Bridging The Knowledge, Practice Gap Among Pediatric Nurses Regarding Electrocardiograph Implementation and Interpretation Skills for Pediatric Patients

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Abstract:

Background: The effective implementation and interpretation of electrocardiographs (ECGs) are crucial in providing optimal care for pediatric patients. However, there exists a knowledge-practice gap among pediatric nurses in this area, which can lead to compromise patient outcomes. The study purpose was to evaluate the impact of an educational program on improving the knowledge and practice of pediatric nurses regarding ECG implementation and interpretation skills. **Methods**: The study design used was quasi-experimental, with a pre- and posttest strategy. The study was conducted on a convenience sample of 46 nurses working in the Cardiac Care Unit and the cardiac department at Mansoura University Children's Hospital, Egypt. Two tools were used for data collection namely: ECG preparation and interpretation skill assessment sheet and the nurses' knowledge and practice concerning electrocardiogram implementation and interpretation questionnaire sheet **Results:** The findings revealed that prior to the educational intervention, nurses had limited knowledge and faced challenges in accurately interpreting pediatric ECGs. Following the implementation of the educational program, a significant improvement was observed in the nurses' knowledge and practice regarding ECG implementation and interpretation skills. The most common causes of gab in knowledge & practice regarding ECG interpretation as replied by the majority of nurses (81.8% & 90,9%) were lack of training and professional development program as well as lack of ECG interpretation protocol respectively. In **conclusion**, implementing an educational program significantly improves the knowledge and practice of pediatric nurses in ECG implementation and interpretation skills. Therefore, the researcher recommends continuous training programs and educational sessions for pediatric nurses about ECG interpretation is mandatory.

Key words: *ECG interpretation; ECG implementation; knowledge-practice gap; nurse education & pediatric nurses*

Introduction

The pediatric ECG has numerous complexities related to age-specific alterations. These results have a direct bearing on how the heart and circulatory system alter as a person grows from an infant to an adult. For instance, the right ventricle is bigger and thicker before birth than the left, and fetal circulation mostly depends on the right side of the heart. The left ventricle enlarges during infancy due to increased physiologic stress and work, and by six months, it has doubled in thickness compared to the right. The left ventricle is at least 2.5 times thicker than the right by adolescence. Children's normal ECGs are variable due to these changes over time, which can occasionally cause delays in emergency department interpretation **(Patel, Sedaghat-Yazdi & Perez, 2018).**

Understanding the fundamentals of pediatric ECG interpretation will help nurses to distinguish between normal and abnormal readings. These include a basic understanding of common pediatric dysrhythmias and findings associated with congenital heart diseases, as well as an understanding of basic cardiac physiologic changes associated with age and maturation, including the adaptation from right to left ventricular predominance. This understanding also includes being familiar with age-related normal findings in waveform morphologies, intervals, axis, and heart rate. Abnormalities in rhythm (regular and irregular) or rate (tachyarrhythmias and bradyarrhythmias) are examples of arrhythmias. The literature reports varying rates of arrhythmias in children, ranging from 55.1 per 100,000 visits to pediatric emergency rooms. Their distribution is typically bimodal, with the first peak happening in infancy and the second peak happening in adolescence. Arrhythmias can happen in kids who have congenital cardiac defects or not and after its surgical correction **(Bobbo, et al., 2019)**.

Identifying patient deterioration through observation of the patient's state and vital signs is a crucial duty of the nurse. This is being augmented more and more by ongoing electrocardiographic (ECG) monitoring. Because of the large amount of nuisance and false alarms, continuous monitoring is ineffective at detecting deterioration. Clinicians have been overly dependent on ECG monitoring without taking into account its limits due to a lack of solid data or official standards for the care of patients using this technology **(Coll-Badell, Jiménez-Herrera & Llaurado-Serra, 2017).**

In the Emergency Department (ED), pediatric electrocardiograms (ECGs) can be difficult to interpret. There are several reasons why the ED obtains ECGs from youngsters. According to **Mowery and Suddaby (2013)**, up to 20% of them had clinically relevant symptoms such prolonged QT syndrome, hypertrophy of the ventricles, or ectopic. The fact that often "abnormal" electrocardiographic results in adults may, in reality, be normal or expected findings in children, depending on the patient's age, presents a problem for pediatric ECGs. The alterations and growth of the heart and circulatory system from birth to adulthood are the cause of these variations **(Brown, Jones, Moore, Meliones, Montgomery and et al.,2019).** Interpreting electrocardiograms (ECGs) for pediatric patients in the emergency department (ED) requires careful consideration of normal variations with age. A systematic approach focusing on heart rate, rhythm, axis, ventricle and atrium size, and repolarization patterns helps to discern what's typical for a child's development versus indicative of a potential cardiac abnormality **(Gilman, Nelson, Murphy, Kidd, Stussyand et al., 2015).**

The electrocardiogram (ECG) is a vital diagnostic tool for heart conditions. ECG evaluation has become the first test to do when cardiac problems are suspected, hence it is critical that pediatricians in all specialties possess this competency. Acquiring and accurately analyzing an ECG can help with early intervention through better management and timely referral. The main purpose of the ECG training program is to assist nurses and pediatricians in developing a foundational understanding of reading ECG readings. It is typically challenging for nurses to learn the significance of various ECG wave shapes, which might indicate clinical symptoms or even potentially fatal diseases or arrhythmias. If the nursing staff does not make the right decisions at the right time, several grave issues may result in death. Therefore, it is advised to provide a platform for educational initiatives **(Chang, 2020; Ebrahim, et al, 2020)**. Although promising initial results emerged from **Nabil, et al., (2018)** study, expanding the training program to a larger and geographically varied group of

Egyptian nurses through further research could significantly improve their ECG performance.

The provision of nursing care for children and adolescents presents a difficult task for pediatric nurses, who must provide care that is developmentally appropriate and diligent in addressing patient and family concerns. In the context of pediatrics, nursing practice can be a fulfilling and demanding vocation. In order to provide pediatric patients with various congenital and acquired heart diseases with high-quality care, pediatric nurses must perform complex tasks and be vigilant at all times. The nurses have little time to update their knowledge and abilities in light of recent developments in practice, particularly with regard to ECG interpretation. This could lead to a gap in the clinical practice's ability to apply information **(Roshan Essani, & Ali, 2011)**. For that reason, this study was conducted to evaluate the effect of implementing educational program on improving knowledge, practice gap among pediatric nurses regarding electrocardiograph implementation and interpretation skills for pediatric patients.

Significance of the study

Pediatric nurses play a critical role in the healthcare of children, including the monitoring and interpretation of electrocardiographs (ECGs) for pediatric patients. However, there exists a significant knowledge and practice gap among pediatric nurses regarding the implementation and interpretation skills of ECGs for pediatric patients. This knowledge gap can lead to inaccurate or delayed diagnosis, potentially compromising patient outcomes and safety. Bridging the knowledge and practice gap will foster professional growth and confidence among pediatric nurses. It will equip them with the necessary skills to provide evidence-based care and make informed clinical decisions. This enhanced competency will not only benefit the nurses themselves but also promote overall quality of care provided to pediatric patients. According to a study by **Funk et al. (2017)**, nurses' knowledge and quality of care, including accurate electrode placement, accurate rhythm interpretation, appropriate monitoring, and ST-segment monitoring, improved significantly after the intervention. This was achieved through the combination of online ECG monitoring education and strategies to implement and sustain change in practice.

Aim of the study

The aim of the study is to evaluate the effect of implementing educational program on improving knowledge, practice gap among pediatric nurses regarding electrocardiograph implementation and interpretation skills for pediatric patients. The following study objectives was assessed (1) Assessment of nurses' knowledge and practice about electrocardiograph implementation and interpretation skills. (2) Implementation of educational program for nurses and Evaluation of the nurse's knowledge and practice about electrocardiograph implementation and interpretation skills. The researchers examine the following hypothesis (H 1) There is an improvement in the level of nurses' knowledge and practice about electrocardiograph implementation and interpretation skills after implementation of educational program.

Subject & Methods

Research design

To achieve the study's goal, a single group (pre and posttest) was employed in a quasi-experimental research design.

Setting

The study was carried out in the Cardiac Care Unit (CCU) and cardiac department at Mansoura University Children's Hospital (MUCH) affiliated to Mansoura University, Egypt. The CCU offer care for children with different cardiac problem post operative or in recovery. While, cardiac department offer care for children with different acquired or cardiac health problem.

Sampling

A convenience sample of 46 nurse employed in the aforementioned study setting and fulfilling the inclusion criteria. In this study, nurses of both sex with varying ages, educational backgrounds, years of experience and who agree and consent to participate the current study were included. The required sample size was determined to be 38 using the Power Analysis software available on the Statistics Kingdom website (Open-Source Statistics for Public Health) and the study data from **Neha, Bist, Dixit, and Pareek (2019)**. The software took into account a level of significance of 5%, a medium effect size, effect type (F), one group (pre/post-test), and a study power of 85%. Eight nurses were added to account for a 20% sample attrition, making 46 nurses in total in the sample.

Instruments of data collection

The researcher created two tools: the ECG preparation and interpretation skill assessment sheet and the nurses' knowledge and practice concerning electrocardiogram implementation and interpretation questionnaire sheet after reading pertinent literature in order to meet the study's objectives.

Tool I: - Nurses knowledge and practice about electrocardiogram implementation and interpretation Questionnaire Sheet

The researchers created the two-part questionnaire after studying relevant literature **(Coll-Badell, et al., 2017; Al-Husaunawy, (2015) & Tahboub, 2018)**. **Part I:** demographic characteristics of Nurses. This part covers question about Gender, age, marital status, educational level and years of experience. **Part II:** Nurses knowledge and practice about electrocardiogram preparation and interpretation Questionnaire Sheet. The part includes questions about No of ECG electrodes, point that electrical impulses start, component of ECG waves (p wave, QRS complex, T wave, normal and abnormal ECG, correct order of ECG waves and intervals, main steps to assess ECG., etc. the questions will be in the form of MCQ and true/ false questions.

Tool II: ECG preparation and interpretation skill Assessment sheet: -

The tool developed by the researcher after reviewing the following literature **(Ahmed, 2015 & Tahboub, 2018)**. It includes two parts: **Part I:** covers nurses' practice regarding electrocardiogram application and preparation. It includes 15 statements concerning the preparation of the child (child positioning, jell application and correct placement of electrodes in normal child and in child with heart in the right side, electrode placement in case of amputation, check metal subject, confirmation of child data and recording. The nurse responds for each statement with yes/ No or I do not know. **Part II** include 20 example of ECG strip (normal &abnormal) Including rate, regularity, P waves, PR interval, QRS interval and ECG interpretation. Part III include nurses' opinion about the causes of gap between knowledge and practice for pediatric nurses concerning analysis and interpretation of pediatric ECG and this consists of eight causes the nurses asked and replied with yes or no like nursing curriculum does not cover the information and skills necessary for ECG analysis and interpretation, lack of experience & exposure to pediatric ECG interpretation cases, insufficient opportunities to practice EKG interpretation skill, Lack of training and professional development for ECG interpretation ------,etc.

The scoring method was created as follows for knowledge and practice; one point was awarded for each correct answer for knowledge and each step that was completed correctly in practice. While the erroneous answer, missing statement, and incorrectly completed checklist all resulted in a score of 0, the total score was computed and classed as competent practice when it reached 75% or more and incompetent practice when it fell below.

Poor knowledge was taken into account when the nurses had a total knowledge score of less than 60%. Good knowledge was assessed when the nurses received a total knowledge score of 75% or greater.

Validity and reliability of tools

The validity of the translated and adapted data gathering instrument was assessed by five pediatric nursing specialists. The Alpha Cronbach's test, which has a 0.85 score, was used to assess reliability.

Ethical considerations

Mansoura University's nursing college provided ethical approval (Ref. No. P:0425). After outlining the purpose, methods, and duration of the study, the hospital director and the department head granted their authorization. The study's goal was discussed, and nurses then provided their written consent. They pledged to protect the confidentiality of the data collected and to be free to withdraw from the study at any time without incurring any costs or consequences.

Pilot study

To assess the feasibility, applicability, and clarity of the tools, a pilot study involving 10% of the five nurses under study was carried out. The necessary modifications will be made in accordance with the findings.

Fieldwork:

The data collecting for this study took place over a six-month period beginning on March 1, 2023, and ending on September 30, 2023. Three phases, the assessment phase, the implementation phase, and the evaluation phase were used to collect data. The head nurse, nurses in the CCU, and in the cardiac department were informed about the purpose and scope of the study during the evaluation phase. Using tools, I and II, the researcher evaluated nurses' knowledge and practice regarding the implementation and interpretation of ECGs throughout this phase. After then, a code number was assigned to each nurse.

The researchers create a teaching program about how to interpret and use ECGs throughout the implementation phase. There are two sessions in the program; one practical and one theoretical. The program is spread out across a month, with two sessions per week lasting between thirty and forty-five minutes each. Five nurses were allocated to each of the groups. The theoretical sessions concentrated on an overview of the anatomy and physiology of the heart, changes brought on by aging in the anatomy, physiology, and function of the heart, and an overview of how to interpret the following ECG parameters in pediatric patients: rate, rhythm, p-wave, QRS axis and complex, T waves, and ST segment and intervals. The focus of the practical session was on pediatric patient preparation for an ECG, using the 12 leads and ECG procedure, and developing practical analysis skills for the most common normal and abnormal ECG analyses (including rate, regularity, P waves, PR intervals, QRS intervals, pediatric cardiac emergencies, and arrhythmias).

Practical & theoretical sessions were done in the nurses' working area to facilitate the training. The session was scheduled for a morning or afternoon shift. Enough time was given for discussions, clarifications, and any questions regarding the practical skills. Every session includes a variety of instructional techniques, such as demonstration and return demonstration, displaying simple training videos for practical skills and power point presentation with pictures used in theoretical part. Using overt observation, the researchers observe pediatric nurses as they apply and interpret ECGs for pediatric patient in real time. They record at least three observations per nurse and calculate the mean score. Using the previously indicated research tools, the knowledge and practice of nurses were assessed during the evaluation phase, which took

place before and 2 months after the training program had been put into place.

Statistical analysis

The gathered data was coded prior to being input into SPSS version 24. Data were entered completely, verified for accuracy, and then presented as a number and percentage. The paired t test was utilized to determine the true difference between two related groups (before and post implementation) for normally distributed variables. Additionally, Mann-Whitney for non-normally distributed variables. The purpose of the U test was to compare the mean ranks of the target group knowledge and practice categories between two groups. To determine the direction and degree of the association between the primary study variables, Pearson correlation (r) analysis was conducted. To determine whether or not the variables are independent of one another, the Chi-Square was employed. Every test was run with a significance level (P-value) of 0.05 was deemed statistically significant.

Results

Table (1) shows demographic and occupational characteristics of the studied nurses. it is evident that 58.7% of nurses were in the age group of 40-<50 years old with a mean age of 38.1 ±5.5 years and majority of them were female (80.4%). Regarding years of experience, approximately one third of the studied nurses had experience from 15 to less than 20 years (36.9%). The majority of the nurses' (82.6% & 95.7% respectively) had bachelor's degree of nursing and did not receive any training programs regarding ECG interpretation skills.

Table 2 displays the nurses' knowledge of electrocardiograms and how to interpret them both before and after the educational program was implemented. It was discovered that nurses' knowledge of the application of electrocardiograms and their interpretation both before and after the implementation of educational sessions had improved either significantly or highly significantly ($p \leq 0.005$ and ≤ 0.001).

According to Table 3, nurses' practice regarding the interpretation of electrocardiograms and the child's preparedness for them both before and two months after the educational intervention improved after the training program was implemented. Nurses' practices varied statistically significantly across all practice items, with a P value of (≤ 0.001).

The distribution of the entire study's nurses' knowledge and practice score on ECG interpretation both before and right after the educational intervention is shown in Table 4. The overall mean knowledge scores after implementation are clearly higher than the pre-implementation values (5.50±3.61-15.30±1.41), respectively. The ECG interpretation score was 3.63±3.40- 10.5±1.68 for the total practice score, with statistically significant variations observed.

There is a positive statistically significant correlation between total nurses' knowledge and total practice score in pre and post intervention phase as illustrated in table 5.

Figure 1 present the most common causes of gab in knowledge & practice regarding ECG interpretation as replied by the majority of nurses (81.8% & 90,9%) were lack of training and professional development program as well as lack of ECG interpretation protocol respectively. Moreover, 63.6% of nurses reported that nursing curriculum does not include enough knowledge and skills about ECG and ECG interpretation in pediatric is more complex compared to adults due to anatomical changes.

Table (1) demographic and occupational characteristics of the nurses

Variables	No (46)	%
Age		
20-<30ys	2	4.3
30-<40ys	17	37
40-<50ys	27	58.7
≥50ys	00	00
Mean ± SD	**38.1 ±5.5**	
Gender		
Male	9	19.6
Female	37	80.4
Qualification level		
Technical Institute of Nursing	8	17.4
Bachelor degree of Nursing	38	82.6
Years of experience		
5≤10	10	21.7
10≤15	9	19.6
15≤20	17	36.9
≥20	10	21.7
Mean ± SD	**17± 7.04**	
Clinical Department		
Medical ward	29	63
Cardia Care Unit (CCU)	17	37
Previous attendance of training program regarding ECG		
No	44	95.7
Yes	2	4.3

Table (2) Nurses knowledge about electrocardiogram preparation and interpretation before, and 2 months after the educational program

Variables	Pre-intervention (n= 46)				After 2 months post-intervention (n= 46)				Significance test
	Correct		Incorrect		Correct		Incorrect		
	No	%	No	%	No	%	No	%	
The number of ECG leads	29	63	17	37	36	78.2	10	21.7	**P=0.03**
The main assessment steps of the electrocardiogram	31	67.4	15	32.6	44	95.7	2	4.3	P≤0.001
The proper wave and interval order in the ECG	14	30.4	32	69.6	35	76.1	11	23.9	P=0.009
The first thought, when the P wave does not appear	10	21.7	36	78.3	33	71.7	13	28.2	P=0.007
The electrical impulse of the heart starts from Sinoatrial node	10	21.7	36	78.3	34	73.9	12	26.1	P≤0.001
The left atrium's activity is shown by the p wave	4	8.7	42	91.3	28	76.1	18	23.9	P≤0.001
The contraction of the ventricles is represented by the QRS complex	10	21.7	36	78.3	29	63.1	17	36.9	P≤0.001
The QRS complex represents ventricular depolarization	8	17.4	38	82.6	30	73.9	16	26.1	P≤0.001
T wave is indicative of the atria's relaxation phase	8	17.4	38	82.6	45	97.8	1	2.2	P≤0.001
Relaxation occurs during the time between the conclusion of the T wave and the start of the P wave in the subsequent period	10	21.7	36	78.3	33	71.7	13	28,2	P≤0.001
When QRS waves merge, it indicates a sluggish pulse	17	37	29	63	36	100	10	0	P≤0.001
V wave is one of ECG wave	13	28.3	33	71.7	40	86.9	6	13.1	P≤0.001
An ECG can identify heart hypertrophy	29	63	17	37	39	84.7	7	15.2	P=0.009
The cardiac muscle depolarizes during the interval between the conclusion of the T wave and the start of the B wave in the subsequent cycle	7	15.2	39	84.8	30	73.9	16	26.1	P≤0.001
Any alterations in the ECG could be a sign of a previous or new myocardial infarction	14	30.4	32	69.6	34	71.7	12	28.2	P≤0.001
The echocardiogram is utilized since the ECG is unable to measure the force of the heart pumping	10	21.7	36	78.3	41	89.1	5	10.9	P≤0.001
When hypokalaemia occurs, a T long wave and a QRS wide wave are observed	12	26.1	34	73.9	41	89.1	5	10.9	P≤0.001
ECG aids in the detection of irregular pulse rhythms brought on by electrical signal-carrying tissue injury	12	26.1	34	73.9	36	78.2	10	21.7	P≤0.001
When the ventricle vibrates, the T and P period looks distorted and convergent	10	21.7	36	78.3	28	60.8	18	39.1	P≤0.001
One of the positive waves in the ECG is the T wave	11	23.9	35	76.1	40	93.5	6	6.5	P≤0.001

Table (3): Nurses practice about electrocardiogram preparation and interpretation before, and 2 months after the educational program

Variables	Pre-intervention (n= 46)				After 2 months post-intervention (n= 46)				Significance test
	True		False		True		False		
	No	%	No	%	No	%	No	%	
The ECG examination takes place after the child lying for ten minutes	15	32.6	31	67.4	32	69.6	14	30.4	**P=0.03**
Gel should be applied below the lead at connecting	10	21.7	36	78.3	35	76.1	11	23.9	P≤0.001
The hand should slightly shift to the side when applying the (V6)	12	26.1	34	73.9	38	82.6	8	17.4	P=0.009
The VI and V2 should be distant from the sternum	15	32.6	31	67.4	33	71.7	13	28.3	P=0.007
Positioned on the right side of the second and third ribs is Lead V1	11	23.9	35	76.1	37	80.4	9	19.6	P≤0.001
V3 has to be positioned at the same vertical level and slightly below V2	11	23.9	35	76.1	39	95.7	7	4.3	P≤0.001
Obtaining the patient's name, gender, and examination date is not required	29	63	17	37	40	76.9	6	23.9	P≤0.001
There shouldn't be any metal or electrical parts on the patient's body	8	17.4	38	82.6	41	89.1	5	10.9	P≤0.001
If the child's heart is on the right side, the chest leads need to be adjusted	14	30.4	32	69.6	39	89.1	7	10.9	P≤0.001
Asking the care giver about the drugs the child takes before the examination	10	21.7	36	78.3	37	80.4	9	19.6	P≤0.001
In the event that the right hand is amputated, the lead should be applied slightly above left hand	6	13	40	87	33	71.7	13	28.3	P≤0.001
The arms' leads can be placed close to the pelvic area and the hands' leads on the shoulders.	10	21.7	36	78.3	6	13	40	87	P≤0.001
The ECG rhythm	9	19.6	37	80.4	43	93.5	3	6.5	P=0.009
The ECG rate	7	15.2	39	84.8	42	91.3	4	8.7	P≤0.001
The ECG axis	11	23.9	35	76.1	35	89.1	11	10.9	P≤0.001
The p wave indicates left atrial activity	14	30.4	32	69.6	38	97.8	8	2.2	P≤0.001
The QRS complex indicated both left and right ventricular depolarization	8	17.4	38	82.6	37	80.4	9	19.6	P≤0.001
Ventricular repolarization is shown by a T wave	11	23.9	35	76.1	32	69.6	14	30.4	P≤0.001
One of the ECG's negative waves is the T wave	14	30.4	32	69.6	36	93.5	10	6.5	P≤0.001
Standard PR intervals range from 0.12 to 0.20 seconds	7	15.2	39	84.8	32	97.8	14	2.2	P≤0.001
V1 and VR leads in a typical ECG are negative waves	11	23.9	35	76.1	34	91.3	12	8.7	P≤0.001
Q waves that are pathologic indicate a history of myocardial infarction	11	23.9	35	76.1	30	65.2	16	34.7	P≤0.001
Atrial fibrillation could be a normal heartbeat	26	56.5	20	43.5	33	71.7	13	28.3	P=0.03
Left ventricular hypertrophy (LVH) can be identified by ECG	15	32.6	31	67.4	40	86.9	6	13.1	P≤0.001
ST elevation appear in leads: V1-V6 in inferior myocardial infarction	11	23.9	35	76.1	42	91.4	4	8.7	P≤0.001
In cases of hypokalaemia, T long waves and QRS wide waves are observed	12	26.1	34	73.9	29	63.1	17	36.9	P≤0.001

Table 4: Total studied nurses' knowledge score regarding electrocardiogram, and its interpretation before and 2month after the educational intervention

Items	Pre-intervention (n= 46)		After 2 months post-intervention (n= 46)		Significance test
	No.	%	No.	%	
Total Level of Nurses Knowledge					
Poor	42	91.3	0	0	***t=17.15***
Average	4	8.7	2	4.3	***P ≤.001***
Good	0	0	44	95.7	
Mean ±SD	5.5±3.6		15.3±1.4		
Total practice score regarding child's preparation score					
Competent	11	23.9	45	97.8	***t=12.13***
Incompetent	35	76.1	1	2.2	***P≤.001***
Mean (SD)	3.50(3.25)		9.75 (1.28)		
Total practice score regarding electrocardiogram interpretation score					
Competent	4	8.7	44	95.7	***t=12.28***
Incompetent	42	91.3	2	4.3	***P ≤.001***
Mean (SD)	3.63(3.4)		10.5(1.68)		
Total practice score					
Competent	4	8.7	45	97.8	***t=12.71***
Incompetent	42	91.3	1	2.2	***P ≤.001***
Mean (SD)	**7.13(6.42)**		**20.25(2.78)**		

Table 5: Correlation between the total studied nurses' knowledge and practice level regarding electrocardiogram & its interpretation

Item	Total studied nurses' knowledge level			
	Pre-intervention (n= 46)		After 2 months post-intervention (n= 46)	
	r	***P***	***r***	***P***
Total studied nurses' practice level	**0.766**	***P ≤.001***	**0.849**	***P ≤.001***

**Correlation is significant at the 0.01 level (2-tailed).

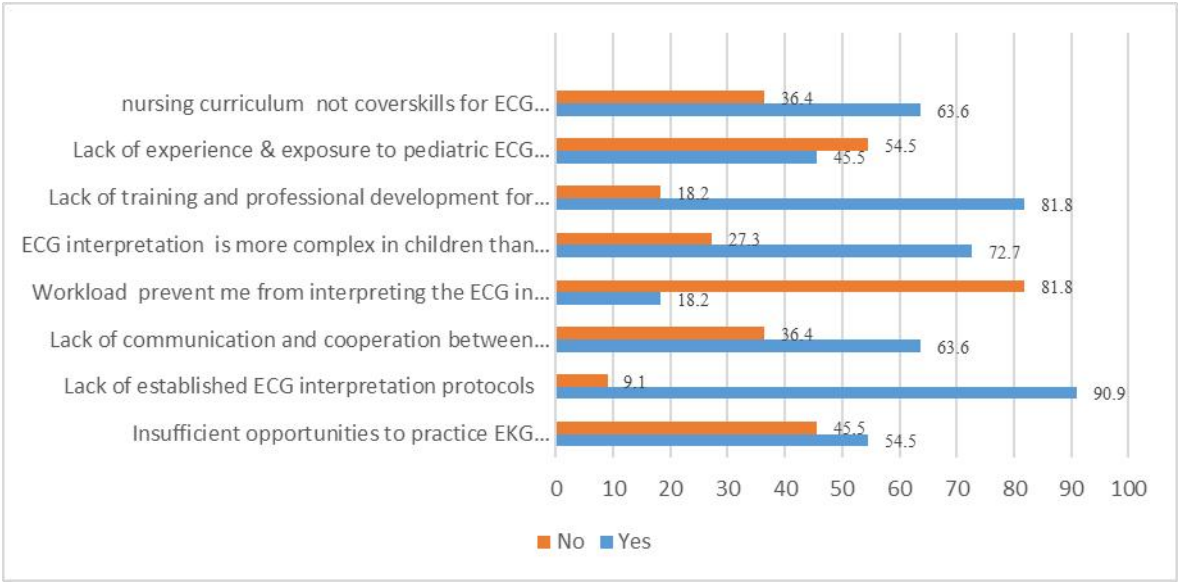

Figure (1) causes of gap between knowledge and practice of pediatric ECG analysis and interpretation for nurses

Discussion

Pediatric cardiology care units (PCCUs) require specialized nursing knowledge and practical abilities in order to provide high-quality nursing care for children because of its complexity and specialization. on order to comprehend, diagnose, and treat children undergoing open heart surgery, nurses need to be well-versed on the physiological, behavioral, psychological, and family responses **(Molala & Downing, 2020)**. As the greatest component of human resources and the backbone of healthcare systems, nurses play a critical role in continuing to provide patients with high-quality treatment. The adoption of an evidence-based practice-based educational program can assist pediatric nurses in the cardiology unit in managing and providing care for children with various cardiovascular conditions. It is crucial to investigate the effects of nurse education programs regarding ECG interpretation.

The views of duty and obligation towards patients by healthcare workers can be influenced by their educational background **(Ruiz-Fernández, 2020)**. According to the study's findings, the majority of nurses held a bachelor's degree in nursing, while a smaller percentage attended a technical nursing institute. This finding opposed with that of **Ageel & Shbeer (2022),** who reported that over one-third of the nurses under study had technical nursing education, which may account for their youth and ability to handle the demanding nature of the work in the critical care unit. It is crucial for nurses to have years of experience working in a cardiology unit and to receive ongoing education and training to ensure they are properly caring for critically ill children. According to the current survey, a small percentage of nurses have previously participated in a training program. This result is consistent with the research by **Abusaad, et al. (2019)**, who found that 25% of the nurses under review completed just one course of training while working in a PICU.

The results of the current study demonstrated that nurses' knowledge of the application of electrocardiograms and their interpretation both before and after the implementation of educational programs had improved, either significantly or highly significantly. The results of the study corroborated those of **Nabil et al., (2018)**, who found that while most study

nurses had satisfactory levels of knowledge regarding ECG, there was an improvement in post-program implementation. This could be attributed to factors such as workload, lack of concentration, and insufficient knowledge, as well as being overburdened with more duties and working longer hours. Additionally, during the follow-up phases, there was a discernible decline in ECG knowledge, but over 75% of them had an acceptable level of knowledge. This may be the result of an educational program's beneficial effects on nurses' increased ECG expertise.

There is a highly statistically significant improvement in nurses' practice level regarding electrocardiogram, its interpretation, and the child's preparation after implementing the educational program in comparison with their practice level before the implementing of educational program. The result is in harmony with **Abusaad, (2019)** who stated that the majority of the studied nurses had an incompetent practice score before conducting the program, while it improved to become competent practices immediately after the program and at follow up.

To update and enhance their knowledge and practice, nurses should participate in regular, ongoing educational and training programs. **Nabil et al., (2018)** reports that the current study found a positive association between the pre- and 2-month program implementation levels of nurses' overall knowledge and practice. This could be because the training course enhanced the nurses' proficiency and understanding of electrocardiography. Furthermore, a number of studies revealed that education increased one's ability to interpret deadly arrhythmias on the ECG. It makes sense that nurses with training would score higher than nurses without training. There is a claim that knowledge and abilities deteriorate with age and that's why refresher courses are necessary. Prior research suggests that nurses should enroll in ECG interpretation courses no less frequently than every five years (**Funk, et al, 2017; Coll-Badell, et al, 2017; Rahimpour, et al, 2021)**.

Similarly, **Aljohani, (2022)** carried out the first study in Saudi Arabia to assess nurses' competence of arrhythmia medical care and ECG interpretation for use in critical care environments. The majority of nurses in this study fell short of the predetermined skill threshold for managing arrhythmias and interpreting ECGs, according to the study's overall findings. Consequently, it is crucial to increase critical care nurses' proficiency in cardiac arrhythmia detection and management as well as ECG monitoring. Improvements can be made through nursing education, in-service training programs, and seminars through cooperation between the health system and educational institutions. Furthermore, the study by **Tahboub and Dal Yilmaz., (2019)** revealed that nurses had a high degree of ECG practice and expertise. ECG interpretation was significantly influenced by the working unit and earlier ECG training sessions. As a result, the nursing education curriculum needs to incorporate more classes on ECG theory and application. It is true that regular training sessions should be supervised by professionals, particularly for critical care unit nurses. Additionally, nurses should never stop learning on their own and keep up with any developments in the field of new techniques or technologies. Ultimately, educational programs and ongoing training courses have a big influence on how much nurses' knowledge and skills have improved.

To conclude, the study finding emphasize how critical it is to raise nurses' proficiency and understanding of ECG

preparation and interpretation. By implementing the recommendations provided and recognizing the implications for nursing practice, healthcare institutions can enhance pediatric patient safety, ensure quality care, and support the professional growth of nurses in this critical area of cardiac assessment.

Strengths, Limitations & Future Work

This study has both strengths and limitations. The first limitation is that it was limited to a particular clinical environment, which could limit the findings' applicability to other healthcare settings with distinct patient populations and resource availability. The study did not examine the sustainability of the improvements over a longer time period; rather, it simply assessed the nurses' knowledge and practice immediately following the educational intervention. As well the study did not evaluate the impact of improved knowledge and practice on pediatric patient outcomes. Therefore, we recommend that further research is need for conducting longitudinal and experimental research studies to explore whether there is a correlation between nurses' proficiency in ECG interpretation and patient outcomes such as early detection of cardiac abnormalities, appropriate treatment decisions, or improved patient safety.

Implications for Nursing Practice

The findings of this study have several implications for nursing practice. First, improving nurses' knowledge and practice in ECG preparation and interpretation can significantly contribute to timely detection and appropriate management of cardiac abnormalities, leading to improved pediatric patient outcomes. Second, continuous education and training in ECG interpretation offer opportunities for professional development and career advancement for nurses. By staying updated with the latest evidence-based practices, nurses can expand their scope of practice and take on more responsibilities in cardiac care settings.

Conclusion and Recommendations

Based on the results it could be concluded that majority of pediatric nurses at cardiology unit never attended any previous training programs about ECG and its interpretation. The nurses' knowledge about ECG improved significantly after the educational program. There were significant improvements in their understanding of the number of ECG leads, the correct order of ECG waves and intervals, and the interpretation of specific ECG components. However, there were still some areas of weakness, such as the meaning of certain ECG waves and intervals.

As well the nurses' practice in ECG preparation and interpretation also showed improvement after the educational program. They demonstrated better adherence to proper lead placement, pediatric patient preparation, and identification of ECG components. However, there were still some areas where improvement is needed, such as knowledge of specific ECG rhythms and abnormalities. Therefore, the researchers recommended continuous training programs and educational sessions for pediatric nurses about ECG interpretation is mandatory. Interdisciplinary Collaboration between nurses, cardiologists, and other healthcare professionals is crucial for optimal ECG interpretation and patient care to enhance their understanding of ECG findings and their implications for pediatric patient management.

Potential Conflicts of Interest

Conflicts of interest are not disclosed by the writers**.**

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