Original Article

Knowledge and Utilization of Electrocardiogram among Resident Doctors in Family Medicine in Nigeria

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Abstract

Background: Electrocardiogram (ECG) is a simple, readily affordable, and noninvasive tool for the evaluation of cardiac disorders. There is a dearth of information on the utility of ECG in general practice in Nigeria. We assessed the knowledge and utilization of ECG among family medicine residents in Nigeria**. Materials and Methods:** A cross-sectional evaluation was conducted between November 2011 and May 2012 in four family medicine training centers in Nigeria. A self-administered questionnaire was used to obtain information from the resident doctors regarding their ECG requests, preferred source of interpretation, most common ECG diagnosis, and update of ECG knowledge. **Results:** Only 61 out of 120 questionnaires (50.8%) were returned. The respondents were mostly between 31 and 40 years (54.7%) and were predominantly males (73.8%) and senior residents (65.6%). Fifty-four (88.3%) respondents made <5 ECG requests/week, and the most common indication was hypertension (50%). ECG interpretation was either self-reported (41%), by a cardiologist (26.5%), or automated reports (21.3%). Self-reporting of ECG was more common among senior residents ($P < 0.01$). Left ventricular hypertrophy was the most common ECG diagnosis (55.8%). About 69% of respondents did not update their knowledge of ECG. Most respondents (50%) reported basic interpretation as the aspect of ECG for which further learning was desired. Teaching ECG to resident doctors in the update courses of the postgraduate medical colleges and continuing medical education (CME) activities was adjudged the best way to improve knowledge/utility (61.1%). **Conclusion:** The attitude to and utility of ECG among family medicine residents in Nigeria is poor. Improved knowledge, attitude, and utilization of ECG through curriculum revision, hands-on tutorials, and CMEs are highly recommended.

Keywords: *Electrocardiogram, family medicine, Nigeria, residents*

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Introduction

Electrocardiogram (ECG) was introduced by William Einthoven in 1902. More than 100 years later, it is still the most common procedure for the diagnosis of heart disease.[1] It is a basic diagnostic tool for the evaluation of cardiac disorders and performed in approximately 2% of all office visits, and 30%–38% of these ECGs are abnormal.[2] In general medical practice, ECG is the most common cardiac investigation and has the advantage of being simple to use, noninvasive, easily accessible, and readily affordable.[3]

The impact of cardiovascular disease (CVD) on global disease burden has been enormous over the years. By 2030, more than 23 million people will die annually from CVDs, with CVD projected to remain the single leading cause of death.[4] Over 80% of these CVD deaths occur in low- and middle-income countries and occur almost equally in men and women.[5] The above

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fact makes knowledge and utility of simple cardiac investigations such as ECG critical in clinical practice. ECG interpretation is a common cognitive skill that is acquired by doctors during residency training and used by most primary care and subspecialty physicians.[6] In most countries including Nigeria, family physicians and resident doctors who are undergoing specialist training in family medicine usually are in charge of the general outpatient clinic and therefore are the first port of call for most patients. It is imperative that every doctor, should be well trained to identify the symptoms and signs of CVDs, and know when to refer the patients and to whom.

As part of family medicine training in Nigeria, the resident doctors undertake rotations in various subspecialty units, it is noticed that the knowledge and interest of some of them regarding some aspects of diagnostic medicine such as ECG are suboptimal. It is this observation that stimulated this preliminary study to assess the knowledge and utilization of ECG among family medicine residents in Nigeria. It is hoped that the findings of this study will engender further discussion among medical educators in our country that will ultimately lead to optimizing the utilization of ECG in the evaluation of patients in general practice.

Materials and Methods

Study design and setting

This cross-sectional evaluation was conducted between November 2011 and May 2012 in four family medicine training centers. Jos University Teaching Hospital and Evangel Hospital, both in Jos Plateau State, North Central Nigeria, as well as Federal Medical Centre Abakaliki, Ebonyi State and Federal Medical Centre, Owerri, Imo State, both in South East Nigeria. The choice of the four centers was based on the location of the authors at the time of the study. It involved 61 family medicine residents categorized based on their duration of training into junior residents (i.e., those in training for 1–2 years) and senior residents (i.e., those in training for 3 years and above). Ethical approvals were obtained from the different centers, and informed consent was obtained from each respondent. The participants were recruited consecutively. Confidentiality was ensured.

Measurement test

Sixty-one family medicine residents from four training centers in North Central and South East Nigeria had questionnaires administered on them. The information contained in the questionnaire included the following:

1. Sociodemographic data
2. Stage in residency training
3. Number of ECG requests made per week
4. Who interprets your ECG?
5. What is your most common ECG diagnosis?
6. How often do you update your knowledge of ECG?
7. What method do you use to update your knowledge?
8. What are you most interested in learning in ECG?
9. What in your thinking is the best way to improve ECG knowledge of doctors?

Statistical analysis was carried out using the Epi Info version 3.5.3 software (CDC, Atlanta, GA, USA). Categorical variables were described using proportions while continuous variables were described using means ± standard deviation. Chi-square test or Fisher's exact test was used to compare differences in proportions. Statistical significance was set at $P < 0.05$.

Results

Out of 120 questionnaires sent out to family medicine residents in four hospitals, only 61 (50.8%) were returned. The majority of the doctors were aged 31–40 years (54.7%) and predominantly males (73.8%). Forty-one percent were 6–10 years' postqualification as doctors, and 65.6% were senior residents [Table 1].

Table 2 shows the knowledge and utilization of ECG among the participants. Only 7 (11.7%) residents requested more than five ECGs per week in their practice, and systemic hypertension was the most common indication for ECG request (50%). Forty-one percent of the doctors reported the ECGs themselves, while 26.5% got their reports from cardiologists, and 21.3% relied on automated reports.

Table 1: Characteristics of the participants (*n*=61)

Characteristics	*n* (%)
Age category (years)	
20-30	12 (19.7)
31-40	34 (55.7)
41-50	15 (24.6)
Sex	
Male	45 (73.8)
Female	16 (26.2)
Years' postgraduation	
1-5	18 (29.5)
6-10	25 (41)
>10	18 (29.5)
Stage of residency training	
Junior residents	21 (34.4)
Senior residents	40 (65.6)

Table 2: Knowledge and utility of electrocardiogram

Characteristics	*n* (%)
Average number of ECG requests/week (*n*=60)	
None	5 (8.3)
2-5	48 (80)
>5	7 (11.7)
Indications for ECG request (*n*=58)	
Angina	5 (8.6)
Arrhythmia	9 (15.5)
Heart failure	9 (15.5)
Hypertension	29 (50)
Nonspecific heart disease	6 (10.3)
Who usually interprets your ECG? (*n*=61)	
Cardiologist	16 (26.5)
Self	25 (41.0)
Senior colleagues	7 (11.5)
Technician/automated reporting	13 (21.3)
Most common ECG diagnosis (*n*=52)	
Arrhythmia	9 (17.3)
Left atrial enlargement	4 (7.7)
LVH	29 (55.8)
Myocardial infarction	6 (11.5)
Normal	4 (7.7)
Frequency of update of ECG knowledge (*n*=61)	
None or not sure	42 (68.9)
Often	14 (23)
Once/month	5 (8.2)
Areas of interest for further learning in ECG (*n*=54)	
Axis	4 (7.4)
Basic interpretation	27 (50)
Heart blocks	2 (3.7)
Life-threatening conditions	2 (3.7)
LVH/HHD	3 (5.6)
Making diagnosis from ECG tracings	11 (20.4)
Rhythm abnormalities	5 (9.3)
What is the best way to improve ECG knowledge and utility? (*n*=54)	
Bedside teaching	5 (9.3)
Electronic materials	1 (1.9)
Interaction with cardiologist	2 (3.7)
More frequent performance	7 (13.0)
Incorporated into medical school/residency curriculum	6 (11.1)
Updates/CME	33 (61.1)

ECG=Electrocardiogram; LVH=Left ventricular hypertrophy; HHD=Hypertensive heart disease; CME=Continuing Medical Education

Table 3: Comparing knowledge and utility of electrocardiogram between junior and senior residents

	Junior residents	Senior residents	χ^2	*P*
Number of ECG requests/week				
None	1	4	0.5	0.75
2-5	17	31		
>5	2	5		
Who usually interprets your ECG?				
Cardiologist	5	11	15	<0.01
Self	6	19		
Senior colleagues	7	0		
Technician/automated	3	10		

Contd...

Table 3: Contd...

Frequency of ECG update				
None/not sure	16	26	0.83	0.36
Often	4	10		
Once/month	1	4		
Best way to improve ECG knowledge/utility				
Bedside teaching	2	3	3.96	0.55
Interaction with cardiologist	0	2		
Electronic materials	0	1		
More frequent performance	4	3		
Put in core medical school/residency curriculum	2	4		
Updates/CME	9	24		

ECG=Electrocardiography; CME=Continuing Medical Education

Left ventricular hypertrophy (LVH) was reported to be the most common ECG diagnosis in the majority of the participants (55.8%), while 4 (7.7%) reported normal ECG to be their most common diagnosis. About 69% of the doctors either did not update their knowledge of ECG or were not sure they did. The aspect of ECG that attracted the highest interest for further learning was the basic interpretation (50%) followed by making a diagnosis from ECG (20.4%). The majority (61.1%) of the residents were of the opinion that teaching ECG in update courses and continuing medical education (CME) programs is the best way to improve ECG knowledge and utility.

When senior and junior residents were compared [Table 3], there was a statistically significant difference regarding who interprets ECG between the two groups with senior residents more likely to report ECGs by themselves ($P < 0.01$). The two groups were similar in other parameters including number of ECG requests per week ($P = 0.75$), frequency of update of ECG knowledge ($P = 0.36$), and best way to improve ECG knowledge/utility ($P = 0.55$).

Discussion

In the outpatient setting, ECG is an inexpensive screening test that is often used along with history and physical examination to evaluate patients with known or suspected CVD, cardiovascular involvement in other systemic illness or to screen for cardiovascular stability, and suitability for certain treatment modalities of non-CVDs.[7,8] Considering the essential role of family physicians as primary health-care providers in most settings, they should be aware of these indications and should also be able to readily interpret ECG findings and their clinical implications for optimal patient management or appropriate referral.

Some studies in different parts of the world have looked at ECG interpretative skills of family physicians.[9-11] To the best of our knowledge, there are no such studies in Nigeria. In this preliminary study, we assessed the knowledge and utilization of ECG in the practice of family medicine residents to form the basis for a later study on ECG interpretative skills and challenges among family physicians.

The utilization of ECG was found to be poor among the participants in this study as only a few residents made more than five ECG requests per week. A similar trend was seen in a large multicenter study in Turkey, where 46.8% of 781 family physicians never ordered ECG for their patients.[12] In another study among family physicians in New Zealand, more than half of the doctors interpreted <1 ECG/week in a clinical context.[13] It has been established that trainees often gain experience in ECG interpretation with regular use of ECG in the clinical management of their patients.[6] Therefore, the dearth of its use among our family medicine residents can only negate this. The list of common indications for ECG among our respondents was narrow and bordered only on few CVDs. This questions their knowledge of ECG and its application in patient management. This may also reflect foundational errors stemming from poor undergraduate knowledge. Overreporting of abnormalities on ECG may not be unrelated to the reliance of a good percentage of the doctors on automated ECG reporting. Unfortunately, false-positive ECG interpretations could lead to unnecessary treatment.[4-19] Computer software can only accurately identify 58%–94% of various non-rhythm ECG abnormalities when compared with expert reports. Accuracy is considerably reduced when computers interpret arrhythmias.[20,21] In addition, reliability may be a problem as several studies show substantial differences in ECG interpretation obtained minutes apart in clinically stable patients.[22-24] A study in the Czech Republic concluded that, despite automated evaluation programs for ECG being almost standard nowadays, physicians should have good knowledge of ECG and

should be able to correct frequent inaccuracies of automated evaluations.[25]

Despite the limitations of automated ECG, evidence suggests that computer interpretation is a useful adjunct to physician's interpretation. A study of resident physicians showed that using computer interpretation software reduced the incidence of serious ECG interpretation errors from 22% to 18%.[26] However, other researches have indicated that preliminary computer interpretations may both benefit and mislead primary care physicians.[27] Reviewing the reliability of computer analysis of ECG of Nigerians,[20] Araoye *et al*. observed that the criteria used were inapplicable to Negroes. They concluded that the following errors were inherent: poor recognition of constitutional variables leading to disparity in the diagnosis of LVH (areas based on voltage criteria), myocardial infarction (areas based on depolarization and repolarization changes), and atrial fibrillation (areas based on accurate sensing of P-waves).

The observation of self-reporting of ECG by a significant number of our respondents is good. A study among South African emergency medicine residents showed a high percentage of self-reporting of ECG among both junior and senior residents.[28] Self-reporting of ECG by family medicine residents will be of more benefit to the health system if regular refresher courses are used to update their knowledge and expertise. While this study did not compare the interpretative skills of junior and senior residents, it showed that senior residents had an edge in utility and understanding of ECG. Furthermore, there is a consensus that the senior residents often have a better understanding, knowledge and use of ECG though it is agreed that ECG interpretative skill is on the decline and that this transcends geographical boundaries, suggesting a new approach to learning ECG skills.[29] However, when the number of ECG requests based on years' postqualification was looked at, it was noticed that this declined with years' postqualification, suggesting the need for training and re-training of practitioners on the use of basic ancillary investigating tools that aid in practice. In a study in New Zealand, students performed better than residents in ECG interpretation. This suggests that skills in ECG interpretation gained in medical schools are not built upon in normal clinical duties postqualification, a role that CME is designed to fill.[14]

Although the respondents in this study recognized that periodic update courses and CME are the way forward in improving knowledge and use of ECG, a good percentage of them were not interested in improving themselves. Family medicine residents in South Africa shared a similar opinion on how to improve learning, and all agreed on the right foundation. Study on the content of ECG in family medicine residency curriculum in Canada advocated a reorganization that is patient oriented,[11] but another study on ECG use among psychiatrists concluded that refresher courses rather than e-books alone improve diagnostic accuracy markedly.[30] However, it remains unclear whether CME, such as didactic courses, hands-on ECG interpretative seminars, or self-assessment programs, can improve ECG interpretation skills after initial residency. Some uncontrolled studies of residents and medical students showed improvement in ECG interpretation skills after structured ECG interpretation seminars.[31,32]

This study had some limitations. It had a relatively small sample size due to the poor response rate from the residents on whom questionnaires were administered. In addition, it did not assess the interpretative skills of these residents, which would have been a better measure of their knowledge. However, it is intended as a preliminary study to awaken the educators to reassess teaching methods and discourage overreliance on automated reports rather than skills acquired through intuitive studies.

Conclusion

This study showed that the attitude and utility of ECG among family medicine residents in Nigeria are poor. This scenario is undesirable considering the place of family physicians as the first port of call in organized health-care delivery as well as the importance of ECG as a simple and noninvasive procedure in the evaluation of CVDs. Improved knowledge, attitude, and utility of ECG through modifications in training curriculum, hands-on tutorials during clinical postings, and workshops/CMEs are highly recommended.

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Conflicts of interest

There are no conflicts of interest.

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