

# NURSES' KNOWLEDGE OF ELECTROCARDIOGRAM MANAGEMENT AND INTERPRETATION

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## CONHECIMENTO DE ENFERMEIROS NO MANEJO E INTERPRETAÇÃO DO ELETROCARDIOGRAMA

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## CONOCIMIENTO DE ENFERMEROS EN EL MANOSEO Y LA INTERPRETACIÓN DEL ELECTROCARDIOGRAMA

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**Objective:** assess nurses' knowledge on the analysis and basic interpretation of the electrocardiogram. **Method:** cross-sectional study developed at a private hospital in Southern Brazil between December 2014 and January 2015. A structured questionnaire was applied to assess sociodemographic characteristics and theoretical and practical knowledge aspects in electrocardiogram analysis. **Results:** the total sample consisted of 24 nurses, being 91.7% female; the most prevalent age range was between 24 and 29 years (41.7%). Only six (25%) nurses in the total sample correctly answered the question on the correct meaning of the QRS complex. Concerning the interpretation of the tracings, 18 (75%) correctly analyzed the "sinus bradycardia". **Conclusion:** the nurses' theoretical knowledge level on the electrocardiogram was unsatisfactory, with correct answer scores inferior to 50%, except on the question that assessed the "origin of the electric impulse". On the tracing interpretation questions, however, correct answer rates were satisfactory for most rhythms.

**Descriptors:** Electrocardiography. Cardiovascular nursing. Knowledge.

*Objetivo: avaliar o conhecimento de enfermeiros na análise e interpretação básica do eletrocardiograma. Método: estudo transversal desenvolvido em um hospital privado no Sul do Brasil, no período de dezembro de 2014 a janeiro de 2015. Foi aplicado um questionário estruturado para avaliar características sociodemográficas e aspectos do conhecimento teórico e prático na análise do eletrocardiograma. Resultados: a amostra total foi de 24 enfermeiros, 91,7% do sexo feminino; a idade com maior prevalência foi de 24 a 29 anos (41,7%). Do total, apenas 6 (25%) da amostra responderam de forma correta o significado do complexo QRS. Com relação à interpretação dos traçados, 18 (75%) analisaram corretamente a "bradicardia sinusal". Conclusão: o grau de conhecimento teórico dos enfermeiros sobre eletrocardiograma mostrou-se insatisfatório, com escores de acertos inferiores a 50%, exceto na questão que avaliou a "origem do impulso elétrico". Entretanto, nas questões de interpretação do traçado, apresentaram taxas satisfatórias de assertividade para a maioria dos ritmos.*

*Descritores: Eletrocardiografia. Enfermagem cardiovascular. Conhecimento.*

*Objetivo: evaluar el conocimiento de enfermeros en el análisis y la interpretación básica del electrocardiograma. Método: estudio trasversal desarrollado en un hospital privado en el Sur de Brasil, en el período de diciembre del 2014 a enero del 2015. Fue aplicado un cuestionario estructurado para evaluar características sociodemográficas y aspectos del conocimiento teórico y práctico en el análisis del electrocardiograma. Resultados: la muestra total*

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*fue de 24 enfermeros, 91,7% del sexo femenino; la edad más frecuente fue de 24 a 29 años (41,7%). Del total, sólo 6 (25%) de la muestra contestaron correctamente la pregunta sobre el significado del complejo QRS. Respecto a la interpretación de los trazados, 18 (75%) analizaron correctamente la "bradicardia sinusal". Conclusión: el grado de conocimiento teórico de los enfermeros sobre electrocardiograma se mostro insatisfactorio, con índices de aciertos inferiores al 50%, excepto en la pregunta que evaluó el "origen del impulso eléctrico". Sin embargo, en las preguntas de interpretación del trazado, presentaron tasas satisfactorias de aciertos para la mayoría de los ritmos.*

*Descriptores: Electrocardiografía. Enfermería cardiovascular. Conocimiento.*

## Introduction

The electrocardiogram (ECG) is a low-cost, simple, non-invasive and widely used exam in clinical practice. The objective of monitoring the electrocardiographic tracings ranges from a simple analysis of the frequency and basic rhythms to the diagnosis of complex arrhythmias, myocardial ischemia, and identification of long QT syndrome<sup>(1)</sup>.

The knowledge process and education are important aspects of the correct interpretation of the ECG - definition of normal/abnormal rhythm, understanding of electrophysiological concepts and characteristics of the monitoring technique<sup>(2-3)</sup>. The nurse, in her care and management activities, is responsible for maintaining comprehensive patient care in a safe and effective way<sup>(4)</sup>. In this sense, it is essential that nursing training focus on the analysis, interpretation and mastery of clinical signs and diagnostic methods in the context of cardiovascular illness<sup>(5)</sup>.

Some previous studies<sup>(6-7)</sup> have shown that nurses' knowledge scores improved when they were assessed before and after ECG training regardless of the learning environment. For example, in the PULSE study, the nurses increased the accuracy in the interpretation of cardiac arrhythmias from 82% to 97% after an interactive education program with emphasis on electrocardiographic analysis<sup>(8)</sup>. In another study that followed this same line of intervention, the nurses' knowledge scores after the third week of training, were satisfactory. As from the eighth week, however, the scores dropped (89% to 63%,  $p < 0.001$ ). Therefore, systematic training, updates and periodic evaluations of ECG are necessary<sup>(9)</sup>.

In view of the evidence highlighted in the literature, in addition to the magnitude of this theme and the need to produce data that cover

nurses active in care for patients with cardiovascular diseases, we propose this study, which aims to evaluate nurses' knowledge in the analysis and basic interpretation of the electrocardiogram.

## Method

A cross-sectional study with a quantitative approach was performed in a medium-sized private hospital in the Northwest of Rio Grande do Sul, Brazil. Of the 39 nurses who worked in the institution, 26 were eligible because they worked with adult patients in the following areas: surgical center, medical and surgical clinic, emergency room and intensive care unit. During the collection period, two professionals were on leave and were therefore excluded. Thus, the final sample consisted of 24 nurses. All participants took part in the study after reading and signing the Informed Consent Form (TCLE).

The study was developed between December 2014 and January 2015. The researchers developed and applied a structured questionnaire. Data collection was performed in a private room before the start of each shift (morning, afternoon or evening). The nurses who agreed to participate received information about the purpose of the study and the method defined to evaluate the outcomes. Closed envelopes containing the questionnaire were delivered individually and responded anonymously, with the guarantee of secrecy and privacy of the information. There was no previous pilot test. In addition, participants were not allowed to take the questionnaire home for completion.

The questionnaire, composed of 20 objective questions, covered the following variables: sociodemographic characteristics (7 questions);

training on ECG and fitness for its accomplishment (2 questions); and knowledge of theoretical aspects in ECG interpretation (11 questions). In the theoretical knowledge variable, questions related to the electrocardiographic leads, the steps to evaluate an ECG and the electrical impulse physiology were addressed. Regarding the certification of the correct interpretation of the electrocardiographic tracings, illustrations with examples were attached to the questionnaire. Each participant should choose only one correct alternative for each question.

All data collected were organized in Epi-info®, version 6.4, with double independent data entry. After checking for errors and typing inconsistencies, the descriptive analysis of the data was performed in the Statistical Package for Social Sciences (SPSS)

version 18.0. Descriptive variables were used by means of absolute and relative frequencies.

In this research, the ethical precepts of National Health Council Resolution 466/12 were considered, ensuring the anonymity of each professional. The research received approval from the Ethics Committee of the institution involved (CAAE: 37828714.0.0000.5330).

## Results

Twenty-four nurses participated in the study; the most frequent age was between 24 and 29 years (41.7%) and 91.7% of the sample was female. Regarding the graduation time, 66.7% had graduated less than four years earlier and the majority (75%) held a specialization degree. The remaining data are displayed in Table 1.

**Table 1** – Sociodemographic and professional characteristics of the investigated nurses. Santa Maria, Rio Grande do Sul, Brazil – 2015 (N=24)

Variable	n	%
<b>Age</b>		
24 to 29 years	10	41.7
30 to 35 years	8	33.3
36 to 41 years	3	12.5
+ 42 years	2	8.3
Did not answer	1	4.2
<b>Sex</b>		
Male	1	4.2
Female	22	91.7
Did not answer	1	4.2
<b>Marital status</b>		
Single	12	50.0
Married	12	50.0
<b>Time since graduation (years)</b>		
≤ 4 years	16	66.7
5 to 9 years	6	25.0
10 to 15 years	1	4.2
> 15 years	1	4.2
<b>Qualification/post-graduation</b>		
Specialization	18	75.0
Specialization incomplete	5	20.8
Did not answer	1	4.2
<b>Length of experience (years)</b>		
≤ 1 year	4	16.7
2 to 4 years	10	41.7
5 to 7 years	5	20.8
8 to 10 years	5	20.8

Source: Created by the authors.

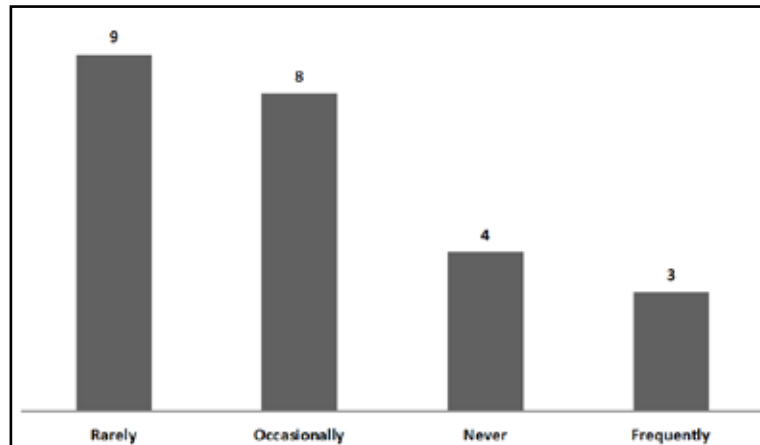
Obs.: Conventional signal used:

- Numerical data equal to zero not resulting from rounding.

According to Graph 1, nine (37.5%) nurses answered that they “rarely” receive ECG training at the institution. On the other hand, only three

(12.5%) informed that they “frequently” receive opportunities for this kind of training.

**Graph 1** – ECG training opportunity at the research hospital. Santa Maria, Rio Grande do Sul, Brazil – 2015 (N=24)



Source: Created by the authors.

Next, the nurses' ECG knowledge variables are presented, obtained from the answers they registered on the research instrument applied. It was observed that only six (25%) individuals from the sample correctly answered

the question about the meaning of the QRS complex (ventricular depolarization) and nine (37.5%) correctly answered the question about the number of leads in this test (12 leads). The other answers are shown in Table 2.

**Table 2** – The nurses' knowledge about electrocardiogram. Santa Maria, Rio Grande do Sul, Brazil – 2015 (N=24)

Variables	Correct		Wrong		No answer	
	n	%	n	%	n	%
<b>What is the meaning of the QRS complex?</b>						
Ventricular depolarization*	6	25	17	70.8	1	4.2
<b>How many leads are there in the electrocardiogram?</b>						
12 leads*	9	37.5	15	62.5	-	-
<b>Identify the main steps to assess an electrocardiogram</b>						
Rhythm, frequency, wave, duration*	6	25	17	70.8	1	4.2
<b>Where does the electrical impulse start?</b>						
Sinoatrial node*	16	66.7	8	33.3	-	-
<b>What is the time-voltage equivalent of the electrocardiogram?</b>						
Vertical is equivalent to voltage 0.1mV and horizontal to time 0.04s*	9	37.5	15	62.5	-	-

Source: Created by the authors.

Obs.: Conventional signal used:




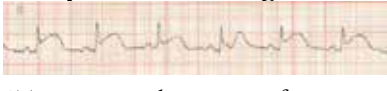
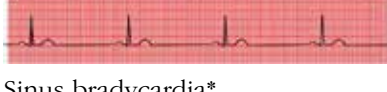

- Numerical data equal to zero not resulting from rounding.

\* Correct answer.

In Table 3, the results of the ECG analysis and interpretation are presented according to different examples of cardiac tracings. In the total sample, 16 (66.7%) and 8 (33.3%) correctly interpreted the ECG “Sinus tachycardia” and

“Ventricular fibrillation”, respectively. In the identification of the “Sinus rhythm”, 14 (58.3%) correctly recognized this tracing and 18 (75%) identified the “ST-segment elevation infarction”.

**Table 3** – The nurses’ interpretation of electrocardiographic tracings. Santa Maria, Rio Grande do Sul, Brazil – 2015 (N=24)

Electrocardiographic tracings	Correct		Wrong		No answer	
	N	%	N	%	N	%
<b>Identify cardiac tracing 1</b>						
 Sinus Tachycardia*	16	66.7	8	33.3	-	-
<b>Identify cardiac tracing 2</b>						
 Ventricular fibrillation*	8	33.3	16	66.7	-	-
<b>Identify cardiac tracing 3</b>						
 Sinus rhythm*	14	58.3	9	37.5	1	4.2
<b>Identify cardiac tracing 4</b>						
 ST-segment elevation infarction*	18	75.0	6	25.0	-	-
<b>Identify cardiac tracing 5</b>						
 Sinus bradycardia*	18	75.0	6	25.0	-	-
<b>Identify cardiac tracing 6</b>						
 Atrioventricular block*	16	66.7	8	33.3	-	-

Source: Created by the authors.

Obs.: Conventional signal used:

- Numerical data equal to zero not resulting from rounding.

\* Correct answer.

## Discussion

This study aimed to fill a gap in the literature that evaluates nurses’ knowledge on the basic analysis and interpretation of the ECG. The findings indicated that the degree of knowledge about technical and practical issues in the research population was variable.

Regarding the characteristics of the sample studied, this study resembles others previously published<sup>(9-10)</sup>. There were a greater proportion of female, young and recently graduated professionals. In addition, most nurses had obtained a specialization degree.

One of the results highlighted was the low frequency of ECG training opportunities offered

by the institution, according to the participants. Of the total sample, 17 nurses answered that they “rarely” or “occasionally” receive this type of training. In the literature, it is emphasized that a systematic education program on ECG is fundamental to enable the professionals to interpret abnormalities in the heart rhythm, frequency and electrical activity<sup>(7,11)</sup>. The need for training is individualized though, according to the specifics of the activity areas and the professional's level of background knowledge. Being a private institution, which is not exclusively focused on the area of cardiology, the training does not happen as frequently as required. This allows us to better understand and contextualize the findings.

In this study, some points that measure the degree of theoretical knowledge about ECG were evaluated. The findings showed that approximately one-third of the sample demonstrated correct knowledge about the number of leads used in the ECG. The guidelines recommend performing the 12-lead ECG for analysis, interpretation and clinical diagnosis, subdivided into six limb leads, bipolar (I, II, III) and unipolar (aVR, aVL, aVF) limbs, as well as six precordial leads (V1, V2, V3, V4, V5, V6)<sup>(1)</sup>. In contrast, two-thirds of the nurses correctly answered the question on the origin of the electrical impulse. The sinoatrial or sinus node is considered the heart's natural pacemaker. Located in the upper right atrium, it automatically produces a cyclic electrical activity that initiates each heartbeat in a sinus rhythm<sup>(12)</sup>. It is essential, therefore, that the nurse knows the cardiovascular physiology, so that the arrhythmias related to the formation system, such as atrial fibrillation, are identified.

Regarding the analysis and interpretation of the electrocardiographic tracings, the results were diversified, although, in an analysis of all answers, only the identification of the “ventricular fibrillation” rhythm scored less than 50%. The PULSE study tested the effect of educational interventions on the practice of ECG monitoring. Nurses from different hospitals, in contrast to the present study, presented a mean baseline knowledge score lower than 50%. After strategies

had been applied in an education program though, the nurses' knowledge improved significantly<sup>(8)</sup>.

A study published in 2017 aimed to evaluate nurses' competence in ECG interpretation. In the sample analyzed, 93% achieved high scores. The question related to acute myocardial infarction presented the lowest rate of correct answers though, in contrast with the results of our study. The authors also argued that it is fundamental to produce scientific evidence in this scenario. In addition, they stressed that it is important for nurses to develop their competence, implement teaching measures and improve their knowledge about ECG<sup>(13)</sup>.

It should be highlighted that, depending on the training method, the results regarding the improvement of ECG knowledge may differ<sup>(6,14)</sup>. In addition, this instruction process should be included continuously, with didactic content and clinical practice<sup>(15)</sup>. In nursing, periodical continuing education programs are fundamental for professional development on ECG in the theoretical and practical context. This process is evidenced through interventions and specialized training, providing continuous improvement of the skills, leading to a high-quality and safe clinical practice in the performance and interpretation of the ECG<sup>(12)</sup>.

One of the limitations of this study is that it included only one private institution in the South of the country, which impairs the external validity of the results. The findings may serve as a basis and discussion for future research on the subject though, as the literature shows a scarce number of productions on nurses' knowledge in the interpretation of the electrocardiogram.

## Conclusion

Among the questions that assessed the “meaning of the QRS complex”, the “number of leads”, “ECG evaluation steps” and “time-voltage equivalence”, only the “origin of the electric impulse” scored more than 50% of correct answers. Although the number of correct answers on the analysis and interpretation questions of the

electrocardiographic tracings was satisfactory, the correct answer rate in the identification of “ventricular fibrillation” was low. Intervention studies including more participants are needed. We conclude that, in the context of a private hospital, the nurses’ theoretical knowledge level about electrocardiography was unsatisfactory, with correct answer scores inferior to 50%, except on the question that evaluated the “origin of the electric impulse”. On the interpretation questions of the tracings, however, the correct answer rates on most rhythms were low. The importance of and need for permanent learning in the health context are emphasized, aiming for the construction of knowledge that allows the nursing professionals to act autonomously in their professional practice. A training and systematic evaluation program of the processes involved in clinical care practice, besides the integration between teaching and research, are essential factors for these professionals’ qualification.

### Collaborations:

1. conception, design, analysis and interpretation of data: Marco Aurélio Lumertz Saffi and Mônica Strapazzon Bonfada;
2. writing of the article and relevant critical review of the intellectual content: Marco Aurélio Lumertz Saffi and Mônica Strapazzon Bonfada;
3. final approval of the version to be published: Marco Aurélio Lumertz Saffi e Mônica Strapazzon Bonfada.

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