KNOWLEDGE LEVEL OF NURSES ON ELECTROCARDIOGRAM INTERPRETATION AND MANAGEMENT AT CRITICAL CARE UNITS, KENYATTA NATIONAL HOSPITAL, KENYA

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DECLARATION AND APPROVAL

Declaration by the Student

I declare that this project is my original work and has not been presented for any other award in any other institution.

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This research project has been presented for examination with our approval as the University supervisors.

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DEDICATION

To my family, thank you for your support, patience and understanding during the period of study.

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ABSTRACT

The electrocardiogram is a non-invasive procedure that is used to evaluate the electrical and muscular activity of the heart. With global and regional rise in cardiovascular disorders, knowledge on electrocardiogram (ECG) interpretation plays a major role in monitoring and diagnosing heart disorders. Critical care nurses (CCNs) often work closely with patients round the clock. They are therefore mandated to possess high level of competence on ECG interpretation in order to detect and capture early any life threatening arrhythmias. The aim of this study was to determine the knowledge level of nurses on normal and abnormal ECG interpretation and management at the Critical Care Units, Kenyatta National Hospital. A cross sectional study design was applied. Convenience sampling technique was utilized. Data was collected using a self-administered questionnaire to 131 nurses working in main critical care unit (CCU) and selected satellite CCUs in the hospital. Data was analyzed using Statistical Package for the Social Science (SPSS) version 25. Inferential statistics were analyzed using Chi Square. The overall knowledge on ECG interpretation and management was found to be 80.9%. This is a "good" level based on the grading criteria used. The knowledge on normal ECG interpretation was 85.2% while that of abnormal ECG interpretation was 72.1%. The knowledge on management of abnormal ECG was scored at 72.6%. There was no significant relationship between knowledge on normal ECG and socio-demographic factors of the respondents. However, there was a statistically significant relationship between age and years of experience of the respondents with knowledge on interpretation of abnormal ECG strips, P value 0.004 and 0.008 respectively. A knowledge gap existed whereby some variables of abnormal ECG strips were interpreted below 70% which was considered unsatisfactory. The study also revelled a gap on monitoring compliance to Advanced Cardiac Life Support (ACLS) certification. The researcher recommends periodic scheduling of Continuous professional development (CPD) programmes to enhance competency. A committee can be set up to monitor compliance of ACLS certification. The curriculum in basic nursing training can also be reviewed to include practical sessions on ECG interpretation and management. A similar study can be carried out in other hospitals both public and private within the country.

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LIST OF ABBREVIATIONS AND ACRONYMS

A&E	Accident and Emergency
ACS	Acute coronary syndrome
AF	Atrial fibrillation
AFL	Atrial flutter
AHA	American Heart Association
AKUH	Aga Khan University Hospital
APA	American Psychological Association
AV	Atrioventricular node
CCN	Critical Care Nurse
CCU	Critical Care Unit
CHD	Coronary Heart Disease
CVD	Cardiovascular disease
ECG	Electrocardiogram
ERC	Ethics Review Committee
HDU	High Dependency Unit
KNH	Kenyatta National Hospital
MKU	Mount Kenya University
NACOSTI	National Commission for Science, Technology and Innovation
NCD	Non-Communicable Diseases
NSTEMI	Non ST-elevation myocardial infarction
SA	Sinoatrial node
SPSS	Statistical Package for Social Sciences
s**SA**	Sub Saharan Africa
STEMI	ST-elevation myocardial infarction

SVT	Supraventricular tachycardia
UN	United Nation
UoN	University of Nairobi
VF	Ventricular fibrillation
VT	Ventricular Tachycardia
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cardiovascular disease (CVD) is the third leading cause of death worldwide and in the developing world, causing approximately 17.9 million deaths each year (WHO, 2020). The disorder causes narrowing of the coronary arteries, thereby restricting blood flow to the heart muscle. The disease contributes to more deaths than any other cause of death in the United States (Benjamin et al., 2017).

American Heart Association (AHA) reported that approximately 400,000 Americans die from cardiovascular disease. It is also estimated that 785,000 Americans have a first-time coronary heart attack each year, while 470,000 have recurrent attacks without symptoms (Muhlestein et al., 2015). Cardiovascular disease continues to be a significant public health issue in India. It is a leading cause of mortality and disability in the world (Pathak et al. 2017). A number of other risk factors for coronary heart disease include diabetes, hypertension, low levels of high-density lipoproteins, and high levels of total cholesterol, low-density lipoproteins, and triglycerides, all of which have been linked to the condition. The presence of pre-existing coronary artery disease is responsible for about two-thirds of all heart failure instances (Gheorghiade et al., 2016). As a result, coronary heart disease is a contributing factor in heart failure in more than 50 percent of incident cases in North America and Europe, 30 percent in Asia, Latin America, and the Caribbean, and fewer than 10 percent in sub-Saharan Africa, according to the World Health Organization (Mensah et al., 2015).

Ischemic heart disease is a cardiovascular disorder which contributes to 9.5% of heart failure incidences in Kenya (Gatonga and Ogengo, 2014). Patients with acute coronary syndrome who present with ST elevated myocardial infarction (STEMI) in the hospitals

are approximated to be 57% (Bahiru et al., 2018). In a study conducted at AKUH-Kenya by Korir (2019), the researcher found out that among patients treated with a diagnosis of acute coronary syndrome, 44% of those admitted had STEMI, 40 % had Non ST elevated myocardial infarction (NSTEMI) while 16% had Angina. The researcher concluded that electrocardiogram (ECG) test is very key for initial diagnosis of STEMI followed by a series of other investigations like Troponin levels.

In addition, 50% of Kenya's hospital admissions and over 55% of hospital deaths in 2012, were due to CVDs (Kenya National Strategy for the prevention and control of Non-communicable Disease, 2015–2020). World heart federation (2018) reported that heart diseases in Kenya cause approximately 25% of hospital admissions and 13% deaths. According to Myers et al. (2017) in a study on characteristics of patients attended at Accident and Emergency (A& E) department KNH, 35% of the diagnoses were cardiovascular related. In an article titled "Is Kenya sitting on ticking heart attack time bomb?" in one of the leading newspapers in Kenya, a consultant cardiologist at Aga Khan University Hospital (AKUH)-Nairobi, reported increasing cases of heart attack in Kenya (Mwango, 2014 for Nation Newspaper Kenya). Patients with suspected acute coronary syndrome should have an electrocardiogram (ECG) performed within ten minutes of initial medical contact, according to the American Heart Association (AHA) (AHA, 2016). However, studies suggest that only 33% of STEMI patients get their ECG done within the recommended time frame (Ndawa, 2013).

In the critical care set up, ECG is utilized on all patients for close monitoring of the physiological functioning of the heart. It is absolutely crucial that nurses develop skills to interpret ECG owing to the fact that not all ECG monitors have a computer software to interpret the reading. A 12-lead ECG can deliver 36% computerised interpretation and therefore there is need for professional competent interpretation of ECG (Ndawa, 2013).

The skill of ECG interpretation is cognitive and is acquired through training. (AHA, 2016).

In nursing education Kenya, ECG content is taught under physiology in diploma, Bachelor's degree and Masters level. The content in these levels is basically on normal ECG physiology except in specialization option like Masters or higher diploma in Critical care nursing. The skill is not tested beyond theory and there is no defined expected competency. Whereas in higher diploma in critical care nursing, the content on ECG is widely covered with 50 hours of electro cardio physiology. The content in this topic includes basic electrophysiology, cardiac rhythms, heart blocks, cardiac/ electrical therapy and anti-arrhythmic drugs. The nurses are then exposed to a practicum module of 240 hours in critical unit and 40 hours in cardiology unit before they are subjected to a competency practicum test, (Kenya Medical Training College, Course Outline- Critical care nursing, 2021). During the training period, the CCN student also undergoes a training on advanced cardiac life support course (ACLS). This course is renewable every two years. The CCN training makes the nurse unique in care giving. With global burden of CVD, quick interpretation of ECG by CCNs is fundamental in enabling early diagnosis and interventions that contribute to improved quality of care and patient health (Kerbage, 2017). The outcome of this study will help in identifying gaps in ECG interpretation among CCNs and therefore guide in improving their interpretation skills.

1.2 Problem Statement

The mortality rate of patients following a successful resuscitation procedure has been estimated to be 25%. Therefore, increased measures in identification of arrhythmias and subsequent prevention of cardiac arrests saves lives. In a patient with cardiac issues, failure to recognise early signs of deterioration often leads to adverse outcomes.

Possession of requisite skills, knowledge and confidence are key for nurses to translate understanding of ECG into safe practice (Kerbage, 2017). At Critical Care Units KNH, three and five lead ECGs are utilised for bedside continuous cardiac monitoring of patients. These types of ECG monitors do not have computer software to interpret ECG like 12-lead ECG machine. The CCN is therefore required to have the requisite skills to interpret normal ECG, abnormal ECG and accurately deliver clinical interventions where applicable. It is a general assumption that all critical care nurses are competent in ECG interpretation. However, studies done in Bagdad (Shalal, et al., 2016), Egypt (Khalil, AbdRahman, and yaserHamouda, 2018) and Tanzania (Ruhwanya, Tarimo, and Ndile, 2018) have shown that nurses have unsatisfactory knowledge regarding ECG interpretation and management of arrhythmias. In addition, according to a study by Zhang and Hsu (2013), nurses' ability to interpret ECG was unsatisfactory. The study reported that nurses' skills were limited in measurement and insufficient in interpretation of ECG. Nurses at the CCUs, KNH have been observed to have varied competences on ECG interpretation. Studies done before on assessment and initial management of chest pain (Chege, 2018) and quality of care given to patients with myocardial infarction at accident and emergency (Motanya, 2020) attributed the limited ability to lack of training, policy guidelines and administrative support. This study therefore seeks to establish the Knowledge level of Nurses on ECG Interpretation and management at Critical Care Units, KNH.

1.3 Objectives of the Study

1.3.1 Broad Objective

To determine the knowledge level of nurses on electrocardiogram interpretation and management at Critical Care Units, Kenyatta National Hospital.

1.3.2 Specific Objectives

1. To determine the relationship between nurses' socio demographic factors and knowledge on normal and abnormal electrocardiogram interpretation at Critical Care Units, Kenyatta National Hospital.
2. To establish the Knowledge level of nurses on normal and abnormal electrocardiogram interpretation at Critical Care Units, Kenyatta National Hospital.
3. To assess nurses' knowledge level on management of abnormal electrocardiogram interpretation at Critical Care Units, Kenyatta National Hospital.

1.4 Research Questions

1. What is the relationship between nurses' socio demographic factors and knowledge on normal and abnormal electrocardiogram interpretation at Critical Care Units, Kenyatta National Hospital?
2. What is the Knowledge level of nurses on normal and abnormal electrocardiogram interpretation at Critical Care Units, Kenyatta National Hospital?
3. What is the Nurses' knowledge level on management of abnormal electrocardiogram at Critical Care Units, Kenyatta National Hospital?

1.5 Hypothesis of the Study

H0: There is no significant statistical relationship between nurses' socio demographic factors and knowledge level on normal and abnormal electrocardiogram interpretation at critical care units, Kenyatta National Hospital

H1: There is a significant statistical relationship between nurses' socio demographic factors and knowledge level on normal and abnormal electrocardiogram interpretation at critical care units, Kenyatta National Hospital.

1.6 Justification of the Study

Electrocardiogram interpretation is a key diagnostic tool in CVD. Competency in interpretation is expected for all CCNs in care giving. Misinterpretation of ECG may insinuate increased mortality and morbidity. Nurses are the closest to patients in that they provide bedside care throughout and thereby emerge the most likely professionals to recognize an ECG abnormality within the shortest time possible (Stephen et al., 2017). This requires them to exhibit excellent skills in ECG interpretation and management in order to improve patient outcomes.

Kenyatta National Hospital is one of the referral hospitals in Kenya and receives many critically ill patients due to the nature of its proximity and publicity. Medical emergencies contribute to the highest number of cases in the accident and Emergency department at KNH with 35% related to CVDs (Myers et al., 2017). Majority of critical cases of such patients are managed at critical care set up whereby bedside continuous cardiac monitoring applies to every patient. Critically ill patients experience heart rhythm disturbances and most commonly ventricular arrhythmias (Ruhwanya, Tarimo, and Ndile, 2018). The outcome of these patients therefore depends on the competence of a CCN to monitor the physiological changes on the ECG and give the appropriate clinical intervention. Because of this key role played by a nurse, a study on knowledge level of Nurses on interpretation of normal ECG, abnormal ECG and accurate application of required clinical interventions is of paramount importance.

The results of this study will determine the level of knowledge among nurses and identify gaps that can be addressed towards improvement. They are likely to be utilized as a base line data in scheduling for training programs on ECG interpretation and management at critical care units, KNH. The study findings are also probable to be used in nursing education to scheme ways of enhancing competency in ECG interpretation and applicable clinical interventions. The results will shed more light on other areas of nursing research in regard to ECG interpretation.

1.7 Limitations of the Study

The study was carried out in one hospital making it hard to generalise the results. Data was collected at the peak of Covid-19 pandemic making conduct a major challenge. Some respondents despite meeting the participation criteria declined to participate due to fear of unknown.

1.8 Delimitations of the study

All the questionnaires were coded and the respondents were required to fill and return them immediately without keeping them. The nurses were reminded to give the right information without fear since there would be no naming on the questionnaires. They were informed that the study findings would perhaps be of benefit not only to the hospital but also play a major role in improvement of patient outcomes through need-based planning in education programs. Covid-19 precautions were strictly observed, keeping distance, wearing mask and sanitizing hands before giving out the questionnaire and after receiving it back.

1.9 Assumptions of the study

It was assumed that nurses working in critical care units, Kenyatta National Hospital were trained on ECG interpretation according to the standard in the curriculum for higher diploma in Critical Care Nursing as well as getting exposure to regular updates through advanced cardiac life support courses, seminars and continuous medical educations held within the department, hospital or elsewhere. Another assumption was that nurses in the critical care units had an opportunity to regularly interpret and make decisions based on ECG findings.

1.10 Operational Definition of Key Terms

12-lead ECG: Consists of 12 leads which view the heart from 12 different angles using 10 electrodes. That is 6 chest leads and 4 limb leads and 2 augmented leads.

3-lead ECG: Three electrodes are placed on the chest. That is right atrium, left atrium and left leg

5-lead ECG: Five electrodes are placed on the chest. That is right atrium, left atrium and left leg, right leg and 4th intercostal space right sternal boarder (V1)

Arrhythmias: Are abnormal heart rhythms whereby the heart beat may be too slow, too rapid, irregular, or of an erratic pattern.

Cardiac Monitor: It is an electronic device which when connected to the patient interprets the heart's electrical activity in form of a wave pattern. It records the rhythm and rate of the heart.

Critical Care Nurse: A nurse who is trained, qualified, licenced and taking care of patients with acute illnesses within the units designated as critical care units.

Electrocardiogram: This is a representation of electrical activity of the heart muscle depolarization and repolarization during each cardiac cycle as it changes with time.

Management: The process of controlling a situation. Management is used interchangeably with clinical interventions in this context to denote the treatment delivered in cases of abnormal ECG.

P wave: This symbol represents the depolarization of the left and right atria, as well as the contraction of the atrium.

QRS complex/interval: Signifies depolarization of the ventricles as electrical impulses are transmitted through the bundle of His to the inter-ventricular septum,

apex of the ventricles, the purkinje fibres and finally the base of the ventricles. It corresponds to contraction of the ventricles.

ST segment: This is the second isoelectric line in the ECG pattern. It represents a situation where all the ventricular cells have acquired a positive charge hence the ECG machine cannot pick an electric impulse. It can be likened to the plateau phase of the action potential where the cells are receiving calcium ions and loosing potassium ions.

T wave: Denotes is possible to accomplish complete closure of the heart beat by repolarizing the ventricular myocardium, in which case all cardiac cells revert to their resting potential. It is associated with the relaxation of the ventricles.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter will cover a review of the existing empirical and theoretical literature on the knowledge level of nurses on electrocardiogram interpretation and management at critical care units at Kenyatta National Hospital. It draws on previous research undertaken by other researchers and attempts to link it to the present study. It will also provide a conceptual framework. The e-database utilised included Pub med and Directory of Open Access Journals (DOAJ). The key search words used were Nurse, Knowledge, electrocardiogram, critical care, arrhythmias and interpretation.

2.2 Theoretical Framework

The theoretical underpinning for this research is Patricia Benner's (1984) theory, From Novice to Expert Excellence and Power in Clinical Nursing Practice. The theory proposes that nursing students and professionals advance through five stages of proficiency: novice/intermediate, proficient/competent, and expert/proficient/expert (Benner, 1984).

The nurse's performance is regulated by stringent institutional regulations that are strictly enforced. Unfortunately, following the rules also restricts the nurse's ability to provide adequate performance since the guidelines are unable to lead the nurse through the critical core activities that must be accomplished in a real-world setting while she is following the rules. Newly licensed registered nurses or workers start a new clinical area as novices since they are familiar with textbook techniques and terminology, but they lack practical experience in the clinical setting. According to Benner's (1984) theory, "intermediate learners are those who can perform at a level that is just acceptable, who

have mastered enough real-life situations to notice recurring meaningful components, and who have mastered enough real-life situations to notice recurring meaningful components." Even at this stage, policies and rules are still essential, but experience enables the nurse to go beyond the level of a beginning.

A mentor, on the other hand, may still be required to spot commonalities between situations involving the nurse. Nurses who are competent are those who have been in the same or comparable conditions for two to three years and are starting to see their actions in the context of long-term objectives, according to Benner (1984). The nurse starts to understand components of the present issue and, having lacked the necessary speed and flexibility but having gained a feeling of achievement from their activities, begins to examine the priority measures that must be taken to solve the condition. Competent caretakers are able to perceive the problem as a totality rather than as a collection of individual elements. At this stage, the caregiver recognizes the seriousness of the problem and establishes long-term objectives in order to comprehend it. The most important thing is to be aware. The nurse's clinical expertise enables her to detect when the anticipated normal result for a patient is not being achieved. They are capable of identifying an issue and developing a strategy to resolve the problem (Benner, 1984). A seasoned nurse has amassed a vast amount of knowledge and expertise in their clinical sector during their career. One may concentrate on the subject at hand while simultaneously removing the unimportant components of the circumstance in a methodical manner. Nurses with extensive experience operate with a complete awareness of the situation and a great intuition for events that may occur in the near future (Benner, 1984).

Using Benner's model of care, we can see how important it is to start with clinical care as the foundation for design. The model also recommends that the most effective form

of learning is via observation and imitation of the acts of a mentor or instructor. Nurses who have previous experience working at a higher level than the newbie are considered mentors or role models. This provides the nurse with a chance to observe and learn from the actions and mental processes of a more seasoned nurse. Being able to witness the behaviours of a more experienced nurse empowers the novice nurse to broaden her field of practice with more confidence and competence (Benner, 1984).

Overall, a novice nurse has limited capacity to comprehend the patient's position, while an advanced beginning has information and know-how but lacks in-depth experience. When compared to an advanced beginning, a skilled nurse understands the pattern and character of a clinical event more immediately. A skilled nurse learns from experience and is able to adapt plans in response to changing circumstances, while an expert nurse has an instinctive understanding of the issue that is based on extensive knowledge and practical experience. If a scenario calls for it, an expert no longer depends simply on rules to guide their behaviour (Gentile, 2012). The notions of competence, skill acquisition, experience, clinical knowledge, and practical knowledge are at the heart of Benner's theory, as are the concepts of competency, skill acquisition, and experience (McEwen and Wills, 2011). According to the hypothesis, prior experience is required in order to become an expert (Benner, 2010). In his proposal, Benner asserts that nurses depend extensively on previous experience to enhance their process of obtaining information as they work through clinical scenarios. She believes that analytical thinking is the foundation for issue solutions (Benner, 2010). She also believes that clinical judgment is an important ability for all nurses to have. The process of acquiring information is made more effective by contemplation.

Nurses come to the organization from a variety of clinical backgrounds and years of experience, as well as from a variety of cultural and ethnic backgrounds. To be effective

in today's complicated nursing practice environment, Benner (2010) believes that nurses must pursue ongoing and long-term professional growth. Among them include knowing the distinctions between a beginner nurse and a more seasoned nurse, as well as acknowledging the cultural variety that occurs in the field of health caring. Because it takes into consideration skill development based on both experience and education, Benner believes that the Dreyfus model of skill acquisition might be applied to the nursing profession.

Benner's theory may be applied successfully to this research in terms of nurses' education, knowledge, and development of abilities in the field of electrocardiography. The performance and learning requirements of the nurses may be determined based on the results of the five phases. Critical care nurses are expected to improve their ECG interpretation skills as they advance in their careers, which they will do via education and practice. From beginner to expert, the nurse's perspective becomes more comprehensive as she progresses through the stages of her career. A CCN must be able to exhibit excellent abilities in the interpretation and execution of clinical treatments in order to give the best care possible to patients on continuous ECG monitoring. Benner characterizes the expert nurse as one who employs intuition based on characteristics acquired through experience, self-awareness, and reflections to provide superior care. An experienced nurse in the intensive care unit (ICU) should be able to properly diagnose aberrant ECGs and apply the appropriate therapeutic interventions. Nurses with extensive expertise in ECG interpretation might act as mentors to others who are less skilled in the field. To maintain the phase, a CCN will need upgrades and refresher training in ECG interpretation. In order to avoid poor patient outcomes, a nurse and other healthcare workers must provide competent clinical intervention and attention. Patients who appear with an irregular ECG are often nervous, and this necessitates the attention

of a nurse who is familiar with the ways in which the arrhythmia is impacting their overall well-being. In the intensive care unit, understanding the EKG is critical to giving great treatment (Peat and Wild, 2018).

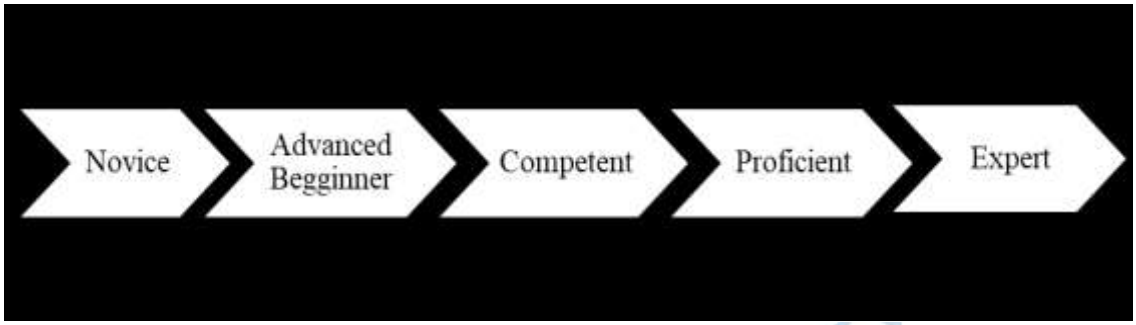

Figure 1: Model of Benner's Theory

2.3 Empirical review

2.3.1 Electrocardiogram

An electrocardiogram (ECG) is a test of recording the heart's electrical activity over time using electrodes placed on the chest. It is an initial diagnostic tool for screening patients presenting to the hospital with chest pain or heart-related complaints. The ECG is one of the simplest and oldest cardiac investigations available, yet it remains essential in assessing cardiac rhythms (Ndawa, 2013). Evaluation of parameters by the ECG includes conduction abnormalities, arrhythmias, electrical abnormalities, ischemic heart disease, and biochemical abnormalities (Santana-Santos et al., 2017). ECG monitoring is considered the best diagnostic tool compared to the increase in cardiac enzyme levels (Zimmermann, Beuhler, and Kerns, 2012). It is a tool that is still inexpensive for diagnosing compared to other technological manoeuvres to diagnose cardiac abnormalities (Fent et al., 2016). The goal of monitoring ECG recordings ranges from analysing rate and primary rhythms to diagnosing complex arrhythmias, myocardial ischemia and identifying long QT syndrome (Sandau et al., 2017).

When monitoring the electrocardiogram tracing, the nurse should be able to analyze several aspects of the printed waves. These are both primary and abnormal rhythms. Analysing abnormal rhythms is critical in critical care, as most are life-threatening. Timely intervention in treating these abnormal rhythms helps improve patient outcomes. This requires a wide range of knowledge for the correct interpretation of the ECG. It is required of a CCN in potentially life-threatening conditions to read the ECG rhythm and react accordingly correctly. In order to do this, the CCN should be well-versed in ECG interpretation (Zhang and Hsu, 2013). With the projected increase in CVD-related deaths, the ECG has become one of the most commonly used diagnostic tools in clinical practice (Carey, 2016). The primary responsibility of a critical care nurse is to ensure that the patient receives comprehensive, safe, and effective care. This requires a comprehensive understanding of cardiovascular disease and adequate training in analysis and interpretation coupled with the relevant clinical interventions to correct identified abnormalities (Barros, Silva, Oliveira, and Escario, 2016).

2.3.2 Electrocardiogram interpretation

The electrical representation in the ECG is magnified in a matter of seconds and is often printed on paper to facilitate examination (Carey, 2016). The heart muscle contracts in response to the electrical depolarization of muscle cells, much like the other muscles in the body. In addition to having four chambers, two atria, and two ventricles, the electrical discharges generated by the sinus node (SA node) are delayed and travel through the atrial muscle fibres. In contrast, depolarization to the atrioventricular node (AV node) is delayed and then passed through its bundle, which is the right and left bundle branch between the Purkinje fibres. Ventricular depolarization occurs due to contraction of the atria associated with the ECG pulse, known as the P wave, followed by the QRS complex.

Ventricular repolarization, indicated by the T wave, happens at the end of the process (Hampton, 2018). The heart's electrical depolarization is recorded at any time point during the cardiac cycle (Jevon, 2019). The context of this study will focus on continuous ECG monitoring, which utilizes either five leads or three leads.

2.3.3 Significant rhythms in ECG interpretation

Sinus rhythm.

The sinus rhythm of the heart is the typical rhythm of the heart. A consistent P wave pattern, positive in leads I and II, with a heart rate between 60 and 100 beats per minute (bpm), with each P wave being followed by a QRS complex and each QRS complex being preceded by a P wave, may be seen on the electrocardiogram. The QRS complex comprises the three deflections between the Q, R, and S waves in the electrocardiogram (Richley, 2019). It is a typical response to movement, fear, and worry, but if it is seen in a person at rest, it should be investigated further. Although sinus tachycardia does not usually need therapy, identifying the underlying reason might be helpful. Fever, pulmonary embolism, heart failure, hyperthyroidism, and anaemia are among the factors that might contribute to sinus tachycardia's occurrence. Cardiac arrhythmias result from CVDs, systemic responses, electrolyte imbalances, or drug toxicity. These are represented by abnormal waves on ECG (Page et al., 2016).

Atrial fibrillation

Atrial fibrillation (AF) is the most frequent kind of persistent arrhythmia (heart rhythm disorder). Asymptomatic, it may also be responsible for a number of symptoms, and it has been linked to a five-fold increase in the risk of stroke. Not only is it important to recognize atrial fibrillation in order to initiate appropriate therapy, it is also important not

to diagnose it in the absence of it, as anticoagulant treatment to prevent stroke is potentially dangerous (Richley, 2019).

Nurses and physicians in the West Midlands often failed to identify atrial fibrillation when it was present and failed to diagnose it when it was missing, according to the findings of a research that examined the capacity of health-care workers in the region to reliably diagnose atrial fibrillation (Mant et al., 2017). In reality, the diagnosis of atrial fibrillation turned out to be more incorrect than correct. There may not be any visible fibrillation waves and the rate may not seem to be clearly irregular in atrial fibrillation with quick ventricular response, which may occur with new onset atrial fibrillation in certain cases. Occasionally, the irregularity of the ventricular rate is mistaken as supraventricular tachycardia (SVT), but careful study of the waveform indicates that this is not the case. Atrial fibrillation is sometimes misdiagnosed when it is not there. This occurs most often when the heart is erratic for some other reason or when artificial fibrillation waves are being imitated by the physician. The artificial deflections may be mistaken with flicker waves, but in the majority of instances, the P wave can be distinguished and the ventricular rhythm is regular, indicating that atrial fibrillation is not present. This issue may often be prevented by ensuring that the patient remains calm and comfortable during the course of the ECG recording session.

Atrial Flutter

Atrial flutter (AFL) rhythm occurs when the atria contract quickly, approximately 300 times per minute, but not all of the atrial impulses are sent to the ventricles, causing the ventricular rate to be lower than the atrial rate, which may be regular or irregular. Identifying characteristics of this wave include a distinctive saw tooth baseline. It is critical not to presume that this is sinus rhythm based on the heart rate being normal,

since atrial flutter has the same anticoagulant consequences as atrial fibrillation in terms of bleeding (Page et al., 2016). Because every other atrial impulse is carried to the ventricles, new onset atrial flutter prior to the initiation of treatment is often accompanied with a heart rate of 150 beats per minute. It is in this circumstance that impulses are carried to the ventricles. Often, since the flutter waves are partly obscured by the QRS complexes and T waves in this circumstance, it is necessary to infer the presence of the flutter waves rather than actually seeing them. A good rule of thumb is to suspect atrial flutter in persons who have a resting heart rate of 150 beats per minute or higher.

Supraventricular tachycardia

Although supraventricular tachycardia (SVT) is unlikely to occur often in general care, it should be detected when it occurs. SVT is a fast, regular rhythm that may reach 250 beats per minute and originates in or is reliant on the involvement of the atria or atrioventricular node (Richley,2019). While it is seldom deadly, it may produce a range of symptoms such as uneasiness, anxiety, disorientation, chest pain, and shortness of breath. During SVT, the ECG exhibits fast, consistent QRS complexes of normal form with no apparent P waves. A diagnosis of SVT usually necessitates an emergency hospital admission, yet in certain cases, a Valsalva technique or carotid sinus massage done by a qualified and competent clinician may be sufficient to stop the tachycardia (National Institute for Health and Care Excellence (NICE), 2015). Sometimes it is not easy to distinguish between supraventricular and ventricular rhythms.

Ventricular Tachycardia

Ventricular tachycardia (VT) is defined as a heart rate of 120 to 250 beats per minute with three or more consecutive beats emanating from the ventricles that are not preceded

by P waves on the ECG and are independent of atrial or atrioventricular (AV) nodal conduction QRS longer than 120 milliseconds on the ECG (Harris et al., 2015). Although this form of arrhythmia maintains a steady rhythm, it may be life-threatening (Al Khatib et al., 2017). Although it is rare to occur often, when it does, it need prompt care. It is more frequent in those who have severe structural heart problems. Most wide complex tachycardias are ventricular in nature. Any patient with VT should be admitted to the hospital as soon as possible (NICE, 2015). The morphology of ventricular tachycardia may be characterized, with monomorphic VT having a single QRS morphology, indicating a fixed structural focus, and polymorphic VT having a constantly shifting QRS structure, indicating a more widespread activation sequence (Hunter et al. 2018). Most VT patients get an implanted cardioverter-defibrillator (ICD) to avoid sudden cardiac death, as well as antiarrhythmic medication, which may prevent VT recurrence but does not decrease mortality, and catheter ablation, which may prevent VT recurrence but does not reduce mortality (Roberts et al., 2017). In a patient who is unstable and has a pulse with uniform wide complex VT (monomorphic VT) the treatment is synchronized cardioversion.

Ventricular fibrillation

Ventricular fibrillation (VF) is a life-threatening disorder characterized by a wide range of cycle length and shape (up to 300 beats per minute), as well as a decrease of cardiac output. VF is the greatest cause of sudden cardiac mortality and out-of-hospital cardiac arrest, with an annual incidence of 12.1 per 100,000 persons (Benjamin et al., 2017). The necessity of early, high-quality cardiopulmonary resuscitation (CPR) and defibrillation, as well as antiarrhythmic medicine, is emphasized in current ventricular fibrillation therapy recommendations (Link et al., 2015).

Heart block

Heart block, also known as atrioventricular (AV) block, is classified into three categories: first-degree heart block, second-degree heart block, and third-degree heart block.

First-degree block

Although it may be indicative of beta-blocker toxicity, this is characterised by a longer PR interval and seldom causes difficulties or necessitates medical intervention. It is more critical to have second and third-degree blocks since they might indicate that a pacemaker has been implanted (Richley, 2019).

Second-degree block

It is possible that not all atrial impulses are carried to the ventricles in second-degree block; in other words, some P waves are not followed by a QRS complex. It is possible to further partition this sort of block into the Wenckebach (also known as Mobitz I and Mobitz II). As time passes, the PR interval becomes longer and longer with each succeeding beat until a P wave is not followed by a QRS wave, which results in an abrupt stop of the heartbeat. This procedure is then repeated over and over again. Following the subsequent break, the PR interval returns to normal and then resumes growing in increments of one beat at a time. Although Wenckebach block is generally a benign finding and may be caused by excessive vagal tone, its presence, especially when combined with symptoms of potential cardiac origin, may be an indication for pacemaker implantation and should, as a result, prompt a referral to a cardiovascular specialist (Kusumoto et al., 2018).

While there is periodic failure of atrial impulses to be carried to the ventricles in Mobitz II block, unlike Wenckebach block, there is no previous increase in the PR interval, and

the PR intervals of all conducted beats are similar, unlike in Wenckebach block. In most cases, Mobitz II AV block is linked with increasing illness of the heart's conduction system, and when discovered, it almost always results in the need for permanent pacemaker placement (Kusumoto et al., 2018). Once an arrhythmia is suspected, it is important to thoroughly assess the total atrial activity, since this is often the determining factor in determining its cause.

Third degree block

The atrioventricular node or the ventricles must produce their own impulses in third degree block, also known as total block, since no atrial impulses are conveyed to the ventricles. The slow ventricular rate associated with total heart block may produce weariness, reduced exercise capacity, and shortness of breath, but the most concerning complication of this conduction abnormality is occasional cardiac arrest, which can cause dizziness or, if left untreated, unconsciousness (Brignole et al., 2013). When a full heart block is discovered, it is typically prudent to refer or promptly admit the patient for pacemaker insertion, depending on the patient's condition.

Atrial Fibrillation with Complete Heart Block

A patient with atrial fibrillation may acquire total heart block, and it is typical for either the atrial fibrillation or the heart block to go unnoticed in this circumstance. However, due of the possible influence on anticoagulant medication and pacemaker placement, a thorough and correct diagnosis is essential. The ECG with full heart block with atrial fibrillation displays normal fibrillation waves, but the ventricular rhythm is sluggish and steady. Atrial fibrillation with complete heart block is one of the few cases in which the ventricular rate returns to normal (Richley 2019).

Stable Angina

Stable angina causes chest discomfort during physical exertion because the heart muscle isn't receiving enough blood, which may be relieved by rest or sublingual nitroglycerine (Tobin et al., 2016). Angina pectoris is a symptom of temporary myocardial ischemia induced by a lack of coronary perfusion. Atherosclerosis is the most prevalent cause (Abrams, 2015). Clinical angina symptoms, which include chest heaviness, tightness, pressure, or burning that may radiate to the jaw, arms, or back, are usually short-lived and may be relieved with rest or sublingual nitrates (Whittaker et al., 2014). If the ECG was taken during an event that was likely to exhibit ST segment depression, it might have altered, indicating a worse prognosis than T-wave inversion alone or no ECG alterations (Bhatheja and Mukherjee, 2017)

Unstable Angina

The clinical appearance of angina with or without ischemia ECG alterations characterizes unstable angina (Bhatheja and Mukherjee, 2017). Chest pain is frequently more acute and protracted in unstable angina, and it may occur at rest or with less physical effort (Braunwald et al., 2012). The identification of unstable angina is still a clinical problem, as it represents one end of the ACS chain (Manning et al., 2017). Therapies to reduce pain, limit platelet aggregation and thrombosis, and contemplate revascularization of vascular stenosis are all part of the medical care of unstable angina pectoris (Amsterdam et al., 2014). Arrhythmias are irregularities or interruptions in the myocardium's normal activation sequence that may be characterized by rate, cause, duration, or source (Bhaumik et al., 2016). Arrhythmias may be a sign of structural heart disease, which may lead to consequences including stroke or deteriorating hemodynamic and cardiac arrest (Papadopoulos et al., 2017). Patients with an abnormal ECG may have symptoms such

as palpitations, dyspnoea, chest pains, disorientation, or orthopnoea, all of which need therapeutic attention (Richley, 2019). In an arrhythmia, the heart is unable to pump enough blood throughout the body, resulting in decreased organ perfusion. (Manning et al., 2017). The reduced heart function might make caring for a severely sick patient very difficult. This demonstrates the need of employing a cardiac monitor to continuously assess heart function in order to properly treat the patient. (Richley, 2019)

A Critical Care Nurse's (CCN) job is to treat arrhythmia patients' symptoms, give comfort, and provide essential therapeutic procedures. The nurse also keeps an eye on the drug's long-term effects and makes necessary adjustments. The nurse should be competent to perform cardiac life support procedures and ensure important organs are effectively perfused in life-threatening conditions such as ventricular fibrillation, Ventricular Tachycardia, or cardiac arrest. (Urden, Stacy, and Lough, 2020)

2.3.4 Relationship between demographics and knowledge on ECG interpretation.

The knowledge acquisition of a critical care nurse in correct interpretation and management of ECG is a key aspect in care. The part of this knowledge includes, characteristics of normal/abnormal ECG rhythm, understanding of electrophysiological attributes and characteristics of the monitoring procedures (Barros, Silva, Oliveira and Escarião, 2016). Critical care nurses in their caring actions are accountable for ensuring complete patient care in a safe and effective manner. It is indispensable that nursing training focus on understanding of ECG interpretation and that critical care nurses have a grasp of vital clinical indicators and diagnostic procedures in the context of cardiovascular disorders (Zegre-Hemsey, Garvey and Carey, 2016)

Studies show that several socio-demographic factors may have direct or indirect influence on nurses' knowledge level on ECG interpretation while others have no direct

impact. Several identified factors like age, gender, institution of training, experience in number of years and level of education have demonstrated little or no influence towards nurses' Knowledge on electrocardiogram interpretation. According to a cross sectional study conducted to assess the ability of nurses to interpret electrocardiography among 100 nurses (80% females) working in at the university of Sao Paulo Hospital in Brazil by Santana-Santos et al. (2017) the respondents' ability to interpret changes in an Electrocardiogram were not significantly influenced by age (p value 0.072) and gender (p value 0.610) or whether they worked in critical or non-critical units. The study reported that 73 % of the nurses had acknowledged to have received theoretical training on electrocardiogram interpretation in at the university/college level while 86 % of the respondents had attended on job training on advanced life support and were certified by American Heart Association. Other demographic factors not significantly associated with the ability to interpret ECG included; experience in number of years as a nurse (p value 0.220), experience of working with ECG in years (p value 0.917) and whether the nurses qualified from a private or public university (p value 0.821) and specialization (p value 0.368). However, in regard to the tendency to review ECG tracing, nurses working in critical care units were more likely to practice review of ECG on daily basis (P value 0.019) (Santana-Santos et al., 2017). This signify that their competence level is expected to be high due to acquired hands on skills.

In a multisite study by Al-Husaunawy (2015) at the University of Thi qre Al Nasiriyah – IRAK, the level of education (p value 0.426), years of experience (0.233), gender (p value 0.501) and age (0.366) did not have a statistically significant effect on knowledge level of ECG interpretation. A more recent study conducted by Kerbage (2017) among 32 nurses in critical units showed that 46.9% of nurses had worked for over 6 years in CCU and only one of them was a male. This shows the domination of female gender in

nursing fraternity. A different study by Malk and Hassan (2018) also established that the studied nurses had 5-10 years of experience working in critical care units. The study reported the years of experience can greatly influence the competency level of the nurses. Those who had worked for longer time the critical care specialty had become experts and their score were high. According to Benner's theory (2010), the expert nurse is expected to use intuition, self-awareness and reflection when giving care. This way, the nurse is able to interpret abnormal ECG and promptly deliver required intervention bringing forth a positive patient outcome.

Environmental orientation, work experience, specialization and exposure to ECG interpretation showed to improve the nurses' knowledge level whereby in Australia, a study by Kerbage (2017) on knowledge and confidence of ECG interpretation among 32 nurses in critical care units showed that knowledge scores increased with years of experience and decreased with number of ECGs interpreted in a month. A study done at Manipal University Hospital India, by Sheilini and Devi (2014) reported that there was a significant association between knowledge on ECG interpretation and area of work experience ($P=0.001$) and years of experience ($P<0.001$). Nurses who were working in cardiology unit seemed to score higher than those working in critical care unit. Santana-Santos et al. (2017) in a study to assess the ability of nurses to interpret 12-lead ECG in a Cardiopneumology hospital in Brazil, observed that nurses who worked in critical care units were more confident to interpret ECG (p value 0.040) than those who were working in the cardiothoracic ward (p value 0.06)

Tendency to master and sustain knowledge on ECG interpretation may also decline with increase in years of experience. Older nurses may tend to relax when it comes to periodic updates assuming that they have enough knowledge. Zimmerman, Beuhler, and Kerns (2012) explored accuracy on interpretation of QRS complex on 36 Emergency and

critical care nurses and stated that nurses with lesser experience seemed to perform better whereby participants with less than 10 years' experience had a 77% rate of identifying abnormal rhythms while those with more than 11years had 73% accuracy. In order for an institution to carb this challenge, it is important to ensure planned periodic updates for all the concerned parties despite their years of experience.

Level of education and professional experience may not have a direct impact on knowledge level on ECG interpretation. In a survey to describe ambulance nurses' ECG interpretation skills, there was no correlation between ECG interpretation skills and factors such as education and professional experience. However, prior experience of working in a coronary care unit was a determining factor (Werner, Kander, and Axelsson, 2016). Ambulance nurses who had worked in cardiology unit seemed to perform better in terms of ECG interpretation and management of identified abnormal rhythms.

Continuous education programs have proven to improve the knowledge level of nurses on ECG interpretation. Exposure to number of ECGs done in a month is likely to improve the knowledge level. Zhang and Hsu (2013) carried out a quasi-experimental study to evaluate effectiveness of continuous education program on nurse knowledge on ECG interpretation, and the results were that nurses who worked in cardiology department scored best in basic ECG knowledge compared to those who worked in Emergency department and Critical care unit. In another study conducted in the south-east of Spain, which assessed the competence of Emergency nurses in ECG interpretation, it was reported that the training had a high score in the last 5 years and the level of knowledge was not influenced by experience or hospital environment (Coll-Badell et al., 2017). Al-Husaunawy (2015) in a multisite study also stated that although some demographic characteristics influenced knowledge score such as attendance to training sessions (p value 0.006) and duration of the previous training session (p value 0.009) had a

significant influence on knowledge score on ECG interpretation, most of the demographic factors did not have a significant association with knowledge score. These included level of education (p value 0.426), years of experience (0.233), residence (0.498), sex (p value 0.501) and age (0.366). From these studies it is clear that majority of social demographic factors may play minimal or no role in identifying different competency levels. This shows that a diploma holder may perform better than a degree holder when it comes to execution of the actual task.

2.3.5 Knowledge level on Normal and Abnormal Electrocardiogram Interpretation

Nurses are crucial in the collection, interpretation, and transmission of ECG data, and their ability to identify aberrant rhythms is a major element in evaluating the quality of treatment (Sheiline, 2018). Nurses must be well-versed in order to do these responsibilities in a manner that optimizes patient care and results (Pettersen et al., 2014). The use of a continuous ECG to identify deterioration creates a scenario where the nursing staff's capacity to undertake proper clinical monitoring of the patient's status is jeopardized (Larson et al., 2018). As a result, the nursing staff's ability to identify arrhythmias on ECG monitors is a significant component in assessing the quality of treatment (Shieline, 2018).

Critical care nurses are required to broadly understand the normal ECG interpretation for them to be able to detect any deviation and intervene in time where possible. Malk and Hassan (2018) at Beni-Suef University Hospital Egypt, evaluated nurses' knowledge on ECG procedure in coronary care and high-risk pregnancy unit. The findings stated that 25 % of nurses had challenges in determining heart rate, 25% couldn't determine heart rhythm, 35% didn't identify p wave correctly while 15% identified PR interval

incorrectly. The study concluded that the knowledge of the studied nurses was unsatisfactory.

Studies have shown that despite the fact that critical care nurses are with patients round the clock, some may encounter challenges in interpretation of abnormal electrocardiogram. An evaluation of a multisite study reported that nurses' knowledge on interpretation of electrocardiogram showed a success rate of 74% but practically more nurses demonstrated competency (95%), (AL-Husaunawy, 2015). In an Iraqi study conducted to identify nurses' knowledge regarding early interventions in patients with ventricular tachycardia in teaching hospitals in Baghdad, showing that the result of the overall assessment of knowledge across the examined samples was low (Mousa and Ahmed, 2016). This put a lot of pressure on nurses to be certified in continuous monitoring, especially in ICUs, in order to provide constant safe and effective ECG monitoring and to determine what courses are needed and what quality improvement initiatives should be implemented (Drew et al., 2016). In addition, improper use of interpreters raises healthcare expenses and may cause delays in the admission process, putting a strain on the hospital and its patients (Larson et al., 2018). with a higher level of experience (years) working in CCU have were likely to identify an arrythmias easily compared with less experienced nurses. Additionally, nurses demonstrated deficits in identifying specific arrhythmias such as heart blocks in addition to understanding of the placement of electrodes. Similar findings were reported by Kerbage (2017) whereby critical care nurses had challenges interpreting a third-degree heart block and establishing whether the lock was junctional or ventricular. Besides placing electrodes and identifying rhythms, nurses' ability to communicate 12 lead ECG is essential (Kerbage, 2017). In a more recent study, placement of electrodes was found to be a challenge among nurses (85%) (Malk & Hassan, 2018).

The study reported, that majority of nurses could easily identify cardiopulmonary arrest arrhythmias such as ventricular fibrillation (77%), Pulseless electrical activity (81%) and pulseless ventricular tachycardia (89%). However, 46 % of nurses could not identify myocardial infarction (Santana-Santos et al., 2017). In a different study by Kerbage (2017), he reported that, critical care nurses had challenges interpreting a third degree block particularly establishing whether the block was junctional or ventricular. Malk and Hassan (2018) showed that 25 % of nurses had challenges in determining heart rate using electrocardiograph, determining heart rhythm (25%), identifying p wave (35%), identifying PR interval (15%) and reporting abnormalities was done incorrectly by 8.3% of the nurses.

Other studies have revealed that critical care nurses are likely to interpret abnormal ECG but fail to quantify the extent of abnormality. Zimmerman, Beuhler, and Kerns (2012) compared nurses and doctors' ability to interpret ECG and found that nurses were quick to identify a wide QRS complex (77%) but unfortunately 44% of the nurses could not accurately measure the duration of QRS

When managing abnormal heart rhythms, a critical care nurse is required to take prompt and effective measures to relieve symptoms and promote comfort. The nurse should ensure that there is enough oxygen circulation to the tissues in order to minimise cardiac workload. Such skills have been found to be unsatisfactory among critical care nurses. Santana-Santos et al. (2017) discovered that majority of nurses could easily identify cardiopulmonary arrest arrhythmias such as ventricular fibrillation (77%), Pulseless electrical activity (81%) and pulseless ventricular tachycardia (89%). However, 46 % of nurses could not identify myocardial infarction. In the events of cardiac arrest or ventricular fibrillation, the nurse should be in a position to apply advanced cardiac life support protocols to maintain major organ perfusion (Urden, stacy, and Lough, 2020).

While administering the prescribed ant-arrhythmic medicines, the critical care nurse is required to demonstrate competence and monitor their adverse effects

Only 38.1 percent of nurses could diagnose ventricular fibrillation, 54.3 percent myocardial infarction, 33.3 percent third-degree atrioventricular block, and 40.5 percent ventricular tachycardia, according to Doan and Melek (2012). Defibrillation, on the other hand, was reported by 20.5 percent of nurses. 60.5 percent of the nurses said they didn't know how to properly monitor the ECG and so couldn't determine the cause of the arrhythmia.

Inability to acquire enough knowledge to interpret abnormal electrocardiogram may be related to several factors as revealed in previous studies. Khalil, Abd Rahman, and yaser-Hamouda (2018) in a certain Egypt teaching hospital stated that nurses had unsatisfactory knowledge on arrhythmia interpretation and the associated factors identified were; lack of in-service training program, inadequate knowledge gain from nursing curriculum and workload burden leading to infrequent update. In critical are unit, the ideal nurse patient ratio is 1:1. In situations where this is not applicable, other priorities may overtake skill acquisition. Malk and Hassan (2018) stated that nurses' unsatisfactory level of practice regarding electrocardiogram procedure might be due to overlapping of work and poor skills.

Santana-Santos et al. (2017) in Brazil, observed that nurses had varied perceptions regarding interpretation of ECG and there was a significant difference between those who worked in critical care units as compared to non-critical care units. It was established that those who worked in critical care units were more confident to interpret ECG (p value 0.040).

Kerbage (2017), in Australia, established that nurses working in critical care units had positive perceptions regarding interpretation of ECG. Three quarter of the respondents

(75%) reported that being proficient in ECG interpretation was an important skill. Additionally, almost all (90.7%) of the respondents rated themselves as being generally confident in ECG interpretation. Unmet education needs have been reported as a major challenge in improving nurses' ability to interpret electrocardiogram although deficient knowledge is not limited to nurses only but to all health professionals. Lack of regular updates contributed to poor retention of knowledge (Kerbage, 2017).The author records that it is part of nurses' job description to interpret electrocardiogram. However, use of machine interpretation was not limiting nurses' exposure since 3.3% of nurses rely on machine interpretation.

Limited confidence interpretation of electrocardiogram is a common challenge to critical care nurses. However, a positive correlation between confidence level and knowledge score in regard to electrocardiogram interpretation and intervention was evident. Subsequently, it was recorded that confidence level increased with experience. The newly recruited nurses often demonstrated low confidence levels with doctors worsening the situation by taking over resuscitation. The frequency of practice is correlated with confidence levels (p value 0.01).

2.3.6 Knowledge level on management of abnormal ECG interpretation.

The CCN must have a 99% ability to identify and treat the ECG signal when the patient is in a fatal arrhythmia or other life-threatening condition. In contrast, the nurse's ability to detect the presence of ischemia or infarction from the ECG result was less than 50% (Zimmerman, Beuhler, and Kerns, 2012). Many efforts have been made to improve nurses' ability to interpret ECGs. In fact, not all health care services are aware of the importance of improving the ability of nurses to reduce the mortality rate due to slow handling (Zhang and Hsu, 2013). Many methods have been developed to simplify ECG

interpretation, such as the automatic reader, the mobile ECG or the computer-aided ECG. However, these methods did not improve the nurses' ability to interpret the ECG (Bojsen et al., 2015). Of all the above advantages of the ECG, its main task is to detect the presence of arrhythmia or dysrhythmia. This means that the patient's diagnosis could be strengthened by using the morphology of the ECG.

The ECG knowledge will greatly be influenced by training and exposure to care for the critically ill patients. In a qualitative study by Nickasch et al. (2016) at a Midwestern hospital, in the USA, the perceived knowledge of registered nurses (RN) on ability to interpret and manage arrhythmias in medical surgical wards was explored. The nurses reported confusion and uncertainty. They had a "what should I do next" feeling. This was thought to be probably due to lack of frequent exposure to patients requiring cardiac monitoring or lack of frequent skill updates.

Inadequate hands-on skills and drill programs are likely to hinder a CCN from being proficient in clinical interventions. In a qualitative study done at a regional hospital in Hong Kong on experiences of CCNs in caring for patients with cardiac arrest, the nurses described having limited opportunities to apply their defibrillation knowledge (Hui, Low, and Lee, 2011). Similar findings were reported by Kerbage (2017) in Australia whereby nurses felt they had limited exposure to real drill programs with nurse led defibrillations. In these drills, nurse led defibrillations were uncommon but instead doctors played the leading role.

Unmet education needs have been reported as a major challenge in improving nurses' ability to interpret an ECG although deficient knowledge is not limited to nurses only but to all health professionals. Lack of regular updates contributed to poor retention of knowledge (Kerbage, 2017).The author records that it is part of nurses' job description

to interpret ECG. However, use of machine interpretation was not limiting nurses' exposure since 3.3% of nurses rely on machine interpretation.

Studies have shown that for nurses to acquire and sustain knowledge on ECG interpretation and clinical intervention, annual updates are of paramount importance. In a study to examine the effect of a standalone web-based ECG tutorial and to assess the retention of skills using multiple follow-up intervals, Bojsen et al. (2015) stated that the newly acquired skills were rapidly lost when the intervention was not repeated. In a randomized clinical trial by Frunk et al. (2017) nurses were trained on ECG and their knowledge improved significantly immediately after the intervention in both groups but was not sustained 15 months later. This implies that annual updates on ECG interpretation is likely to enhance knowledge level among CCNs. Other studies have shown that the level of knowledge can be enhanced by training without considering the environment under study.

Some previous studies have shown that nurses' knowledge scores improved when they were assessed before and after ECG training regardless of the learning environment. For instance, in the PULSE study, the nurses increased the accuracy in the interpretation of heart arrhythmias from 82% to 97% after an interactive education program with emphasis on electrocardiographic analysis (Funk et al., 2017). In a similar study that employed the same methodology, the nurses' knowledge scores after the third week of training, were satisfactory. However, as from the eighth week, the scores dropped (89% 63%, $p<0.001$) (Brooks, Kanyok, O'Rourke and Albert 2016). This affirms the significance of periodic training programs in form of refresher courses to enhance in sustaining the knowledge level on ECG interpretation to remain above satisfactory level.

When a patient comes to the clinic with chest discomfort, an ECG is taken and a nursing adviser assesses the patient to determine whether additional examination is necessary

(Pottle, 2015). Many algorithms were created and developed to aid nurses in swiftly interpreting ECGs, such as the Cardiac Rhythm Identification for Simple People (CRISP) technique. The PULSE (Practical Use of the Latest Standards for Electrocardiography) study is an online ECG monitoring training program. This model for implementing and maintaining change in practice, driven by champion nurses on each unit, was shown to increase nurses' understanding of ECG monitoring and quality of care linked to ECG monitoring and patient outcomes in a study by Funk et al. (2010).

2.7 Conceptual Framework

Independent Variables **Dependent Variables**

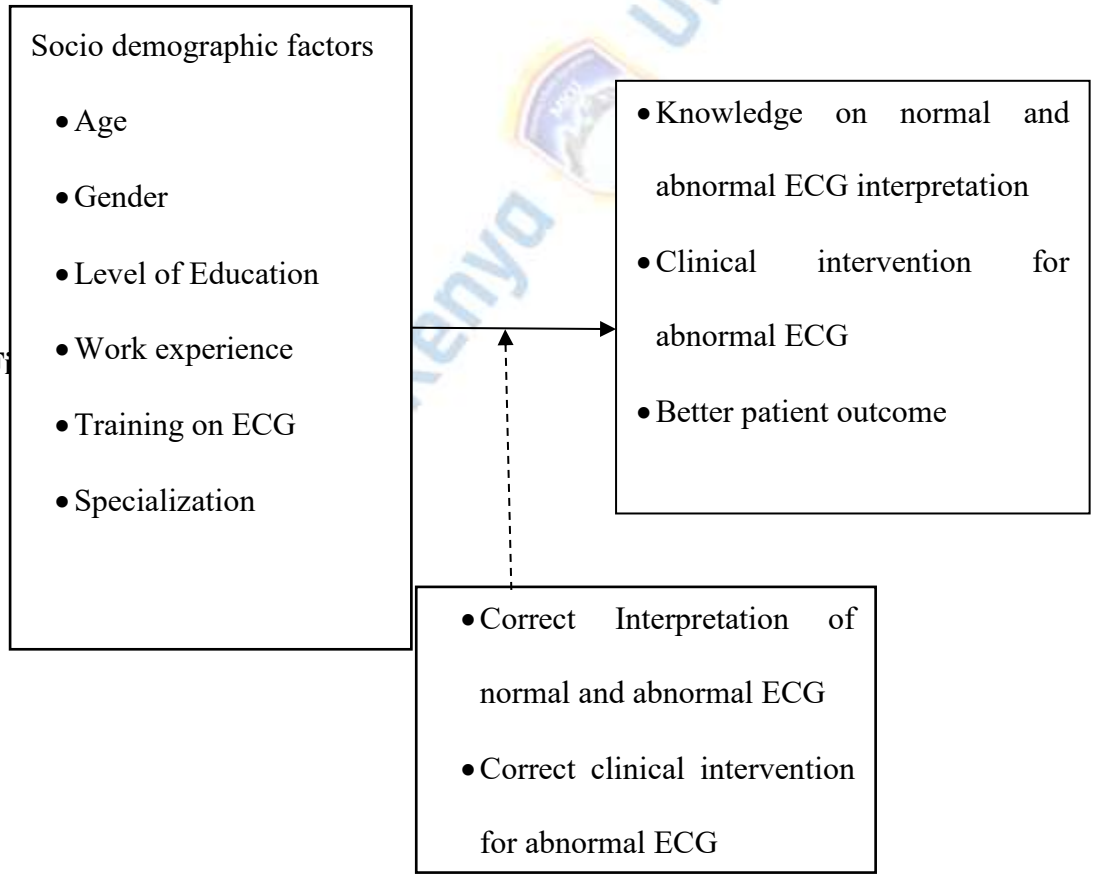

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Figure 3: Conceptual Framework

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses research design, study area, target population, sample size and sampling methodologies are. Additionally, it discusses research instruments, as well as the piloting of such instruments, as well as their validity and reliability.

3.2 Study Design

This was a cross sectional quantitative study which was carried out over one month period from November 2020 to December 2020 at the Critical Care Units, Kenyatta National Hospital. The nurses working in the identified critical care units were recruited as study participants.

3.3 Study Area

The study was based at KNH, Nairobi County which is a National Teaching and Referral Hospital serving East and Central Africa. It is located at upper hill along hospital road, off Ngong road about 4 km from Nairobi city centre. Within the complex is the College of Health Sciences, University of Nairobi (UoN), Kenya Medical Research Institute (KEMRI), National Laboratories and Kenya Medical Training College (KMTC). The hospital comprises of 50 wards, 22 outpatient clinics, 16 specialized theatres, 8 general theatres and one Emergency department. The bed capacity in the hospital is 1800 for general wing and 220 for private wing.

The Main CCU is situated at first floor of the old hospital. It's bordered by renal unit at south and burns unit northwards. The bed capacity is 21 and majority of patients admitted here are surgical cases. There are satellite CCUs which have been set up on different

floors at the tower block. Labour ward at ground floor with 5 beds, Paediatric Intensive Care Unit (PICU) with 5 beds, Neonatal Intensive Care Unit (NICU) at the 2nd floor with 5 beds, Cardiothoracic CCU 4th floor with 5 beds, Medical CCU (MICCU) 7th floor and 8th floor with 5 bed capacity each respectively. There is also a high dependency unit (HDU) at the private wing of the hospital with a capacity of 5 beds. This makes a total of 56 CCU beds in the hospital (KNH Records, 2019). The study will be done in three units. These will be Main CCU, Medical CCU and Cardiothoracic CCU. These units are preferred because they are designated to care for critically ill adult patients with medical or surgical related problems.

3.4 Study Population

The study targeted all nurses working in the three critical care units. The total number is 200 nurses. The main CCU consists of 125 nurses, Medical CCU 60 nurses and Cardiothoracic CCU 15 nurses making a total population of 200 nurses.

3.5 Inclusion and Exclusion Criteria

3.5.1 Inclusion criteria

Inclusion criteria consisted of licensed specialised or non-specialised nurses with more than six months experience in critical care nursing.

3.5.2 Exclusion Criteria

Exclusion criteria consisted of all nurses on clinical placement, internship, off duty, sick leave or annual leave. Specialised or non-specialised nurses with less than six months experience in critical care nursing were excluded.

3.6 Study Sampling Formula

Cochran (2007), formula of determining sample size was adopted which is;

$$n = \frac{z^2 xpxq}{d^2}$$

Where;

n = intended sample size.

Z= 95% confidence interval standard deviation (1.96)

P= Population with characteristics of interest. From literature review, 74% of nurses were found to be capable of interpreting ECG (Al-Husaunawy, 2015).

P= 0.74

Q= 1-0.74=0.26

D= the allowed degree of error at 95% confidence interval= 0.05

Using that formula, the sample size was;

$$n = \frac{1.96^2 x \quad 0.74 \quad x \quad 0.26}{0.05^2}$$

n = 295.65

Considering that nurses at critical care unit KNH is less than 10,000 in number, an adjustment is made as per alternate Cochran (2007). The adjustment formula is;

$$nf = \frac{n}{1 + n/N}$$

Whereby,

n=295.65

N=Number of nurses in critical care units to be sampled is 200.

nf=the adjusted sample size

$$nf = \frac{295.65}{1 + \frac{295.65}{200}}$$

$$nf = 119.30$$

Ideally, the sample size ought to be 119 nurses. Some questionnaires may be partially filled and thereby be disregarded during analysis. In order to reduce the margin of error due to non-response, 10% of sample size was added whereby;

$$\frac{10}{100} \text{x } 119 = 12$$

$$119 + 12 = 131$$

In this study therefore, the researcher considered to work with a sample size of 131 nurses.

3.7 Sampling Technique

Stratified sampling method was applied. This method was utilised to divide the population sample based on one characteristic that they all work in the CCUs. The units sampled in this study were: Main CCU (125 Nurses), Medical CCU (60 Nurses) and Cardiothoracic CCU (15 Nurses) making a total of three strata. Convenience sampling was utilised to collect data in every shift. Each unit consisted of the following sample size as demonstrated below.

$$\text{Sample size per unit} = \frac{\text{Population per unit}}{\text{Total population (N)}} \text{ x Sample size(n)}$$

Therefore;

Main CCU = $\frac{125}{200}$ x 131 = 82

Cardiothoracic CCU= $\frac{15}{200}$ x 131 = 10

Medical CCU= $\frac{60}{200}$ x 131 = 39

Table 1: Sample Size Determination

Department	Population of Nurses	Stratified Sample estimate
Main CCU	125	82
Medical CCU	60	39
Cardiothoracic CCU	15	10
Total	**200**	**131**

Source: Researcher (2019)

3.8 Recruitment and consenting procedure

The recruitment exercise was carried out at the three proposed Critical Care Units; Main, Cardiothoracic and Medical Critical Care Units. The researcher could approach each nurse participant conveniently since they work on different shifts during the day from 7.30 a.m.to 4.30p.m. (Evening shift), 7.30 a.m.to 12.30 p.m. (Morning shift) and 12.30 p.m. to 5.30 p.m. (Afternoon shift). With the help of the CCU duty schedules, the researcher was able to understand the flow of the shifts since the nurses were scheduled in groups. This made it easy to know the approximate number of nurses available per day. The process commenced at Main CCU for two weeks, then Medical CCU for one week and lastly Cardiothoracic CCU for three days. The appropriate time to approach the nurses was 11a.m after morning procedures and 3 p.m. after afternoon procedures. These are known to be the common timings when nurses settle to take their break. The appropriate time to pick the questionnaires was 1 p.m. for those on morning shift and 4 p.m. for those on afternoon shift. For the ones on evening shift, the researcher would rhyme them with either the morning team or afternoon team.

Upon approaching a nurse participant, the researcher would give a brief self-introduction, produce evidence of study approval and explain briefly on purpose of the study. Once

the nurse accepted to participate, a consent form was provided to in order to sign after which a self-administered questionnaire was provided for filling. A verbal acknowledgement would follow upon receiving the questionnaire back. A draft of the consent form is attached as appendix 1.

3.9 Variables

The independent variables included; demographics; Age of the participant, gender, years of work experience, level of education, specialization and training on ECG.

The dependent variables included; Knowledge on normal and abnormal ECG interpretation, clinical intervention for abnormal ECG. The outcome variables were; correct Interpretation of normal and abnormal ECG tracings, correct clinical interventions for abnormal ECG and better patient outcomes.

3.10 Data Collection procedures

A self-administered questionnaire was utilised. The questionnaire comprised of close ended questions and only one open ended question to avoid vagueness. There were three segments of the questionnaire namely the Socio demographic factors, Knowledge level on normal ECG, and Knowledge level on abnormal ECG and clinical interventions. The process of data collection took four weeks. It was collected five days in a week from 7.30 a. m to 4 p.m. A nurse was expected to fill one questionnaire for twenty minutes.

Data collection would begin by seeking a brief oral consent for participation in research and booking an appointment with the staff. If the appointment was granted, the researcher would meet the participant at the agreed time and venue. Once the consent form was signed, the researcher would go ahead and issue the respondent with an indexed questionnaire to help reduce chances of misplacement. The participant was expected to

fill the questionnaire without referring from any source. Upon receiving the questionnaire, the participant w verbally appreciated for their effort and honest responses.

3.11 Pretesting of the data collection tool

Pretesting of the tool was conducted on 12 (10% of sample size) nurses in the acute room of the accident and emergency department. Nurses in this unit utilize both 3 lead and 5 lead ECG models to monitor the critically ill patients and therefore they were definitely assumed to possess ECG interpretation skills and management equivalent to critical care nurses. The tool passed this test and no changes were required which could warrant its review.

3.12 Validity and Reliability

The pretested data was analysed using Cronbach alpha index. The tool was deemed reliable for data collection as the correlation coefficient of more than 0.7 was obtained for data collected in two different occasions. The tool yielded a correlation coefficient value of 0.899 which was acceptable as it met the minimum acceptable value of 0.7**.**

3.13 Data Management

Coding and analysis of the filled questionnaires was done using SPSS version 25. Data was summarised using descriptive statistics in form of frequency tables and pie charts. Inferential statistics was analysed using chi-square to calculate the correlation coefficient between variables. This analysis compared respondents' social demographics characteristics with their knowledge on normal ECG, abnormal ECG and management of abnormal ECG.

A grading score was utilized to rank the levels of knowledge on ECG interpretation per objective. Questions answered correctly were awarded one mark while those done incorrectly were awarded a zero mark. The score criteria was modified from Cardino, Ruth and Cruz, (2020) grading techniques as follows, less than 70% unsatisfactory, 70-74% pass, 75- 79 % satisfactory, 80-89 % good, and a score of 90-100% Excellent. To achieve this grade in each variable scored, at least 97 respondents should have given correct interpretation.

3.14 Ethical Considerations

Clearance was sought from KNH- UON ERC reference number A/327 and MKU Research and Ethics Committees. The research was registered with NACOSTI for the purpose of obtaining a research permit. Permission was sought from KNH Research and Programs department, Head of department Anaesthesia and specialised units, overall nurse in-charge specialised units, and Nurse in-charge CCU. Participation in the study was voluntary. Confidentiality was achieved by not recording personal data of respondent such as names and identification numbers on the research instruments. A written informed consent was obtained prior to data collection. In order to prevent COVID-19 disease transmission, the researcher kept a one point five (1.5m) meter distance when addressing the participant, maintained proper wearing of mask and observed hand hygiene. After the research, a feedback seminar at KNH will be provided to ensure the institution benefits from the analysed information for the purpose of improving service delivery.

3.15 Study results dissemination plan

The findings of this study were disseminated to the following; KNH Research and Programs department, Head of department Anaesthesia and specialised units, overall nurse in-charge specialised units, Nurse in-charge CCU, Department of Nursing Education, Research, Leadership and Management (NERLM), and School of Post Graduate Studies MKU. In addition, the findings will of this study will be presented at relevant scientific conferences, seminars and workshops. The research will also be published in peer reviewed scientific journals.

CHAPTER FOUR

REEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter discusses an analysis and study findings of the data collected in relation to the research objectives. The purpose of the study was to establish the knowledge level of nurses on electrocardiogram interpretation and management at critical care units, Kenyatta National Hospital. As a result, this chapter focuses on the research's results and comments, highlighting crucial aspects such as the questionnaire return rate, biodata, the validity and reliability of the pretest construct, and study findings by objective. A total of 131 questionnaires were distributed, with a 92.4 percent (n=121) return rate. The information gathered was coded and analyzed using SPSS Version 25. The findings of simple descriptive and inferential statistics were presented in tables.

4.2 Reliability and Validity Tests

4.2.1 Test for reliability

The researcher used reliability analysis to examine the degree to which the study construct was consistent in testing the intended test. To assess the data gathering tool's dependability, a pretest study was conducted. Random distribution of 12 data capturing forms was used in the research, which took place in acute rooms of accident and emergency departments. Cronbach's Alpha index was excellent after reliability analysis. A score of higher than 0.7 shows that the data collecting instruments have a high degree of internal consistency (Mugenda & Mugenda, 2003), creating the foundation for benchmarking and conclusion.

Table 2: Test for Reliability

Variable	No. of items	Cronbach's Alpha index	Remarks
Knowledge on Normal ECG interpretation	8	0.834	Reliable
Knowledge on Abnormal ECG interpretation	10	0.901	Reliable
Knowledge on clinical interventions of Abnormal ECG	10	0.964	Reliable

Source: Field Data (2020)

It can therefore be concluded that the study construct was reliable due to high index of over 0.7 between the related items in the study variables.

4.3 Response Rate

The study response rate was as follows:

Table 3: Response rate (n=121)

Response	Frequency (n)	Percent (%)
Returned questionnaires	121	92.4
Unreturned questionnaires	10	7.6
Total	**131**	**100**

Source: Field Data (2020)

As shown in table 3 above, a total of one hundred and thirty-one (131) research questionnaires were distributed to nurse officers working in various Critical Care Units at KNH. Of those, one hundred and twenty-one (121) questionnaires were filled and returned. Only questionnaires that were ≥ 80% complete were analyzed. The returned questionnaires accounted for 92.4% response rate that was adequate for analysis.

4.4 Socio-demographics of nurses working at the CCU

The study sought to determine Sociodemographic Characteristics as they were considered as categorical variables which provides basic insights of the study participants. The characteristics considered in the study were: Age, gender, education level, specialization, years of experience in critical care and last time trained. Descriptive characteristics of the study participants is discussed below.

4.4.1 Age

The study sought to determine the age of the respondents.

Table 4: Age (n=121)

Age in years	Frequency (n)	Percentage (%)
21 to 27	16	13.2
28 to 34	19	15.7
35 to 41	42	34.7
Over 41	44	36.4
Total	**121**	**100**
Mean		**37.3**

Source: Field Data (2020)

From the study findings in table 4, majority (36.4%, n=44) of the respondents reported to be over 41 years, followed by 34.7% (n=42) who were between the age of 35 to 41 years, 15.7% (n=19) were between 28 to 32 years and13.2% (n=16) between 21 to 27 years. The mean age was established to be 37.3 years. This shows that the most productive age bracket was well considered and represented in the survey.

4.4.2 Gender

Table 5: Gender (n=121)

Gender	Frequency (n)	Percentage
Male	36	29.8
Female	85	70.2
Total	**121**	**100.0**

Source: Field Data (2020)

From the study findings as illustrated in table 5, majority of the respondents 85(70.2%) were female while 36(29.8%) were male. This indicates that females were dominant gender compared to their male counterparts in the study location. The findings of this study are in line with a study by Githemo (2017) in her study on quality of nursing care revealed that nursing profession is dominated by female gender.

4.4.3 Education Level

According to the study findings shown in (table 4.5) majority 58 (47.9%) of the respondents revealed that they had attained Higher diploma in Nursing as the highest level of the education. Most (84.2%) of the nurses in the CCU were also noted to have higher diploma and above leading to the conclusion that majority of the respondents were well educated to participate in the study and give reliable information.39 (32.2%) of the respondents reported to be BSN holders as their highest level of education. 19 (15.7%) of the respondents were of Diploma in Nursing and 5 (4.1%) MSC nursing. This shows that majority of the respondents were well educated to participate and give reliable information sought. The study findings are in line with a study on knowledge and skills among nurses working in critical care settings in Tanzania by Ruhwanya, Tarimo and Ndile (2018) where 70.2% of the nursing workforce in the Critical care settings had attained a diploma in nursing.

Table 6: Education Level

Education level	Frequency (n)	Percentage (%)
MSc Nursing	5	4.1
BScN	39	32.2
Higher diploma in Nursing	58	47.9
Diploma in Nursing	19	15.7
Total	**121**	**100.0**

Source: Field Data (2020)

4.4.4 Last training in Advanced Cardiac Life Support (ACLS)

Findings revealed that out of the study participants 55.4% (n=67) have trained in Advanced life support courses in the less than 1 years ago, 41.3% (n=50) having trained in over 2 years ago and 3.3% (n=4) have never been trained in the ACLS course.

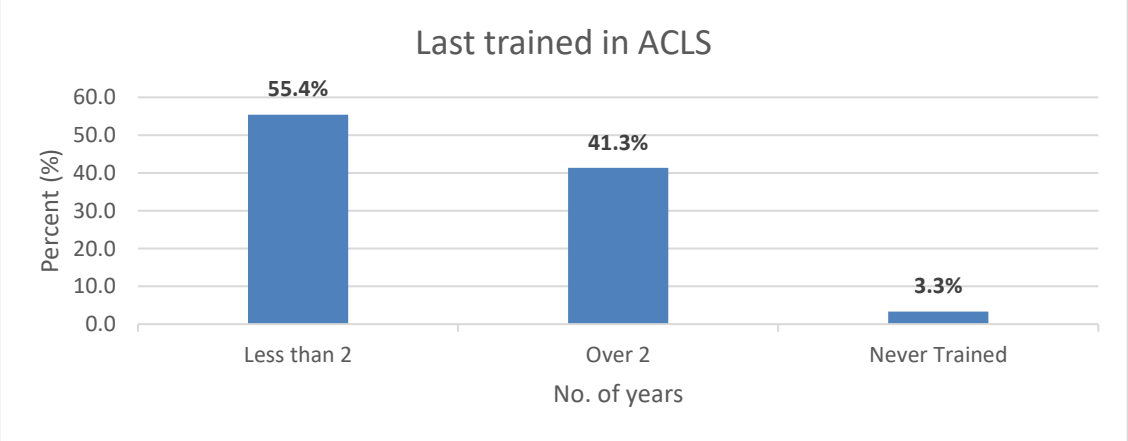


Figure 4 : Last training in ACLS

4.4.5 Years of experience in the CCU

Table 7: Years of experience

Years of experience	Frequency (n)	Percentage
1-4 years	55	45.5
5-8 years	36	29.8
Over 9 years	30	24.8
Total	**121**	**100.0**
Mean		**6.192**

Source: Field Data (2020)

Out of the 121 participants, 45.5% (n=55) have worked in critical care unit for 1 to 4 years followed by 29.8% (n=36) had an experience ranging from 5 to 9 years and 24.8% (n=30) who had an experience of over 9 years. The mean years of experience was 6.192.

4.5 Analysis of study variables

4.5.1 Overall knowledge level on ECG interpretation management

According to the study findings (figure 4.2) the overall knowledge on various parameters on ECG interpretation and management of abnormal ECG was reported as 80.9% pass and 19.1% fail. About abnormal ECG management, the rating on average was 72.6% with 27.4% fail. Therefore, majority of the nurses had correct answers in terms of knowledge on ECG interpretation and management.

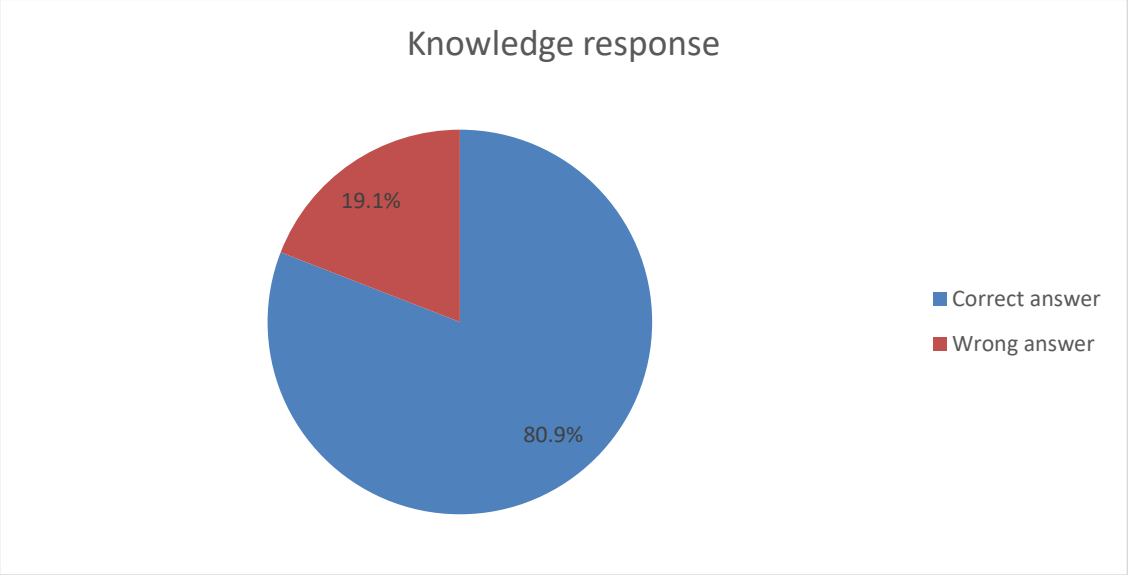


Figure 5: Overall knowledge on ECG interpretation and management

4.5.2 Statements on general knowledge on ECG

After analysis of data, 83.5% of the nurses were noted to understand the meaning of defibrillation. On responding to the purpose of ECG, 73.6% scored correctly with 26.4% scoring wrong. This is a reflection of a study by Sheilini & Sanatombi Devi, (2014) where it was reported that almost 75% of nurses are likely to frequently identify the correct ECG representation in a graph with 25% unable to detect the correct answer. Finally, the average general knowledge on ECG was reported as 81.2%.

Table 8: General knowledge on ECG

Statement on knowledge	Correct answer n (%)	Wrong answer n (%)
The purpose of ECG is to evaluate the heart's electrical activity	89(73.6)	23(26.4)
Defibrillation is whereby electrical current is passed through the heart that causes the entire myocardium to depolarize completely at the moment of the shock	101(83.5)	20(16.5)
Cardioversion disrupts the heart rhythm rather than completely depolarize the heart	86(71.1)	35(28.9)
Which rhythms are treated with cardioversion	74(61.2)	47(38.8)
Normal PR interval duration	56(46.3)	65(53.7)
Overall general knowledge on ECG	**81.2**	**18.8**

Source: Field Data (2020)

4.5.3 Knowledge level on Normal ECG Waves and Intervals

In a bid to establish the knowledge level on normal ECG interpretation, it was noted that 73.6% of the nurses correctly identified the wave for Ventricular depolarization, and 55.1% of nurses incorrectly identified the wave for atrial repolarization.

Table 9: Knowledge level on Normal ECG interpretation

Function	Wave and Interval	
	Correct answer	**Incorrect answer**
Ventricular depolarization	89(73.6)	23(26.4)
Impulse transmission through, the atria and AV node	111(92.7)	10(8.3)
Ventricular repolarization	93(85.3)	28(14.7)
Atrial repolarization	50(45.9)	71(55.1%)
Overall, Knowledge level on Normal ECG interpretation	**85.8**	**14.2**

Source: Field Data (2020)

4.5.4 Knowledge level on abnormal Rhythm ECG

Table 10 presents knowledge of nurses on abnormal ECG interpretations which included ten (10) questions on abnormal scenario of EGG patterns presented as rhythm strips. Most (86.8%) of the nurses in the study correctly identified the asystole rhythm. Most nurse correctly identified the most ECG interpretations listed in table 10 but notably 43.8% of the nurses incorrectly identified the sinus tachycardia rhythm. A trial flatter was correctly interpreted at 82.6%. The overall correct interpretation on ECG score was established to be at 72.1.

Table 10: ECG interpretation

ECG interpretation	Correct answer n (%)	Incorrect answer n (%)
Ventricular Tachycardia	79(65.3)	42 (34.7)
Sinus bradycardia	91(75.2)	30 (24.8)
Ventricular fibrillation	76(62.8)	45 (37.2)
Sinus tachycardia	68(56.2)	53 (43.8)
Asystole	105(86.8)	16 (13.2)
1st Degree heart Block	83(68.6)	38 (31.4)
2nd degree heart block	91(75.2)	30 (24.8)
3rd degree heart block	98(81.0)	23 (19.0)
Atrial Tachycardia	81(66.9)	40 (33.1)
Atrial flutter	100(82.6)	21 (17.4)
Overall interpretation score	**72.1**	**27.9**

Source: Field Data (2020)

4.5.5 Management of Abnormal ECG

According to table 11 below, Majority (80.2%) of the nurses in this study correctly indicated the management of ventricular tachycardia, 68.4% correctly indicated the management of sinus bradycardia. Notably management of sinas tachycardia, asystole and 1st degree health block was wrongly indicated by a majority of nurses. Others were correctly indicated by a majority by over 50%. Nurses involved in the study scored 72.6 on knowledge on management of abnormal ECG.

Table 11: Knowledge on Management of Abnormal ECG

No.	Management	Correct answer n (%)	Incorrect answer n (%)
1.	**Ventricular Tachycardia**: Catheter ablation/Amiodarone/ defibrillation	97(80.2)	24(19.8)
2.	**Sinus bradycardia**: Atropine	84(68.4)	37(30.6)
3.	**Ventricular fibrillation**: Defibrillation/ Amiodarone	67(55.4)	54(44.6)
4.	**Sinus tachycardia**: Cardio-selective beta blockers/ Amiodarone	55(45.5)	66(54.5)
5.	**Asystole**: Epinephrine/CPR/ Atropine	60(49.6)	61(50.4)
6.	**1st Degree heart Block**: Amiodarone	54(44.6)	67(55.4)
7.	**2nd degree heart block:** Pacing	87(71.9)	34(28.1)
8.	**3rd degree heart block**: CPR/Pacing	62(51.2)	59(48.8)
9.	**Atrial Tachycardia Beta blockers:** Amiodarone	64(52.9)	57(47.1)
10.	**Atrial flutter**: Catheter ablation/cardioversion	96(79.3)	25(20.7)
	Overall	**72.6**	**27.4**

Source: Field Data (2020)

4.5.6 Graphic representation

Majority (76%, n=92) of the nurses reported that they defibrillate 0-5 patients in a month while 51.2% (n=62) reported that cardioverting 0-10 patients in a month. The distribution is as shown in table 12 below.

Table 12: Frequency of Defibrillation and Cardioversion in the CCU

Parameter	Frequency (n)	Percent (%)
How often do you defibrillate patients in a month?		
None	25	20.7
0 -5 cases	92	76.0
6 -10 cases	4	3.3
> 10 cases	-	-
How many patients do you cardiovert in a month?		
None	12	9.9
0-10 cases	62	51.2
11-20 cases	38	31.4
Above 20 cases	9	7.4

Source: Field Data (2020)

4.5.7 Cardioversion nurses are comfortable with performing

From the findings, it was noted that 58.7% (n=71) of the nurses stated they are comfortable performing chemical cardioversion while 41.3% (n=50) were comfortable with mechanical. On specific chemical, 39.4% (n=28) of them chose verapamil, closely followed by 38.0% (n=27) who chose amiodarone and 22.5% (n=16) chose adenosine.

Table 13: Cardioversion nurses are comfortable with performing

Parameter	Frequency	Percent
Which type of cardioversion are you comfortable with performing		
Mechanical	50	41.3
Chemical	71	58.7
Specific chemical		
Adenosine	16	22.5
Amiodarone	27	38.0
Verapamil	28	39.4

Source: Field Data (2020)

4.6 Inferential Analysis

A Pearson correlation analysis was conducted and established the findings presented in table 14, 15 and table 16.

4.6.1 Relationship between demographic and Knowledge on Normal ECG

The test results shows that there is no statistical significance between knowledge of normal ECG and gender, education level or years of experience since the p value indicated is greater than 0.05.

Table 14: Relationship between demographic and Knowledge of Normal ECG

Parameter	Knowledge on Normal ECG		X^2 (P-Value)
	Correct answer	Incorrect answer	
Age in years			14.007
21 to 27	15	-	(0.07)
28 to 34	19	-	
35 to 41	32	10	
Over 41	34	11	
Gender			4.29
Male	31	5	(0.607)
Female	69	16	
Education level			4.228
MSc Nursing	5	-	(0.238)
BScN	29	-	
Higher diploma in Nursing	51	7	
Diploma in Nursing	15	4	
Years of experience			5.050
Less than 6 months	-	-	(0.168)
1-4 years	46	8	
5-9 years	28	6	
Over 9 years	26	7	

Source: Field Data (2020)

4.6.2 Relationship between demographic and Knowledge on Abnormal ECG

According to the study findings, the nurses' age was found to be statistically significant to knowledge on abnormal ECG pattern interpretation as well as the years of experience. This is because the p values of age and years of experience was established as p=0.004 and 0.008 respectively, values which are less than 0.05. There was not statistical significance between gender and education level against knowledge on abnormal ECG patterns.

Table 15: Relationship between demographic and Knowledge on Abnormal ECG

Parameter	Knowledge on Abnormal ECG		X^2 (P-Value)
	Correct answer	Incorrect answer	
Age in years			15.192
21 to 27	0	15	(0.004)
28 to 34	6	13	
35 to 41	8	34	
Over 41	20	25	
Gender			1.53(0.825)
Male	11	25	
Female	23	62	
Education level			1.369 (0.713)
MSc Nursing	1	4	
BScN	10	29	
Higher diploma in Nursing	19	39	
Diploma in Nursing	4	15	
Years of experience			11.751
Less than 6 months	46	8	(0.008)
1-4 years	19	15	
5-9 years	22	10	
Over 9 years	0	1	

Source: Field Data (2020)

4.6.3 Relationship between Management of abnormal ECG and demographics

Findings shows that there was no statistical significance between nurses' management of abnormal ECG and socio demographic factors. All the P values were greater than 0.05 as shown in table 16 below.

Table 16: Relationship between Management of abnormal ECG and demographics

Parameter	Management of Abnormal ECG		X^2 (P-Value)
	Correct answer	Incorrect answer	
Age in years			13.989 (0.07)
21 to 27	14	1	
28 to 34	12	7	
35 to 41	32	10	
Over 41	22	23	
Gender			0.573 (0.530)
Male	22	14	
Female	58	27	
Education level			3.496 (0.321)
MSC nursing	3	2	
BSN	28	11	
Higher diploma in Nursing	34	24	
Diploma in Nursing	15	4	
Years of experience			12.233 (0.07)
1-4 years	44	10	
5-9 years	17	17	
Over 9 years	19	14	

Source: Field Data (2020)

4.6.4 Analysis of variance (ANOVA)

Table 17: ANOVA (n=121)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.026	3	0.507	2.137	.150[b]
	Residual	17.327	118	0.156		
	Total	19.353	121			

a Predictors:(Constant) age, gender, level of education, years of experience

b Dependent Variable: knowledge level on normal and abnormal electrocardiogram interpretation

Source: Field Data (2020)

The findings indicate that correlation between performance and the predictors. A significance level of 0.150, which is greater than the p-value, 0.05 thus we fail to reject the null hypothesis. The estimated value of F exceeded the critical value of F (2.137 < 2.47) an indication that social demographics do not influence knowledge level on normal and abnormal electrocardiogram interpretation. The conclusion in this correlation was that the null hypothesis was accepted while the alternative hypothesis was rejected.

4.7 Knowledge scores

Table 18 below shows the score established by the study. This is in line with the following criteria; less than 70% unsatisfactory, 70-74% pass, 75- 79 % satisfactory, 80-89 % good, and a score of 90-100% Excellent, as per Score grading system utilised on knowledge level (Cardino, Ruth and Cruz, 2020).

Table 18: Summary of Knowledge scores

Variable	Proportion (%)	Grade
Overall knowledge on ECG interpretation	80.9	Good
General basic knowledge on ECG	81.2	Good
Knowledge on normal ECG	85.8	Good
Knowledge on abnormal ECG	72.1	Satisfactory
Knowledge on management of abnormal ECG	72.6	Satisfactory

Source: Field Data (2020)

CHAPTER FIVE

SUMMARY OF FINSINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes all findings of the study and provides useful conclusions and recommendations. In this chapter, findings of the study are discussed in line with the study objectives. The results of the study have also been compared with other study findings both locally, regionally and internationally. Conclusions from the study findings, recommendations and areas for further research have also been outlined in this chapter. The study was conducted on 131 intensive care nurses of various ages, experience and educational levels working in three critical care units. In this study, the majority of respondents indicated Advanced Cardiac Life Support (ACLS) as their main refresher course, helping them improve their knowledge of ECG interpretation and management. The overall correct interpretation and treatment of an abnormal ECG was rated at 80.9%, with at least 19.1% giving incorrect answers.

5.2 Summary of Findings

5.2.1 Demographic findings of the respondents

The study clearly indicates that most of the nurses working in the critical care units were middle in their middle age (37.2 years). It therefore confirmed the assumption that the nurses possessed a wide range of experience in patient care and management. These findings resemble those by the Kenya nursing workforce that showed that majority of nurses were aged over 40 years (Wakaba, Mbindyo, Ochieng et al., 2014). This clearly illustrates the need to have more young nurses joining the profession. Another assumption is that, despite more nurses joining the profession, majority have not managed to access a formal employment.

The findings contrasted with those by Tahboub and Yilmaz, (2019) whose participants in a similar study at Turkey had a mean age of 26.9 years. Notably majority of the nurses were females. Slightly above two thirds of the nurses were females while a third of respondents were males. This indicated that the nursing profession and more especially those working in the critical units are females. The findings correspond with a report of a cross sectional study at Brazil by Santana-Santos et al. (2017). The study which whose aim was to assess the ability of nurses to interpret electrocardiogram among 100 nurses, outlined that 80% of respondents were female nurses who were working at the university of Sao Paulo Hospital. Of the study participants, 63.6% are holders of either higher diploma or diploma in nursing. These results are consistent with research conducted by the Kenya Nursing Workforce, which found that 76 percent of the 16,371 nurses in the public non-tertiary sector are females, while 24 percent are men (Wakaba, Mbindyo, Ochieng et al., 2014). Women's dominance in the nursing profession has also been recorded in other places. Kellett, Gregory, and Evans observed similar results in Canada (2014). They stated in their research on contextualizing the low numbers of men in nursing that despite relative advances in the number of women joining historically male-dominated professions, the proportion of males practicing nursing has remained low. Despite the lengthy history of nursing as a profession, this illustrates that there are still fewer males than women in the industry.

On the education level, majority were higher diploma account holders. These findings are comparable to Appiagyei, Kiriinya and Gross et al. (2014) who in their study reported that most nurses are either diploma or higher diploma holders. The high number of diploma related nurses can be attributed to the nursing council of Kenya’s effort to upgrade certificate nurses to diploma level. The study differed with a similar one done at

Turkey by Tahboub and Yilmaz, (2019) who reported that the highest number of nurse participants possessed a Bachelor's degree in nursing.

5.2.2 Knowledge on Normal ECG interpretation

In this study, 73.6% of nurses were able to identify the correct wave in Ventricular depolarization, 92.7% the Impulse transmission through, the atria and AV node, 85.3% Ventricular repolarization, 45.9% atrial repolarization. With respect to the analysis of the normal ECG wave, atrial repolarization (T wave) was the least correctly interpreted at 45.9% (Table 4.8). The interpretation of this particular wave is very critical, especially when there is an electrolyte imbalance. For example, in cases of elevated potassium levels, the graph shows a spiked T wave. It is therefore important that CCNs acquire more knowledge in this aspect. Generally, the findings clearly indicate that majority of the nurses are able to determine the right wave and interval for various normal ECG readings. Overall, a rating of 85.8% represents a high level of nursing knowledge on interpretation of the ECG waves and the relevant intervals. This study findings are consistent with a study by Motanya, (2020) which revealed that over 70% of the nurses working in the critical care units, KNH are well trained and equipped with prerequisite skills of ECG interpretation. In addition, AL-Husaunawy, (2015) in a multisite study at Irak on knowledge on interpretation of electrocardiogram reported a success rate of 74% but practically more nurses demonstrated competency at (95%).

Findings further revealed that, demographic characteristics of age, gender, education level and years of experience were found to be statistically insignificant in determining knowledge level of normal ECG interpretation. The overall identification of ECG waves and intervals was reported as 85.8% and 14.2% respectively. Studies have shown that for nurses to acquire and sustain knowledge on ECG interpretation and clinical intervention,

annual updates are of paramount importance. Bojsen et al. (2015) found that newly learned abilities were quickly lost when the intervention was not repeated in research to explore the impact of a standalone web-based ECG training and to test the retention of skills using different follow-up intervals. Nurses were educated on ECG in a randomized clinical study by Frunk et al. (2017), and their knowledge increased considerably in both groups immediately after the intervention, but not 15 months afterwards. This implies that annual updates on ECG interpretation is likely to enhance knowledge level among critical care nurses.

5.2.3 Knowledge on Abnormal ECG interpretation

Study results showed that most (86.8%) of the nurses interpretated the asystole arrhythmia correctly. Atrial flutter was also well interpreted with a score of 82.6%, ECG interpretation of 3rd degree heart block (81%), 2nd degree heart block and Sinus bradycardia was at 75.2% correct interpretation. In comparison with a study by Coll-Badell et al. (2017) who reported that majority of the nurses were able to recognise ventricular tachycardia and atrial flutter, it shows that the findings of two studies were similar in a way. Sinus tachycardia, is one of the deadly rhythms. It was the least interpreted at 56.2%. (Table 4.9). In addition, the management of this rhythm scored low with 53.3% of correct results. Heart blocks were given correct management at 45.5% (Table 4.10). Asystole, which scored well on interpretation at 86.8%, was correctly managed at 49.6%. Overall, correct responses of nurses on average were 72.1% as compared to incorrect responses at 27.9%. This therefore indicated that majority of nurses in the CCUs were knowledgeable in matters of abnormal ECG interpretation. The study findings are consistent with a study by Mahmoud and Bayoumy, (2014) which revealed that majority of the nurses have good knowledge on ECG reading. Similar

findings were reported by Tahboub and Yilmaz, (2019) where by participants interpreted ventricular tachycardia (87.7%), atrial flutter (84.6%), and acute myocardial infarction (72.3%).

Age and years of experience of the respondents was found to be statistically significant at p=0.004 and p=0.008 respectively in regards to knowledge of abnormal ECG interpretation.

According to Al-Husaunawy (2015), a study done in IRAK, the level of education (p value 0.426), years of experience (0.233), gender (p value 0.501) and age (0.366) did not have a statistically significant effect on knowledge level of ECG interpretation.

5.2.4 Knowledge on Management of Abnormal ECG Interpretation.

According to the study findings, 72.6% of the nurses were able to identify the correct management in the 10 strips provided with 80.2% indicating catheter ablation/amiodarone/ defibrillation management approach for Ventricular Tachycardia as the most correctly interpreted followed by 79.3% catheter ablation/cardioversion management for Atrial flutter. However, management cases for 1st Degree heart Block and Sinus tachycardia were the hardest to identify the management approach with scores of 44.6% and 55.4% respectively

There was no statistical significance on age, years of experience, education level and gender in relation to management of abnormal ECG. Management of Ventricular Tachycardia was the most correctly identified at 80.2% while management of 1st Degree heart Block was list identified at 44.6%. The average knowledge on management of abnormal ECG was found to be 72.6%. The study findings concur with a study conducted in Saudi Arabia in Khalid Hospital by Bassuni and Bayoumi, (2015) that revealed that majority of the nurses in CCUs have the confidence and ability to identify the correct

mode of managing abnormal ECG in patients. According to Kerbage, (2017) some factors that limit nurses in knowledge acquisition was limited exposure to real drill programs. In these drills, nurse led defibrillations were uncommon but instead doctors played the leading role (Kerbage, 2017).

The results of this study showed a "good" level of knowledge on ECG interpretation and management among nurses based on the score grading system used, (80-89, good). More than 70% of nurses passed the questionnaire with correct answers. A score below 70% would signify unsatisfactory level of knowledge. The achieved score is higher than that of prior studies done. A Study by Werner, Kender and Axelsson (2016) reported that 54% of nurses achieved correct answers on ECG interpretation. Some variables of abnormal ECG strips were interpreted below 70% (unsatisfactory) signifying a knowledge gap in interpretation and management of abnormal ECG. The knowledge gap could be attributed to lack of regular training, lack of policy guidelines and administrative support according findings by Chege, (2018) who carried out a study to determine the nurse's performance in assessment of chest pain and initial management in the Accident and Emergency unit, KNH. Other than the gap in chest pain assessment and management in KNH, the current findings depict that there is a knowledge gap in interpretation and management of majority the abnormal ECG rhythms.

5.3 Conclusion

Acquiring knowledge of the correct interpretation and handling of the ECG is a key aspect especially in critical care nursing. Acquisition of this knowledge has not been emphasised well in the basic training of nurses leading to challenges of ECG interpretation on nurses who have not specialised in Critical care nursing. From this study, up to date ACLS course didn't seem to be clearly considered as an important

requirement for one to work in Critical care unit. The knowledge gap in this study was mostly on how to interpret and manage abnormal ECG. This could be attributed to lack of periodic sensitization, monitoring and assessment of ECG interpretation skills. The fact that there was a fraction of nurses with expired ACLS certificates signifies that there is a gap in monitoring compliance on certification.

Therefore, it is imperative that nursing education unit in KNH periodically focuses on assessment of ECG interpretation skills and monitor ACLS certification in the critical care units. The hospital should also ensure that critical care nurses understand the key clinical indicators and diagnostic procedures associated with cardiovascular disease in order to maximise good patient outcomes to the critically ill.

5.4 Recommendation

Continuous professional development (CPD) programmes on ECG interpretation are recommended. A committee can be set to oversee the ECG skills application and also carry out self-audits. This will help to identify the areas of improvement. It is important that critical care nurses acquire or update Advanced Cardiac Life Support (ACLS) certificates every two years as required by AHA. Strategies need to be put in place to monitor the certification or recertification of ACLS certificates to all nurses working in critical care units at KNH. A similar study can be carried out in other hospitals both public and private so as to establish the nurses' knowledge level on ECG interpretation and management.

The curriculum on ECG interpretation in basic training of nurses can be reviewed to include some practical sessions.

REFERENCES

Abrams, J. (2015). Clinical application. Angina that is chronic and stable. *N Engl J Med*, *352*, 2524-e2533.

Al-Khatib, S. M., Stevenson, W. G., & Ackerman, M. J. (2017). *The American College of Cardiology Foundation/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society have released a guideline for the care of patients with ventricular arrhythmias and the prevention of sudden cardiac death*.

American Heart Association (AHA). (2016). *Advanced cardiovascular life support (ACLS).http://cpr.heart.org/AHAECC/CPRAndECC/Training/HealthcareProfessional/AdvancedCardiovascularLifeSupportACLS/UCM_473186_Advanced-Cardiovascular-LifeSupport-ACLS.jsp*

Amsterdam, E. A. (2014). *The American College of Cardiology/American Heart Association Task Force on Practice Guidelines published a study on the care of individuals with non-ST-elevation acute coronary syndromes*.

Appiagyei, A. A., Kiriinya, R. N., & Gross, J. M. (2014). *A mixed methods research of variables impacting pre-service training capacity and production to inform the scale-up of Kenya's nursing workforce*.

Bahiru, E., Temu, T., & Gitura, B. (2018). A registry research from Kenyatta National Hospital in Nairobi, Kenya, looked at the presentation, care, and prognosis of acute coronary syndrome. *Africa's Cardiovascular Journal*, *29*(4), 225–230.

Barros, M. S., & Silva, M. A. (2016). Demystifying theory in practice - Practical ECG teaching is a new ECG training style. *Rev Bras Med Educ*.

Bassuni, E. M., & Bayoumi, M. M. (2015). *Improve the quality of emergency medical treatment. In Saudi Arabia, nursing staff development initiatives are being used to ensure patient safety. International magazine of health science*.

Benjamin, E. J., & Jiménez, M. C. (1984). The American Heart Association has released an update on heart disease and stroke data for 2017. e146-e603. In *Circulation* (Vol. 135, pp. e146–e603). P. Benner.

Benner, P. E., Tanner, C. A., & Chesla, C. A. (2010). *Nursing expertise, including compassion, clinical judgment, and ethics*. Springer Publishing Company.

Bhaumik, A., & Aishwarya, M. N. L. (2016). *Cardiovascular arrhythmia and ablation: current invasive methods as well as the outlook for the future are discussed. The magazine of pharmaceutical and medical research across the world*.

Brooks, C. A., & Albert, N. M. (2016). A blended-learning course's ability to keep students' basic electrocardiographic information. *Am J Crit Care*, *25*(1), 61–67.

Cardino, J. M., & Ruth, C. A. O. (2020). *LUMAT international journal of math science and technology aims to enhance the teaching and learning of mathematics*.

Carey, M. G. (2016a). *Cardiac Monitoring is in the Emergency Room. There is a group called Crit Care Nursing North American that helps people who need help with their health*.

Carey, M. G. (2016b). Myocardial Infarction (MI). *Research in the Field of Health Sciences*, *28*.

Chege G.N. (2018). *Determination of nurses' practice in assessment and initial management of cardiac related chest pain among adult patients at A&E, KNH*

CKS. (n.d.). Org.uk. Retrieved February 18, 2023, from https://cks.nice.org.uk/

Coll-Badell, M., & Llaurado-Serra, M. (2017). A cross-sectional investigation of emergency nurses' ability to read electrocardiograms in Spain. *Journal of Emergency Nursing*.

Doğan, H. D., & Melek, M. (2012). Evaluation of nurses' ability to diagnose ECG abnormalities related to emergency heart illness and decide on relevant treatment techniques. *Turkish Journal of Cardiovascular Nursing*.

Drew, B. J. C. (2004). *The Councils on Cardiovascular Nursing of the American Heart Association issued a scientific statement outlining best practices for electrocardiographic monitoring in hospitals*.

Funk, M. (2017). Experiment found a link between the application of practice standards for electrocardiographic monitoring and nurses' knowledge, quality of care, and patient outcomes. *Circulation: Cardiovascular Quality and Outcomes*.

Gatonga, P. M., & Ogengo, J. (2014). An Adult Kenyan Population's Heart Failure Pattern. *The International Journal of Cardiovascular Research*.

Gheorghiade, M., & Bonow, R. O. (2012). Heart failure with coronary artery disease: a difficult confluence to bridge. *Journal of Infusion Nursing*, *114*(11), 101–107.

Githemo, G. K. (2017). *Patient involvement improves nursing care quality in Kenyan hospitals, according to Orem's hypothesis*.

Hui, G. C., Low, L. P., & Lee, I. S. (2011). Qualitative research of ICU nurses' perspectives of defibrillation's probable limits and expected assistance. *Intensive and Critical Care Nursing*, *27*(4), 186–193.

Jevon, P. (2007). Procedure for recording a 12-lead electrocardiogram using conventional equipment. *British Journal of Nursing*, *19*(10), 649–651.

Kellett, P., & Evans, J. (2014). Penigma of the atriarchy: gender performance and the career paths of male nurses. *An International Journal*.

Kenya Medical Training College. (2021). *Course outline Kenya Registered community health nurse*

Kerbage, S. H. (2017). *The Arrhythmia Interpretation Skills and Self-Belief of Critical Care Nurses*.

Korir, L. C. (2019). *Outcome Prediction in People with Acute Coronary Syndrome who were treated at the Aga Khan University Hospital-Kenya (Doctoral dissertation)*.

Kusumoto, F. M., Schoenfeld, M. H., & Barrett, C. (2018). ACC/AHA/HRS guidelines on how to evaluate and treat patients with slow heartbeats and slow heartbeats. *At the American College of Cardiology*, 38984–38988.

Link, M. S., & White, R. D. (2015). Adult advanced cardiovascular life support (Part 7): 2015 American Heart Association recommendations for cardiopulmonary resuscitation and emergency cardiovascular treatment. *2015 American Heart Association Recommendations for Cardiopulmonary Resuscitation and Emergency Cardiovascular Treatment. S444-S464 in Circulation*, *132*.

Mahmoud, M. H., & Bayoumy, H. M. (2014). From the viewpoint of nurses, what are the barriers and enablers to completing the nursing process? *The International Journal of Advanced Research Is a Peer-Reviewed Journal That Publishes Research*.

Malk, R. N., & Hassan, H. E. (2018). *Evaluation of Electrocardiogram (ECG) Nurses' Practice*.

Manning, P., & Awtry, E. H. (2014). *Unstable Angina: Signs, Symptoms, and Treatment Options. Cardiovascular Medicine and Research Encyclopedia*.

Mensah, G. A. (2015). *Mortality from cardiovascular disease in Sub-Saharan Africa, 1990-2013: a systematic review of data from the Global Burden of Disease Study*.

Motanya, A. W. (2020). *Nursing treatment for patients with myocardial infarction at Kenyatta National Hospital's Accident and Emergency Unit*.

Mousa, A. M., & Ahmed, H. A. O. R. S. (2016). At Baghdad teaching hospitals, nurses' awareness of early therapies for patients with ventricular tachycardia. *The Kufa Journal of Nursing Sciences*.

Mugenda, O. M., & Mugenda, A. G. (2003). *There are both quantitative and qualitative approaches to research. ACT Nairobi offers this course. Is Kenya about to be hit by a heart attack?*

Mwango, D. (2014). *Is Kenya sitting on ticking heart attack time bomb?*

Myers, J. G., Hunold, K. M., & Ekernas, K. (2017). *a cross-sectional, prospective investigation of patient characteristics in the A&E department of the hospital. The BMJ is now open for business*.

Ndawa, D. J. M. (2013). *Impact of a screening protocol on the time it takes to get from the door of the accident and emergency department of Kenyatta National Hospital to get an ECG. This information was found on erepository*.

Nickasch, B., & Marnocha, S. (2016). *What should I do next?' Nurses are confused and unsure about how to read ECGs. Nurses work in the field of medicine*.

Page, R. L., Joglar, J. A., & Caldwell, M. A. (2016). *Adults with supraventricular tachycardia should be treated according to recommendations from the American College of Cardiology, the American Heart Association, and the Heart Rhythm Society*. American Heart Association, and the Heart Rhythm Society.

R, K., S, S., & Y, G. (2016). Assessing adherence to advanced cardiovascular life support (ACLS) protocols in residents during simulated cardiac arrest. *Analgesia & Resuscitation: Current Research*, *05*(02). https://doi.org/10.4172/2324-903x.1000142

Ruhwanya, D. I., & Ndile, M. (2014). People who work in critical care at Muhimbili National Hospital in Dar es Salaam, Tanzania, have a lot of knowledge and skills. *TAJHR*, *20*.

Sandau, K. E., & Funk, M. (2017). The Scientific Statement on Practice Standards for Electrocardiographic Monitoring in Hospital Settings has been revised by the American Heart Association. *American Heart Association. Circulation*.

Santana-Santos, E. (2017). Nurses' ability to read a 12-lead electrocardiogram. *Revista Baiana de Enfermagem Tecbahia*.

Shalal, S. H. (2016). *At Baghdad Teaching Hospitals, nurses' knowledge of early interventions for patients with ventricular tachycardia. The Kufa Journal of Nursing Sciences is a publication dedicated to the study of nursing*.

Sheiline, M. (2018). The effectiveness of a competence program for staff nurses working in critical care settings in terms of ECG monitoring and interpretation, as well as the variables that influence their competency. 1-7 in Asian. *Journal of Cardiovascular Nursing*.

Sheilini, M. (2014). The impact of an educational intervention on nursing students' ECG monitoring and interpretation. pages. 01-05 in. *Journal of Dental and Medical Sciences*, *12*.

Stephens, K. E. (2017). What Nurses Know About Interpreting 12-Lead ECGs for Acute ST-Elevation Myocardial Infarction Cardiovascular. *Nursing Journal*, *22*(3).

Tahboub, O. Y. H., & Yılmaz, Ü. (2019). *Electrocardiogram interpretation knowledge and practice among nurses*.

Urden, L. D., Stacy, K. M., & Lough, M. E. (2020). *The most important things in critical care nursing are caring for the critically ill patient and managing heart disease*. Elsevier has them.

Wakaba, M., & English, M. (2014). *Public sector nursing staff in Kenya: a county-level study. For health, we need people*.

Werner, K. (2016). *Ambulance nurses are better at reading electrocardiograms than they used to be. The Journal of Cardiovascular Nursing in Europe*.

Whinnett, Z. I. (2012). People who have supraventricular tachycardia can be diagnosed and treated. *The BMJ*, *345*.

Wills, E. M. (1998). *The foundation of nursing theory*. Lippincott Williams & Wilkins.

World health organization (WHO). (1984). In *Yearbook of the United Nations 1984* (pp. 1220–1228). United Nations.

Zhang, H., & Hsu, L. L. (2013). The success of a program to teach nurses how to read electrocardiograms. In *Emergency nursing in other countries*.

Zimmerman, T., & Kerns, W. (2012). Does the nurse's interpretation of the ECG QRS Width turn out to be correct? *Journal of Toxicology in Medicine*.

APPENDICES

Appendix I: Participant Information and Consent Form

Title of Study: Knowledge Level of Nurses on Electrocardiogram interpretation and Management at the Critical Care Units, Kenyatta National Hospital

Introduction: My name Annastacia Mutindi Mbatha, a student at the School of Nursing, Mount Kenya University undertaking a Master's Degree in Nursing (Critical Care).

I am carrying out a study on "**Knowledge Level of Nurses on Electrocardiogram Interpretation and Management at Critical Care Units, Kenyatta National Hospital**." as part of my course requirement.

This consent form's objective is to provide you with the information you'll need to determine whether or not to participate in the research. Feel free to ask any questions you have regarding the study's objective, what happens if you participate, the potential risks and benefits, your rights as a volunteer, or anything else that is unclear about the study or this form. You may decide whether or not to participate in the research once all of your questions have been addressed to your satisfaction. I'll ask you to sign this form after you've read the information and agreed to participate in the research. You should be aware of the following general guidelines that apply to all volunteers in medical research: Your choice to participate is completely optional; you may withdraw from the study at any time without having to provide a reason; and your refusal to engage in the research will have no impact on the services you are entitled to at this or other institutions.

May I continue? YES / NO

Protocol No:

About the research:

Participants in this study will be quizzed on their understanding of normal and abnormal ECG reading, as well as the therapeutic actions that go with it.

If you agree to participate in this study, the following things will happen: A self-administered questionnaire will be given out to you. It will take you approximately twenty (20) minutes to fill it. The questionnaire will cover topics such as basic characteristics of normal and abnormal ECG and Corresponding clinical interventions.

Risks associated with the study: There are no risks associated with this study. You are not supposed to indicate your name on the questionnaire hence it cannot be traced to you. The questionnaires will be stored in a lockable cabinet by the researcher for a period of 1 year or when not required. The only people who will come into contact with the questionnaires are those involved in the study.

Benefits of participating in the study: There is no financial benefit in this study. The information you provide will help in development of policies and training on ECG.

Cost to participant: Participation in this study will cost you absolutely nothing. The principal investigator will cater for the implicated cost.

Future concerns and rights: If you have further questions or concerns about participating in this study, please call or send a text message to the numbers provided at the below. Any charges incurred for such will be reimbursed by the researcher.

For more information about this study you may contact the Researcher: Annastacia Mutindi Mbatha, of Mount Kenya University- telephone number: 0722665248 or email at mbatha028@gmail.com, Supervisors: Dr. Nilufar Jivraj-telephone number: 0731888093 and Ms. Lucy Meng'anyi- telephone number: 0721419297 as well as the Secretary/Chairperson, KNH/UoN-ERC, Telephone Number: 2726300 Ext: 44102, Fax: 0725272; Email: uonknh_erc@uonbi.ac.ke.

Statement of a participant

This permission form has been read to me or I have had the information read to me. I got the opportunity to speak with the primary investigator about this research project. My inquiries were addressed in a language that I could comprehend. I've been informed about the dangers and rewards. I am aware that my participation in this research is entirely voluntary, and that I may withdraw at any moment. I voluntarily accept to take part in this research study.

I am aware that every attempt will be taken to keep information about my personal identification private.

I consent to take part in this research study: Yes, but

I have not waived any of my legal rights as a participant by completing this consent form.

Participant printed initials: _____

Participant signature / Thumb stamp _____ Date _____

Statement of the researcher

I, the undersigned, have thoroughly described the pertinent information of this research project to the above-mentioned participant, and believe that the participant has understood and provided his/her agreement voluntarily and freely.

Researcher's Name: _____ **Date**: _____

Signature _____

Appendix II: Questionnaire

SECTION A: SOCIO DEMOGRAPHIC FACTORS

1. What is your age in years? _____

2. Gender

a) Male []

b) Female []

3. Education level

a) MSc Nursing []

b) BScN []

c) Higher diploma in Nursing []

d) Diploma in nursing []

4. Do you have a specialization in critical care nursing?

a) Yes []

b) No []

5. How long have you worked in critical care unit? _____

6. When did you last train in advanced life support course?

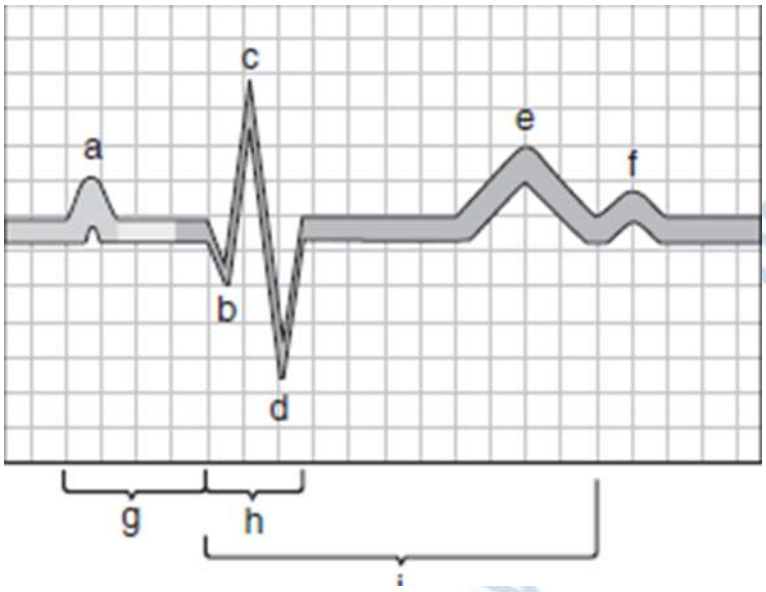
a) < 2years []

b) >2 years []

c) Never trained []

SECTION B: KNOWLEDGE LEVEL ON NORMAL ECG

7. Using the diagram below Match the letter that represents the events in the waves, segments and intervals of the cardiac rhythm. (P wave, PR segment, PR interval, QRS complex, ST segment, T wave, QT interval) **Note: Indicate the event in the table provided using the specific letters on the diagram.**



Q. no	Function	Wave	Interval
a)	Ventricular depolarization		
b)	Impulse transmission through, the atria and AV node		
c)	Ventricular repolarization		
d)	Atrial repolarization		

8. What is the normal PR interval duration?

   a) 0.04-0.08 seconds []

   b) 0.06-0.12 seconds []

c) <0.11 seconds []

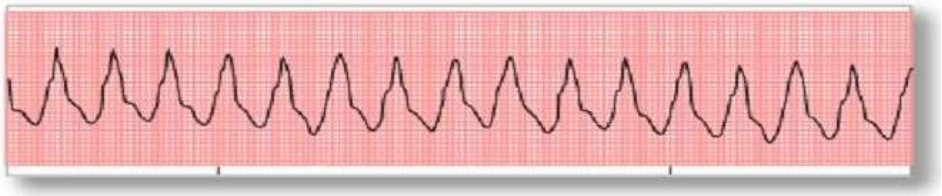
d) 0.12-0.20 seconds []

SECTION C: KNOWLEDGE LEVEL ON ABNORMAL ECG INTERPRETATION AND CLINICAL INTERVENTION

Directions:

- All strips are six second strips
- All strips are lead II unless otherwise noted
- For questions 9 to 19, indicate the rhythm and management for each strip in the space provided. Same management may apply for more than one rhythm.

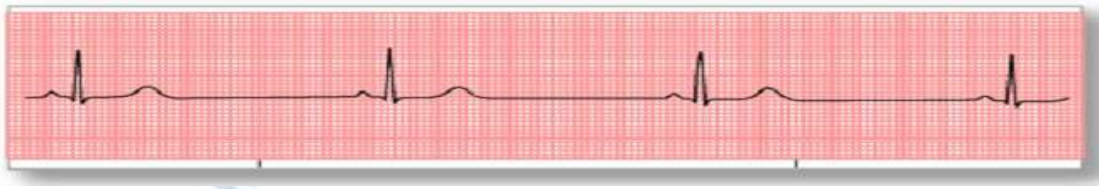
9.



Rhythm interpretation: _____

Management: _____

10.



Rhythm interpretation: _____

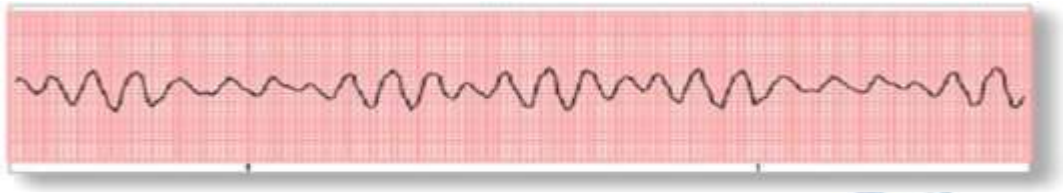
Management: _____

11.

Rhythm interpretation: _____

Management: _____

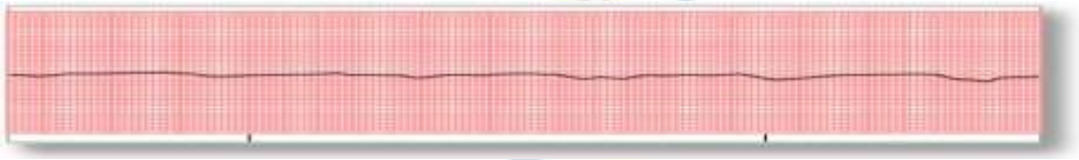
12.



Rhythm interpretation: _____

Management: _____

13.



Rhythm interpretation: _____

Management: _____

14

Rhythm interpretation: _____

Management: _____

15.

Rhythm interpretation: _____

Management: _____

16.

Rhythm interpretation: _____

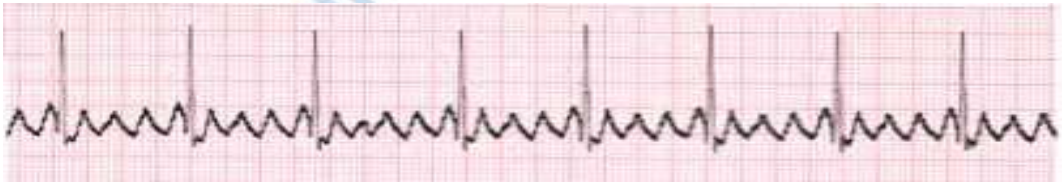
Management: _____

17.

Rhythm interpretation: _____

Management: _____

18



Rhythm interpretation: _____

Management: _____

19.How often do you defibrillate patients in a month?

a) None []

b) 0-5 cases []

c) 6-10 cases []

d) >10 cases []

20. How many cases do you cardiovert in a month?

a) None []

b) 0-10cases []

c) 11-20cases []

d) Above 20 cases []

21.Which type of cardioversion are you comfortable in performing?

a) Mechanical []

b) Chemical []

22.If chemical, which one?

Specify_____

Appendix III: MKU ERC Approval Letter

Mount Kenya University

REF: **MKU/ERC/1542** Date: 13 January 2021
TO: **ANNASTACIA MUTINDI MBATHA** REG: **MCSN/2016/57909**

Dear Sir/Madam,

RE: KNOWLEDGE LEVEL OF NURSES ON ELECTROCARDIOGRAM INTERPRETATION AND MANAGEMENT AT CRITICAL CARE UNITS, KENYATTA NATIONAL HOSPITAL

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **644.** The approval period is **29/01/2020 – 28/01/2021.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P.O. Box 342-01000 THIKA

Prof. Francis W. Muregi
Chairman, Mount Kenya University IERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika Tel: +254 67 2820 000

Appendix IV: Postgraduate Letter

Mount Kenya University

OFFICE OF THE DEAN, SCHOOL OF NURSING

REF: MKUOO/NURS/2020/57909 *05/03/2020*

The Director,

NACOSTI

Dear Sir,

RE: ANNASTACIA MUTINDI MBATHA MSCN/2016/57909

This letter is to introduce the above student who is pursuing Master of Science in Nursing –

Programme at Mount Kenya University, School of Nursing.

The student wishes to carry out a research on '***DETERMINANTS OF ELECTROCARDIOGRAPHIC INTERPRETATION AMONG NURSES AT CRITICAL CARE UNIT, KENYATTA NATIONAL HOSPITAL***'

Your support will be highly appreciated.

Thank you.

MOUNT KENYA UNIVERSITY
DEAN, SCHOOL OF NURSING
DATE.....
SIGN.....

Dr. Jane Karonjo
Dean, School of Nursing.
JK/jm

Main Campus, General Kago Road, P.O. Box 342-01000 Thika. Tel: +254 67 2820 000,
Cell: +254 720 790 796, 0709 153 000
Email:info@mku.ac.ke, Web: www.mku.ac.ke

Appendix V: NACOSTI Authorization

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **655949**

Date of Issue: **30/March/2020**

RESEARCH LICENSE

This is to Certify that Ms.. ANNASTACIA MUTINDI MBATHA of Mount Kenya University, has been licensed to conduct research in Nairobi on the topic: DETERMINANTS OF ELECTROCARDIOGRAPHIC INTERPRETATION AMONG NURSES AT CRITICAL CARE UNIT, KENYATTA NATIONAL HOSPITAL for the period ending : 30/March/2021.

License No: **NACOSTI/P/20/4674**

655949

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix VI: KNH Approval Letter

KNH/R&P/FORM/01

KENYATTA NATIONAL HOSPITAL
P.O. Box 20723-00202 Nairobi

Tel.: 2726300/2726450/2726565
Research & Programs: Ext. 44705
Fax: 2725272
Email: knhresearch@gmail.com

Study Registration Certificate

1. Name of the Principal Investigator/Researcher
   ANNASTACIA MUTINDI MBATHA
2. Email address: Mbatha626@gmail.com Tel No. 0722665248
3. Contact person (if different from PI) N/A
4. Email address: ..... Tel No. .....
5. Study Title
   Knowledge Level of Nurses on ECG interpretation and Management of Critical Care units, Kenyatta National Hospital.
6. Department where the study will be conducted Critical Care Unit
   (Please attach copy of Abstract)
7. Endorsed by Research Coordinator of the KNH Department where the study will be conducted.
   Name: ..... Signature ..... Date .....
8. Endorsed by KNH Head of Department where study will be conducted.
   Name: Dr K. Momanyi Signature ..... Date 06/10/2020
9. KNH UoN Ethics Research Committee approved study number _____
   (Please attach copy of ERC approval)
10. I ANNASTACIA M. MBATHA commit to submit a report of my study findings to the Department where the study will be conducted and to the Department of Research and Programs.
    Signature ..... Date 7.10.2020
11. Study Registration number (Dept/Number/Year) CCU 135/2020
    P146/01/2020
    (To be completed by Research and Programs Department)
12. Research and Program Stamp _____

All studies conducted at Kenyatta National Hospital **must** be registered with the Department of Research and Programs and investigators **must commit** to share results with the hospital.

Version 2: August, 2014

Appendix VII: KNH- UON ERC Approval Letter

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/327

23rd September 2020

APPROVED
2 1 SEP 2020
KNH/UoN-ERC

Annastacia Mutindi Mbatha
Reg. No.MScN/2016/57909
School of Nursing
Mount Kenya University

Dear Annastacia

RESEARCH PROPOSAL – KNOWLEDGE LEVEL OF NURSES ON ELECTROCARDIOGRAM INTERPRETATION AND MANAGEMENT AT CRITICAL CARE UNITS, KENYATTA NATIONAL HOSPITAL (P16/01/2020)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 23rd September 2020 – 22nd September 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website http://www.erc.uonbi.ac.ke

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
Supervisors: Dr. Nilufa Jivraj(School of Nursing, Mount Kenya University)
Lucy Wankuru Meng'anyi(School of Nursing, Mount Kenya University)

Appendix X: Location of Kenyatta National Hospital

Source: Google Maps (2019).

Appendix XI: Similarity Index

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