



## Nurses' Knowledge and Practices of Electrocardiogram Interpretation

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### ABSTRACT

**Background:** Electrocardiogram (ECG) is a diagnostic tool that is routinely used non-invasively to assess the electrical and muscular functions of the heart. All nurses should be able to recognize basic ECG rhythms.

**Objective:** This study aimed to determine the ECG knowledge and practice among nurses in university hospitals in North Cyprus.

**Methods:** This descriptive study was conducted on the registered nurses who worked in critical care units, including intensive care unit, coronary care unit, emergency department, recovery department, and cardiology department in two university hospitals (Near East University Hospital and Dr. Suat Günsel Hospital). Totally, 72 registered nurses worked in both hospitals 65 one of whom took part in the study voluntarily. The study data were collected using a researcher-made questionnaire. The questionnaire was prepared in Turkish and was used after being reviewed by three specialist nurses and one cardiologist. The questionnaire contained three sections and 15 questions.

**Results:** The majority of the nurses had B.Sc. degrees (93.8%) and recorded ECGs for patients (89.2%). The majority of the participants had passed ECG training courses (60.0%). Considering the nurses' knowledge of ECG, the total frequency of correct answers was 69%. Considering their practice of ECG interpretations, the total frequency of correct answers was 67%. Cardiology department nurses had the highest percentage of correct answers ( $P = 0.002$ ). Indeed, the lowest and highest means of correct answers were observed among the nurses with less than one year and more than six years of work experience, respectively.

**Conclusion:** The study results showed a high level of ECG knowledge and practice among the nurses. The hospital unit and passage of previous ECG training courses played an important role in the nurses' experience of ECG interpretation. Hence, ECG training courses were effective in improving the nurses' ECG knowledge.

### 1. Background

Electrocardiogram (ECG) is a diagnostic tool that is routinely used non-invasively to assess the electrical and muscular functions of the heart. ECG has been considered to be the first diagnostic tool in chest pain and enables specialists to assess the risks and symptoms. ECG has also made a focal point of modern medicine because it provides information about diagnosing acute coronary syndromes and cardiac arrhythmias (1-4).

Nurses are usually the first responders to in-hospital cardiac arrests. Therefore, they must be master in basic resuscitation skills. They should also be able to recognize

basic ECG rhythms since they are responsible for monitoring and clinical decision-making based on the information obtained from the monitor (5-7). In the research by Doğan and Melek, 60.5% of the nurses expressed that they did not know the right electrocardiography monitoring and could not recognize the type of arrhythmias (8). Another study was conducted on early intervention for patients with ventricular tachycardia in Baghdad. The results indicated the nurses' insufficient knowledge (9). Inappropriate interpretations, in turn, increase the cost of healthcare and can delay the admission process, which impose an unpleasant burden on both hospitals and patients (10, 11).

Rapid Access Chest Pain Clinic (RACPC) was established in England, which made nurses assess patients, form a care plan immediately, and decide if further investigation is

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require without waiting for a physician (12). Practical Use of the Latest Standards for Electrocardiography (PULSE) trial is also an online ECG monitoring educational program, which increases nurses' knowledge of ECG monitoring, quality of care related to ECG monitoring, and patient outcomes (13).

It has been reported that work unit in the hospital affected the knowledge and practice of ECG. Zhang et al. showed higher test scores among the nurses working in the cardiology department in comparison to those working in the Emergency Department (ED) and Intensive Care Unit (ICU) (14). Another study in Iraq demonstrated that most nurses who worked in Coronary Care Unit (CCU), ICU, and ED passed the questions regarding knowledge, except for those concerning ECG changes with regard to new and old myocardial infarction. This implied that there was weakness in the practical section, which required intensive training courses (15).

Studies have proved that training could influence nurses' performances (16-20). Determination of nurses' knowledge and practice of ECG might be useful in improving their knowledge level and enhancing their initiation to become more professional in ECG interpretation.

## 2. Objectives

This study aims to determine the knowledge and practice of ECG among nurses working in university hospitals in North Cyprus.

## 3. Patients and Methods

This descriptive study was conducted in university hospitals in Turkish Republic of North Cyprus. The study was performed on registered nurses who worked in critical care units, including ICU, CCU, ED, recovery department, and cardiology department in two university hospitals. Totally, 72 registered nurses worked in both hospitals 65 ones of whom took part in the research voluntarily.

The study data were collected using a questionnaire developed by the researcher on the basis of literature review (14-16). The questionnaire contained three sections. The first section consisted of 11 questions dealing with the nurses' demographic characteristics. The second section consisted of 15 true/false questions regarding the nurses' knowledge of ECG. Finally, the third section included eight multiple-choice questions about the nurses' practice of ECG interpretation. Since all nurses in both hospitals spoke Turkish, the questionnaire was prepared in Turkish and was applied after being reviewed by three specialist nurses and one cardiologist.

A pilot study was performed on 10 nurses on April 1 - 10, 2018. The data were collected by the researcher using the above-mentioned questionnaire in May 2018. The nurses were required to complete the questionnaire while they were at work. It took 15 minutes to complete the questionnaire.

### 3.1. Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Near East University (2018-57-554). Indeed, informed consent forms were obtained from the nurses. Organizational permission was gained, as well.

### 3.2. Statistics Analysis

Statistical Package for the Social Sciences (SPSS) software, version 22 (MAC OS) was used to analyze the data. Descriptive statistics, such as percentage and frequency, were used for the true/false statements employed for evaluation of knowledge questions.  $P < 0.05$  was considered to be statistically significant.

## 4. Result

The mean age of the participants was  $26.94 \pm 4.26$  years and the majority of them were female (66.2%). Indeed, most of the nurses had B.Sc. degrees (93.8%) and had less than five years of work experience as a registered nurse (53.8%). The questionnaires were applied to the nurses working in the following critical departments in the hospital: ED (23.1%), ICU (27.7%), CCU (24.6%), cardiology department (10.8%), and recovery unit (13.8%). Most of the participants had taken ECGs for patients (89.2%). Besides, the majority of them had passed ECG training courses (60.0%).

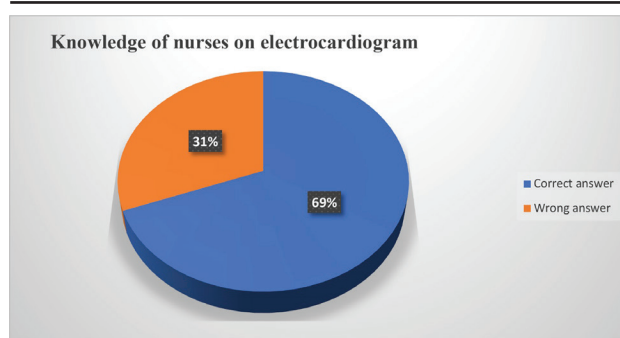
Considering the nurses' knowledge of ECG, the most frequently known and correctly responded item (92.3%) was "ST depression in ECG indicates myocardial ischemia". However, the most frequently incorrectly answered item (55.4%) was "T long wave and QRS wide wave are seen in case of hypokalemia".

The nurses' practice on ECG interpretations was evaluated using eight questions including scenarios of ECG interpretations. The results indicated that most frequently known items were interpretation and recognition of ventricular tachycardia (87.7%), atrial flutter (84.6%), and acute myocardial infarction (72.3%).

## 5. Discussion

This study was conducted in ICU, CCU, ED, recovery unit and cardiology department where knowledge and interpretation of ECG is very important. According to the results of evaluation of the nurses' knowledge of ECG presented in Figure 1, the majority of the nurses (69%) provided correct answers to the questionnaire items, which was satisfying. The lowest percentage of correct answers was related to the item "T long wave and QRS wide wave are seen in case of hypokalemia" (Table 1). Therefore, nurses should attend educational courses to get prepared and endorse with patients. Similarly, the results of a study conducted in Iraq indicated that most nurses passed the

**Figure 1.** The Nurses' Knowledge of ECG



The total frequencies of correct and incorrect answers were 69% and 31%, respectively.

**Table 1.** The Nurses' Knowledge of Electrocardiogram (n = 65)

Statements on ECG	True/False	Correct Answers		Incorrect Answers	
		n	%	n	%
The P wave represents right and left atrial repolarization.	False	41	63.1	24	36.9
QRS complex represents right and left ventricular depolarization.	True	56	86.2	9	13.8
T wave represents ventricular repolarization.	True	55	84.6	10	15.4
T wave is one of the negative waves in ECG.	False	41	63.1	24	36.9
Normal PR interval is between 0.12 and 0.20 seconds.	True	56	86.2	9	13.8
In a normal ECG, V1 and aVR leads are negative waves.	True	43	66.2	22	33.8
Pathologic Q waves are a sign of previous myocardial infarction.	True	49	75.4	16	24.6
Atrial fibrillation could have a regular rhythm.	False	40	61.5	25	38.5
ECG can detect left ventricular hypertrophy (LVH).	True	37	56.9	28	43.1
ST elevation in inferior myocardial infarction appears in leads V1-V6.	False	38	58.5	27	42.5
ST elevation in lateral myocardial infarction appears in leads I, aVL, V5, and V6.	True	47	72.3	18	27.7
ST elevation in anterior myocardial infarction appears in leads II, III, and aVF.	False	45	69.2	20	30.8
ST depression in ECG indicates myocardial ischemia.	True	60	92.3	5	7.7
RSR pattern appears in V1, V2, and V3 in right bundle branch block rhythms.	True	38	58.5	27	41.5
T long wave and QRS wide wave are seen in case of hypokalemia.	False	29	44.6	36	55.4

questions regarding knowledge, except for a question concerning ECG changes regarding new and old myocardial infarction (15). Nurses must have critical thinking and knowledge in detection of myocardial infarction. Stanfield (20) also found that the first intervention of trained nurses in patients with myocardial infarction was faster. In the present study, the nurses had passed all questions related to myocardial infarction. In this context, the most frequently known and correctly responded item (92.3%) was "ST depression in ECG indicates myocardial ischemia (Table 2). This study also evaluated the nurses' competence in ECG interpretation. The results revealed the satisfying practice of the nurses on ECG interpretation. Accordingly, 67% of the nurses passed the questionnaire (Figure 2), which is higher compared to other studies. The lowest percentage of correct answers was related to identifying the case scenario of atrial tachycardia. Similarly, in the study conducted by Coll-Badell, nurses were more familiar with ventricular tachycardia and atrial flutter arrhythmias (16). In the present study, the diagnosis rate of acute myocardial infarction on ECG was 72.3% among the nurses. This finding is similar to the results of the study performed by Coll-Badell et al. in 2017 (71.9%) (16).

It has been reported that nurses' work experience as well as their clinical and ECG training courses had a positive impact on their knowledge. The current study findings showed that the nurses with less than one year of job tenure had the lowest average of correct answers, while those with six or more years of working experience had the highest average of correct answers.

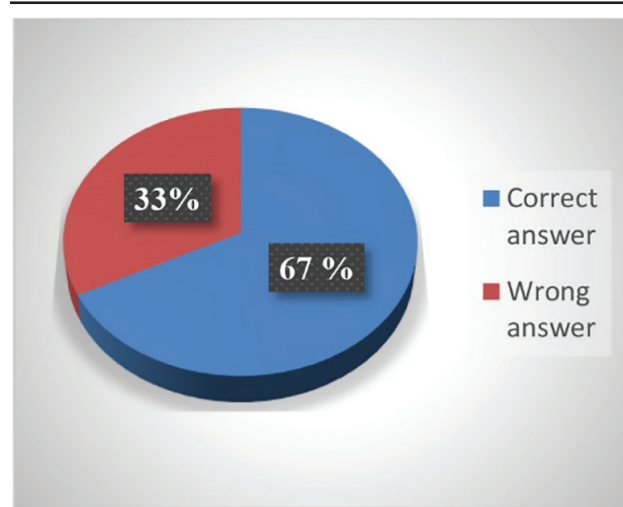
In the present study, the highest percentage of correct answers was observed among the nurses working in the cardiology department. Consistently, Zhang reported higher test scores among the nurses working in the cardiology department compared to those working in ED and ICU (14).

There was a statistically significant relationship between the nurses' work unit and correct ECG information. In this

regard, the lowest percentage of correct answers was related to the recovery unit ( $P < 0.05$ ).

The results showed a significant relationship between the nurses' knowledge of ECG and previous ECG training. Accordingly, the nurses who had previously received ECG training provided more correct answers to the questions ( $P < 0.05$ ). These results were in agreement with those obtained by Coll-Badell, which demonstrated that the nurses who had received training within the previous five years scored significantly higher in comparison to those who had not (16).

Comparison of ECG interpretations with respect to the nurses' working experience indicated the lowest mean of correct responses among the nurses with less than one year of work experience ( $P < 0.05$ ). Similar results were also obtained by Lak (21). The current study findings

**Figure 2.** The Nurses' Practice of ECG Interpretations

The total frequencies of correct and incorrect answers were 67% and 33%, respectively.

**Table 2.** The Nurses' Practice on ECG Interpretations (n = 65)

Scenario of ECG Interpretations	True Interpretations	Correct Answers	
		n	%
You perform an ECG and observe this rhythm. What do you think it might be?	An atrial flutter.	55	84.6
You perform an ECG and observe this rhythm. How would you act?	Ask for help without leaving the patient alone because it is a ventricular fibrillation.	44	67.7
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.	It is an atrial fibrillation	41	63.1
A hospitalized patient had surgery due to an acute myocardial infarction. His vital signs are unstable. You perform an ECG and observe the following.	The patient presents a ventricular tachycardia.	57	87.7
You performed ECG for a patient who had chest pain appeared after leaving an important meeting two hours ago. He is 52 years old and hypertensive and he was diagnosed with type II diabetes mellitus a few months ago. The ECG is as follows.	It is an acute myocardial infarction.	47	72.3
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 (three hours earlier). You perform an ECG and observe the following.	It is a normal ECG.	35	53.8
A 30-year-old woman comes to the emergency department reporting palpitations, chest tightness, and dyspnea. You perform an ECG and observe the following.	It is an atrial tachycardia.	33	50.8
What pathology do you think the patient with this ECG has?	A third-degree heart block.	39	60.0

also revealed that the working unit in the hospital was significantly effective in the nurses' practice of ECG interpretation. Accordingly, the nurses who worked in the cardiology department had more correct answers, which is similar to the results of the research by Zhang (14). CCU nurses also had a high percentage of correct answers. Lak also stated that having the experience of working in CCU was associated with better results on the ECG test (21). The nurses working in the recovery unit had a significantly lower mean of correct answers ( $P < 0.05$ ). Furthermore, the nurses who had passed previous ECG training courses provided a larger number of correct ECG interpretations ( $P < 0.05$ ).

### 5.1. Limitations

This study was only conducted in two university hospitals in North Cyprus, which limited the generalizability of the results.

### 5.2. Conclusion

The results of the present study showed a high level of ECG knowledge and practice among the nurses. Working unit and previous ECG training courses played an important role in ECG interpretation. Therefore, further courses regarding ECG knowledge and practice should be incorporated in the nursing education curriculum. Indeed, regular courses should be held under the supervision of qualified staff, especially for the nurses working in critical care units. Nurses should also continue self-learning and stay up-to-date with respect to development of new protocols or technologies in the world.

Based on the results, the following recommendations are made:

- 1- Refreshing intensive training courses must be run under

the supervision of qualified staff in electrocardiography at least every two years.

- 2- Further courses regarding ECG knowledge and practice should be incorporated into the nursing education curriculum.

- 3- Handbooks should be prepared to improve nurses' ECG knowledge.

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### Authors' Contribution

Concept: O.T. and Ü.D.Y.; design: O.T. and Ü.D.Y.; supervision: Ü.D.Y.; resource: O.T. and Ü.D.Y.; data collection and/or processing: O.T.; analysis and/or interpretation: O.T.; literature review: O.T. and Ü.D.Y.; writing: O.T. and Ü.D.Y.; critical reviews: Ü.D.Y.

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### References

1. AlGhatrif M, Lindsay J. A brief review: history to understand fundamentals of electrocardiography. *Journal of Community Hospital Internal Medicine Perspectives*. 2012;**2**(1):14383.
2. George A, Arumugham PS, Figueredo VM. aVR—the forgotten lead. *Experimental & Clinical Cardiology*. 2010;**15**(2):e36.
3. Martínez-Sellés M, Bueno H, Sacristán A, Estévez Á, Ortiz J, Gallegoa L, et al. Dolor torácico en urgencias: frecuencia, perfil clínico y estratificación de riesgo. *Revista Española de Cardiología*. 2008;**61**(9):953-9.

4. WHO. The top 10 causes of death. [cited Accessed January, 2017]; Available from: <http://www.who.int/mediacentre/factsheets/fs310/en/>.
5. Atwood D, Wadlund DL. ECG Interpretation Using the CRISP Method: A Guide for Nurses. *AORN Journal*. 2015;**102**(4):396-408.
6. Funk M, Fennie KP, Stephens KE, May JL, Winkler CG, Drew BJ, et al. Association of Implementation of Practice Standards for Electrocardiographic Monitoring With Nurses' Knowledge, Quality of Care, and Patient Outcomes. *Circulation: Cardiovascular Quality and Outcomes*. 2017;**10**(2).
7. Hernández-Padilla J, Suthers F, Fernández-Sola C, Granero-Molina J. Development and psychometric assessment of the Basic Resuscitation Skills Self-Efficacy Scale. *European Journal of Cardiovascular Nursing*. 2014;**15**(3):e10-e8.
8. Doğan HD. Determination of the Abilities of Nurses in Diagnosing the ECG Findings About Emergency Heart Diseases and Deciding the Appropriate Treatment Approaches. *Journal of Cardiovascular Nursing*. 2012;**3**(1):60-9.
9. Sara'a HS, Zedaan HA, Ahmed RS, Owaid HA, Mousa AM. Nurses' Knowledge Concerning Early Interventions for Patients with Ventricular Tachycardia at Baghdad Teaching Hospitals. *kufa Journal for Nursing sciences*. 2016;**6**(2):8-15.
10. Drew BJ, Funk M. Practice Standards for ECG Monitoring in Hospital Settings: Executive Summary and Guide for Implementation. *Critical Care Nursing Clinics of North America*. 2006;**18**(2):157-68.
11. Larson TS, Brady WJ. Electrocardiographic monitoring in the hospitalized patient: a diagnostic intervention of uncertain clinical impact. *The American Journal of Emergency Medicine*. 2008;**26**(9):1047-55.
12. Pottle A. A Nurse-Led Rapid Access Chest Pain Clinic—Experience from the First 3 Years. *European Journal of Cardiovascular Nursing*. 2016;**4**(3):227-33.
13. Funk M, Winkler CG, May JL, Stephens K, Fennie KP, Rose LL, et al. Unnecessary arrhythmia monitoring and underutilization of ischemia and QT interval monitoring in current clinical practice: baseline results of the Practical Use of the Latest Standards for Electrocardiography trial. *Journal of Electrocardiology*. 2010;**43**(6):542-7.
14. Zhang H, Hsu LL. The effectiveness of an education program on nurses' knowledge of electrocardiogram interpretation. *International Emergency Nursing*. 2013;**21**(4):247-51.
15. Ahmed A. AL-Husaunawy, Evaluation of Nurses Knowledge and Practice of Electrocardiogram Toward Adolescent Patient. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*. 4(4):10-6.
16. Coll-Badell M, Jiménez-Herrera MF, Llauro-Serra M. Emergency Nurse Competence in Electrocardiographic Interpretation in Spain: A Cross-Sectional Study. *Journal of Emergency Nursing*. 2017;**43**(6):560-70.
17. Fuenzalida C, Hernández G, Ferro I, Siches C, Ambrós À, Coll-Vinent B. Long-term benefits of education by emergency care nurses at discharge of patients with atrial fibrillation. *International Emergency Nursing*. 2017;**35**:7-12.
18. Refaey A. Impact of Adesigned Teaching Protocol about Advanced Cardiac Life Support (ACLS) On Critical Care Nurse's Knowledge and Practices at Benha University Hospital, Cairo, Egypt. *J Am Sci*. 2012;**8**(12):838-50.
19. Spiers CM. Using the 12-lead ECG to diagnose acute myocardial infarction in the presence of left bundle branch block. *Accident and Emergency Nursing*. 2007;**15**(1):56-61.
20. Stanfield L. Improvement of Door-to-Electrocardiogram Time Using the First-Nurse Role in the ED Setting. *Journal of Emergency Nursing*. 2018;**44**(5):466-71.
21. Lak K, Zareie F, Habibzadeh H, Mohammadpour Y, Rahnemoon K, Zare H, et al. A survey on the effect of educational software method of arrhythmias stimulator on the level of knowledge of electrocardiograms interpretation in nurses. *Iran J Crit Care Nurs*. 2013;**6**(3):173-80.