PREPAREDNESS OF RADIOLOGY DEPARTMENTS IN KENYATTA NATIONAL HOSPITAL AND UNIVERSITY OF NAIROBI DEPARTMENT OF DIAGNOSTIC IMAGING AND RADIATION MEDICINE TO ADEQUATELY MANAGE CARDIOPULMONARY ARREST EVENTS

PRINCIPAL INVESTIGATOR:
DR. GITAU DENNIS KAGONA
H58/34661/2019
DEPARTMENT OF DIAGNOSTIC IMAGING AND RADIATION MEDICINE,

A RESEARCH DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTERS OF MEDICINE IN DIAGNOSTIC IMAGING AND RADIATION MEDICINE, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF NAIROBI.

DECLARATION

I, **Dr. Gitau Dennis Kagona**, declare that the work contained herein is my original idea and has not been presented at any other university or institution of higher learning to the best of my knowledge.

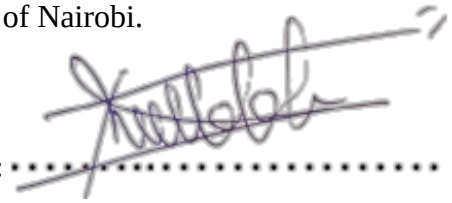
Dr. Gitau Dennis Kagona,

Signature:  **Date:** 02/11/2023

SUPERVISOR'S APPROVAL

This research proposal has been submitted with my approval as a university supervisor.

Dr. Mutala Timothy Musila, MBChB. (UON), MMed. Diagnostic Imaging (UoN)
Lecturer Department of Diagnostic Imaging and Radiation Medicine, Faculty of Health Sciences, University of Nairobi.



Signature: ..... **Date:** 02/11/2023

DEDICATION

I would like to dedicate this book to **God** almighty, for without him I am nothing. To my dear parents, **Stephen Gitau Kagona** and **Margaret Ngoiri Gitau**, for their unwavering support and encouragement. To my brother, **Ernest Ngugi Gitau**, for cheering me on and supporting me. To my lovely daughter, **Jewel Ngoiri Kagona**, for being my anchor and constant motivation through this journey.

ACKNOWLEDGEMENT

I would like to acknowledge my supervisor, **Dr. Timothy Mutala**, for his guidance and mentorship. I am forever grateful.

I acknowledge **Hamdi Issack** and **Fred Mboya** for their amazing and dedicated work as research assistants. Thank you for everything.

I acknowledge **Dr. Tej Thatthi, Dr. Parag Patel** and **Dr. Erin Nasrallah.** Working with you has been a blessing and inspiration to undertake this study.

May God bless you all.

DECLARATION OF ORIGINALITY FORM

UNIVERSITY OF NAIROBI

This form must be completed and signed for all works submitted to the University for Examination.

Name of student: **Dr. Gitau D. Kagona**

Registration Number: **H58/34661/2019**

Faculty/School/Institute: Faculty of Health Sciences

Department: Department of Diagnostic Imaging & Radiation Medicine

Title of the work: **PREPAREDNESS OF RADIOLOGY DEPARTMENTS IN KENYATTA NATIONAL HOSPITAL AND UNIVERSITY OF NAIROBI DEPARTMENT OF DIAGNOSTIC IMAGING AND RADIATION MEDICINE TO ADEQUATELY MANAGE CARDIOPULMONARY ARREST EVENTS**

DECLARATION

1. I understand what Plagiarism is and I am aware of the University's policy in this regard.
2. I declare that this Thesis (Thesis, project, essay, assignment, paper, report etc) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work, or my own work has been used, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.
3. I have not sought or used the services of any professional agencies to produce this work
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own work
5. I understand that any false claim in respect of this work shall result in disciplinary action in accordance with University Plagiarism Policy.

Signature:  Date: 02/11/2023

DEPARTMENTAL APPROVAL

This dissertation has been presented and approved by the Department of Diagnostic Radiology and Radiation Medicine.

Dr. Callen Kwamboka Onyambu

Chairperson

Department of Diagnostic Imaging and Radiation Medicine,

University of Nairobi.

P.O. Box 30197 – 00100, Nairobi

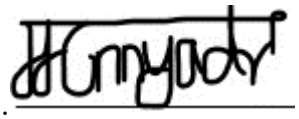
Signed…  Date: 02/11/2023

TABLE OF CONTENTS

STUDENT'S DECLARATION ii
SUPERVISOR'S APPROVAL iii
DEDICATION iv
ACKNOWLEDGEMENT v
DECLARATION OF ORIGINALITY FORM vi
DEPARTMENTAL APPROVAL vii
TABLE OF CONTENTS viii
LIST OF FIGURES xi
LIST OF TABLES xi
LIST OF ABBREVIATIONS AND ACRONYMS xii
ABSTRACT xiii
1.0 CHAPTER ONE: INTRODUCTION 1
1.1 Background 1
2.0 CHAPTER TWO: LITERATURE REVIEW 3
2.1 Current Situation 3
2.1.1 Situation in Radiology Departments Internationally 3
2.1.2 Situation in Radiology Departments Locally 4
2.2 Relevant Training, Training Formats and Rationale 5
2.3 Equipment Requirements 6
2.4 Study Justification 7
2.5 Research Question 7
2.6 Hypothesis 8
2.7 Study Objectives 8
2.7.1 Broad Objective 8
2.7.2 Specific Objectives 8
3.0 CHAPTER THREE: METHODOLOGY 9
3.1 Study Design 9
3.2 Study Area Description 9
3.2.1 Specific Study Sites 9
3.3 Study Population 9
3.3.1 Population Characteristics 9

3.3.2 Inclusion/Exclusion Criteria 9
3.4 Study Sample 10
3.5 Sample Size Determination 10
3.6 Sampling Procedure 10
3.7 Recruitment and Consenting Procedures 10
3.8 Variables 10
3.8.1 Independent Variables 10
3.8.2 Dependent Variables 11
3.9 Data Collection Procedures 11
3.10 Materials 11
3.11 Quality Assurance Procedures 11
3.12 Ethical Consideration 11
3.13 Data Management 12
3.14 Study Results Dissemination Plan 12
3.15 Study Limitations 12
3.16 Study Closure 12
4.0 CHAPTER FOUR: RESULTS 13
4.1 Introduction 13
4.2 Demographic Characteristics 13
4.3 Attitude Towards Emergency Life Support Training 13
4.4 Self-Assessment On BLS/ACLS Knowledge, Skills Levels and Equipping of The Department 15
4.5 Knowledge Levels on Current BLS And ACLS Guidelines 17
4.6 BLS And ACLS Certification Status 20
4.7 Factors Associated with BLS And ACLS Certification 21
4.8 Factors Associated with BLS And ACLS Knowledge Levels 23
4.9 Availability of Resuscitation Equipment 24
5.0 CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS 25
5.1 Discussion 25
5.1.1 Demographic Characteristics 25
5.1.2 Attitude Towards Emergency Life Support Training 25
5.1.3 Self-Assessment on BLS/ACLS Abilities Versus Knowledge Levels on the Guidelines 26
5.1.4 BLS And ACLS Certification Status and Factors Associated with Certification .28

5.1.5 Factors Associated with BLS And ACLS Knowledge Levels 29
5.1.6 Self-Assessment Versus Availability of Resuscitation Equipment 29
5.2 Limitations 31
5.3 Conclusion 31
5.4 Recommendations 31
REFERENCES 32
APPENDICES 35
Appendix A. Data collection form (Demographics, attitudes and knowledge levels) 35
Appendix B. Data Collection Form (Equipment Checklist) 42
Appendix C: Consent Information Document 45
Appendix D: Consent form (statement of consent) 48
Appendix E: KNH/UoN-ERC Letter of Approval 50
Appendix F: Approval of Modification 52
Appendix G: Certificate of Plagiarism 54

LIST OF FIGURES

Figure 1:Believe that BLS training is relevant 14
Figure 2:Believe that ACLS training is relevant 14
Figure 3:Self-assessment on availability of equipment 16
Figure 4:Self-assessment on ability to offer BLS 16
Figure 5:Self-assessment on ability to offer ACLS 17
Figure 6:Overall knowledge on BLS and ACLS guidelines 18

LIST OF TABLES

Table 1:Demographic characteristics of the study respondents 13
Table 2:Observation of cardiac or respiratory arrest in a radiology department 15
Table 3:Knowledge on basic life support guidelines amongst the respondents 18
Table 4:Knowledge on acute cardiovascular life support guidelines 19
Table 5:Certification on basic life support (BLS) and Advanced cardiovascular life support (ACLS) 20
Table 6:Factors affecting BLS certification amongst respondents 21
Table 7:Factors affecting ACLS certification among the respondents 22
Table 8:Factors affecting knowledge on BLS and ACLS guidelines 23
Table 9:Availability of resuscitation equipment 24

LIST OF ABBREVIATIONS AND ACRONYMS

ACLS	Advanced Cardiovascular Life Support
AED	Automated External Defibrillator
AHA	American Heart Association
ARLS	Advanced Radiology Life Support
BLS	Basic Life Support
CPA	Cardiopulmonary arrest
CPR	Cardiopulmonary resuscitation
CT	Computed tomography
DDIRM	Department of Diagnostic Imaging and Radiation Medicine
ED	Emergency Department
KNH	Kenyatta National Hospital
UK	United Kingdom
UON	University of Nairobi

ABSTRACT

Study Background: Cardiopulmonary arrest refers to the sudden loss of heart function and is a common occurrence in the hospital and associated with a high mortality rate. The radiology department is one of the areas in the hospital where cardiopulmonary arrest events may occur with some studies showing worse patient outcomes when the events occur during radiological procedures. The chances of survival after cardiopulmonary arrest are heavily dependent on the rapid initiation of the chain of survival which forms the basis for life support training courses including Basic Life Support (BLS), Advanced Cardiovascular Life Support (ACLS) and Advanced Radiology Life Support (ARLS). Practice of the guidelines has been shown to not only facilitate timely decision making but also to positively impact the morbidity and mortality rate following cardiopulmonary arrest events. For radiology departments to adequately manage these events, the staff needs to be up to date on current life support guidelines and well equipped to practice them. Few studies have been carried out to assess the management of cardiopulmonary arrest in radiology departments locally.

Broad Objective: To evaluate the preparedness of radiology departments in Kenya to adequately respond to cardiopulmonary arrest events by assessing staff attitudes and knowledge levels on basic and advanced life support, certification status and availability of the necessary resuscitation equipment.

Study design and sites: An observational, cross-sectional study conducted in radiology departments in Kenyatta National Hospital (KNH) and University of Nairobi Department of Diagnostic Imaging and Radiation Medicine (UoN-DDIRM).

Participants and method: Study subjects were 75 health professionals including radiologists (12%), radiology residents (34.7%), radiographers (41.3%) and radiology nurses (12%) from the two facilities who met the inclusion criteria. Data was collected via two structured questionnaires. The collected data was entered in SPSS and analyzed for prevalence and prevalence odds. Conclusions on adequacy of practice and the factors affecting the ability of radiology departments to adequately manage cardiopulmonary events were drawn from the data collected.

Results: The findings revealed that 50(66.7%) of the respondents were female, 54(72%) were aged between 20 to 35 years. Thirty-one (41.3%) of the respondents were radiographers and twenty-six (34.7%) were radiology residents. Majority of the respondents felt that life support training was relevant in their field of practice with 73(97.3%) for basic life support and 67(89.3%) for advanced cardiovascular life support training. 47(62.7%) of respondents reported having witnessed a patient go into cardiac or respiratory arrest in a radiology department with CPR being initiated in 42(89.3%) of the cases and achieving return of spontaneous circulation (ROSC) in 27(64.3%) of the attempts. An automated external defibrillator or manual defibrillator was reported to have been used 10(30.3%) of the times. 50(66.7%) were familiar with the location of resuscitation equipment and drugs in the radiology department with 27(36%) of them checking the resuscitation cart before starting procedures each day.

Findings showed that 51(68%), 52(69.3%) and 58(77.3%) of the respondents felt either comfortable or very comfortable in identifying signs of impending and ongoing cardiac arrest, initiating CPR and their ability to give adequate chest compressions.

Majority of the respondents 49(65.3%) and 56(74.7%) did not feel comfortable using an Automated External Defibrillator (AED) and manual defibrillator respectively. 36(48%) were not comfortable identifying emergency cardiac rhythms while 39(52%) were not comfortable being team leader during resuscitation. The group had an average knowledge level of 51.6% and 46.1% for BLS and ACLS guidelines respectively. Only 20(27%) of the respondents had good overall knowledge on BLS and ACLS guidelines. Majority had been exposed to BLS (85.3%) and ACLS (62.7%) training at least one but recertification rates were low with only 21(32.8%) and 13(27.7%) of the respondents having valid BLS and ACLS certification at the time of the study.

Gender (df =1, p =0.035), cadre of the respondent (df =3, p =0.009 and having ACLS certification (df =1, p<0.001) were shown to be significantly associated with BLS certification while gender (df =1, p =0.018), cadre of the respondent (df =3, p<0.001), having BLS certification (df =1, p<0.001) and believe that ACLS is relevant in the field of practice (df =1, p =0.003) were significantly associated with ACLS certification. Age of the respondent (df =2, p=0.019) and cadre of the respondent (df =2, p =0.043) were significantly associated with good knowledge on BLS and ACLS guidelines.

KNH Siemens CT room had 31.8% of items in the airway and breathing checklist, 28.6% of the items in the circulation checklist and 50% items in the drugs checklist. The IR suite had 68.2% of items in the airway and breathing checklist, 57.1% of the items in the circulation checklist and 25% of items in the drugs checklist. The MRI room and Neusoft CT room had 40.9% and 36.4% of items in the airway and breathing checklist, 35.7% and 21.4% of the items in the circulation checklist respectively and 37.5% each for items in the drugs checklist. UoN-DDIRM did not have an emergency trolley or tray at the time of the study which was the case since the department stopped offering fluoroscopy services.

Conclusion: In this study we were able to conclude that CPA does occur in our radiology departments and resuscitation saves lives. Despite a belief that training is relevant and a good attitude towards the same amongst the respondents, the majority did not have valid certification leading to a knowledge gap on the current BLS/ACLS guidelines. There was a discrepancy between the knowledge levels and the respondents' confidence levels in their own ability to manage CPA. The departments were found not to be adequately equipped with the required items for the practice of the resuscitation guidelines.

1.0 CHAPTER ONE: INTRODUCTION

1.1 Background

Cardiopulmonary arrest (CPA), also commonly referred to as cardiac arrest is the sudden loss of heart function with drops in perfusion and ventilation. In-hospital cardiac arrest is common and associated with a high mortality rate (1) and thus the need for health professionals working in areas handling critically ill patients to be adequately prepared to manage CPA.

Some of these cardiac arrest cases can occur in the radiology department despite efforts and advancements in stabilizing patients before diagnostic and interventional radiology procedures, a rare but potentially lethal occurrence. Common locations for CPA within the radiology department include the CT scan room and vascular procedures area, 33% and 30% of cases respectively (2). Anaphylactic reactions to contrast media, though infrequent, are also seen with CPA being one of the possible severe outcomes. It is therefore important for health professionals to have the knowledge and skills to ensure optimal patient care as observed by Onyambu and her colleagues (3).

Though cardiac arrest events are relatively infrequent in radiology departments, the importance of staff in these departments being capable of initiating basic life support cannot be overemphasized. This was demonstrated in a study assessing in-hospital overall outcomes of cardiac arrest in two hospitals in Cape Town which showed that cardiac arrests in the imaging department had the worst outcomes in the hospitals (4). To ensure the best possible outcomes for patients suffering CPA in our radiology departments, deliberate efforts to determine the root causes of this finding are a necessary step to finding ways to improve the departments' preparedness in the management of cardiac arrest.

The chances of survival after CPA are heavily dependent on the rapid initiation of a sequence of events commonly referred to as the chain of survival (5). These events include early identification of cardiopulmonary arrest, activation of the emergency response system, early initiation of cardiopulmonary resuscitation (CPR), early defibrillation, airway management and use of appropriate emergency medication. The rapid initiation of the chain of survival is dependent on the ability of health professionals to quickly and confidently make decisions during a high-pressure situation and hence the formulation and regular updates on resuscitation guidelines that were first developed in 1966 by the National Research Council in America in a bid to standardize training and practice.

From then on, the guidelines were updated every 5 years up until 2015 when the process of 5-year updates changed to a format that uses continuous evidence evaluation rather than periodic reviews allowing for significant changes in scientific evidence to be reviewed and incorporated directly into the guidelines as appropriate (6).

The latest updates to the American Heart Association (AHA) guidelines for CPR were published on 21st October 2020 reviewing several evidence-based recommendations for resuscitation. Some of the highlighted updates include reaffirmation of the benefits of early high quality chest compressions, early defibrillation for ventricular fibrillation and pulseless ventricular tachycardia and early use of epinephrine. Of note is an update directly relating to the use of radiology in resuscitation with the use of point-of-care ultrasound noted as useful in identification of potentially reversible causes of cardiac arrest like cardiac tamponade and tension pneumothorax but not recommended for use in prognostication (7).

The AHA guidelines form the basis of most Basic Life Support (BLS) and Advanced Cardiovascular Life Support (ACLS) certification courses which are the most common life support training programs. Advanced Radiology Life Support (ARLS) is a course fashioned after the ACLS course with focus on unique emergencies that can occur in the radiology department including anaphylactic reactions to contrast media (3).

Healthcare systems with a responsibility for the management of patients in cardiac arrest, including radiology departments, should evaluate their processes to ensure that they are able to deliver care that ensures the best achievable survival rates (8). The outcome in a patient with a cardiac event depends on the knowledge and skills of the resuscitator and the promptness in which care is initiated (9). Promptness in initiating care is also heavily dependent on the availability of the necessary medical equipment and the attitudes of the health professionals as noted by Lenjani and colleagues. Based on this assertion, this study seeks to assess the resuscitation knowledge amongst radiology staff according to the latest guidelines and identify factors that could affect the uptake of training and the timely initiation of resuscitation in radiology departments.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Current Situation

With the continuous growth in the field of radiology, a wider variety of radiological examinations and procedures are currently available for patient investigation and management. This means more patients, including critically ill patients, are being attended to in the radiology department. Despite medical advancements in patient monitoring and efforts to stabilize critically ill patients before radiological procedures, these patients may destabilize in the radiology department and go into CPA (10).

Another factor that could lead to CPA in the departments is that patients may suffer severe adverse reactions to the contrast media used for a large number of radiological procedures. Advancements in the chemical composition of the contrast and careful patient selection have made severe reactions including CPA infrequent, but not unheard of (3).

CPA still remains a possibility in our radiology department and one that has a high mortality rate especially when not promptly managed.

2.1.1 Situation in Radiology Departments Internationally

Researchers in various countries have investigated the life support knowledge levels of health professionals. Some of the studies focused only on radiology department staff while others tried to compare findings from various departments in the hospital.

One of these studies carried out in Pakistan assessing Basic Life Support (BLS) knowledge amongst 29 radiology consultants and 95 radiology residents concluded that radiology consultants and residents lacked adequate knowledge and thus were unable to appropriately manage adult cardiopulmonary arrest scenarios (11). These findings by Tariq and colleagues were in line with the results of a study carried out in the Department of Clinical Radiology, University Hospital of Wales that highlighted a significant lack of knowledge on adult resuscitation in the department (12).

In South Africa, Vorster and Beningfield carried out a study seeking to determine if radiology staff in public hospitals in the Western Metro of Cape Town felt confident enough to initiate BLS. They demonstrated a lack of confidence in providing basic life support amongst the participants (13). Only 2 of the 74 respondents in this study had undertaken BLS training within the year preceding the study which is in keeping with findings from other similar studies that showed that many health professionals were not up to date on their

certification. Participants were of the opinion that regular training and better support systems were necessary to improve their confidence and skill levels.

Closer home, while assessing CPR knowledge and skills amongst health workers in Muhimbili National Hospital in Tanzania, Kaihula et al demonstrated poor levels in CPR knowledge and skills with only 13% of participants achieving the international minimum passing test score of 75% in either the written or practical test (14). This study included participants from all the departments in the hospital though only 5.4% (n = 19) were from the radiology department. When results were analysed per department, participants from the emergency department (ED) had significantly higher test scores with no significant difference in scores amongst participants from the other departments including radiology.

2.1.2 Situation in Radiology Departments Locally

Locally, a study looking at knowledge and skills in managing CPA amongst radiologists, radiology residents and radiographers was carried out in 2016 at Kenyatta National Hospital (KNH), the leading teaching and referral hospital in the region. The investigators demonstrated knowledge gaps in management of CPA and anaphylactic reactions which they largely attributed to lack of adequate training with most of the study participants having not been trained in any life support course in the 5 years preceding the study (14). 83% of the 80 study participants reported to have taken part in at least one life support training course during their career. This however did not reflect in the questionnaire results with the majority of the respondents scoring less than 50% highlighting the importance of regular recertification training.

Osiemo and her colleagues went a step further to assess the exposure of the respondents to cardiopulmonary arrest events and their awareness of the location of resuscitation equipment in the department. 38% (n=31) of the respondents had witnessed a cardiopulmonary arrest event in the radiology department with the chain of survival being initiated in 71.9% of the reported events. The outcomes of the resuscitation attempts and reasons for failure to initiate care as per the BLS/ACLS guidelines in the remaining cases were not assessed in this study. 63.8% of participants were aware of where the resuscitation equipment was located in the department but only 12.5% (n=10) made a point to check them before radiological procedures. This could lead to delays in initiating appropriate CPA management as valuable time may be wasted looking for the equipment or troubleshooting those with malfunctions not identified prior to the start of the procedure.

According to the author's knowledge, this is the only study carried out locally looking at the management of CPA in radiology departments, further highlighting the need for more work to be done in this area. In a study looking at CPR knowledge and its impact on practice amongst clinicians in Coast General Hospital, it was found that the majority 68.8% (n=97) had trained in CPR. Despite the high number of trained participants, 75.9% (n=104) were scored below average on specific aspects on CPR knowledge which could be partly explained by the fact that 33.3% (n= 47) of the clinicians had taken more than three years since their last training which is more than the recommended 1 to 2 years for recertification. This significantly affected the way they rated their CPR practices. The researchers concluded that CPR practices at Coast General Hospital were significantly affected by the clinicians' knowledge (15). The study participants were from various departments in the hospital but unfortunately failed to include the radiology department. A similar study was undertaken to determine the knowledge, attitude and practice of CPR amongst anesthesiology and obstetrics residents in KNH. On top of identifying gaps in knowledge levels, the researcher also demonstrated that participants thought lack of equipment (77.5%), lack of knowledge (65%) and lack of teamwork (55%), were the major factors affecting the practice of CPR (16).

The findings of these local studies are in line with those carried out in other countries and confirm low resuscitation knowledge and skills levels amongst health professionals not only in radiology departments but also in other departments that were included in the studies.

2.2 Relevant Training, Training Formats and Rationale

The use of the resuscitation guidelines has not only been beneficial in ensuring that healthcare providers know exactly what to do in the event of cardiopulmonary arrest but has also been shown to reduce the mortality rate associated with these events. A study assessing outcomes in participants suffering cardiopulmonary arrest in the radiology department found that after resuscitation 19 patients (70%) survived the initial code, 14 patients (52%) survived 24 hours, and 9 patients (33%) survived until discharge (2). This shows the potential positive impact that training health professionals in resuscitation skills and facilitating them to practice the same can have on patient outcomes.

The chain of survival forms the basis of BLS and ACLS training which is key in ensuring proper management of cardiopulmonary arrest. Some of the recognized training formats include theoretical CPR instruction, video-assisted instruction, simulation, multimedia learning and a combination of self-directed learning and instructor-led teaching with hands-

on training (17). A comparison of a two-day class-based training format and a format replacing one of the days with online sessions found no significant difference in first aid and BLS competencies of the study population (18). Based on this, radiology departments can choose a training format that best fits the busy schedules of radiologists and radiology students while still achieving the desired outcomes.

As with all other forms of knowledge, degradation over time is noted with BLS and ACLS knowledge and skills with performance skills degrading faster (19). The authors of this study highlighted the need for frequent refresher training in line with recommendations of the Resuscitation Council in the United Kingdom for clinical staff to update their skills annually (20). Health professionals should undergo resuscitation training as part of their professional studies and frequent, time-specific refresher or recertification courses thereafter have shown to be necessary in knowledge and skills retention. (21,22)

In a study titled Factors influencing the level of knowledge of cardiopulmonary resuscitation in hospitals in Peru, Aranzabal sought to determine the association between social and education factors and CPR knowledge. 59% of the 1075 respondents failed the CPR test corresponding with findings from other studies showing low knowledge levels amongst health professionals. The authors also demonstrated that more experience working in emergency services and being a physician or a nurse was associated with better knowledge. Respondents still in training, interns and residents, had the lowest scores pointing toward the importance of learning through working experience and the role the combined load of academic and clinical work could have on knowledge decay (23).

2.3 Equipment Requirements

As with most aspects of medical practice, proper patient care is not only dependent on availability of motivated and knowledgeable health professionals, but also proper facilitation to enable them to apply the knowledge and skills they possess. Facilitation includes provision of a conducive working environment including functional and well-maintained medical equipment. The standards for clinical practice and training for CPR in the UK include a list of the required equipment for the proper practice of BLS and ACLS guidelines. Oxygen, suction devices, resuscitation drugs, equipment for airway management, circulatory access and fluid administration, cardiac monitor, Automated External Defibrillator (AED) and/or a manual defibrillator are deemed necessary for adequate cardiopulmonary resuscitation.

The equipment is usually placed in a crash cart and should be ideally checked daily with all staff members being familiar with the location of such equipment in their work stations (20). Hogh and colleagues demonstrated significant variation in resuscitation equipment available in various clinical areas with accident and emergency departments (A&E) and critical care units (CCU) more likely to be better equipped than medical, surgical, obstetrics and gynecology wards (24). This study did not include data on radiology departments despite the central role that they play in management of critically ill patients.

Given prior findings that health professionals thought a lack of equipment to be one of the factors affecting their ability to adequately manage CPA, establishing availability of the same in radiology departments is crucial.

2.4 Study Justification

The radiology department is one of the areas in the hospital where cardiopulmonary arrest events may occur with some studies showing worse patient outcomes when the events occur during radiological procedures. The chances of survival after cardiopulmonary arrest are heavily dependent on the rapid initiation of the chain of survival which forms the basis for life support training courses including Basic Life Support, Advanced Cardiovascular Life Support and Advanced Radiology Life Support.

Review of various publications on BLS and ACLS knowledge and practice consistently highlighted low knowledge and skill levels amongst health workers both internationally and locally. Many of the studies did not focus on the radiology department with some totally excluding or having a very small number of staff from the radiology department amongst the respondents. The study carried out in KNH by Osiemo et al. highlighted low life support knowledge and skill levels amongst the staff in the radiology department with a lack of up-to-date training being a major contributor to the finding.

The study did not include radiology nurses who are important members in the resuscitation team. This study hopes to build on this by evaluating the current knowledge and skill levels in BLS and ACLS guidelines amongst staff in the radiology departments and further defining the factors affecting the uptake of training and practice of the same in radiology departments including availability of the necessary equipment.

2.5 Research Question

Are radiology departments in KNH and UoN-DDIRM well prepared to adequately respond to cardiopulmonary arrest events during radiological procedures and what are the factors influencing the same?

2.6 Hypothesis

The management of cardiopulmonary arrest in radiology departments in KNH and UoN-DDIRM is not limited by staff knowledge levels, staff attitudes towards resuscitation and the resuscitation equipment available in the departments.

2.7 Study Objectives

2.7.1 Broad Objective

To evaluate the preparedness of radiology departments in KNH and UoN-DDIRM to adequately respond to cardiopulmonary arrest events by assessing staff attitudes and knowledge levels on basic and advanced life support, certification status and availability of the necessary resuscitation equipment.

2.7.2 Specific Objectives

a) To determine attitudes of radiology staff on their own knowledge and skill levels in preparedness for cardiopulmonary arrest events.

b) To assess knowledge of current BLS and ACLS guidelines amongst radiologists, radiology residents, radiographers and radiology nurses.

c) To determine certification status and factors affecting uptake and practice of BLS and ACLS certification training amongst staff in radiology departments.

d) To assess availability and state of equipment necessary for Cardiovascular resuscitation in radiology departments.

3.0 CHAPTER THREE: METHODOLOGY

3.1 Study Design

This was an observational, cross-sectional study

3.2 Study Area Description

The study looked to recruit participants from the two facilities that partner to offer the largest public radiology training program in Kenya.

3.2.1 Specific Study Sites

Radiology departments in the following facilities;

- Kenyatta National Hospital (KNH) – level VI teaching and national referral hospital, Nairobi
- University of Nairobi Department of Diagnostic Imaging and Radiation Medicine (UON - DDIRM) – teaching department in partnership with KNH Nairobi

3.3 Study Population

3.3.1 Population Characteristics

Participants were drawn from radiologists, radiology residents, radiology nurses and radiographers from the above-mentioned facilities that consented to take part in the study

3.3.2 Inclusion/Exclusion Criteria

3.3.2.1 Inclusion Criteria

- Consultant radiologists working full time or on locum basis in the above-mentioned facilities
- Radiology residents from the listed facilities that offer radiology training
- Radiographers and sonographers working full time or on locum basis in the listed facilities
- Nurses working full time or on locum basis in the above-mentioned radiology departments
- Consent to take part in the study

3.3.2.2 Exclusion criteria

- Visiting members of staff
- Visiting radiology residents
- Staff who did not consent to be part of the study

3.4 Study Sample

The study sample was drawn from the study population.

3.5 Sample Size Determination

A sample size for the study was calculated using the Cochran formula (1963) with a confidence level of 95%, precision of 0.05 and assuming a prevalence of 50%.

$$n_0 = \frac{Z^2 pq}{e^2}$$

where Z = 1.96

p = estimated proportion with adequate knowledge (50%)

e = desired level of precision (0.05)

q = 1 - p

Using the above formula, a Cochran sample size (css) of 385 participants was arrived at.

To better suit the study's small study population, the modification for the Cochran formula was applied;

$$\text{New sample size} = \frac{\text{cochran sample size (css)}}{1 + \left(\frac{\text{css} - 1}{\text{Total population size (93)}}\right)}$$

This gave us a modified sample size of 75 participants.

3.6 Sampling Procedure

Participants were selected using the random sampling method for the assessment of knowledge, attitude and certification status. All the facilities were assessed on the availability of resuscitation equipment.

3.7 Recruitment and Consenting Procedures

Participants were informed in English on the purpose of the study and that participation was to be voluntary and anonymous. Consent was sought through a consent form sent electronically to eligible participants as part of the recruitment process.

3.8 Variables

3.8.1 Independent Variables

- Demographics: age and gender

- Cadre
- Work station
- BLS/ACLS certification status
- Resuscitation equipment available in each department
- Exposure to CPA events in the department

3.8.2 Dependent Variables

- BLS/ACLS test scores
- Self-assessment on BLS/ACLS practices
- Attitudes on BLS/ACLS training
- Awareness of availability and location of resuscitation equipment

3.9 Data Collection Procedures

Two structured questionnaires were used for data collection. The first questionnaire was filled by all eligible consenting participants and collected data on demographics, BLS/ACLS knowledge and skill levels, self-assessment on BLS/ACLS practice, attitudes on BLS/ACLS training and awareness on availability and location of resuscitation equipment. The questionnaire was uploaded on Google forms and the link shared to respondents electronically for them to fill.

The second questionnaire was filled by research assistants in each of the radiology departments participating in the study and collected data on the types, number and status of resuscitation equipment available in each center.

3.10 Materials

Materials required for the study were airtime and internet access.

3.11 Quality Assurance Procedures

The questionnaire section assessing BLS/ACLS knowledge levels was balanced and sectioned.

3.12 Ethical Consideration

Permission to undertake the study was sought from the administration of each of the participating facilities. The study was conducted in accordance with the Declaration of Helsinki by the World Medical Association. As per the declaration, the study was carried out in a manner that did not expose the respondents to any risk or infringe on their rights.

Participation in the study was voluntary, anonymous and participation did not lead to any increased burden to the participants including financial costs.

3.13 Data Management

The collected data was entered in SPSS and analyzed for prevalence and prevalence odds.

3.14 Study Results Dissemination Plan

The findings of the study were shared electronically with all participating departments in the form of a facility-specific report. The report also includes recommendations drawn from analysis of the collected data.

3.15 Study Limitations

Given the busy schedule of radiology department staff members, the response rate may have been low. This was addressed by clearly explaining the objective of the study to the participants during recruitment and follow up via email and text messages.

3.16 Study Closure

The study was declared closed once data collection stopped with reminders sent to participants two weeks prior. The closure was also communicated to the departmental administration.

4.0 CHAPTER FOUR: RESULTS

4.1 Introduction

The present study sought to assess the preparedness of radiology departments in KNH and UoN-DDIRM to manage cardiopulmonary arrest. The sample size was 75 participants from both departments. We had a 100% (9/9) response rate from nurses in the radiology departments with response rates lower than 50% recorded from consultant radiologists and radiographers.

4.2 Demographic Characteristics

72% of respondents were 35 years of age and below. 76% of the respondents were either radiographers (41.3%) or radiology residents (34.7%) with the majority of respondents 66.7% (50/75) being female. Other general characteristics are as shown in Table 1.

Table 1:Demographic characteristics of the study respondents

GENDER Male Female	FREQUENCY 25 50	PERCENT 33.3 66.7
AGE 20 – 35 Years 36 – 50 Years > 50 Years	 54 16 5	 72.0 21.3 6.7
CADRE Nurse Radiographer Radiology Resident Consultant Radiologist	 9 31 26 9	 12.0 41.3 34.7 12.0
WORKSTATION Kenyatta National Hospital (KNH) University of Nairobi - DDIRM	 59 16	 78.6 21.3

4.3 Attitude Towards Emergency Life Support Training

Results showed that the majority of the respondents believed that training in both BLS (97.3%) and ACLS (89.3%) is relevant in their work as shown in Figure 1 and Figure 2 respectively.

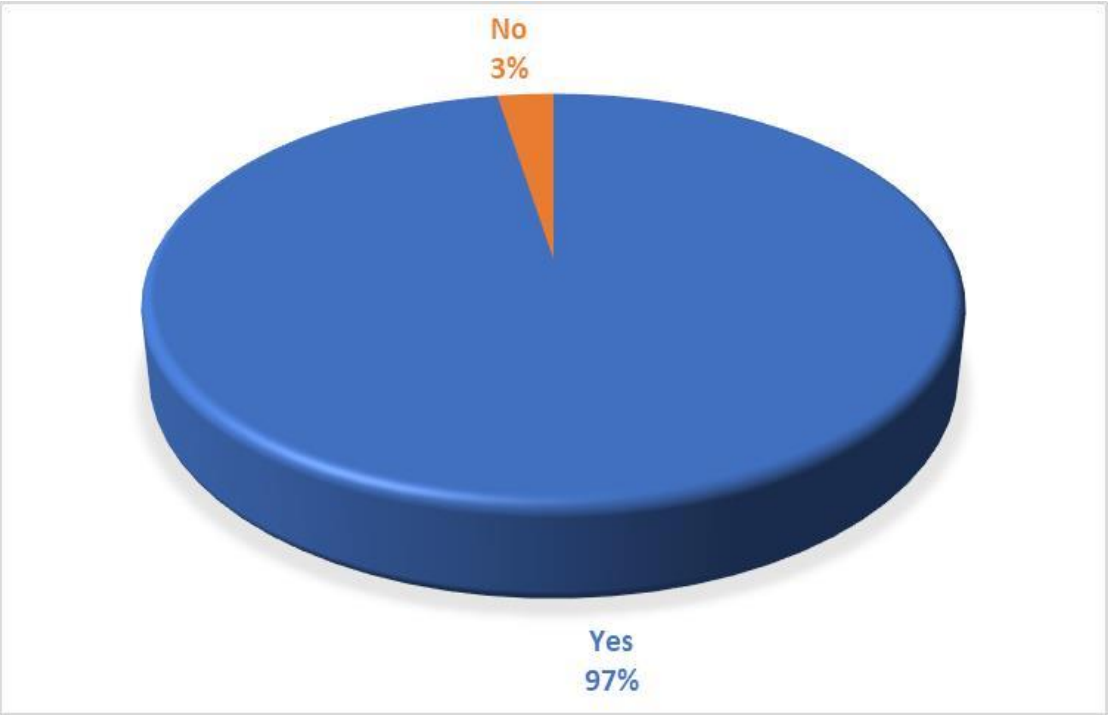


Figure 1:Believe that BLS training is relevant

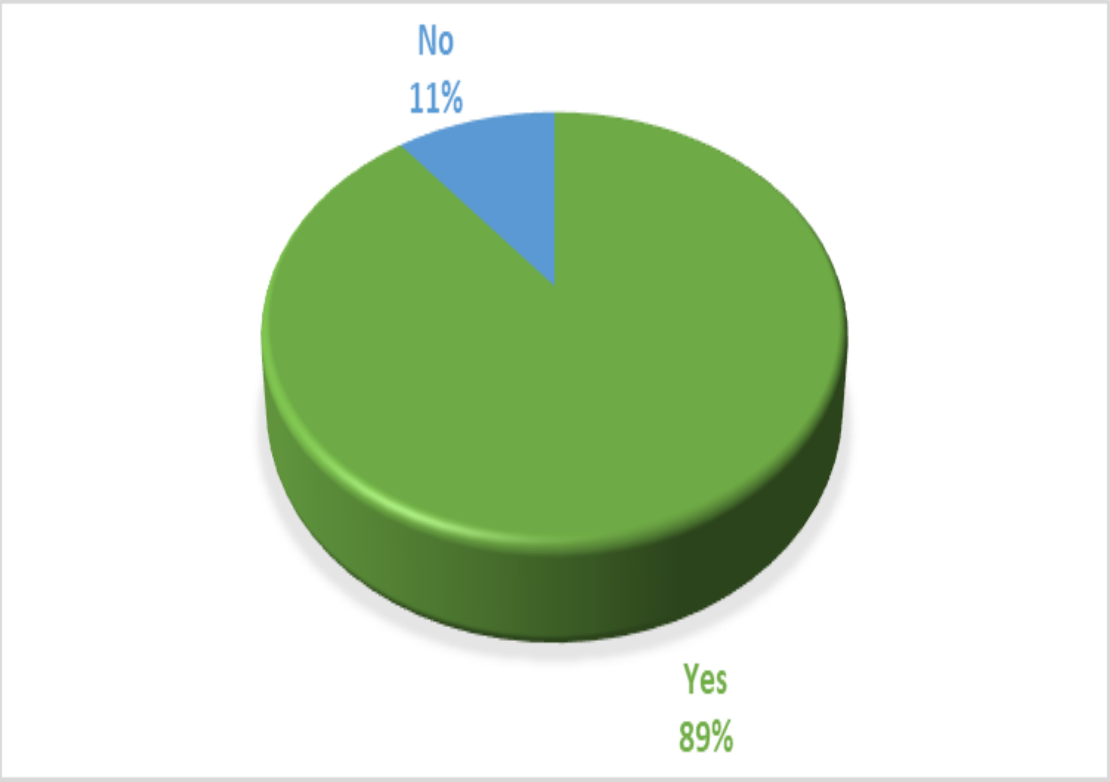


Figure 2:Believe that ACLS training is relevant

47 (62.7%) of participants responded in the affirmative to having witnessed a patient go into CPA in the radiology department. CPR was initiated in 42(89.3%) of these incidents with return of spontaneous circulation (ROSC) reported in 27 (64.3%) of the patients as shown in Table 2.

Table 2:Observation of cardiac or respiratory arrest in a radiology department

Table 2: Observation of Cardiac or Respiratory Arrest in a Radiology Department		
Have you ever observed a patient go into cardiac or respiratory arrest in a radiology department Yes No	FREQUENCY 47 28	PERCENT 62.7 37.3
Was CPR initiated Yes No	 42 5	 89.3 10.7
What was the outcome (N =42) Return of spontaneous circulation (ROSC) No return of spontaneous circulation	 27 15	 64.3 35.7
Was an Automated External Defibrillator or manual defibrillator used (N =33) Yes No	 10 23	 30.3 69.7

4.4 Self-Assessment On BLS/ACLS Knowledge, Skills Levels and Equipping of The Department

Only 29.3% of respondents thought that their department was adequately equipped for management of CPA while 41.4% did not know if the department was well equipped or not. 66.7% reported being familiar with the location of resuscitation equipment and drugs in the department but only 36% responded in the affirmative to checking the equipment and drugs before starting procedures each day as shown in Figure 3.

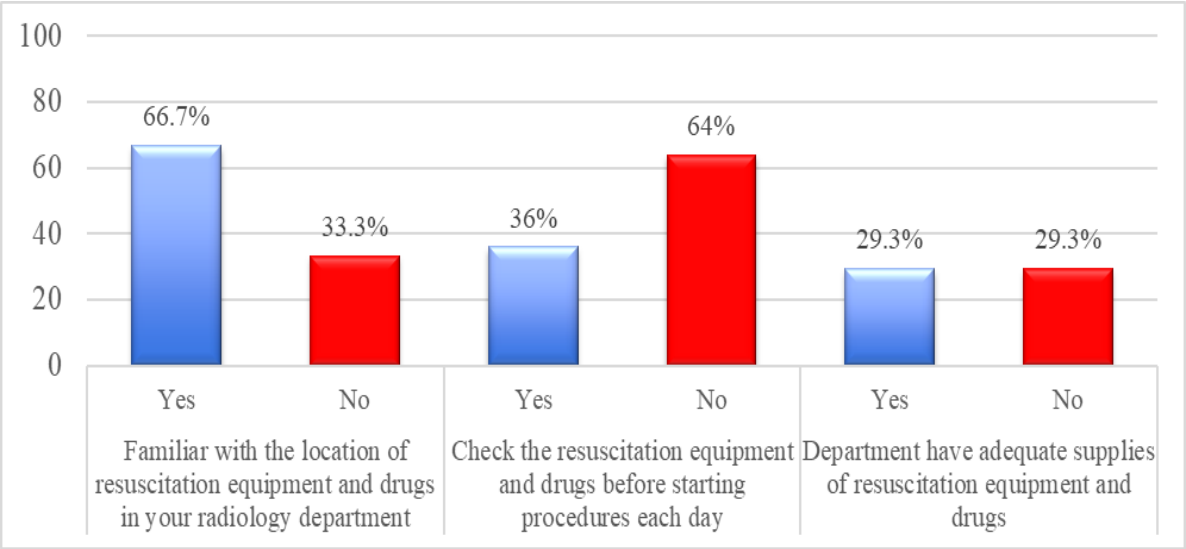


Figure 3:Self-assessment on availability of equipment

Majority of the respondents expressed confidence in their ability to practice 3 of the 4 key BLS components that they were asked to assess themselves on. 68%, 69.3% and 76.3% of the respondents were either comfortable or very comfortable with their ability to identify signs of impending/ongoing cardiac arrest, initiate CPR and give adequate chest compressions respectively. Most respondents were not confident in their ability to use an Automatic External Defibrillator (AED) with 65.3% not being comfortable as demonstrated in Figure 4.

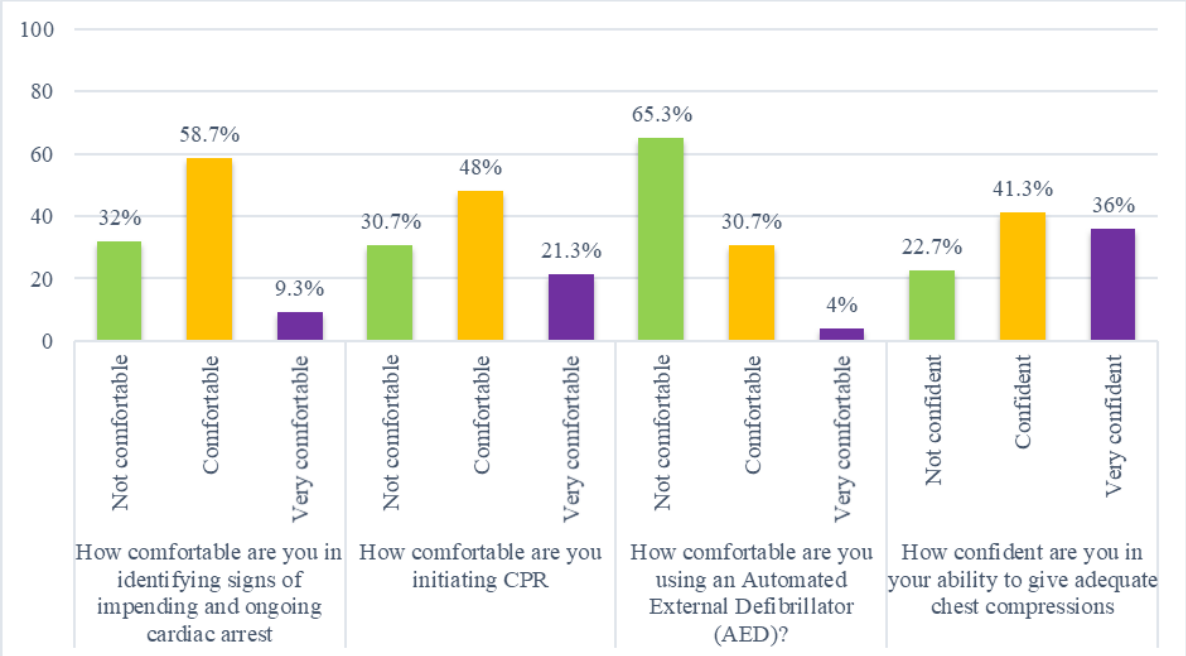


Figure 4:Self-assessment on ability to offer BLS

The respondents expressed low confidence levels in their ability to practice the 3 main ACLS components included. 52% and 74.7% of respondents were not comfortable being team lead during resuscitation and using a manual defibrillator respectively. 52% reported being comfortable or very comfortable with their ability to identify emergency cardiac rhythms as shown in Figure 5.

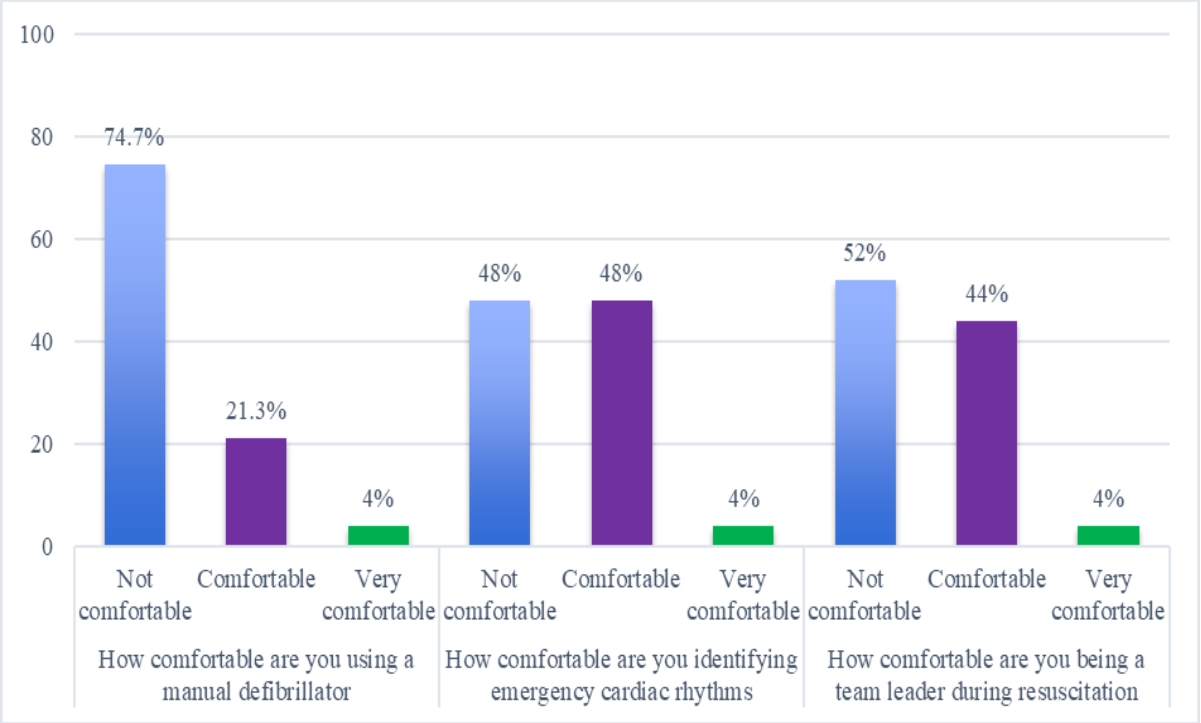


Figure 5:Self-assessment on ability to offer ACLS

4.5 Knowledge Levels on Current BLS And ACLS Guidelines

The average BLS score for the group was 51.6% with only 24% of respondents knowing the correct order of interventions i.e., circulation, airway and breathing vs airway, breathing and circulation. 57.3% and 62.7% knew the location of chest compressions in adults and neonates respectively while 57.3% knew the rate of chest compressions. A further 57.3% knew the correct compressions to breaths ratio in adults. Knowledge levels on other BLS components were as shown in Table 3.

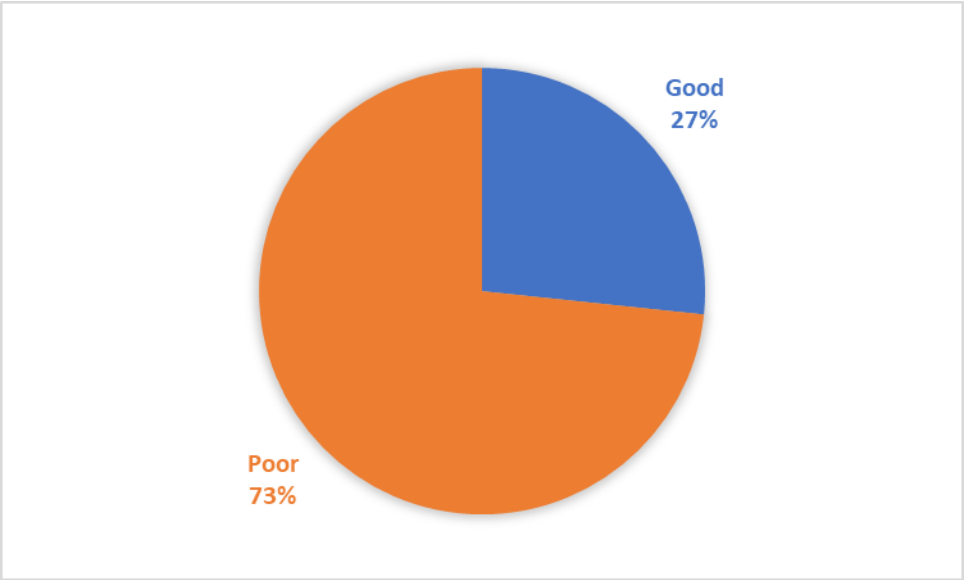


Figure 6:Overall knowledge on BLS and ACLS guidelines

Table 3:Knowledge on basic life support guidelines amongst the respondents

If a patient suddenly becomes unresponsive while receiving a CT scan and does not respond to verbal and physical stimulation, what will be your immediate action?		
Check pulse	62	82.7
What is the location for chest compression in adults?		
Mid chest	43	57.3
What is the location for chest compression in infants?		
Two finger breadths below the nipple line	47	62.7
Rate of chest compression in adults and children during CPR?		
100 - 120 compressions/min	43	57.3
Ratio of Compressions to Breaths in adults is		
30:2	43	57.3
In a neonate the chest compression to ventilation ratio is?		
3:1	15	20.0
What is the correct order during resuscitation?		
Circulation>Airway>Breathing (CAB)	18	24.0
Knowledge on Basic life support		51.60%

The average ACLS score for the group was 46.1% with 70.1% of the respondents not knowing that compressions and defibrillation are the interventions to be prioritized during resuscitation. 42.7% and 44% knew the shockable rhythms and the cardiac arrest rhythms in which a manual defibrillator is not indicated respectively.

Only 42.7% knew that a manual defibrillator does not automatically identify cardiac rhythms and only 26.7% knew that the defibrillator should be used as soon as it is available during resuscitation. 86% correctly identified epinephrine as the first line drug for cardiac arrest but only 40% knew it was the first line drug for severe reactions to contrast media. Knowledge levels on other ACLS components were as shown in Table 4.

Table 4:Knowledge on acute cardiovascular life support guidelines

Table 4: Knowledge on acute cardiovascular life support guidelines

	Frequency	Percentage
Magnesium Sulphate would be useful for which cardiac rhythm?		
Tosardes de pointes	22	29.3
Which of the following is NOT a function of a manual defibrillator?		
Automated rhythm identification	32	42.7
Which cardiac rhythms would benefit from defibrillation?		
Ventricular fibrillation and pulseless ventricular tachycardia	32	42.7
Which of the following is not a sign of instability in a patient undergoing fluoroscopy?		
Tachycardia	36	48.0
In an UNSTABLE patient, for which rhythm would you NOT use a manual defibrillator with pacing capabilities?		
Pulseless electrical activity and asystole	33	44.0
Which of the following is not a cardiac arrest rhythm?		
Atrial fibrillation	38	50.7
Which is the first line drug for management of cardiac arrest?		
1mg of epinephrine	65	86.7
Which is the second line drug for management of cardiac arrest?		
300mg of amiodarone	34	45.3
Which is the first line drug for severe anaphylactic reactions to iodinated contrast media?		
Epinephrine	30	40.0
Which two interventions should be prioritized in the management of cardiac arrest?		
Chest compressions and defibrillation	22	29.3
A patient goes into cardiac arrest with a shockable rhythm in the interventional radiology suite and you start chest compression. Once the defibrillator is availed, when would you use it?		
Immediately	20	26.7
After delivering defibrillation shock and patient remains in cardiac arrest, what's the immediate next step?		
Resume chest compressions	51	68.0
Knowledge on ACLS		**46.1%**

The findings showed that only 20(27%) of the respondents had good overall knowledge on BLS and ACLS guidelines as shown in Figure 6. This was based on an international pass mark of 75%.

4.6 BLS And ACLS Certification Status

Results showed that 64 (85.3%) and 47 (62.7%) of the participants have trained and certified in BLS and ACLS respectively at least once. Majority of the respondents did not have valid certification with only 21 (32.8%) and 13 (27.7%) of the participants having certified in BLS and ACLS respectively within 2 years before the study dates as per international recommendations as shown in Table 5.

Table 5:Certification on basic life support (BLS) and Advanced cardiovascular life support (ACLS)

	Frequency	Percent
Certified in BLS		
Yes	64	85.3
No	11	14.7
Last BLS training (N =64)		
≤2 years	21	32.8
3 - 5 years	31	48.4
More than 5 years ago	12	18.8
Certified in ACLS		
Yes	47	41.3
No	28	37.3
Last ACLS training (N =47)		
1 - 2 years	13	27.7
3 - 5 years	27	57.4
More than 5 years ago	7	14.9
Estimated cost of training		
10,000 - 20,000	31	44.3
More than 20,000	4	5.7
Sponsored	20	28.6
I don’t know	15	21.4

4.7 Factors Associated with BLS And ACLS Certification

Gender (p = 0.035), cadre (p = 0.009) and prior ACLS certification (p = 0.001) were shown to be significantly associated with BLS certification. Female respondents were more likely to have been certified in BLS than their male counterparts, with 92% (46/50) and 72% (18/25) of female and male respondents having been certified in BLS at least once respectively. While looking at cadre, nurses (100%) were noted to have the highest BLS certification rates > residents (88.5%) > consultants (77.8%) > radiographers (58.1%). This was captured in Table 6.

Table 6:Factors affecting BLS certification amongst respondents

	BLS certification		
	Yes n (%)	No n (%)	
Age			
20 - 35 years	48(88.9)	6(11.1)	
36 - 50 years	12(75)	4(25)	0.363
>50 years	4(80)	1(20)	
Gender			
Male	18(72)	7(28)	0.035
Female	46(92)	4(8)	
Cadre			
Nurse	9(100)	0	
Radiographer	18(58.1)	13(41.9)	0.009
Radiology Resident	23(88.5)	3(11.5)	
Consultant Radiologist	7(77.8)	2(22.2)	
Certified ACLS			
Yes	14(45.2)	3(27.3)	<0.001
No	17(54.8)	8(72.7)	
BLS relevance			
Yes	62(84.9)	11(15.1)	0.726
No	2(100)	0	

Gender (p=0.018), cadre (p<0.001), prior BLS certification (p<0.001) and belief in relevance of ACLS in their practice (p=0.003) were significantly associated with ACLS certification. Female respondents were more likely to have been certified in ACLS than their male counterparts, with 50% (25/50) and 24% (6/25) of female and male respondents having been certified in ACLS at least once respectively. Nurses (88.9%) were noted to have the highest ACLS certification rates > consultants (66.7%) > residents (61.5%) > radiographers (35.5%) as shown in Table 7.

Table 7:Factors affecting ACLS certification among the respondents

	ACLS Certification		P-value
	Yes	No	
Age			
20 - 35 years	25(46.3)	29(53.7)	
36 - 50 years	4(25)	12(75)	0.057
>50 years	2(40)	3(60)	
Gender			
Male	6(24)	19(76)	0.018
Female	25(50)	25(50)	
Cadre			
Nurse	8(88.9)	1(11.1)	
Radiology Resident	2(7.7)	24(92.3)	<0.001
Radiographer	15(48.4)	16(41.6)	
Consultant Radiologist	6(66.7)	3(33.3)	
BLS Certification			
Yes	31(48.4)	33(51.6)	<0.001
No	0	11(100)	
ACLS relevance in the field of practice			
Yes	28(43.8)	36(56.2)	0.003
No	3(27.3)	8(72.7)	

4.8 Factors Associated with BLS And ACLS Knowledge Levels

Results showed that age of the respondent (p=0.019) and cadre (p=0.043) were significantly associated with good BLS and ACLS knowledge levels. 19 of the 20 respondents (95%) with good knowledge levels were between the age of 20-35 years. Radiology resident were 75% (15/20) of the respondents with good knowledge levels > nurses (15%) > consultants (10%) > radiographers (0%). Prior BLS and ACLS certification (p=0.535 and p=0.072 respectively were not shown to be significantly associated with good knowledge levels as demonstrated in Table 8.

Table 8:Factors affecting knowledge on BLS and ACLS guidelines

	Knowledge		
	Good n (%)	**Poor n (%)**	**P-value**
Age			
20 - 35 years	19(95.0)	35(63.6)	
36 - 50 years	0	16(29.1)	0.019
>50 years	1(5.0)	4(7.3)	
Gender			
Male	6(30.0)	19(34.5)	0.461
Female	14(70.0)	36(65.5)	
Cadre			
Nurse	1(5.0)	8(14.5)	
Radiographer	4(20.0)	27(49.1)	0.043
Radiology Resident Consultant Radiologist	13(65.0) 2(10.0)	13(23.6) 7(12.7)	
Certified BLS			
Yes	19(95.0)	45(81.8)	0.269
No	1(5.0)	10(18.2)	
Certified BLS			
Yes	10(50.0)	21(38.2)	0.256
No	10(50.0)	34(61.8)	
Believe BLS is relevant			
Yes	20(100)	53(96.4)	0.535
No	0	2(3.6)	
Believe ACLS relevance			
Yes	20(100)	47(85.5)	0.072
No	0	8(14.5)	

4.9 Availability of Resuscitation Equipment

Table 9 shows the findings on availability of resuscitation equipment in the 2 CT scan rooms, MRI room and IR suite in the KNH department and the UoN-DDIRM. KNH Siemens CT room had 7 of the 22 items in the airway and breathing checklist (31.8%), 4 of 14 of the items in the circulation checklist (28.6%) and 4 of 8 items in the drugs checklist (50%). The Neusoft CT room had 8 of the 22 items in the airway and breathing checklist (36.4%), 3 of 14 of the items in the circulation checklist (21.4%) and 3 of 8 items in the drugs checklist (37.5%). The IR suite had 15 of the 22 items in the airway and breathing checklist (68.2%), 8 of 14 of the items in the circulation checklist (57.1%) and 2 of 8 items in the drugs checklist (25%). One of the missing drugs in the IR suite was epinephrine which is the first line for both cardiac arrest and severe contrast reactions. The MRI room had 9 of the 22 items in the airway and breathing checklist (40.9%), 5 of 14 of the items in the circulation checklist (35.7%) and 3 of 8 items in the drugs checklist (37.5%) while UoN- DDIRM did not have an emergency trolley or tray at the time of the study.

Table 9:Availability of resuscitation equipment

Service area	Airway and breathing	Circulation	Drugs	Average score
IR suite	68.2%	57.1%	25%	50.1%
MRI room	40.9%	35.7%	37.5%	38%
Siemens CT room	31.8%	28.6%	50%	36.8%
Neusoft CT room	36.4%	21.4%	37.5%	31.8%
UON-DDIRM	N/A	N/A	N/A	N/A

5.0 CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The present study sought to assess the preparedness of radiology departments in KNH and UoN-DDIRM to manage cardiopulmonary arrest by assessing the participants' demographics, their attitude towards emergency life support training, certification status, confidence in their own abilities compared with their actual knowledge levels and availability of the required equipment.

5.1.1 Demographic Characteristics

The departments were shown to have a relatively young workforce with 72% of respondents being 35 years of age and below with the majority of respondents, 66.7% (50/75), being female. 76% of the respondents were either radiographers (41.3%) or radiology residents (34.7%) making these two cadres the most likely for patients in the department to interact with including in the event of CPA. Nurses and consultant radiologists made up 12% (9/75) of the respondents each.

Compared with the 2016 study by Osiemo and her colleagues looking at knowledge and practices of CPA in the KNH radiology department, radiology residents and radiographers were still the majority of the respondents (77.6%) corresponding with their overall numbers in the department. However, in their study, the male respondents were 53.8% (43/80) and the ages of the participants ranged from 23 - 65 years.

5.1.2 Attitude Towards Emergency Life Support Training

The data suggested that the staff in the radiology departments had a positive attitude towards emergency life support training with the majority of respondents believing that training in both BLS (97.3%) and ACLS (89.3%) is relevant for radiology staff. Findings also revealed that participants had been exposed to incidences of CPA and the application of emergency life support guidelines with 47 (62.7%) of participants having witnessed a patient go into CPA in the radiology department with return of spontaneous circulation (ROSC) reported in 27 (64.3%) of the 42(89.3%) patients in whom CPR was initiated.

A previous study looking at outcomes amongst participants suffering CPA in the radiology department showed that 70% survived the initial code with 33% surviving till discharge (2). This was in keeping with the current study's findings which would only further support the respondents' belief in the relevance of emergency life support training and lifesaving potential of the guidelines thus contributing to the positive attitude.

Compared with a previous study carried out in KNH in 2016, we saw an increase in the percentage of those who had witnessed CPA in the department from 38.8% to 64.3% which could either point to an increase in number of incidents or just the staff being more exposed compared to the group interviewed in the previous study (14). This study also showed that radiology staff are willing to offer emergency life support when called upon with CPR initiated in 89.3% (42/47) of the CPA cases reported, this compared with 71.9% (23/31) of CPA cases in the 2016 study by Osiemo et al.

5.1.3 Self-Assessment on BLS/ACLS Abilities Versus Knowledge Levels on the Guidelines

This study showed high and average confidence levels amongst respondents in their ability to offer basic and advanced life support respectively, though it also revealed a discrepancy between the BLS confidence and knowledge levels amongst the participants. The findings showed that only 20(27%) of the respondents had good overall knowledge on BLS and ACLS guidelines based on an international pass mark of 75%.

Majority of the respondents expressed confidence in their ability to practice 3 of the 4 key BLS components that they were asked to assess themselves on with 68%, 69.3% and 76.3% of the respondents being either comfortable or very comfortable with their ability to identify signs of impending/ongoing cardiac arrest, initiate CPR and give adequate chest compressions respectively. A previous study by Vorster and Beningfield in South Africa demonstrated a lack of confidence in providing basic life support (12).

Most respondents in the present study were not confident in their ability to use an Automatic External Defibrillator (AED), with 65.3% not being comfortable, which would affect their use of electrical therapy in the management of CPA which together with chest compressions are the two interventions that should be prioritized. Knowledge on chest compression techniques was noted to be low with 57.3% and 62.7% knowing the location of chest compressions in adults and neonates respectively while 57.3% knew the rate of chest compressions while a further 57.3% knew the correct compressions to breaths ratio in adults. The average BLS score for the group was 51.6% with only 24% of respondents knowing the correct order of interventions i.e., circulation, airway and breathing vs airway, breathing and circulation compared with 22.2% for the same question in a previous study in a study that had an average BLS score of 52.4% (14). The low knowledge levels were consistent with previous studies carried out amongst radiologists and radiology residents in Pakistan and Wales (10,11).

Low knowledge levels on CPR were also demonstrated amongst other health professionals as shown in a similar study looking at staff from different departments in a hospital in Tanzania with only 13% of the respondents in that study achieving the passing score (13). The high confidence levels coupled with low knowledge levels amongst respondents in the present study could lead to failure to follow recent evidence that has been shown to improve resuscitation outcomes, though the high confidence levels may contribute to the high rate of CPR initiation demonstrated by the study (89.3%).

The respondents expressed average confidence levels in their ability to practice the 3 main ACLS components included with 52% and 74.7% of respondents not comfortable being team lead during resuscitation and using a manual defibrillator respectively. 52% reported being comfortable or very comfortable with their ability to identify emergency cardiac rhythms. The average ACLS score for the group was 46.1% with 70.1% of the respondents not knowing that compressions and defibrillation are the interventions to be prioritized during resuscitation. 42.7% and 44% knew the shockable rhythms and the cardiac arrest rhythms in which a manual defibrillator is not indicated respectively.

Only 42.7% knew that a manual defibrillator does not automatically identify cardiac rhythms and only 26.7% knew that the defibrillator should be used as soon as it is available during resuscitation. 86% correctly identified epinephrine as the first line drug for cardiac arrest but only 40% knew it was the first line drug for severe reactions to contrast media. This was consistent with findings from the study by Osiemo et al carried out in KNH that showed low knowledge levels with only 30 % having identified epinephrine as the first line drug for severe reactions to contrast media.

Based on a previous study in which 65% of respondents identified lack of knowledge as one of the major factors affecting the practice of CPR (16), the low knowledge levels demonstrated by the present study would be expected to hinder the adequate management of CPA in the departments.

Despite being repeatedly demonstrated in previous studies, this study still showed low knowledge levels pointing to the need for the departments to deliberately develop programs that encourage certification and recertification amongst their staff members.

5.1.4 BLS And ACLS Certification Status and Factors Associated with Certification

Despite demonstrating a belief amongst participants that training in BLS and ACLS is relevant to them and a majority having had prior exposure to the training, this study showed that majority of the respondents did not have valid BLS and ACLS certification pointing to a low recertification rate.

Results showed that 64 (85.3%) and 47 (62.7%) of the participants had trained and certified in BLS and ACLS respectively at least once but only 21 (28%) and 13 (17.3%) of the participants had certified in BLS and ACLS respectively within 2 years from the study dates as per international recommendations. The finding of low recertification rates was similar to previous studies in radiology departments in South Africa and Kenya which showed that a huge majority of the respondents did not have valid BLS certification (12,14). The low recertification rates would be expected to affect knowledge of the recent resuscitation guidelines and thus impact the ability of participants to adequately manage cardiopulmonary arrest supported by the assertion from a previous study that BLS knowledge and skills degrade over time with skills degrading faster (19).

Gender ($p = 0.035$), cadre ($p = 0.009$) and prior ACLS certification ($p = 0.001$) were shown to be significantly associated with BLS certification. Female respondents were more likely to have been certified in BLS than their male counterparts, with 92% (46/50) and 72% (18/25) of female and male respondents having been certified in BLS at least once respectively. While looking at cadre, nurses (100%) were noted to have the highest BLS certification rates > residents (88.5%) > consultants (77.8%) > radiographers (58.1%).

Gender ($p=0.018$), cadre ($p<0.001$), prior BLS certification ($p<0.001$) and belief in relevance of ACLS in their practice ($p=0.003$) were significantly associated with ACLS certification. Female respondents were more likely to have been certified in ACLS than their male counterparts, with 50% (25/50) and 24% (6/25) of female and male respondents having been certified in ACLS at least once respectively. Nurses (88.9%) were noted to have the highest ACLS certification rates > consultants (66.7%) > residents (61.5%) > radiographers (35.5%). The association between ACLS certification and prior BLS certification was explained by the fact that most training programs require one to have been certified in BLS before training in ACLS. The low certification rates in BLS amongst radiographers despite them being the majority of the respondents (41.3%) and the most likely to interact with patients would significantly affect the chances of CPA being adequately managed in the departments. This would make the radiographers an ideal target group for BLS sensitization, training and certification.

Various training formats have been implemented including fully theoretical, video-assisted instruction, physical sessions and hybrid formats combining both online and physical simulation training. A previous study comparing a two-day class-based format and a format replacing one of the days with online sessions found no significant difference in BLS competencies amongst the participants (18). Based on this, the departments can choose a training format that best suits the schedules of their staff with the same outcomes.

5.1.5 Factors Associated with BLS And ACLS Knowledge Levels

Results suggested that younger respondents that were radiology residents were more likely to have good BLS and ACLS knowledge levels. Age of the respondent ($p=0.019$) and cadre ($p=0.043$) were significantly associated with good knowledge levels with 95% (19/20) of respondents with good knowledge levels being between the age of 20-35 years and radiology residents being 75% (15/20) of the respondents with good knowledge levels > nurses (15%) > consultants (10%) > radiographers (0%).

The findings were consistent with those of a previous study carried out in Peru amongst health professionals from different departments which sought to determine the association between social and education factors and CPR knowledge. This study by Aranzabal et al. showed that being a nurse or physician was associated with better knowledge levels (23).

Prior BLS and ACLS certification ($p=0.535$ and $p=0.072$ respectively were not shown to be significantly associated with good knowledge levels, similar to findings by Osiemo et al. (14). This was attributed to the low recertification rates that the data demonstrated.

5.1.6 Self-Assessment Versus Availability of Resuscitation Equipment

This study showed that only 29.3% of respondents thought that their department was adequately equipped for management of CPA while 41.4% did not know if the department was well equipped or not. 66.7% reported being familiar with the location of resuscitation equipment and drugs in the department but only 36% responded in the affirmative to checking the equipment and drugs before starting procedures each day.

The percentage of participants familiar with the location of resuscitation equipment was comparable with that from a previous study by Osiemo et al. that had the number at 63.8% (14). When comparing the percentage of respondents who reported checking the equipment before procedures, the study by Osiemo et al. showed 12.5% checked the equipment against the 36% demonstrated in this present study. Despite this improvement, the percentage was still low and likely to lead to delays in initiating care as valuable time would be lost looking for equipment or troubleshooting those with malfunctions not identified prior to the start of

the procedure. This was supported by recommendations that equipment should be checked daily with all staff members being familiar with the location of such equipment in their work stations (20).

Resuscitation equipment available in 5 key service areas across both departments was assessed against a standardized checklist derived from the standards of clinical practice and training for CPR in the UK (20). The checklist was divided into 3 categories, namely airway and breathing equipment, circulation equipment and emergency drugs as per the main components of resuscitation. 2 CT scan rooms, 1 MRI room and 1 IR suite in the KNH department plus the UoN-DDIRM were assessed with results showing that all the areas were inadequately equipped to manage CPA. The IR suite was the best equipped and scored an average of 50.1% with 68.2% in the airway and breathing checklist, 57.1% in the circulation checklist and 25% in the drugs checklist. One of the missing drugs in the IR suite was epinephrine which is the first line for both cardiac arrest and severe contrast reactions. The IR suite was also the only area with any means of offering electrical therapy with a functional manual defibrillator available. The MRI room had an average score of 38% with 40.9% in the airway and breathing checklist, 35.7% in the circulation checklist and 37.5% in the drugs checklist.

KNH Siemens CT room scored an average of 36.8% with 31.8% in the airway and breathing checklist, 28.6% in the circulation checklist and 50% in the drugs checklist. The Neusoft CT room had an average score of 31.8% with 36.4% in the airway and breathing checklist, 21.4% in the circulation checklist and 37.5% in the drugs checklist. UoN-DDIRM did not have an emergency trolley or tray at the time of the study which was reported to be the case since the department stopped offering fluoroscopy services more than 2 years before the study dates.

The finding of poor and variable availability of resuscitation equipment is similar to a previous study by Hogh et al. that demonstrated significant variability in resuscitation equipment available in different clinical areas with accident and emergency (A&E) and critical care units (CCU) more likely to be better equipped (24). Hogh's study did not include radiology departments as part of the study areas despite the central role radiology plays in the management of critically ill patients. The lack of equipment would affect the prompt initiation of the chain of survival and further hamper the ability of staff in the departments to adequately manage CPA. This is in keeping with findings from a previous study in which 77.5% of respondents identified lack of equipment as one of the major factors affecting the practice of CPR (16).

5.2 Limitations

This study only managed to assess radiology departments in KNH and UON-DDIRM which work closely together and thus it was not possible to extrapolate the findings to the other radiology departments in the country. Assessing other major radiology departments would have given a clearer picture of the situation across the country.

5.3 Conclusion

In this study we were able to conclude that CPA does occur in our radiology departments and resuscitation saves lives. Despite a belief that training is relevant and a good attitude towards the same amongst the respondents, the majority did not have valid certification leading to a knowledge gap on the current BLS/ACLS guidelines. There was a discrepancy between the knowledge levels and the respondents' confidence levels in their own ability to manage CPA. The departments were found not to be adequately equipped with the required items for the practice of the resuscitation guidelines.

5.4 Recommendations

Some of the recommendations that have emerged from the study findings are formation of a joint Emergency Response Stewardship Committee to guide implementation of changes to improve the current situation in both departments. Emergency life support training should be included as part of the curriculum with monitoring of certification status of members of the departments with frequent refreshers through an emergency life support continuous medical education (CME) program for both departments. Departments to review their resuscitation carts and ensure adequate equipment with people assigned to go through the checklist each day.

Further research can be done to assess the frequency of CPA in radiology departments as well as the patient outcomes beyond the first code in patients where CPR is administered. The preparedness of other main radiology departments in the country to manage CPA should also be investigated to give an overview of the situation across the country.

REFERENCES

1. Andersen, L. W., Holmberg, M. J., Berg, K. et al. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696
2. Hope, W. W., von der Embse, K., Mostafa, et al. (2011). Cardiopulmonary arrest occurring in the radiology department: patient characteristics, incidence, and outcomes. *The American Surgeon*, *77*(3), 273–276.
3. Onyambu, C., Aywak, A., Osiemo, S., et al. (2021). Anaphylactic Reactions in Radiology Procedures. https://doi.org/10.5772/intechopen.95784
4. Mabasa, T. E. (2012). *A prospective study on the outcomes on adult cardiopulmonary resuscitation in Cape Town*. University of Cape Town. http://hdl.handle.net/11427/11935
5. Cummins, R. O., Ornato, J. P., Thies, et al. (1991). Improving survival from sudden cardiac arrest: the "chain of survival" concept. A statement for health professionals from the Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee, American Heart Association. *Circulation*, *83*(5), 1832–1847. https://doi.org/10.1161/01.CIR.83.5.1832
6. Merchant, R. M., Topjian, A. A., Panchal, et al. (2020). Part 1: Executive Summary: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*, *142*(16_suppl_2), S337–S357. https://doi.org/10.1161/CIR.0000000000000918
7. Berg, K. M., Soar, J., Andersen, L. W., et al. (2020). Adult Advanced Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation*, *142*(16_suppl_1), S92–S139. https://doi.org/10.1161/CIR.0000000000000893
8. Monsieurs, K. G., Nolan, J. P., Bossaert, L. L., et al. (2015). European Resuscitation Council Guidelines for Resuscitation 2015: Section 1. Executive summary. *Resuscitation*, *95*, 1–80. https://doi.org/10.1016/j.resuscitation.2015.07.038
9. Basri Lenjani, Nehat Baftiu, Kelmend Pallasak, K. H. (2014). Cardiac arrest and cardiopulmonary resuscitation. *Taehan Kanho. The Korean Nurse*, *20*(5), 55–59. https://doi.org/10.1016/s2221-6189(14)60007-x

10. Alam, T., Jamil Khattak, Y., Anwar, M., et al. (2014). Basic Life Support: A Questionnaire Survey to Assess Proficiency of Radiologists and Radiology Residents in Managing Adult Life Support in Cardiopulmonary Arrest and Acute Anaphylactic Reaction. *Emergency Medicine International*, *2014*, 356967. https://doi.org/10.1155/2014/356967
11. Rachapalli, V., Goyal, N., Smith, R., & Hourihan, M. D. (2009). Adult resuscitation: are we up to date? A study of staff resuscitation skills in the radiology department of a tertiary referral centre. *The British Journal of Radiology*, *82*(980), 645–648. https://doi.org/10.1259/bjr/40466685
12. Vorster, I. D., & Beningfield, S. (2019). Evaluation of self-reported confidence amongst radiology staff in initiating basic life support across hospitals in the Cape Town Metropole West region. *South African Journal of Radiology; Vol 23, No 1 (2019)DO - 10.4102/Sajr.V23i1.1720* . https://sajr.org.za/index.php/sajr/article/view/1720/2377
13. Kaihula, W. T., Sawe, H. R., Runyon, M. S., et al. (2018). Assessment of cardiopulmonary resuscitation knowledge and skills among healthcare providers at an urban tertiary referral hospital in Tanzania. *BMC Health Services Research*, *18*(1), 935. https://doi.org/10.1186/s12913-018-3725-2
14. Osiemo, S. K., Onyambu, C. K., & Aywak, A. A. (2020). Knowledge and practices of cardiopulmonary arrest and anaphylactic reactions in the radiology department. *South African Journal of Radiology; Vol 24, No 1 (2020)DO - 10.4102/Sajr.V24i1.1841* . https://sajr.org.za/index.php/sajr/article/view/1841
15. Ndung'u Paul, Kimani Samuel, Kirui Angeline, M. J. (2019). Evaluation of Cardiopulmonary Resuscitation Knowledge and Its Impact on Practice Among Clinicians at a County Referral Hospital in Kenya. *Information and Knowledge Management*, *9*(April), 22–28 https://doi.org/10.7176/IKM
16. Patience Kivungi et al. (2012). A survey on knowledge, attitude and practice regarding resuscitation of pregnant women among anaesthesiology and obstetrics registrars in Kenyatta National Hospital.
17. Onan, A., Turan, S., Elcin, M., Erbil, B., et al. (2018). The effectiveness of traditional Basic Life Support training and alternative technology-enhanced methods in high schools. *Hong Kong Journal of Emergency Medicine*, *26*(1), 44–52. https://doi.org/10.1177/1024907918782239

18. Lippmann, J., Livingston, P., & Craike, M. J. (2010). Comparison of two modes of delivery of first aid training including basic life support. *Health Education Journal*, *70*(2), 131–140. https://doi.org/10.1177/0017896910386208
19. Smith, K. K., Gilcreast, D., & Pierce, K. (2008). Evaluation of staff's retention of ACLS and BLS skills. *Resuscitation*, *78*(1), 59–65. https://doi.org/https://doi.org/10.1016/j.resuscitation.2008.02.007
20. Gabbott, D., Smith, G., Mitchell, S., et al. (2005). Cardiopulmonary resuscitation standards for clinical practice and training in the UK. *Resuscitation*, *64*(1), 13–19. https://doi.org/10.1016/j.resuscitation.2004.11.001
21. Avisar, L., Shiyovich, A., Aharonson-Daniel, L., et al. (2013). Cardiopulmonary Resuscitation Skills Retention and Self-Confidence of Preclinical Medical Students. *Isr Med Assoc J*, *15*, 622–627.
22. Bhanji, F., Mancini, M. E., Sinz, E., et al. (2010). Part 16: education, implementation, and teams: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*, *122*(18 Suppl 3), S920-33. https://doi.org/10.1161/CIRCULATIONAHA.110.971135
23. Aranzábal-Alegría, G., Verastegui-Díaz, A., Quiñones-Laveriano, et al. (2017). Factors influencing the level of knowledge of cardiopulmonary resuscitation in hospitals in Peru. *Colombian Journal of Anesthesiology*, *45*(2), 114–121. https://doi.org/https://doi.org/10.1016/j.rcae.2017.01.001
24. Hogh, L., Kane, I., Bhalla, A., & Ward, M. C. (2005). Variations in the provision of resuscitation equipment: survey of acute hospitals. *Postgraduate Medical Journal*, *81*(956), 409–410. https://doi.org/10.1136/pgmj.2004.026930

APPENDICES

Appendix A. Data collection form (Demographics, attitudes and knowledge levels)

Title: Preparedness of radiology departments in Kenyatta National Hospital and University of Nairobi Department of Diagnostic Imaging and Radiation Medicine to adequately manage cardiopulmonary arrest events

Investigator: Dr. Gitau D. Kagona, Resident Department of Diagnostic Imaging and Radiation Medicine, University of Nairobi.

Section A: Demographics, certification status and factors affecting uptake of training

1. Mention your age
    a) <20
    b) >20 to 35
    c) >35 to 50
    d) >50

0. Gender
    a) Male
    b) Female

3. Cadre
    a) Consultant radiologist
    b) Radiology resident
    c) Nurse
    d) Radiographer

4. Work Station
    a) Kenyatta National Hospital
    b) University of Nairobi – DDIRM
    c) Kenyatta University Teaching Referral and Research Hospital
    d) Moi Teaching and Referral Hospital
    e) Coast Provincial General Hospital
    f) Jaramogi Oginga Odinga Teaching and Referral Hospital

5. Have you been certified in BLS before?
    a) Yes
    b) No

6. If your answer to No.5 is yes, when was your last BLS training?

a) Less than 1 year ago
b) 1 - 2 years ago
c) 3 – 5 years ago
d) More than 5 years ago

7. Have you been certified in ACLS before?

a) Yes
b) No

8. If your answer to No.7 is yes, when was your last ACLS training?

a) Less than 1 year ago
b) 1 - 2 years ago
c) 3 – 5 years ago
d) More than 5 years ago

9. Do you believe that BLS training is relevant for your work?

a) Yes
b) No

10. Do you believe that ACLS training is relevant to your work?

a) Yes
b) No

11. If your answer to either No. 5 or 7 is yes, what was the cost for the training? (Kindly specify for BLS and ACLS)

---

12. Have you ever observed a patient go into cardiac or respiratory arrest in a radiology department?

a) Yes
b) No

13. If your answer to No. 12 is yes, was CPR initiated and what was the outcome?

a) No, CPR was not initiated
b) Yes: Return of spontaneous circulation (ROSC)
c) Yes: No return of spontaneous circulation

14. If your answer to No. 12 is yes, was an Automated External Defibrillator or manual defibrillator used?

a) Yes
b) No

15. If your answer to No. 12 is no, what was the reason for not starting CPR?

_____

Section B: Self-assessment

1. Are you familiar with the location of resuscitation equipment and drugs in your radiology department?

a) Yes
b) No

2. Do you check the resuscitation equipment and drugs before starting procedures each day?

a) Yes
b) No

3. Does your department have adequate supplies of resuscitation equipment and drugs?

a) Yes
b) No
c) I am not aware

4. How comfortable are you in identifying signs of impending and ongoing cardiac arrest?

a) Not comfortable
b) Comfortable
c) Very comfortable

5. How comfortable are you initiating CPR?

a) Not comfortable
b) Comfortable
c) Very comfortable

6. How comfortable are you using an Automated External Defibrillator (AED)?

a) Not comfortable
b) Comfortable
c) Very comfortable

7. How comfortable are you using a manual defibrillator?

a) Not comfortable
b) Comfortable

c) Very comfortable

8. How comfortable are you identifying emergency cardiac rhythms?

a) Not comfortable
b) Comfortable
c) Very comfortable

9. How comfortable are you being a team leader during resuscitation?

a) Not comfortable
b) Comfortable
c) Very comfortable

10. How confident are you in your ability to give adequate chest compressions?

a) Not confident
b) Confident
c) Very confident

Section C: Knowledge assessment

1. If a patient suddenly becomes unresponsive while receiving a CT scan and does not respond to verbal and physical stimulation, what will be your immediate action?

a) Give rescue breaths
b) Check pulse
c) Start chest compressions
d) Shake with more force

2. What is the location for chest compression in adults?

a) Mid chest
b) Left side of chest
c) Right side of Chest
d) Over sternal angle

3. What is the location for chest compression in infants?

a) One finger breadth above the nipple line
b) Two finger breadths below the nipple line
c) Over the xyphoid process
d) Left side of chest

4. Rate of chest compression in adults and children during CPR?

a) 100-120 compressions/min
b) 72 compressions/min
c) 80 compressions/min

d) 60-100 compressions/min

5. Ratio of Compressions to Breaths in adults is

a) 30:2
b) 3:1
c) 15:2
d) 30:1

6. In a neonate the chest compression to ventilation ratio is? (Double rescuer)

a) 3:1
b) 30:2
c) 15:2
d) 15:1

7. What is the correct order during resuscitation?

a) Breathing > Circulation > Airway (BCA)
b) Circulation> Airway > Breathing (CAB)
c) Airway > Breathing > Circulation (ABC)
d) Airway > Circulation > Breathing (ACB)

8. Magnesium Sulphate would be useful for which cardiac rhythm?

a) Ventricular Fibrillation
b) Atrial Fibrillation
c) Tosardes de pointes
d) Bradycardia

9. Which of the following is NOT a function of a manual defibrillator?

a) Defibrillation
b) Synchronized cardio version
c) Transcutaneous pacing
d) Automated rhythm identification

10. Which cardiac rhythms would benefit from defibrillation?

a) Pulseless Electrical Activity and asystole
b) Ventricular fibrillation and atrial fibrillation
c) Ventricular Fibrillation and Pulseless Ventricular Tachycardia
d) Bradycardia in unstable patient

11. Which of the following is not a sign of instability in a patient undergoing fluoroscopy?

a) Acute onset severe chest pain

b) Hypotension
c) SPO2 levels lower than 94
d) Tachycardia

12. In an UNSTABLE patient, for which rhythm would you NOT use a manual defibrillator with pacing capabilities?

a) Pulseless Electrical Activity and asystole
b) Ventricular fibrillation and atrial fibrillation
c) Ventricular fibrillation and Pulseless ventricular tachycardia
d) Bradycardia

13. Which of the following is not a cardiac arrest rhythm?

a) Ventricular fibrillation
b) Pulseless Electrical Activity (PEA)
c) Asystole
d) Atrial fibrillation

14. Which is the first line drug for management of cardiac arrest?

a) 1mg of epinephrine
b) 1mg of atropine
c) 300 mg of amiodarone
d) 6mg of adenosine

15. Which is the second line drug for management of cardiac arrest?

a) 1mg of epinephrine
b) 1mg of atropine
c) 300 mg of amiodarone
d) 6mg of adenosine

16. Which is the first line drug for severe anaphylactic reactions to iodinated contrast media?

a) High dose hydrocortisone
b) Low dose hydrocortisone
c) Epinephrine
d) Chloramphetamine

17. Which two interventions should be prioritized in the management of cardiac arrest?

a) Chest compressions and emergency drugs
b) Securing airway and IV access
c) Defibrillation and emergency drugs

d) Chest compressions and defibrillation

18. A patient goes into cardiac arrest with a shockable rhythm in the interventional radiology suite and you start chest compression. Once the defibrillator is availed, when would you use it?

a) After completing the ongoing cycle of compressions and breaths
b) Immediately
c) After 5 cycles of compressions and breaths
d) After first dose of the emergency drug

19. After delivering defibrillation shock and patient remains in cardiac arrest, what's the immediate next step?

a) Resume chest compressions
b) Recharge defibrillator and give second shock
c) Assess for reversible causes of cardiac arrest
d) Give normal saline for hypotension

Appendix B. Data Collection Form (Equipment Checklist)

Title: Preparedness of radiology departments in Kenyatta National Hospital and University of Nairobi Department of Diagnostic Imaging and Radiation Medicine to adequately manage cardiopulmonary arrest events

Investigator: Dr. Gitau D. Kagona,
Resident Department of Diagnostic
Imaging and Radiation Medicine,
University of Nairobi.

Health facility: _____ **Date:** _____

EQUIPMENT	**No. AVAILABLE**	**LOCATION IN THE DEPARTMENT**	**SIZES AVAILABLE (Where applicable)**	**STATUS (FUCTIONAL/ NON-FUCTIONAL)**	**LAST MAINTAINENCE DATE (As per maintenance sticker)**	**PICTURES (Kindly attach image of each item noted to be available in its usual location)**
1. AIRWAY & BREATHING					42	
Pocket mask with oxygen port						
Oxygen mask with reservoir						
Clear face masks						
Oropharyngeal airways						
Nasopharyngeal airways						
Portable Suction						
Laryngeal mask airway						
Oxygen cylinder						

Piped oxygen sockets						
Oxygen tubing						
Magill forceps						
Stethoscope						
Endotracheal tubes						
Tracheal tube introducer (stylet)						
Intubating bougie						
Laryngoscope handles						
Laryngoscope blades						
Spare laryngoscope batteries						
Syringes						
Lubrication						
Strapping tape						
Pulse oximeter						
2. CIRCULATION	**No. AVAILABLE**	**LOCATION IN THE DEPARTMENT**	**SIZES AVAILABLE (Where applicable)**	**STATUS (FUCTIONAL/ NON-FUCTIONAL)**	**LAST MAINTAINENCE DATE (As per maintenance sticker)**	**PICTURES (Kindly attach image of each item noted to be available in its usual location)**
Automated external Defibrillator (AED)						
Manual defibrillator						
Adhesive defibrillator pads						
Razor						
ECG Electrodes						
Intravenous Cannulas						
IV infusion set						
0.9 % sodium chloride						

Needles and syringes						
Intraosseous access device						
Ultrasound (to assess for reversible causes)			N/A			
Blood glucose analyzer			N/A	N/A	N/A	
Blood sample tubes			N/A	N/A	N/A	
Access to algorithms for emergency drug doses			N/A	N/A	N/A	
3. DRUGS	**No. AVAILABLE**	**LOCATION IN THE DEPARTMENT**	**SIZES AVAILABLE (Where applicable)**	**STATUS (SAFE/ EXPIRED)**	**LAST MAINTAINENCE DATE (As per maintenance sticker)**	**PICTURES (Kindly attach image of each item noted to be available in its usual location)**
Adrenaline 1:10000					N/A	
Amiodarone					N/A	
Adenosine					N/A	
Atropine					N/A	
Hydrocortisone					N/A	
Glucose for IV use					N/A	
Lidocaine					N/A	
Aspirin					N/A	

Appendix C: Consent Information Document

PARTICIPANT INFORMATION AND CONSENT FORM SAMPLE. ADULT CONSENT FOR ENROLLMENT IN THE STUDY

(To be administered in English)

Title of Study: Preparedness of radiology departments in Kenyatta National Hospital and University of Nairobi Department of Diagnostic Imaging and Radiation Medicine to adequately manage cardiopulmonary arrest events

Principal Investigator and institutional affiliation: DR. GITAU D. KAGONA, RESIDENT AT UNIVERSITY OF NAIROBI, DEPARTMENT OF DIAGNOSTIC IMAGING AND RADIATION MEDICINE

Introduction:

I would like to tell you about a study being conducted by the above listed researcher. The purpose of this consent form is to give you the information you will need to help you decide whether or not to be a participant in the study. Feel free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide to be in the study or not. This process is called 'informed consent'. Once you understand and agree to be in the study, I will request you to sign your name on this form.

You should understand the general principles which apply to all participants in medical research:

i) Your decision to participate is entirely voluntary

ii) You may withdraw from the study at any time without necessarily giving a reason for your withdrawal

iii) Refusal to participate in the research will not affect the services you are entitled to or offer in this health facility or other facilities.

We will give you a copy of this form for your records.

May I continue? YES / NO

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee protocol No. P710/08/2021

What Is This Study About?

The researchers listed above are interviewing radiologists, radiology residents, radiology nurses and radiographers working in various government-run radiology departments in Kenya. The purpose of the interview is to determine participants' attitudes and knowledge on current life support guidelines, certification status and factors influencing the same. The researchers will also assess availability of resuscitation equipment in the various department. Each participant in this research study will fill in a questionnaire collecting data on demographics, level of education, certification status, staff attitudes and BLS/ACLS knowledge levels. One participant from each department, that will be appointed by the department head, will fill a second questionnaire assessing availability of resuscitation equipment and will be requested to attach images of the same.

There will be approximately 75 participants in this study randomly chosen. We are asking for your consent to consider participating in this study.

What Will Happen If You Decide To Be In This Research Study?

If you agree to participate in this study, the following things will happen: You will be contacted and a link to the online questionnaire will be shared electronically. You will be required to fill the section on BLS/ACLS knowledge in one sitting. We will ask for a telephone number where we can contact you if necessary. If you agree to provide your contact information, it will be used only by people working for this study and will never be shared with others. The reasons why we may need to contact you include getting further clarification or more information if need be.

Are There Any Risks, Harms Discomforts Associated With This Study?

Medical research has the potential to introduce psychological, social, emotional and physical risks. Effort should always be put in place to minimize the risks. One potential risk of being in the study is loss of privacy. We will keep everything you tell us as confidential as possible. We will use a code number to identify you in a password-protected computer database and will keep all of our paper records in a locked file cabinet. However, no system of protecting your confidentiality can be absolutely secure, so it is still possible that someone could find out you were in this study and could find out information about you. Also, answering questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them. You have the right to refuse the interview or any questions asked during the interview.

Are There Any Benefits Being In This Study?

The information you provide will help us better understand current practices in Kenyan radiology departments in management of cardiopulmonary events as well as factors affecting the same with a view of improving uptake of training and improving patient outcomes.

Will Being In This Study Cost You Anything?

No additional costs will be incurred.

What Are Your Other Choices?

Your decision to participate in research is voluntary. You are free to decline participation in the study and you can withdraw from the study at any time without injustice or loss of any benefits.

What If You Have Questions In Future?

If you have further questions or concerns about participating in this study, please call or send a text message to the study staff at the number provided at the bottom of this page. For more information about your rights as a research participant you may contact the following persons;

Secretary, Kenyatta National Hospital-University of Nairobi Ethics and Research Committee
Telephone No. 2726300 Ext. 44102
Email: uonknh_erc@uonbi.ac.ke.

Supervisor: Dr. Mutala Timothy Musila
Telephone No. +254719244869
Email: mutala@uonbi.ac.ke

The study staff will pay you back for your charges to these numbers if the call is for study-related communication.

Appendix D: Consent form (statement of consent)

Participant's statement

I have read this consent form or had the information read to me. I have had the chance to discuss this research study with a study counsellor. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation in this study is voluntary and that I may choose to withdraw any time.
I freely agree to participate in this research study. I understand that all efforts will be made to keep information regarding my personal identity confidential. By signing this consent form, I have not given up any of the legal rights that I have as a participant in a research study.

I agree to participate in this research study: Yes/ No

I agree to provide contact information for follow-up: Yes /No

Participant printed name: _____

Contact (mobile number): _____

Participant signature _____Date _____

Researcher's statement

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has willingly and freely given his/her consent.
Researcher 's Name: **Dr. Gitau D. Kagona** Date: _____

Signature _____

Role in the study: Principal investigator.
For more information contact Dr. GITAU D. KAGONA at +254726040063 from 8am to 5pm, all weekdays or via email kagonagitau@students.uonbi.ac.ke

Supervisor:

Dr. Mutala Timothy Musila

Telephone No. +254719244869

Email: mutala@uonbi.ac.ke

Or

The Secretary

KNH-UoN ERC,

Telephone No. 726300-9 Ext 44355, 44102

Email: uonknh_erc@uonbi.ac.ke

Appendix E: KNH/UoN-ERC Letter of Approval

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

KNH-UON ERC
Email: uonknh_erc@uonbl.ac.ke
Website: http://www.erc.uonbl.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/49

10th February, 2022

Dr. Dennis Kagona Gitau
Reg. No. H58/34661/2019
Dept. of Diagnostic Imaging and Radiation Medicine
Faculty of Health Sciences
University of Nairobi

KENYATTA NATIONAL HOSPITAL APPROVED 10 FEB 2022 KNH/UoN-ERC P.O. Box 20723 - 00202 NAIROBI

Dear Dr. Gitau,

RESEARCH PROPOSAL: PREPAREDNESS OF RADIOLOGY DEPARTMENTS IN KENYA TO ADEQUATELY MANAGE CARDIOPULMONARY ARREST EVENTS (P710/08/2021)

This is to inform you that KNH-UoN ERC has reviewed and approved your above research proposal. Your application approval number is **P710/08/2021.**The approval period is 10th February 2022 – 9th February 2023.

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 KNH-UoN ERC.
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 KNH-UoN ERC 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research mus: be reported to KNH-UoN ERC 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 KNH-UoN ERC.

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

Yours sincerely,

DR. BEATRICE K.M. AMUGUNE
SECRETARY, KNH-UoN ERC

c.c. The Dean, Faculty of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
The Chair, Dept. of Diagnostic Imaging and Radiation Medicine, UoN
Supervisor: Dr. Timothy Musila Mutala, Dept. of Diagnostic Imaging and Radiation Medicine, UoN

Cardiopulmonary Arrest Preparedness in Radiology

ORIGINALITY REPORT

11%	8%	6%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.iiste.org Internet Source	2%
2	www.ncbi.nlm.nih.gov Internet Source	2%
3	Raina M. Merchant, Alexis A. Topjian, Ashish R. Panchal, Adam Cheng et al. "Part 1: Executive Summary: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care", Circulation, 2020 Publication	1%
4	pesquisa.bvsalud.org Internet Source	1%
5	brieflands.com Internet Source	1%
6	www.moh.gov.my Internet Source	1%
7	www.jove.com Internet Source	<1%