice by correctly analyzing the ECG rhythm of Atrial Flutter 90.6% (n = 231), Ventricular Fibrillation 88.6% (n = 226), and Atrial Fibrillation 82.4% (n = 210).

Table 5: Practice items regarding ECG interpretation

Practice regarding ECG	Correct answer		Incorrect answer	
	n	%	n	%
1. You perform an ECG and observe this register. What do you think it might be?	231	90.6	24	9.4
2. You perform an ECG and observe this register. How would you act?	226	88.6	29	11.4
3. A patient comes to the Emergency Department due to a respiratory distress. He has 140 beats per minute. You perform an ECG and observe the following:	210	82.4	45	17.6
4. A 24-year-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 (3 hours earlier). You perform an ECG and observe the following:	160	62.7	95	37.3
5. A 30-year-old woman comes to the Emergency Department reporting palpitations, chest tightness and dyspnea. You perform an ECG and observe the following:	188	73.7	67	26.3

Association between nurse's demographic with the level of knowledge and practice of ECG interpretation at the NHI

Table 6 presents the association between nurses' demographic characteristics and their level of knowledge and actual practice of ECG interpretation. Pearson Chi-Square test was conducted to determine the association between the variables ($p < 0.05$). There was not statistically significant between nurses' demographic characteristics with the level of knowledge of ECG interpretation ($p > 0.05$). However, it was found that there was a statistically significant on years of service ($p = 0.001$) and competency level ($p = 0.003$) toward the level of actual practice in interpreting ECG reading in the study area. Other demographic characteristics show no significant difference with the practice of ECG interpretation.

Table 6: Association between nurse's demographic with the level of knowledge and practice of ECG interpretation at the NHI

Variables	Level of ECG knowledge		Level of Practice of ECG	
	Test statistic	*p*-value	Test statistic	*p*-value
Age	1.69	[a] 0.430	[a] 5.045	[a] 0.080
Gender	0.99	[a] 0.753	[a] 1.75	[a] 0.19
Service	5.412	[b] 0.199	24.81	[b] 0.001
Unit	1.97	[b] 0.575	0.72	[b] 0.91
Education	1.99	[b] 0.612	2.59	0.44
Race	3.47	[b] 0.422	4.89	0.19
Attended course	0.588	[a] 0.443	[a] 3.411	[a] 0.07
Last course taken	1.91	[b] 0.613	2.65	[b] 0.45
Education sources	2.59	[b] 0.766	5.90	[b] 0.28
Competency level	[a] 0.901	[a] 0.637	[a] 11.32	[a] 0.003
Desire to learn	[a] 0.67	[a] 0.795	[a] 0.13	[a] 0.71

[a] = Chi-square test

[b] = Fisher exact test

Significant value = $p < 0.05$

The association between the level of knowledge and practice and of ECG interpretation among nurses at the NHI

Based on table 7 shows the findings of the relationship between the level of knowledge and the level of practice regarding ECG interpretation among nurses in NHI, where there are significant, using the chi-square test, x^2(1, n = 255) = 16.82, $p = 0.001$. From the table, we can see an association between both variables, where nurses with good knowledge also had good ECG interpretation practice (n = 216). Meanwhile, nurses with poor knowledge had poor practice on ECG interpretation (n = 7). This concludes that good knowledge results in good practice.

Table 7: Association between the level of knowledge and practice and of ECG interpretation among nurses at the NHI

Variables	Level of Practice		x^2 (df)	p-value
Level of knowledge	Good	Poor		
Good	216	23	x^2 (1)	0.001
Poor	9	7		

Discussion

This cross-sectional study examined the level of knowledge and practice of interpreting ECG readings among nurses at the National Heart Institute (NHI) in Malaysia. Overall, their knowledge and actual practice of interpreting ECG readings among nurses at the NHI was good, scoring 93.7% and 88.2%, respectively. Similar results of good knowledge and practice of ECG interpretation with previous studies (9-12). However, there was contradicting result by previous studies, which discovered that low the level of knowledge and practice was low in interpreting ECG reading (5, 6). At the NHI, good knowledge and practice in ECG interpretation could be related to the attended courses such as ACLS and BLS, when 65.1% of the participants can answer the questions correctly. This is because, during the course, participants were taught to interpret ECG for life-threatening arrhythmias and to provide rapid intervention in managing cardiac arrest, coronary artery disease, and stroke patients. For the question "In normal ECG V1 and aVR leads are negative waves", nearly half of the participants answered it incorrectly. This is the fundamental part of understanding ECG, which the participants should be able to interpret well. The lack of knowledge in ECG interpretation should be improvised. Similar results with the questions related to detecting ECG changes on the AMI ECG strip, and the result was supported by another study (13). Detection of ECG changes is crucial because it can reduce door-to-balloon time to less than 90 minutes for primary percutaneous coronary interventions (PCI) and prompt treatment for fibrinolysis, door-to-needle time of fewer than 30 minutes. This time interval can reduce total ischemic time and achieve an early reperfusion strategy (14). The result showed that there was no association between nurses' demographic (age, race, gender, education level, working unit, working department, previous attending the course, education courses, competency level, and desire to learn ECG with the level of knowledge on ECG interpretation.

Most of the participants who responded have good practice at reading ECG (88.2%). The result is similar to other studies (8). On the contrary, Raju and Babu (15) found that the nurses in Ludhiana needed a higher skill level regarding ECG interpretation. Wrongly interpretation of the rhythm contributed to the most incorrect answer (6, 13). Questions related to atrial tachycardia became the second most incorrect answer by the participants. The result was supported by a previous study (8).

Participants have good practice regarding ECG rhythms of atrial flutter, ventricular fibrillation, and atrial fibrillation. The result is similar to others studies (11). However, the result is contradicted by other studies (5, 12) when they found that most participants have difficulty identifying the normal ECG atrial flutter, pathological waves, atrial fibrillation, and acute myocardial infarction. The explanation behind the incorrect answer could be that the participant needs clarification about the rhythm of atrial tachycardia and insufficient training on detecting atrial tachycardia rhythm. Interpreting atrial fibrillation and other arrhythmias is essential because early diagnosis can help the patient receive the correct intervention (5). Continuous education on ECG is recommended to improve retention skills in ECG interpretation. The study's findings revealed a statistically significant difference between their level of competency and working experience regarding their level of practice on ECG interpretation. Years of working explained that experiences helped nurses to perform well in management by correctly interpreting the ECG rhythm (8, 16). This study also found an association between the level of knowledge and the level of practice on ECG interpretation as the knowledge increases, the level of practice also increases (15).

Conclusion

According to the study's findings, staff nurses at Malaysia's National Heart Institute generally possess a high degree of knowledge and practice regarding ECG interpretation. There was no statistically significant difference in the knowledge level of ECG interpretation between the socio-demographic characters (age, race, gender, education level, working unit, working department, previous attending the course, education courses, competency level, and desire to learn ECG). There was a statistically significant difference in the practice level of ECG interpretation between years of working and the competency level of the nurses. It was found that there was an association between the knowledge level and practice level of ECG interpretation. For future studies, the researchers should consider an observational study that uses a checklist to assess nurses' actual ECG interpretation practices. The constraint of this study is due to the COVID-19 pandemic, and face-to-face interaction is discouraged.

Competing interests

The authors declare that they have no competing interests.

Ethical clearance

We obtained approval from the the Research Ethics Committee Universiti Teknologi MARA with reference

number REC/12/2021(UG/MR/1131) and the IJN research ethic community (IJN REC/556/2022).

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