Ref: Ro J Med Pract. 2023;18(3)
DOI: 10.37897/RJMP.2023.3.5

Role of nurses' electrocardiography competency in emergent situations

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ABSTRACT

Electrocardiography is an essential tool in emergency care and monitoring of patients with severe cardiovascular diseases. Nurses are at the center of this evaluation and play an important role in the outcome of therapy. Data shows that nurses are limited in their ability to record and interpret electrocardiography diagrams accurately. Little is known about the role nurses play in electrocardiographic evaluation in an emergency. This narrative literature review assesses the competency of nurses in electrocardiography in an emergency, the implications for medical practice, and tries to identify possible improvement solutions.

Keywords: electrocardiography, telemetry, nursing, ECG competency, ECG education, emergency care

Abbreviations:
ECG - Electrocardiography
AHA - American Heart Association
ED - Emergency department
ICU - Intensive Care Unit
BLS - Basic Life Support
ALS - Advanced Life Support
AMI - Acute Myocardial Infarction

INTRODUCTION

Electrocardiography (ECG) is a vital diagnostic tool in emergent situations, especially for patients suffering from acute coronary syndrome or other life-threatening arrhythmias [1]. Continuous monitoring of ECG through telemetry has become an indispensable tool in the management of critical care patients [2]. Correct placement of leads and usage of electrocardiographic devices ensures consistency and accuracy of interpretation. Nurses are in a favorable position to augment patient outcomes in an emergent situation by correctly performing the test and readily identifying patients in need of emergent intervention, decreasing waiting time [3]. Evidence showed that rapid and accurate interpretation skills of cardiac rhythm have an impact on patient outcomes [4]. Thus, nurses need to possess an elevated degree of knowledge and competency in the technical aspects of ECG assessment, interpretation of results, recognition of EGC patterns, and then report and respond appropriately. EGC recording and interpre-

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Article History:
Received: 30 August 2023
Accepted: 7 September 2023

tation of rhythm is a component of undergraduate training of nurses, and training is required at least every 5 years [5,6]. Yet, little is known about nurses' competency in EGC assessment and interpretation, and if training programs make a difference in their performance in emergent situations. In this narrative review, we explore relevant literature data about the role that nurses play in ECG assessment in emergency settings and ways to improve performance.

MATERIALS AND METHODS

An inquiry of PubMed database was performed using key terms such as nursing, ECG monitoring, telemetry, ECG competency, ECG education, knowledge, and emergency care. The articles were reviewed and appropriate data was extracted regarding nurses' capacity to perform ECG assessments.

Lead placement and standards

In 2004 a standard on ECG assessment and telemetry was issued by the American Heart Association (AHA) [2,7,8]. These standards improved resource use and patient outcomes if correctly implemented [9]. However, there seems to be a constant lack of implementation of these standards in the current medical practice by medical professionals [10]. Nurses are key players in improving patient outcomes as they can elevate the quality of surveillance for cardiac arrhythmias [9]. It has been long suggested that health providers including nurses face difficulty in the correct positioning of ECG leads [11]. Inaccuracy of results following telemetry also stems from other potential flaws in EGC assessment such as lack of site preparation through shaving, skin cleaning, and removal of dead tissue, improper attachment of leads, lack of aseptic measures such as protective covers for telemetry, improper feedback to attending physicians, and lack of relevant information delivery to patients such as electromagnetic interference of other electric devices [10,12]. Fålun et. al. performed a 6-year longitudinal study on AHA standards and found that nurses consistently fail in the above criteria and there is a persistent lack of implementation through protocols [10]. These findings are supported by previous research [9,11-13] (Table 1).

Time management is also a significant factor. Management of emergent situations and critical care involves a multidisciplinary team and good cooperation between health providers, and nurses are usually the first responders [10]. AHA recommends a maximum of 10 minutes of elapsed time between the onset of symptoms and ECG (dor-to-ECG) [14]. A randomized clinical study has shown that the average door-to-ECG time

TABLE 1. *Nurses adherence to AHA standards*

Author	Study type	Cohort	Findings
Fålun [10]	Prospective observational 6-year study	Two hospitals: 185 and 178 nurses each	Mispositioned electrode placement (38%); Shaving improved (90% to 98%); Skin cleaning is often neglected (performed by 27%); Protective telemetry cover in only 65% ; Only 64% informed patients about the need for the procedure; 87% were unaware of AHA recommendations; Slight increase in local protocols implementation (40% to 54%); Only 39% of nurses gave feedback to ICU attending physicians
Funk [9]	6 years multisite clinical trial	17 hospitals with a total of 65 cardiac units; 3013 nurses; 4587 patients	Mispositioning of electrodes 22.6%; Educational intervention improved the quality of care and electrode placement correctness; Implementation of AHA standards improved patient outcomes
Pettersen [12]	Prospective interventional study	366 ICU patients: 201 pre-educational intervention; 165 post-educational intervention	Misplacement of electrodes 26% (23% post-intervention); Shaving in 44% of cases (52% post-intervention); Skin cleaning in 3% (1% post-intervention); Poor electrode attachment 6% (10% post-intervention); Protective telemetry cover 71% (94% post-intervention); Informed about the need for the procedure 70% (82% post-intervention); Informed about telephone use 12% (23% post-intervention)
Saethre[13]	Prospective observational study	55 ICU patients	Misplacement of electrodes 30%; Poor attachment 22%; Protective telemetry cover 71%; Informed about the need for the procedure 76%
Rajaganeshan [11]	Prospective observational study	72 Physicians; 37 Nurses; 10 cardiac technicians	Misplacement by 51% of nurses

AHA – American Heart Association; ICU – Intensive Care Unit

was 43 minutes on average, and just 59% were evaluated in the recommended 10-minute time that guidelines support [15]. Gender was an independent predictor of time as females had higher delays (53 min vs. 34 min for males; p -0.001). Although reasons for the delay exist in the emergency room (such as overcrowding) the study also suggests that the level of education and experience of staff could play a major role as some might not be aware of ACC/AHA standards of care. Lack of awareness regarding standards has been suggested as a culprit by other studies as well [9,10].

Monitoring

Telemetry has become an essential tool for ECG monitoring of patients with cardiovascular disease [16]. It is within nurses' duty to observe and monitor telemetry devices and respond to device alarms in intensive care units [10]. A degree of over-monitoring of cardiac patients has been reported, which puts a strain on nurse staff, does not contribute to the overall improvement of cardiac patient outcomes, and leads to fatigue and increased costs [9]. A study has shown that 20.2% of telemetries were performed for noncardiac reasons [16]. There are concerns about alarm fatigue and desensitization of nurses related to prolonged monitoring of patients which leads to failure in recognition of real life-threatening conditions [17]. It is unclear what the involvement of nurses could be in the augmentation of the relevance of telemetry or the duration of it but the PULSE clinical trial revealed a significant decrease in unnecessary monitoring after a training intervention for nurses [9]. It has been stated that much of the in-hospital training of hospital staff is done by observing nurses in their activities which might explain the above effect [11].

Interpretation of ECG data

Myocardial ischemia and arrhythmia are facilely recognizable through ECG and telemetry, as such identification of symptomatic patients and proper recording and interpretation of ECG in a timely manner is detrimental in any clinical or surgical department [1]. A recent meta-analysis of 43 scientific papers that evaluated nurses' competency in ECG interpretation has shown that knowledge levels vary significantly and that there is a scarcity of training and exposure to adequate interpretation of electrocardiographic recordings [18]. Ho and colleagues performed a cross-sectional study on 96 emergency department (ED) nurses and found their knowledge and skills in the identification of heart rhythms to be fair, and that these are heavily dependent on formal education, exposure, and years of experience [19]. ED nurses have good skills in interpreting ECG regardless of professional level, another study shows [6]. However, a recent study shows poor performance of intensive care nurses and ED nurses in ECG interpretation [4]. Ambulance nurses have been shown to lack the necessary competency in ECG interpretation [20]. Lack of skill is a reoccurring conclusion of many studies [19-21] (Table 2). A concerning aspect is the consistent misdiagnosis of acute myocardial infarction (AMI) on ECG by both ED and ambulance nurses [6,20]. However, this assessment is dependent on competency evaluation which was different in all the above studies, and so far a standard assessment of competency is lacking [18]. There are current efforts to redefine competency and reach a consensus [22]. All the above studies assess different demographic populations which vary in their undergraduate teaching programs for nurses. This might explain the variation in nurses' skills between studies. Most studies report on ED nurses' competency, thus there is a lack of representation of ward and surgical nurses which warrants further research.

Implications for medical practice

The human factor remains significant in electrocardiographic assessment and is subjected to various potential pitfalls. Improper placement of leads has consequences on ECG waveform morphology, which increases the risk of misdiagnosis and consequently clinical error and mistreatment [9,12]. A noisy signal increases the frequency of false alarms which negatively impacts nurses' performance [23,24]. Doctors recognize potential faults in ECG recordings and thus there is a degree of mistrust between health providers which is detrimental in an emergent situation [11]. Patient outcomes in an emergency are dependent on nurses' level of knowledge and skill in the interpretation of ECG recordings [9]. Studies show a consistent lack thereof with dire consequences on patient safety (Table 2).

Training for nurses

Training at all levels of experience seems to be the appropriate solution but that has proved to be difficult and limited for nurses. A recent survey of final-year medical students reveals that 80% received less than 6h hours of training in rhythm interpretation during undergraduate education [5]. This had an effect on their confidence level regarding ECG interpretation and impacted their willingness to seek assistance in patient care. Moreover, in hospitals, the training of other staff members in ECG lead placement is usually limited to the observation of nurses' activity which puts the weight of teaching on practicing nurses and undesirably perpetuates the mistakes [11]. Fålun et al. show that despite governmental-influenced educational efforts, nurses' performance and accuracy in monitoring improved minimally, and was suboptimal as nurses failed consistently in lead placement, proper hygiene and site preparation, epidemiologic precautions, and interpretation

TABLE 2. *Nurses' competency in ECG interpretation at different levels of experience and training*

Author	Cohort	Level of knowledge
Alijohani [4]	255 ICU and ED nurses	Nurses performed poorly in ECG interpretation; Almost half failed to identify ventricular fibrillation, atrial flutter and fibrillation, and heart block
Rahimpour [21]	105 ED nurses, 65 ED staff	Nurses performed poorly in ECG interpretation; Females performed better; Competency was dependent on experience, training, and type of training, and feedback from doctors
Ho [19]	96 ED nurses	Nurses performed fairly in rhythm recognition; Most were not able to identify heart block types; Males performed better; Competency was dependent on years of experience and training level; Completion of BLS or ALS did not improve skills
Chen [5]	114 final year nursing students	Student nurses performed poorly in rhythm recognition; Most failed to identify ventricular fibrillation and tachycardia
Coll-Badell [6]	57 ED nurses	Nurses performed fairly in ECG interpretation; Nurses performed poorly in the identification of AMI; Those with training courses in the past 5 years performed slightly better; Competency was not associated with professional level
Funk [9]	3013 nurses of cardiac unit	Nurses performed poorly in ECG interpretation; Educational intervention improved knowledge and decreased mortality but was not sustained after 15 months
Werner [20]	132 ambulance nurses	Nurses performed poorly in ECG interpretation; Nurses poorly identified AMI; No correlation with experience and years of practice

ICU – Intensive Care Unit; ED – Emergency Department; ECG – Electrocardiography; BLS – basic life support; ALS – advanced life support; AMI – acute myocardial infarction

of emergent cardiac arrhythmias [10]. An interventional study showed minimal improvement in the performance of nurses after attending a specially designed course, regarding mainly epidemiologic measures such as protective covers for telemetry monitors and information delivery [12]. Arguably this is due to staff members' inherent resistance to change suggesting the need for long-term measures and education plans. Others have provided teaching plans that improve nurses' performance in ECG interpretation [25]. Simulation-based methods are emerging as superior teaching methods [26,27]. Dedicated courses are needed to target and improve areas of vulnerability such as alarm fatigue [19,24]. As well, skill decay is an important issue and must be addressed through continuous education and consistent evaluation [5,6]. To date, no teaching standard has been established [28].

CONCLUSION

Electrocardiography and telemetry are important assessments in emergent situations that are highly dependent on nurses' skills. Though of significant importance, nurses' level of knowledge is limited in EGC interpretation in emergent situations. There is a current need for raising awareness and local implementation of AHA standards of practice. Training is a significant factor for patient outcome improvement but has been proven difficult as there is a lack of standardization and no teaching method has emerged superior. Relevant in-service training, skill sharing, and simulation-based learning are potential strategies for future improvement.

Conflict of interest: The authors declare no conflict of interest.

Financial support: none declared

Author's contributions

Conceptualization, I.R.A. and C.A.E.; writing-original draft preparation, I.R.A. and F.B.D; writing-review and editing, F.B.D., D.A.M., and C.L.E.; supervision C.A.E.

All authors have read and agreed to the published version of the manuscript.

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