

Electrocardiogram Interpretation Competency Among Emergency Nurses in Jordan: A Cross-Sectional Study

Abstract

Background: Electrocardiogram (ECG) is considered one of the most frequently carried out diagnostic tests in emergency rooms. To develop and refine the competencies of emergency nurses, it becomes imperative to assess the current level of knowledge and practice among nurses regarding ECG and other diagnostic tests. The study aimed to assess the ECG interpretation competency and its associated factors among emergency nurses in Jordan. **Materials and Methods:** A descriptive cross-sectional study was conducted from December 2022 to March 2023. Data were collected from 287 Jordanian emergency nurses working in six governmental, private, and teaching hospitals, and they had at least 1 year of clinical experience. Badell-Coll ECG Interpretation Competency Questionnaire was used in this study. Descriptive analyses were conducted using an independent *t*-test and one-way analysis of variance. A statistical significance of $P < 0.05$ was assumed. **Results:** Approximately, 61.43% of emergency nurses had been involved in educational sessions on ECG interpretation. The mean of the total participants' score on the ECG assessment tool was 4.35 out of 10. Significant differences were found in the ECG interpretation competency scores based on the highest educational level ($t_{285} = -0.64, P < 0.001$), job title ($t_{285} = -5.91, P < 0.001$), and previous engagement in ECG training sessions ($t_{285} = 2.50, P = 0.013$). **Conclusions:** The level of emergency nurses' ECG interpretation competency was low. Nurses should engage in ECG refreshing courses to improve their ability to detect arrhythmias early. Efforts should be made to improve the nursing educational curricula and ECG training sessions by employing electronic systems and addressing both basic and advanced arrhythmias.

Keywords: *Diagnosis, electrocardiography, emergencies, Jordan, nurses*

Introduction

Emergency nursing is a specialty through which nurses provide care to clients who are mostly complaining of undiagnosed life-threatening and/or urgent conditions. This necessitates that emergency nurses should have specific qualities including intuition, extraversion, openness to experience, agreeableness,^[1] self-control, tenacity, and resilience.^[2] Furthermore, emergency nursing competencies and interventions can be categorized into five domains including diagnostic function, effective management of rapidly changing situations, administering and monitoring therapeutic interventions, helping role, and workload and organizational competencies.^[3]

The emergency care context and process are mostly characterized by the unpredictability and acuity of received cases that demand

that health providers act promptly to save clients' lives.^[4] In light of the shortage of emergency health care providers, which has led to intensifying crowdedness and increasing waiting time, it becomes so essential to develop the knowledge and skills of emergency nurses in early recognition and diagnostic function.^[5] Furthermore, it has been emphasized that decisions made by emergency teams based on their preliminary diagnosis had a big contribution in directing subsequent care and improving clients' outcomes.^[6]

Attaching and obtaining an electrocardiogram (ECG) was considered one of the most frequently carried out diagnostic procedures in the emergency room.^[3,7] ECG is considered as one of the first-line diagnostic procedures for evaluating and investigating chest pain,

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which is the typical symptom of cardiovascular disease.^[8] Nurses' role in ECG procedure includes both technical and cognitive. The technical aspect involves attaching the client to the machine by positioning electrodes and setting alarms. On the other hand, cognitive skills involve ECG interpretation and subsequent clinical decision-making.^[9] However, it has been found that nurses intensify their efforts in the technical aspects, with less focus on ECG interpretation,^[8] and this was attributed mainly to lack of regular training, inadequate engagement in interpretive activities, and lack of confidence.^[10]

Many studies were conducted to assess the ECG interpretation competency among healthcare providers. A recent study was conducted by Amini *et al.* (2022)^[11] to explore the healthcare providers' capability in ECG interpretation. The study revealed that study participants had low ECG interpretation competency, particularly in analyzing normal sinus rhythm and acute myocardial infarction ECG changes. Furthermore, it has been found that physicians had the highest ECG interpretation competency score among healthcare team members. This was attributed mainly to the frequent engagement of physicians in ECG interpretation in addition to the perceptions of nonphysicians of that ECG interpretation as a task out of their scope.^[11]

The ECG interpretation competency among nurses was the focus of many previous studies, particularly emergency nurses. A Spanish study conducted by Coll-Badell *et al.* (2017)^[12] indicated that emergency nurses have high efficiency in interpreting ECG strips. However, in accordance with Amini *et al.* (2022)^[11] study, it was found that a few participants were able to analyze ECG changes associated with myocardial infarction. Another study conducted by Ho *et al.* (2021)^[8] revealed that despite the general proficiency of emergency nurses in interpreting ECG changes, there was inadequate competence in detecting all types of heart block.

Regarding the factors associated with competency in ECG interpretation, it was found that holding a higher educational degree, work experience, and perceiving ECG interpretation as a part of the profession scope had a significant contribution to higher scores in ECG interpretation skills.^[11-13]

In Jordan, ECG reading and interpretation are integrated into undergraduate nursing education in both theoretical and practical courses. Most of the nursing curricula address the technical role of nurses in performing ECGs, fundamentals of ECG analysis, and recognition of normal ECG and abnormal sinus, atrial, and ventricular rhythms. Traditional lecture-based learning is still the principal method for ECG interpretation. A minority of nursing schools rely on the simulation. Continuing education units in hospitals and medical centers hold numerous ECG courses and workshops for nurses. However, most of these courses are

paid and nonobligatory. Therefore, a few nurses engage in such courses. At the local level and in light of the efforts of the higher nursing authorities in Jordan to develop and refine the competencies of registered nurses and emergency nurses, it becomes imperative to assess the current level of knowledge and practice among Jordanian nurses. Up to the researcher's knowledge, ECG interpretation competency was not addressed locally at the research level. Accordingly, this study was conducted to assess the ECG interpretation competency and its associated factors among emergency nurses in Jordan.

Materials and Methods

A descriptive cross-sectional study was conducted from December 2022 to March 2023. The population of this study included all nurses working in the emergency departments in Jordan, which were distributed over five governorates including Amman, Irbid, Jerash, Ajlun, and Al-Mafraq. A consecutive sampling method was used in this study. The researchers selected eligible emergency nurse participants who were working in two governmental, two private, and two teaching hospitals and met the inclusion criteria from a specified work shift determined by the researchers for each included hospital. For example, the researcher selected nurse participants from the hospital (I) at the work shift (C) on a given day. Eligible participants from another hospital were selected at different work shifts, on different days, and so on. Inclusion criteria were Jordanian emergency nurses who had at least 1 year of clinical experience and were willing to participate in the study. Nurses who were called only for assistance in emergency departments in specific situations and those who refused to participate in this study were excluded.

The sample size was estimated using G*Power (version 3.1.9.4). The minimum sample size required for this study is 280, assuming a significance level of 0.05, an effect size of 0.25, and a power of 0.95. To overcome the anticipated low response rate, a total of 500 questionnaires were distributed to eligible potential participants. The study was conducted in emergency departments in six Jordanian hospitals that provide their services to residents of five governorates.

A paper-based questionnaire was used to gather data for this study. After obtaining the approval of the Institutional Review Boards (IRBs) from Jerash University and the targeted hospitals, the researchers contacted nurse administrators in each participating hospital to assist in identifying potential nurse participants. After that, the researchers approached eligible participants as they joined their assigned shifts, asking them to participate in the current study. Nurses who approved to participate were given an envelope containing the consent form and the questionnaires. This data collection procedure was repeated until the required sample size was achieved. It takes about 35 days to gather data. The questionnaires were gathered directly by the

researchers as the participants completed filling it. It takes an average of 11 minutes to complete each questionnaire. Each questionnaire consists of two parts. The first part involved the demographic variables of the emergency nurses including age, gender, years of experience, level of education, job title, type of hospital, whether participated in ECG interpretation workshops or courses, and details regarding these ECG courses (date, method, and duration). The second part consisted of an ECG interpretation competency assessment tool involving 12 multiple-choice questions. This tool was developed by Coll-Badell and colleagues (2017).^[12] Each participant was asked to select the best answer for each question. Each correct answer was given one point. If the participant answered the question incorrectly or selected the option “I don’t know”, no points were given. The total score of each participant was converted to 10. According to the original author, a score of 7.5 or higher is considered good competency in ECG interpretation. Psychometric tests of the tool were established by the original authors, showing adequate test–retest reliability and content validity with values of 0.869 and 0.870, respectively.

A pilot study was conducted prior to the main study to assess the appropriateness and psychometric properties of the ECG interpretation competence tool for the population of the study. The results of the pilot study found that the tool is easy to read and easy to comprehend. Furthermore, it was found that participants in the pilot study required about 11.3 minutes to fill the tool. Regarding psychometric properties, the results showed an adequate test–retest reliability of 0.852.

Data analysis was performed using SPSS Statistics 22.0 (IBM Corp., Armonk, N.Y., USA). Means, standard deviations (SD), frequencies, and percentages were computed to describe data related to participants’ demographics and their scores on ECG interpretation competency tools. A two-tailed independent *t*-test and ANOVA were used to detect if there were any differences in ECG interpretation competency scores based on participants’ demographics.

Ethical considerations

The researchers obtained the approval of the Institutional Review Boards (IRBs) of Jerash University (Code Number: DJR 122263, Date: 4-12-2022) and the targeted hospitals. With the assistance of a number of nurse administrators in the targeted hospitals, the researcher identified the potential nurse participants. After that, the researcher approached the eligible nurses, explained the study’s purpose, and invited them to participate in the study. Eligible nurses who agreed to participate in this study were asked to sign the consent form. Then, they were given a copy of the questionnaire along with an envelope. All study participants were not asked to express or write their names or any other identifying information on the questionnaires. Furthermore,

participants were informed that all completed questionnaires would be placed in a locked file cabinet in the researcher’s office over the study period to maintain confidentiality.

Results

A total of 287 Jordanian emergency nurses participated in this study. The mean age of participants was 29.72 years old. About 52% of nurse participants were female. One hundred and thirty-seven participants (47.74%) were working in governmental hospitals. The majority of participants (62.72%) had a bachelor’s degree in nursing as the highest academic qualification. One hundred and seventy-five (60.98%) emergency nurses were working as staff nurses. About 60% of participants had 5 years of experience or less.

With regard to attending courses in ECG reading and interpretation, it was found that one hundred and seventy-six (61.32%) had been involved in educational sessions on ECG interpretation, particularly in the last year (59.66%). The majority of participants (78.98%) stated that the face-to-face learning pattern was the main method that was

Table 1: Participants’ demographics and experiences (N=287)

Variable	N (%)	Mean (SD)
Age (years)		29.72 (6.51)
Gender		
Male	138 (48.08)	
Female	149 (51.92)	
Years of experience		
1-5 years	169 (58.89)	
6-10 years	59 (20.56)	
>10 years	59 (20.56)	
Highest educational qualification		
Bachelor's degree	180 (62.72)	
Diploma degree	107 (37.28)	
Job title		
Staff nurse	175 (60.98)	
Practical nurse	112 (39.02)	
Type of hospital		
Governmental	137 (47.74)	
Private	107 (37.28)	
Teaching	43 (14.98)	
Attended electrocardiogram (ECG) courses		
Yes	176 (61.32)	
No	111 (38.68)	
Learning pattern in ECG courses (N=176)		
Face-to-face	139 (78.98)	
Blended	12 (6.82)	
Online	25 (14.20)	
Duration of ECG courses (N=176)		
Last year	105 (59.66)	
Past 2-5 years	39 (22.16)	
Past>5 years	32 (18.18)	

used in ECG courses. Detailed results on demographic characteristics are shown in Table 1.

Forty-three participants (14.98%) scored 7.5 points and higher. The mean of the total participants' score on the ECG assessment tool was 4.35 out of 10. The question with the highest number of correct responses was the first question (77.70%), which addresses the correct order of ECG waves and intervals. On the other hand, the question with the lowest number of correct responses was the twelfth question (22.30%), which addresses a case of atrial tachycardia. The complete list of ECG competence questions as ranked based on participants' correct responses is shown in Table 2.

Significant differences in the total score on the ECG interpretation competence scale were found among nurse participants based on the highest educational qualification, job title, and previous engagement in ECG courses. The findings revealed that nurse participants who had a bachelor's degree in nursing and working under the title of staff nurse had significantly higher ECG interpretation scores than participants who had a diploma degree in nursing and working under the title of practical nurse. Furthermore, it has been found that nurse participants who had been involved in previous ECG training sessions scored significantly higher scores on the ECG competence scale than those who had not. On the other hand, no significant differences in the mean scores were found in the ECG interpretation scores based on gender, years of experience, and type of hospital [see Table 3].

Discussion

The purpose of this study is to assess the ECG interpretation competency and its associated factors among emergency nurses in Jordan. In congruence with the findings of many previous studies,^[10,11,14,15] the current study revealed that the ECG interpretation competency of the emergency nurse participants was inadequate. This might be attributed to the immersion of emergency nurses in the technical aspect of ECG, leaving the interpretation tasks of ECG strips to physicians, particularly in contexts of work overload.^[11] Furthermore, it has been found that nurses' involvement in ECG training courses might be insufficient to enhance their ability to interpret ECG readings if it is not coupled with continuous exposure to ECG interpretation.^[10]

The findings of the current study were incongruent with the results of prior studies that were conducted by Coll-Badell *et al.* (2017) and Ros *et al.* (2022), which indicated an adequate level of knowledge and interpretation competency among nurse participants.^[12,16] Coll-Badell and colleagues (2017) found that up to 93% of emergency nurses get a score of 7.5 and higher on the ECG interpretation scale, and this was attributed to the adequacy of training courses on ECG interpretation that nearly all participants in their study received,^[12] and this was emphasized in Ros *et al.*

Table 2: Descriptive data on participants' Electrocardiogram (ECG) competence questions (N=287)

Item	Frequency of correct responses (%)
The item regarding correct order of ECG waves and intervals	223 (77.70)
The item regarding appearance of P wave	176 (61.32)
The item regarding atrial flutter	146 (50.87)
The item regarding ventricular fibrillation	148 (51.57)
The item regarding atrial fibrillation	107 (37.28)
The item regarding pathological Q wave	103 (35.89)
The item regarding third-degree heart block	124 (43.21)
The item regarding ventricular tachycardia	144 (50.17)
The item regarding acute myocardial infarction	99 (34.49)
The item regarding normal ECG	65 (22.65)
The item regarding ventricular extrasystole	108 (37.63)
The item regarding atrial tachycardia	64 (22.30)

*SD: Standard Deviation

Table 3: Differences in the participants' Electrocardiogram (ECG) competence score based on demographic variables (N=287)

Variable	N (%)	Mean (SD)	t	P
Gender				
Male	138 (48.08)	4.52 (2.39)	1.19	0.235
Female	149 (51.92)	4.19 (2.36)		
Years of experience				
1-5 years	169 (58.89)	4.41 (1.94)	0.26	0.773
6-10 years	59 (20.56)	4.38 (2.74)		
>10 years	59 (20.56)	4.15 (3.06)		
Highest educational qualification				
Bachelor's degree	180 (62.72)	3.26 (1.96)	-0.64	<0.001*
Diploma degree	107 (37.28)	5.00 (2.37)		
Job title				
Staff nurse	175 (60.98)	3.38 (1.89)	-5.91	<0.001*
Practical nurse	112 (39.02)	4.98 (2.45)		
Type of hospital				
Governmental	137 (47.74)	4.56 (2.47)	3.30	0.065
Private	107 (37.28)	3.90 (2.22)		
Teaching	43 (14.98)	4.83 (2.31)		
Attended ECG courses				
Yes	176 (61.32)	4.63 (2.38)	2.50	0.013*
No	111 (38.68)	3.91 (2.31)		

* $p < 0.05$, **SD: Standard Deviation

(2022) study.^[16] Accordingly, it might be said that the low level of competency among emergency nurses in the current study is attributed mainly to insufficient training programs on ECG interpretation in terms of both topics covered and innovational teaching methods.

The current study revealed that the majority of nurse participants had identified the correct order of ECG waves and intervals. However, the competency level in this study

was lower than in previous studies.^[12] The current study showed that the identification of P wave indication and atrial flutter had been ranked as second and third most items answered correctly, respectively. In terms of rank, this finding was similar to the results of Tahboub and Yilmaz (2019) study, in which it was found that about 85% of participants were able to identify atrial flutter conditions.^[15] This might be attributed to the uniformity and regularity of atrial flutter waves.^[17]

Atrial tachycardia was the least correctly identified ECG arrhythmias by study participants. This finding is congruent with Ebrahim *et al.* (2020),^[18] who highlighted the risk of significant morbidity and mortality from tachycardia-induced conditions due to failure to recognize atrial tachycardia. Another study conducted by Tahboub and Yilmaz (2019)^[15] pointed to atria tachycardia as the most difficult condition to recognize and that most participants were confused between atrial tachycardia and atrial extrasystoles.

The current study revealed that recognizing normal sinus rhythm was among the least mastered competencies. This was congruent with the results of Amini *et al.* (2022)^[11] study, which used the same tool that was used in the current study and found that nearly three-quarters of participants were not able to interpret normal rhythm. In both studies, the majority of the participants tended to answer the related question as “atrial bradycardia”. This might be attributed to the fact that participants were confused with bradycardia, which represents the physiological adaptation of athletes.^[19] It was argued that recognizing the normal rhythm is essential to detect any deviation.^[10] Accordingly, efforts should be intensified to enhance emergency nurses’ ability to identify sinus rhythms as a prerequisite for recognizing arrhythmia.

The findings of the current study indicated that emergency nurses who had a bachelor’s degree in nursing and were appointed as staff nurses scored significantly higher scores than those who had a diploma degree and were appointed as practical nurses. This result was congruent with studies that were conducted by Amini *et al.* (2022) and Ros *et al.* (2022).^[11,16] A possible explanation for that result might be based on the concept of “Use it or lose it”,^[20] which indicates that practical nurses who usually do not engage in ECG interpretation tasks, particularly in Jordan, lose the familiarity and mastery of ECG interpretation skills as they concentrate their efforts on the technical aspects of therapeutic procedures. On the other hand, the responsibilities of staff nurses who hold a bachelor’s degree in nursing go beyond the technical aspect to the cognitive and decision-making of ECG procedure, so they are continuously engaging in ECG interpretation.

In congruence with many previous studies,^[11,13,21,22] the findings of the current study revealed that involvement

in ECG courses and training sessions had a significant effect in improving the ability to interpret ECG. However, regardless of engagement in ECG courses, the general scores of study participants on ECG interpretation were low. This might indicate the inadequacy of training sessions the study participants received, particularly in terms of teaching and learning patterns. The majority of ECG training sessions in which study participants were involved were traditional and face-to-face. In their distinguished research work, Dzikowicz and Carey (2022) evaluated the use of interactive technology such as electronic tablets, E-Pencil, and multimedia-enhanced applications in improving the students’ ECG interpretation competency. They argued that interactive technology enhanced the participants’ ability to measure ECG waveforms and intervals, and this had a significant impact on improving their interpretation competency and confidence in them.^[22] On the other hand, some researchers argued that online learning style should be used as an adjunct to traditional face-to-face learning in teaching ECG interpretation due to the stepwise approach and useful feedback that the online teaching method provides.^[23]

This study provides helpful data for both clinical decision-makers in the health care systems and educators in the academic areas by highlighting the shortcomings that exist in emergency nurses’ ECG interpretation competencies. It is recommended that the hospital administration develop mandatory training programs for the emergency nurses on ECG interpretation due to its importance as a diagnostic tool to detect life-threatening conditions. Moreover, it is recommended to incorporate interactive technology in ECG courses and training sessions to enhance their usefulness and nurses’ confidence. Current nursing curricula should be revised to involve basic and advanced arrhythmias recognition and management, in addition to employing simulation and electronic systems in education.

The main limitation of this study was the use of nonprobability consecutive sampling, which might not guarantee the selection of a representative sample.

Conclusion

The level of emergency nurses’ ECG interpretation competency was found to be low. Nurses should engage in ECG refreshing courses to improve their ability to detect arrhythmias early. Efforts should be made to improve the nursing educational curricula and ECG training sessions by employing electronic systems and addressing both basic and advanced arrhythmias.

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Conflicts of interest

Nothing to declare.

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