KNOWLEDGE AND PRACTICES AMONG, RADIOLOGISTS, RADIOLOGY RESIDENTS AND RADIOGRAPHERS IN MANAGEMENT OF CARDIOPULMONARY ARREST AND ANAPHYLACTIC REACTIONS IN RADIOLOGY DEPARTMENT

A DISSERTATION AS PARTIAL FULFILLMENT OF THE UNIVERSITY OF NAIROBI, FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN DIAGNOSTIC IMAGING AND RADIATION MEDICINE

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REGISTRATION NUMBER: H58/67555/2013

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DECLARATION

I declare that this is my original work and that it has not been presented in any other place to the best of my knowledge; and that all the sources used or quoted have been indicated and acknowledged by means of complete references.

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UNIVERSITY OF NAIROBI

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Department _________________________________________________________________

Course Name _________________________________________________________________

Title of the work_______________________________________________________________

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DEDICATION

I dedicate this to my husband Dr. Kenneth N. Kaminja
ACKNOWLEDGEMENT

I am eternally grateful to God for his grace and blessings that enabled me to start and complete this work.

I would like to express my sincere appreciation to my supervisors Drs Angeline A. Aywak and Dr. Callen Onyambu for their professional guidance and encouragement that gave this study its appeal and relevance.

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- Mr. Allan Ongaga, the information technology specialist who assisted me with information technology aspects
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LIST OF ABBREVIATIONS

CPR: Cardiopulmonary resuscitation
BLS: Basic life support
ACLS: Advanced cardiac life support
SCA: Sudden cardiac arrest
CPA: Cardiopulmonary arrest
AHA: American heart association
LOCM: Low osmolar contrast media
VT: Ventricular tachycardia
VF: Ventricular fibrillation
AED: Automated external defibrillator
HCP: Health care professional
PEA: Pulseless electrical activity
ECG: Electrocardiogram
BP: Blood pressure
SC: Subcutaneous
IM: Intramuscular
PO: Par oral
O2SAT: Oxygen saturation
PO2: Partial pressure of oxygen
KNH: Kenyatta National Hospital
UON    University of Nairobi

DDIRM: Department of diagnostic imaging and radiation medicine

Ksh:    Kenyan shillings
### DEFINITION OF TERMS

**Assessment:** This is the act of judging the value, quality or importance of something.

**Knowledge:** This is the understanding/familiarity of a subject that one acquires by experience or study.

**Attitude:** The feelings or opinions of an individual towards something, and is expressed by their behavior or reactions towards a particular situation.

**Practice:** Is the act of doing an activity regularly so as to improve one’s skills.

**Resuscitation:** is the restoration of a person who appears to be dead. It depends on the revival of cardiac and respiratory function.

**Cardiopulmonary resuscitation:** this is refers to the act of re-establishing the action of the heart and lungs after cardiac arrest or apparent sudden death by artificial ventilation or chest cardiac massage.

**Radiological emergency:** this is a sudden, unexpected, and dangerous event or illness that occurs within the radiology department and poses an immediate risk to a person’s life/health thus demanding immediate action.

**Anaphylaxis:** this is an allergic reaction that is rapidly progressing and potentially life threatening.

**Cardiac Arrest:** This is the sudden and unexpected cessation of cardiac function as a result of rapid irregular twitching of the cardiac muscle fibers (fibrillation) or complete cessation of cardiac muscular contractions.
Pulmonary arrest: This is the cessation of normal breathing due to failure of lung or respiratory center function

Asystole: this is the state of absent cardiac electrical activity with resultant absence of myocardial contractility and cardiac output.

Ventricular Fibrillation: rapid irregular twitching of the ventricular muscles resulting in an abnormally irregular rhythm which undermines the hearts ability to supply oxygenated blood to the body.

Defibrillation: the process by which an electric device transmits a controlled electric shock to the heart to stop a rapid irregular heart beat and restores it to normal rhythm
ABSTRACT

Background

Emergencies in the radiology department are uncommon. They may arise in critically ill patients who are brought to the department for imaging, interventional procedures or as a result of adverse reactions to contrast media used for imaging. Adverse reactions to contrast media are infrequent and likely related to pre existing conditions. They range from very minor to severe life threatening effects and therefore initial prompt management decreases the chances of complications.

Consultant radiologists, residents and radiographers must possess knowledge of the management of anaphylactic/ anaphylactoid contrast reactions and cardiopulmonary arrest (CPA) as they are likely to be the first responders in case they occur. Previous studies have shown that many radiologists lack knowledge of the management of acute contrast reactions and cardiopulmonary arrest and several institutions have instilled training programs to help their staff keep abreast with the knowledge. No similar study has been done to determine such knowledge in this country.

Objective

The aim of this study was to determine the knowledge and practice of radiologists, radiology residents and radiographers in the radiology departments of University of Nairobi and Kenyatta National Hospital with regard to management of cardiopulmonary arrest and anaphylactic reactions.

Material and Methods

A cross sectional study was conducted among 80 radiologists, radiology residents and radiographers in the radiology departments of University of Nairobi and Kenyatta National Hospital between March 2016 and August 2016. Simple random sampling was used to select the participants and questionnaires assessing the knowledge and practice were administered. Data analysis was performed using the statistical package for social studies version 20.0
Results

A total of 80 participants were enrolled. This included radiology consultants (n = 18), radiology residents (n = 39) and radiographers (n = 23). Most of the respondents demonstrated inadequate knowledge on the fundamental and critical components of basic life support and advanced cardiac life support. None of them answered all the questions correctly, only 55% of radiology consultants, 35% of residents and 39% of radiographers scoring above 50%. Majority (82%) of the respondents had adequate knowledge on the symptoms, signs and risk factors of adverse reactions to contrast media. However only 24% knew that intravenous epinephrine is the recommended drug for severe anaphylactic reaction. There was an association between the cadre of the respondents and their knowledge (p<0.001) on contrast reactions, however no such association was noted in CPR knowledge. Shortcomings in terms of adequate training were accentuated in this study with majority of the respondents having not attended any life support course in the last 5 years.

Conclusion

The health providers within the radiology unit had knowledge on identifying both mild and severe symptoms of anaphylactic reactions to contrast media. There were however knowledge gaps on management of such reactions. They also demonstrated inadequate knowledge of the fundamental and critical components of basic life support and advanced cardiac life support. Study findings highlight the need to focus on improving provider knowledge and awareness of evidence based recommendations contained in clinical guidelines. There is need for an extensive study covering more health facilities in the country. This will lead to focused continued medical education in life support and contrast anaphylaxis management.
1.0 CHAPTER ONE: INTRODUCTION

1.1 History of Resuscitation
Resuscitation is a vital life saving skill which if administered quickly and correctly, greatly improves chances of survival following cardiac arrest. The practice of cardiopulmonary resuscitation (CPR) dates back to biblical times when prophet Elisha revived a child who was thought to be dead around 800B.C. [1] “And he went up, lay upon the child, put his mouth upon his mouth, his eyes upon his eyes, his hands upon his hands, stretched himself upon the child. The flesh of the child waxed warm and the child sneezed seven times and opened his eyes”.

Ancient Egyptians in 1500AD [2] attempted resuscitation by application of flagellation which involved whipping the victim to shock him back to life. In 18-12 AD the trotting horse method was used where a drowned victim would be placed on a horses and rode up and down the beach to cause alternate compression and relaxation of the chest.

In the 1530’s the bellows method was used to introduce air into the lungs by use of a contraption called a bellow that was initially used to put out fires in a fireplace. [3]

In the 1732 Tossach performed the first documented resuscitation of a coal miner overcome by fumes, using mouth-to-mouth and some years later mouth to mouth resuscitation was deemed successful and recommended for drowning victims in France. [4] In 1904 the first successful use of external chest compression in human resuscitation was reported by Dr George Crile. He stated that the use of the thoracic pressure produced artificial circulation by action on the heart and great vessels [5, 6]

The first successful resuscitation of cardiac arrest using defibrillation was recorded in 1947 where Claude Beck performed open cardiac massage and internal defibrillation using alternating current in a 14 year old boy who was undergoing surgery for congenital funnel chest. He made full recovery thereafter [7]. With this success Paul Zoll [8] in 1955 developed an external defibrillator which was used successfully on four different cardiac arrest patients. This machine was however very large and heavy thus was not easily portable. This problem was solved by Bernard Lown [2] in 1961 who devised a defibrillator that used direct current supplied by battery and this enabled considerable reduction in size and weight of the device thus making it portable.
James Elam, was the first to publish an article on mouth to mouth resuscitation, proving that expired air was sufficient to maintain adequate oxygenation in 1956 [5].

This led the National Research Council of the National Academy of Sciences to recommend mouth-to-mouth resuscitation as the emergency technique of choice in the same year. Kouwenhoven, Knickerbocker, and Jude subsequently described the benefits of external chest compressions [8]. In the 1960’s American Heart Association (AHA) took up mouth to mouth resuscitation and external chest compressions and began modern CPR as we know it.[2] Over the years several reviews have been made to improve the quality of CPR and it is vital for healthcare professionals to keep updating their knowledge of these changes so as to provide optimum care to their patients. Different countries and health organizations have varied methods of performing CPR but the basic combination of providing rescue breaths and chest compression remains.

1.2 Cardiac Arrest

This refers to the cessation of cardiac activity with collapse of the hemodynamic system. It results in absence of blood flow to the vital organs, depriving them of oxygen and glucose. If left untreated will result in death and thus immediate treatment is required to improve chances of survival [9].

Sudden cardiac arrest (SCA) is cessation of the cardiac activity and hemodynamic collapse within a short period of symptom onset [9].

Cardiac arrest can occur in the presence or absence of previous cardiac disease. The signs and symptoms include rapid shallow breathing, apnea, chest pain, pulselessness, decline in mental alertness, collapse or brief convolution in the case of SCA. The presence of ventricular tachycardia (VT), ventricular fibrillation (VF) and asystole on a cardiac monitor and changes on the electrocardiogram (ECG) indicate impending cardiac arrest[10].

Identifying treatable causes of cardiac arrest like hypoxia and hypovolemia by use of rapid bed side tests may improve management. Rapid intervention is essential by employing BLS and advanced cardiac life support (ACLS) algorithms
1.3 Respiratory Arrest

This refers to the cessation of breathing which prevents delivery of oxygen to the body. Irreversible damage to the vital organs may occur if there is an interruption of pulmonary gaseous exchange for more than 5 minutes [11]. Failure of the respiratory function to return almost always results in cardiac arrest. The etiology of respiratory arrest in both adults and children is due to airway obstruction, decreased respiratory effort and weakness of the respiratory muscles due to various causes. Signs and symptoms of impending respiratory arrest include a patient who is struggling to breathe, confused, diaphoretic, tachycardia, gasping, paradoxical breathing movement and intercostal and sternoclavicular retractions. Presence of stridor indicates upper airway obstruction [12]. Treatment should be prompt by employing BLS and ACLS protocols.

1.4 Basic Life Support (BLS)

BLS refers to the care healthcare providers give to patients who are experiencing respiratory arrest, cardiac arrest or airway obstruction[13]. BLS includes psychomotor skills for performing high-quality cardiopulmonary resuscitation (CPR), using an automated external defibrillator (AED) and relieving an obstructed airway for patients of all ages. BLS also focuses on the integration of critical thinking, problem solving, communication and team dynamics in order to achieve optimal patient outcomes [14]. In this algorithm, emphasis has been placed on recognition of SCA by assessing for the presence of abnormal breathing or absence of breathing and also to assess for unresponsiveness. Prompt defibrillation using an AED is also emphasized upon. The previously used sequence of A-B-C (Airway- Breathing –Compression) in 2010 has now been replaced by C-A-B (Compression- Airway- Breathing)-2015 BLS guidelines. [15, 16]
Lifesaving BLS intervention can be summarized in the following flow chart:

Figure 1- BLS Flow Chart.

**Adult BLS Healthcare Providers**

1. Unresponsive
   - No breathing or no normal breathing (i.e., only gasping)

2. Activate emergency response system
   - Get AED/defibrillator
   - or send second rescuer (if available) to do this

3. Check pulse:
   - DEFINITE pulse within 10 seconds?

   **Definite Pulse**
   - **3A**
     - Give 1 breath every 5 to 6 seconds
     - Recheck pulse every 2 minutes

   **No Pulse**

4. Begin cycles of 30 COMPRESSIONS and 2 BREATHS

5. AED/defibrillator ARRIVES

6. Check rhythm:
   - Shockable?

   **Shockable**
   - Give 1 shock
   - Resume CPR immediately for 2 minutes

   **Not Shockable**
   - Resume CPR immediately for 2 minutes
   - Check rhythm every 2 minutes; continue until ALS providers take over or victim starts to move

Note: The boxes bordered with dashed lines are performed by healthcare providers and not by lay rescuers

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1.5 Pediatric BLS Algorithm

The protocol is similar to what is done in adults except in the pulse check where the in infant the pulse is checked at the brachial artery while in adults it is checked at the carotid artery[18]. If only a single health care professional (HCP) is available then the chest compressions are given using the 30:2 sequence while if two personnel are present, a rate of 15:2 is used[19].

High quality compressions in pediatrics are achieved by applying a force that compressed the chest to minimum of 1/3 of its AP diameter i.e 4cm in children less than 12 years old. In infants only two fingers are used to perform the compression. If two HCPs are available then the thumb encircling technique may be performed. When using the AED, a dose attenuator may be used to control the amount of shock, however if this is not available then adult padds may be used[13, 15]

1.6 Advanced Cardiac Life Support

According to the 2010 guidelines by AHA, ACLS focuses on BLS as the basic component with additional algorithms that are tailored to deal with different emergencies. They include: cardiac arrest algorithm, pulseless electrical activity (PEA) and asystole algorithm, VF/VT algorithm, bradycardia algorithm, tachycardia algorithm, acute coronary syndrome algorithm and suspected stroke. Emphasis is made on supporting the airway by use of definitive airways like endotracheal tubes and laryngeal tubes. Use of appropriate medications to manage rhythm-amiodarone/atropine and to control blood pressure (BP) -dopamine/epinephrine is included. Investigation and treatment of reversible causes of arrest is also emphasized in ACLS [20, 21]. Only qualified health care providers can provide ACLS
ACLS algorithm is summarized by the flow chart:

Figure 2- ACLS algorithm.
1.7 Anaphylactic Reactions to Contrast Media

Contrast media is a substance that is used to enhance the differentiation of tissues within the body in medical imaging. They are used daily in imaging departments worldwide and have various side effects[22].

Although these side effects are infrequent, the knowledge of their presentation, their relationship with pre existing conditions and their management is required to ensure optimal patient care.

Most of the contrast agents are iodine based and are divided into ionic and non-ionic contrast agents depending on their osmolality in relation to blood. Ionic contrast agents are hyperosmolar to blood and have a high risk of adverse reactions. Non ionic agents are iso-osmolar or low osmolar in nature and have fewer adverse effects[23].

Majority of contrast reactions occur unpredictably and severe reactions may occur even when there has been a previous uneventful examination.

Risk factors that increase the likelihood of occurrence of adverse reactions include:

1. Previous history of allergy like reaction to contrast media.
2. Allergy to food or other drugs.
3. History of asthma.
4. Renal insufficiency.
5. Cardiac disease e.g. Congestive cardiac failure, angina
6. Anxiety
7. Others: sickle cell trait, use of drugs like beta blockers, infants and neonates.[24, 25]

A detailed history should be obtained and pre medication administered prior to contrast use to reduce the risk of reaction occurrence.

Adverse reactions to contrast can be divided into organ specific and non organ specific or general reactions. They can also be classified into acute and delayed based on the timing after contrast administration.
Acute hypersensitivity reactions are those that develop within 1 hour of contrast administration and can be classified into allergic-like and physiologic [26]. Allergic-like reactions are largely dose and concentration independent. They do not require prior sensitization or Ig-E and are thus called idiosyncratic/anaphylactoid reactions. They occur via direct mast cell stimulations or via activation of complement by immune complexes [27]. These are the most frequent type of adverse reactions and may have serious, occasionally fatal, complications.

Physiologic reactions are those that are dose and concentration dependent and are thus called non idiosyncratic reactions. They are due to direct chemotoxic or osmotoxic effects of the contrast media [28].

These acute reactions can be further subclassified into three categories based on severity: mild, moderate, and severe [26]. Mild reactions are those that are self-limiting. The mild allergic-like reactions include limited urticaria, pruritus, cutaneous edema, nasal congestion while the physiologic reactions include limited nausea and vomiting, transient flushing, headache, dizziness, anxiety and vasovagal reactions that resolve spontaneously [26]. Moderate reactions are those that are progressive and more pronounced and require medical management [29]. The moderate allergic-like reactions include diffuse urticaria/pruritus, diffuse erythema with normal vital signs, facial edema, throat tightness, wheezing and bronchospasms. While the moderate physiological reactions include protracted vomiting, hypertensive urgency, vasovagal reactions that require treatment and respond to it [26]. Severe reactions are those that are potentially life-threatening with impending death if not managed properly [22]. The severe allergic-like reactions include diffuse edema with dyspnea, diffuse erythema with hypotension, laryngeal edema with stridor, bronchospasms with hypoxia and anaphylactic shock. The severe physiologic reactions include vasovagal reactions resistant to treatment, convulsions, arrhythmia and hypertensive emergency [26]. The end result of severe allergic-like and physiologic reactions is CPA which is a medical emergency and prompt and proper management using the BLS protocol and drugs including epinephrine, vasopressors, antihistamines and inhaled B-agonists is necessary to save lives.

Contrast induced acute kidney injury and nephropathy can also occur following contrast administration [30]. Risk factors include co-morbidities like diabetes mellitus, dehydration, cardiac disease, hypertension and multiple iodinated contrast media doses in less than 24 hours.
Baseline serum creatinine +/- glomerular filtration rate should be availed before injection of contrast media in at risk patients[26]. Contrast media administration in such patients can be done with caution by: reduced dose of contrast media, hydration and use of iso-osmolar agents.

1.8 Management of Acute Contrast Media Reactions[26]

Management of acute contrast begins with discontinuation of injection if not completed. General principals of BLS and ACLS should apply in case of cardiorespiratory arrest

Summary of the management of contrast reactions is as follows:

Table 1- Management of Contrast Reactions.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Monitoring</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaphylactoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urticaria (skin rash)</td>
<td>Initial size with marking and follow</td>
<td>Mild-Usually none; if symptomatic consider diphenhydramine, 25–50 mg orally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate/Severe-monitor vitals and obtain IV access. Consider diphenhydramine, 25–50 mg orally intramuscularly/ intravenously; epinephrine (1:1,000), 0.1–0.3 mL subcutaneously/intramuscularly</td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>Oxygen saturation, pulse, Blood pressure (BP)</td>
<td>In all forms of bronchospasms: preserve IV access, monitor vitals and oxygen saturation and give oxygen by mask 6-10L/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild: Inhaled B-agonist- 2 puffs at 90mcg/puff and can be repeated up to 3 times. If response is not satisfactory, emergency response team should be contacted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate Inhaled B-agonist- 2 puffs at 90mcg/puff and can be repeated up to 3 times</td>
</tr>
<tr>
<td>Reaction</td>
<td>Monitoring</td>
<td>Treatment</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Epinephrine (1:1000), 0.3 mL intramuscularly-this can be repeated every 5-15 minutes as needed up to 1ml(1mg) total; OR Epinephrine (1:10,000), 1 mL(0.1mg) intravenously (slowly) if hypotensive; This can be repeated every few minutes as needed up to 10ml(1mg) total call the emergency medical team; call the emergency medical team</td>
</tr>
<tr>
<td>Severe: Epinephrine (1:1000), 0.1–0.3 mL intramuscularly-this can be repeated every 5-15 minutes as needed up to 1ml(1mg) total; OR Epinephrine (1:10,000), 1 mL(0.1mg) intravenously (slowly) if hypotensive; This can be repeated every few minutes as needed up to 10ml(1mg) total Call the emergency medical team and Inhaled B-agonist (may work synergistically). Call the emergency medical team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial or laryngeal edema</td>
<td>Oxygen saturation, pulse, BP</td>
<td>In all forms of laryngeal edema: preserve IV access, monitor vitals and oxygen saturation and give oxygen by mask 6-10L/min Call the emergency medical team if severe Epinephrine (1:1000), 0.3 mL intramuscularly-this can be repeated every 5-15 minutes as needed up to</td>
</tr>
<tr>
<td><strong>Reaction</strong></td>
<td><strong>Monitoring</strong></td>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>1ml(1mg)total; OR Epinephrine (1:10,000), 1 mL(0.1mg) intravenously (slowly) if hypotensive ; This can be repeated every few minutes as needed up to 10ml(1mg) total call the emergency medical team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypotension(systolic BP &lt;90mmHg) and tachycardia (&gt;100bpm) Oxygen saturation, pulse, BP</td>
<td>Preserve IV access, Elevate legs 60°; oxygen, 6–10 L/min; rapid intravenous fluids(1 litre of 0.9% normal saline or lactated Ringer’s); epinephrine (1:10,000), 1 mL(0.1mg) intravenously (slowly); This can be repeated every few minutes as needed up to 10ml(1mg) total OR Epinephrine (1:1000), 0.3 mL intramuscularly-this can be repeated every 5-15minutes as needed up to 1ml(1mg)total call the emergency medical team</td>
<td></td>
</tr>
<tr>
<td>Hypotension(systolic BP &lt;90mmHg) and bradycardia (&lt;60bpm) Oxygen saturation, pulse, BP</td>
<td>Elevate legs 60°; oxygen, 6–10 L/min; rapid intravenous fluids(1 litre of 0.9% normal saline or lactated Ringer’s) If mild, no further treatment is necessary If patient remains symptomatic despite the above measures: Atropine, 0.6–1 mg intravenously (slowly); repeat to total of 2–3 mg (0.04 mg/kg) if needed; call the emergency medical team</td>
<td></td>
</tr>
<tr>
<td>Reaction</td>
<td>Monitoring</td>
<td>Treatment</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td>Oxygen saturation, pulse, BP, ECG</td>
<td>Follow ACLS protocols; call the emergency medical team</td>
</tr>
<tr>
<td>Hypertensive crisis (diastolic BP &gt;120mmHg; systolic BP &gt;200mmHg)</td>
<td>Oxygen saturation, pulse, BP, ECG</td>
<td>Nitroglycerine, 0.4 mg sublingually; can repeat every 5-10 minutes OR Labetalol intravenously 20mg, administer slowly over 2 minutes. The dose can be doubled every 10 minutes. OR Lasix intravenously 20-40mg, slowly over 2 minutes. Phentolamine, 5 mg intravenously for pheochromocytoma; Call the emergency medical team</td>
</tr>
<tr>
<td>Seizures</td>
<td>Oxygen saturation, pulse, BP, ECG</td>
<td>Observe and protect the patient Secure airway; oxygen, 6–10 L/min; Preserve IV access and give diazepam, 5 mg intramuscularly/intravenously OR midazolam, 0.5–1 mg intravenously OR phenytoin infusion, 15–18 mg/kg at 50 mg/min; call the emergency medical team</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>Oxygen saturation, pulse, BP</td>
<td>If patient is able to swallow orally give half a cup of fruit juice or 15g of glucose Is the patient is unable to swallow safely, obtain IV access and give 50% dextrose, 1 ampule-25gms over 2 minutes OR 100ml/hr of 5% dextrose.</td>
</tr>
</tbody>
</table>
Is patient is unable to swallow and IV access is not available give intramuscular glucagon 1mg.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Monitoring</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary edema</td>
<td>Oxygen saturation,</td>
<td>Preserve IV access, Secure airway; oxygen, 6–10 L/min;</td>
</tr>
<tr>
<td></td>
<td>pulse, BP, ECG</td>
<td>Elevate head of the bed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>furosemide, 20–40 mg intravenously (slowly over 2 minutes); morphine, 1–3 mg intravenously; call the emergency medical team</td>
</tr>
</tbody>
</table>

[26, 31, 32]

**1.9 Premedication Of At Risk Patients.**

Premedication of patients who have a higher risk of acute allergic like reactions should be considered to reduce the chance of reaction occurrence[33]. For elective premedication oral prednisolone and diphenhydramine are used. For emergency premedication I.V methyl prednisolone sodium succinate or dexamethasone sodium sulfate. I.V diphenhydramine can be used instead of steroids in emergency cases[26].

**1.10 Reaction Rebound Prevention.**

Intravenous corticosteroids play a role in preventing short term recurrence of an allergic like reaction The may also be administered to patients having severe allergic like manifestations prior to transport to an emergency unit. They are however not useful in the acute treatment of any reaction.
1.11 Literature Review

Medical emergencies in the radiology department can occur in critically ill patients brought in for imaging or in patient undergoing imaging that requires intravenous contrast media administration. A study by van Tonder et al on the medical emergencies in the imaging department of a university hospital in Melbourne, [34] showed that their medical emergency team responded to 124 emergency calls from the radiology department. Of these calls, 14% were due to seizures, 14% due to hypotension, 13% due to altered conscious states, 12% due to cardiac arrest, 10% due to hypoxia, 8% due to vasovagal response, 4% due to contrast anaphylaxis likely due to use of low osmolar contrast media (LOCM) and 39% due to other miscellaneous causes. This shows that most of the emergencies arise from etiologies related to the primary condition of the patient and less from the etiologies related to the imaging procedure.

The outcomes of such emergencies in the radiology department were assessed by Ott LK et al [35] at Michigan state university. 39% of these emergencies were due to neurological causes, 38% due to cardiac and 22% due to respiratory causes. 34 % of patients required intensive care admission, 50% required respiratory support and 18% cardiac support. 3% of these patients died during the emergency resuscitating while 19% died later in hospitalization.

Contrast media reactions are rare in occurrence. The landmark study by Katayama et al [36] in Japan, compared adverse drug reactions to high-osmolar ionic contrast media and low-osmolar nonionic contrast media. The study revealed that the overall prevalence of reactions was 12.66% in the ionic contrast media group and 3.13% in the nonionic contrast media group. Severe reactions occurred in 0.22% of the ionic and 0.04% of the nonionic contrast media examinations. One death occurred in each group, but a causal relationship to the contrast medium could not be established. They concluded that nonionic contrast media significantly reduce the frequency of severe and potentially life-threatening reactions to contrast media. A follow up study by Carolyn Wang et al[37] on the frequency, outcome, and appropriateness of treatment of nonionic iodinated contrast media reactions revealed a decrease in the prevalence of contrast media reactions to 0.6%. Of these, 77% were mild, 21% were moderate and 2% were severe. The most commonly administered drug was diphenhydramine and 99% of the patients recovered well while the remaining 1% had short term sequelae due to receiving non recommended treatment.
These statistics show that radiologists, residents and radiographers must be capable of managing CPA and anaphylactic reactions.

1.12 Knowledge of CPR

The knowledge of CPR is important for all healthcare professionals. Various studies have assessed the knowledge of CPR among health professionals and have generally found them to be lacking. In many medical schools, BLS training has been included in the curriculum and graduate doctors and nurses are thus thought to be well equipped in BLS when they leave their learning institutions. This is however not the case as was found by Dr Adulrahma et al[38] who assessed the knowledge of BLS among students and healthcare professionals at Qassim university. Ninety-three responders were medical students, 7 were medical interns, 6 were dental students, 7 were pharmacy students, 11 were medical science students and 15 were clinical practitioners. No responder scored 100% on the BLS survey. Only 1.4% scored 90–99%. 16.5% scored 60–69%. 20.1% scored 50–59%. Of these, only 2 were doctors. The remaining 49.6% scored less than 50%. They concluded that knowledge of BLS among students and healthcare providers was poor and needed to be improved.

A questionnaire survey done by Marzooq et al [39] on cardiopulmonary resuscitation knowledge among nurses working in Bahrain, revealed that out of 82 nurses who were evaluated, 58% of the respondents perceived recalling CPR information as easy, however only 7% passed the assessment test. The study identified a significant problem with knowledge of CPR.

The radiographer, radiology resident or radiologist is likely to be the first medical practitioner to respond to a medical emergency within the radiology department. It is therefore essential that every radiology department should be organized and the staff be well equipped to deal with any emergency immediately it arises. Majority of the staff have undergone theoretical training on the clinical presentation and management of contrast media reactions. However practical knowledge on life support training and management of contrast media reactions is lacking.

The knowledge and attitude of radiology technologists towards CPR was assessed by Hamid et al[40] in four tertiary referral hospitals in Ahvaz, Iran using a questionnaire. None of the 95 participants had attended a training program since employment and none of them answered all questions correctly. Majority scored between 35-80% and had a positive attitude towards performing CPR. It was concluded that, although the attitude of participants towards CPR was
positive in general, however their technical knowledge was poor. This finding should therefore urge decision-makers to consider delivering in-service training courses to radiology technologists considering the increasing number of casualties and critically ill patients referred to radiology departments.

In sub-Saharan Africa a study was undertaken to assess the knowledge, attitude and practices of resuscitation of patients among radiographers’ during emergency cases in three tertiary hospitals in Enugu State, Nigeria. A total of 45 radiographers answered a questionnaire on age, gender, work experience and questions regarding resuscitation. 71% scored 100% with regards to the definition of cardiac arrest. 60-80% knew the causes of cardiac arrest. Impressively 87.5% knew the drugs used in management of cardiac arrest. Only 69% had witnessed cardiac arrest. With regards to contrast media use, 80% mentioned more than 1 complication of IV contrast media use while <50% scored 100% in the questions regarding management of such complications. An analysis of the emergency preparedness of the department was done and it was found that emergency drugs and other resuscitation materials were not readily available in the department. These results showed that radiographers had good knowledge, positive attitude and good practice towards patients in need of resuscitation[41]

1.13 Knowledge of Contrast Media Reactions and Management

Radiologists, radiographers and residents must be aware of the clinical signs and symptoms of adverse contrast media reactions and their management.

The understanding of radiologists on contrast media reactions and their management was assessed by Sadler et al[42]following the publication of the Royal College of Radiologists guidelines for the management of reactions to intravenous contrast media in 1994. A questionnaire was used and they found that of the 61/101 respondents, knowledge of minor contrast media reactions was generally good but the understanding of treatment of severe reactions was poor. Knowledge of optimal management was inversely related to radiological seniority.

The management of anaphylactic reactions varies with the severity. Mild reactions are self-limiting and are managed by observation and reassurance. They do not usually require medical management. Moderate reactions may require medical management as they can become severe if
left untreated. Severe reactions are potentially life threatening and require urgent medical intervention. Even though severe contrast reactions are uncommon nowadays due to use of non ionic contrast media, they still do occur and the knowledge of their management by radiographers, radiologists and residents is paramount. This knowledge was assessed by Bartlett et al[43] among 42 Australian radiologists and residents in 4 teaching hospitals. They were presented with scenarios of an adult who developed life-threatening symptoms of anaphylaxis immediately after intravenous contrast administration, adult with ventricular fibrillation and another with bradycardia. Questions were asked with regards to adrenaline, corticosteroid, antihistamines, intravenous volume expansion, cardio-pulmonary resuscitation, knowledge of the emergency telephone number and presence of an anaphylaxis management chart. Overall, 53% of questions were answered correctly. Only 43% knew the adrenaline dose and those who gave an incorrect dose it was more likely to be an overdose. Marked inadequacies were also found with the dosages of corticosteroids, atropine, antihistamines and intravenous fluid. Only 26% had done a resuscitation course in the previous 2 years. 45% knew the emergency telephone number and 55% of rooms that used intravenous contrast had a visible chart for management of contrast reactions.

Similar findings of lack of knowledge in management of contrast reactions were found by Lightfoot et al[44] who assessed 253 radiologists from 13 Canadian universities and 13 United States universities. A scenario was given of a. They answered questions regarding their initial drug of choice in case of a severe reaction to contrast media. They were then asked specific questions regarding epinephrine. 91% chose epinephrine as the most important initial medication. However none of radiologists gave an ideal response on the route of injection, the dose and concentration of epinephrine used. Only 11% of radiologists knew what concentration of epinephrine was available in their crash cart and the equipment required to administer it. It was therefore concluded that Radiologists’ knowledge of epinephrine for the management of severe contrast induced allergic reactions was deficient.

These findings indicate the need for training on recognition of contrast media reactions and their management. The limited frequency of contrast reactions requires that educational methods of reinforcement be employed to maintain such knowledge and skill. A study by Andrew trout et al[45]in Michigan, assessed the changes in radiology residents’ knowledge and confidence
following a mandatory annual educational course on contrast media reactions. Assessments were performed immediately before and after the course and thereafter at intervals of 1, 3, 6 and 9 months. They found that residents’ knowledge significantly improved following the course and remained improved for 6 months. However, by 9 months, a decline in knowledge was observed. Residents’ confidence also improved following the course, however at 6 months there was a decline in confidence. Residents who had managed a contrast reaction during the follow-up period were more confident. They recommended the need for bi-annual refresher training on the management of acute contrast reactions to maintain residents’ knowledge and confidence.

1.14 Practice of Management of CPA And Anaphylactic Reactions

In addition to lacking adequate knowledge on the basics of adult life support, most radiologists, residents and radiographers display inability and under-confidence to initiate BLS. A study done by Tariq Alam et al[46]in Pakistan to assess the proficiency of radiologists and radiology residents in managing adult life support in cardiopulmonary arrest and acute anaphylactic reactions revealed that radiology consultants and residents in Pakistan do not meet objectives of basic life support and are unable to manage adult cardio respiratory arrest. The study showed that out of the 124 participants only 28.2% had attended basic life support course within the previous eight years, while 42.7% had not attended course at all. 44% answered all the questions correctly. Those who attended the BLS course performed well in comparison to those who did not attend the course. Similarly, those who attended the BLS course in the recent years performed well in comparison to those who attended the course in earlier years. The main reason for the inability and underconfidence to initiate BLS by the radiology residents and radiologists was inadequate training. It was recommended that BLS training programs and refresher courses should be mandatory during residency in order to acquire the required competency level for BLS.

Similar findings were demonstrated by Tapping et al who performed an assessment on the ability and confidence of radiologists and residents in managing cardiopulmonary arrest and acute anaphylactic reactions. 105 radiologists and residents from 6 facilities in the United Kingdom (UK) answered questions on recent training, knowledge and confidence on management of adult resuscitation according to the 2005 UK guidelines and acute anaphylaxis. 90% of the respondents felt confident to initiate life support, however only 13% correctly answered all questions assessing the life support procedure. The mean score was 2.3 out of
5. There was no correlation between the grade of the radiologist or resident and the likelihood of giving a correct answer. No correlation was found between feeling confident and the knowledge of life support. They also found flaws in training with only 61% of radiologists having attended life support training in the preceding 4 years. The study emphasized the need for regular life support training and the need to change the attitude of the radiologist to considering it their role to initiate effective life support in case of an emergency[47].

The experience of CPR and cardiac defibrillation by radiologists was assessed by Schellhammer et al[48] among German radiologists. A questionnaire sent via email to 650 radiologists, however only 12.6% responded. The low response rate indicated the low level of importance of CPR to the respondents. 72% had performed at least one CPR in their course of practice. 67.9% had opportunities to attend life support training, only 41% had utilized them.

The knowledge of CPR and management of acute anaphylactic reactions among radiology staff is expected to be good and updated. Unfortunately, knowledge per se is not enough, as regular hands-on practice is required in order to retain the skills. A study to assess the proficiency of radiologists, radiology residents in managing adult basic life support in CPA and acute anaphylactic reactions has not been done in Kenya. I was motivated to undertake this study in order to add to available literature and to raise the awareness on the topic.
2.0 CHAPTER TWO: STATEMENT OF THE PROBLEM

Life threatening emergencies can occur in patients brought into the radiology department for imaging and interventional procedures. Despite the rare occurrence of these emergencies, they carry substantial morbidity and mortality and require immediate intervention by the attending radiologist, resident or radiographer. They must therefore be equipped with up to date knowledge and skills to manage these emergencies.

The radiologists, residents and radiographers working at the UoN and KNH may not be aware of the current BLS and ACLS guidelines with regard to management of cardiopulmonary arrest. They may also be incapable of recognizing the signs and symptoms of adverse reactions to contrast media and their correct management as stipulated by the American college of radiology.

2.1 Rationale

Emergencies in the radiology department, though rare, are still important and their urgent and correct management plays a major role in patient outcome. Since the radiologist, resident or radiographer is usually the first responder in such cases, their knowledge of cardiopulmonary resuscitation and management of contrast induced anaphylactic reactions must be accurate and up to date. Studies evaluating the knowledge and practice of radiologists, residents and radiographers of CPR and management of anaphylaxis have been done elsewhere but not in Kenya.

Currently there are no standard operating procedures regarding management of cardiopulmonary arrest and contrast anaphylaxis in the radiology departments in KNH and UoN. Well equipped emergency trays are available however most staff do not know their location or content. Findings from this study aim to create awareness and help in setting the SOPs of management of emergencies in the radiology setting. The findings will also contribute to the body of knowledge on this topic, lay foundation for future studies evaluating other institutions and may contribute to the curriculum of learning in our institution.
2.2 Hypothesis

2.2.1 Null Hypothesis

All the radiologists, radiology residents and radiographers at the University of Nairobi and KNH are proficient in managing cardiopulmonary arrest and anaphylactic reactions to contrast media.

2.3 Study Questions

1. Are radiologists, radiology residents and radiographers aware of current BLS and ACLS guidelines?
2. Are radiologists, radiology residents and radiographers aware of the contrast media reactions?
3. Are radiologists, radiology residents and radiographers capable of managing cardiopulmonary arrest?
4. Are radiologists, radiology residents and radiographers capable of managing contrast media reactions?

2.4 Objectives

2.4.1 Broad Objective

To determine knowledge and practices of radiologists, radiology residents and radiographers in the management of cardiopulmonary arrest and anaphylactic reactions to contrast media at the University of Nairobi and KNH.

2.4.2 SPECIFIC OBJECTIVES

1. To assess the level of knowledge of radiologists, radiology residents and radiographers on management of cardiopulmonary arrest and anaphylactic reactions at the University of Nairobi and KNH.

2. To determine the practices of radiologists, radiology residents and radiographers when it comes to resuscitation in radiological emergencies.
2.5 Study Design
This is a cross sectional study conducted among radiologists, radiology residents and radiographers at the University of Nairobi and KNH to determine their knowledge and practices of resuscitation of patients during radiological emergencies.

2.6 Study Area Description
1. Department of diagnostic imaging and radiation medicine-University of Nairobi, Nairobi County, Kenya
2. Kenyatta National Hospital, Nairobi County, Kenya

2.7 Study Population
Radiology consultants, residents and radiographers at the University of Nairobi and KNH

2.8 Inclusion Criteria
Any radiology consultants working or teaching at the University of Nairobi and KNH

Any radiology resident studying at the University of Nairobi

Any radiographers working at the University of Nairobi and KNH

2.9 Exclusion Criteria
Declined consent

Visiting radiologists, residents and radiographers from other institutions

2.10 Sample Size Estimation
For populations that are large (i.e. 10,000 and above), sample size for proportions is estimated as:

\[ n_0 = \frac{Z^2 \times p(1-p)}{e^2} \]  

[Coehran (1963)]

Where

\( n_0 \) is the sample size for target population >10,000,

\( Z^2 \) is the abscissa of the normal curve that cuts off an area \( \alpha \) at the tails (1 - \( \alpha \) equals the desired confidence level, e.g., 95%).
e is the desired level of precision,
p is the estimated proportion of an attribute that is present in the target population which is obtained from previous similar study,

This study desired a 95% confidence level and ±5% precision. The study assumed p=0.5 since there was no similar study conducted in regions similar to our settings.

Substituting the above parameters, the sample size became:

\[ n_0 = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2} = 385 \]

Since the target population was less than 10,000 (i.e. target population =103) then the sample size was adjusted downward.
The sample size \( n_0 \) was adjusted using:

\[ n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \]  

[Coehran (1963)]

Where

n is the adjusted sample size
N is the target population size.

Therefore the adjusted sample size becomes:

\[ n = \frac{385}{1 + \frac{(385 - 1)}{103}} = 82 \]

82 participants were to be recruited in the study.
2.11 Sampling Procedures

All consultants, residents and radiographers working at the University of Nairobi and Kenyatta National Hospital were assigned a number to constitute study sampling frame. Simple random sampling method was then used to select study participants.
3.0 CHAPTER THREE: DATA MANAGEMENT AND ANALYSIS

3.1 Data Collection
Ethical approval and permission from both hospital and University managements was obtained. The respondents were divided into two groups based on location i.e KNH and UoN. These were then subdivided according to cadre i.e radiology consultants, residents and radiographers. Further subdivision was done based on year of study for residents and the questionnaires were then administered to the groups in phases, with intervals of 4 weeks in between. This ensured the respondents would not recall the details of the questionnaire just in case they may have discussed it amongst themselves. After reading and signing the consent form, the study participants filled a pretested structured questionnaire which was administered by the principal researcher and research assistants.

3.2 Materials
Each participant included in the study anonymously filled the structured questionnaire consisting of multiple choice questions and closed ended questions related to the study title.

The questionnaires addressed the following areas;

1. Demographic data including age, cadre and year of study
2. Knowledge on BLS and ACLS
3. Knowledge on contrast media reactions and their management
4. Knowledge on emergency facilities in the department

3.3 Training Procedures
One research assistant was recruited from the medical officers employed in casualty KNH and was trained for one day on how to explain about the study and how to administer the questionnaires.

3.4 Quality Assurance Procedures
A pretest of the questionnaire was performed to establish its validity. Questionnaires were administered to two residents from the University of Nairobi (UON) department of Internal
medicine and two trainers of trainees in ACLS/BLS. The interviewer was the principle investigator and obtained clarification of answers from the respondents. Additional respondents' views were obtained during a post-questionnaire interview and necessary adjustments made.

The basis of the pretest was to identify comprehension difficulties; identify any problem questions; ensure proper interpretation of the questions; and ensure time taken to fill in the questionnaire is reasonable. This was with an aim of improving the problem areas.

3.5 Ethical Considerations

1. Written informed consent was sought from the participants with the risks and benefits of participation explained to the participants. The consent form also included the rights of the participants
2. Ethical clearance: The research team obtained ethical clearance to conduct this study from the KNH/UoN Ethics and Scientific Review Committee.
3. Institutional permission was sought from both KNH and UoN
4. Confidentiality was maintained at all times during the study

3.5.1 Confidentiality of participants

The principal investigator ensured that there were no identifiers that may link the research data to study participants

Each study participant was allocated a unique numeric identifier that will was used in the data abstraction tool and database.

3.5.2 Confidentiality of data obtained

Access to the participant data was restricted.

No unauthorized persons were allowed any access to participant records.

These records were stored in a locked in cabinet.

All electronic databases are password protected to control access.

5. Beneficience/Maleficience

The results of the study will be used to improve patient management by the participants and will be published to benefit other radiologists, residents and radiographers.

All participants were protected from any health, physical, social or economic harm.
3.6 Data Entry and Storage

All questionnaires were reviewed on upon reception by the principle investigator to ensure they were completed appropriately. Data collected was entered into an Excel spreadsheet in a password protected computer. Back-up copies were stored in an external hard drive and compact disc which were in sole custody of principal investigator.

The filled questionnaires were in the safe custody of the principal investigator who filed and stored them in a locked cabinet for verification during analysis.

Further data cleaning was carried out after entry using frequency distributions and cross-tabulations until no more errors could be detected. A biostatistian was involved in data analysis.

3.7 Data Analysis

In order to achieve the objectives of the study, data analysis was done by using univariate and bivariate analysis techniques. Univariate analysis involved frequency distributions for categorical variables and descriptive statistics (means, medians, standard deviations) for continuous variables. Categorical variables (e.g. sex, cadre, life support training attended e.t.c) were presented using bar charts, pie charts and frequency distribution tables. Histogram was used to present continuous variables e.g age. Univariate analysis was also used to assess knowledge and practices of radiologists, residents and radiographer on CPR and management of acute anaphylactic reactions. This gave an understanding of the characteristics of the study participants.

Chi square tests were used to compare demographic characteristics of the respondents with adequate knowledge on management of CPA and contrast media reactions and their respective practices. The demographic characteristic used in the comparison were cadres, years of experience and attendance of life support training. The differences found with chance probability ≤ 5% (p ≤ 0.05) were considered as statistically significant.

Statistical Package for Social Sciences Programme (SPSS) version 20.0, was used for data analysis.
3.8 Data Dissemination

The results of this study will be bound in a Master’s thesis book and disseminated to the department of Diagnostic imaging and Radiation medicine. A copy shall be provided to KNH radiology department. This study will also be disseminated to a wider audience through publications in peer review journals, technical briefs and presentations in Kenyan and international meetings.

Data dissemination budget included printing of extra copies of the final report and purchasing of stationary. These items were included in the study budget.

3.9 Study Limitations

3.9.1 Information bias

The responses of the questionnaire were self reported and this may have given rise to bias information. Some respondents might have given wrong information to appear knowledgeable given that there is an expected level of knowledge on certain subjects in medicine and in particular, radiology. Closed ended questions were used to eliminate this bias.

Colleagues within the institution may have discussed the questionnaire. We tried to eliminate this by dividing the potential respondents into groups and administering the questionnaire in phases to ensure that the respondents would not recall any discussions they may have had. Some individuals may have had access to reference material during the study; the filling of questionnaires was observed by the principal investigator or research assistant to mitigate against this limitation.

This study was done in university based departments in a major teaching and referral hospital in Kenya. These departments are not an ideal representation of the radiology departments in Kenya in terms of staffing and equipment. This brought about generalisability of findings and may be overcome by future studies extending the study area to include other facilities.
4.0 CHAPTER FOUR: DATA ANALYSIS, RESEARCH FINDINGS AND INTERPRETATION

4.1 Results
The total enrollment in the study was 80 participants including radiology consultants (n = 18), radiology residents (n = 39) and radiographers (n = 23) in KNH and University of Nairobi’s Department of Diagnostic Imaging and Radiology Medicine.

4.2 Demographic Characteristics
The mean age of the participants was 35 years ± 8.3 with an age range between 23 and 65 years. The participants age distribution presented in figure 3 shows that most 46 (57.5%) health providers were aged between 30 and 39 years, followed by those in the age group 23-29 years 18 (22.5%).

![Age distribution of radiologists, radiology residents and radiographers in KNH](image)

Figure 3: Age distribution of radiologists, radiology residents and radiographers in KNH
There were 43 (53.8%) males and 37 (46.3%) female participants giving a male to female ratio of approximately 1: 1. Out of the 80 health providers, 39 (48.8%) were radiology residents, 23 (28.8%) were radiographers and the remaining 18 (22.5%) were consultant radiologists (table 2).
Table 2: Age distribution of radiologists, radiology residents and radiographers in KNH

<table>
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<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>43</td>
<td>53.8</td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>46.3</td>
</tr>
<tr>
<td><strong>Cadre</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultant</td>
<td>18</td>
<td>22.5</td>
</tr>
<tr>
<td>Radiology resident</td>
<td>39</td>
<td>48.8</td>
</tr>
<tr>
<td>Radiographer</td>
<td>23</td>
<td>28.7</td>
</tr>
</tbody>
</table>

Out of the 18 consultants, most (77.8%) had between 1-4 years and >15 years experience. (The two experience ranges are wide. You could split them or state it differently) Majority (43.5%) of the radiographers had between 1-4 years experience (Table 3), while the residents being in a 4 year training program ranged between 1-4 years of experience in the radiology department with 12 out of 38 being in the second year of training. (Figure 4)

Table 3: Work experience among consultant radiologists and radiographers Residents

<table>
<thead>
<tr>
<th>Years of practice</th>
<th>Consultants</th>
<th>Radiographers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>1-4 years</td>
<td>7 (38.9)</td>
<td>10 (43.5)</td>
</tr>
<tr>
<td>5-9 years</td>
<td>3 (16.7)</td>
<td>4 (17.4)</td>
</tr>
<tr>
<td>10-15 years</td>
<td>1 (5.6)</td>
<td>6 (26.1)</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>7 (38.9)</td>
<td>2 (8.7)</td>
</tr>
</tbody>
</table>
4.3 Life support training

Most 67 (83.8%) health workers reported that they had attended life support training with 36 (45%) having attended both BLS and ACLS courses (figure 3). 28 (35%) attended BLS course only and 3 (3.8%) attended ACLS course.

Figure 4: Year of training among radiology resident participating in study

Figure 5: Life support training among radiology consultants, registrars and radiographers in KNH and University of Nairobi
There was a significant association between health workers’ cadre and their attendance of life support training courses \( (p = 0.024) \), table 3. Radiographers mostly reported having attended BLS course only 14 (60.9%), while most residents 22 (56.4%) had attended both BLS and ACLS courses.

### Table 4: Life support training course attendance according to health provider cadre

<table>
<thead>
<tr>
<th>Health worker cadre</th>
<th>BLS</th>
<th>ACLS</th>
<th>BLS and ACLS</th>
<th>None</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultant</td>
<td>6(33.3)</td>
<td>0(0.0)</td>
<td>7(38.9)</td>
<td>5(27.8)</td>
<td>0.024</td>
</tr>
<tr>
<td>Radiology resident</td>
<td>8(20.5)</td>
<td>3(7.7)</td>
<td>22(56.4)</td>
<td>6(15.4)</td>
<td></td>
</tr>
<tr>
<td>Radiographer</td>
<td>14(60.9)</td>
<td>0(0.0)</td>
<td>7(30.4)</td>
<td>2(8.7)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows that the attendance of ACLS course was significantly associated with the health provider cadre \( (p = 0.018) \) while attendance of BLS course was not associated with cadre \( (p = 0.198) \). Overall, 81% of participants had attended BLS and 49.4% had attended ACLS course. Residents were more likely to report having recently attended ACLS (attendance in 2009-11 12[30.8%] and 2012-14 10[25.6%]) while radiographers 7 (30.4%) were least likely to attend ACLS.

Only 2 (8.7%) radiographers had not attended BLS course compared to 9 (23.1%) residents and 4 (23.5%) radiology consultants (table 5).
Table 5: Life support training according to cadres in radiology unit

<table>
<thead>
<tr>
<th>Last BLS course attended</th>
<th>Consultant</th>
<th>Resident</th>
<th>Radiographer</th>
<th>Total</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 to 2006</td>
<td>6(35.3)</td>
<td>5(12.8)</td>
<td>5(21.7)</td>
<td>16(20.3)</td>
<td>0.198</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>1(5.9)</td>
<td>7(17.9)</td>
<td>2(8.7)</td>
<td>10(12.7)</td>
<td></td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>1(5.9)</td>
<td>11(28.2)</td>
<td>6(26.1)</td>
<td>18(22.8)</td>
<td></td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>5(29.4)</td>
<td>7(17.9)</td>
<td>8(34.8)</td>
<td>20(25.3)</td>
<td></td>
</tr>
<tr>
<td>Never done</td>
<td>4(23.5)</td>
<td>9(23.1)</td>
<td>2(8.7)</td>
<td>15(19)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Last ACLS course attended</th>
<th>Consultant</th>
<th>Resident</th>
<th>Radiographer</th>
<th>Total</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 to 2006</td>
<td>3(17.6)</td>
<td>3(7.7)</td>
<td>1(4.3)</td>
<td>7(8.9)</td>
<td>0.018</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>0(0)</td>
<td>0(0)</td>
<td>2(8.7)</td>
<td>2(2.5)</td>
<td></td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>3(17.6)</td>
<td>12(30.8)</td>
<td>1(4.3)</td>
<td>16(20.3)</td>
<td></td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>1(5.9)</td>
<td>10(25.6)</td>
<td>3(13.0)</td>
<td>14(17.7)</td>
<td></td>
</tr>
<tr>
<td>Never done</td>
<td>10(58.8)</td>
<td>14(35.9)</td>
<td>16(69.6)</td>
<td>40(50.6)</td>
<td></td>
</tr>
</tbody>
</table>

4.4 CPR and Anaphylaxis Reaction Knowledge

Nine (9) items on CPR and six (6) anaphylaxis reaction items were used to assess health workers knowledge. The responses to these knowledge questions are presented in figure 4. Comparing the two areas participants displayed higher knowledge scores in anaphylaxis reactions compared to CPR. The modal (most frequent) score on anaphylaxis reaction was 4 out of 6 with 33 (41.3%) participants scoring four items correct. Nine (11.3%) scored all 6 anaphylaxis reaction items correct. For CPR knowledge the modal score was 3 out of 9 correct items n = 16 (20%). There
were 15 (18.8%) participants each scoring 4 out of 9 correct items and 5 out of 9 correct items. (Figure 6)

Figure 6: Number of correct health worker responses to knowledge items regarding CPR and anaphylaxis reaction

4.5 CPR Knowledge

Table 6 summarizes responses provided for each item assessing CPR knowledge. At least one-half of all health workers responded correctly to four of the nine items: head tilt-chin lift maneuver for opening the airway 63 (78.8%), appropriate to administer rescue breaths if pulse is present 54 (67.5%), appropriate to initiate compressions if pulse is absent 51 (63.8%), and correct adrenaline administration (1 mg) during cardiac arrest 43 (53.8%).
Table 6: Radiology and imaging consultants, residents and radiographers responses to CPR knowledge items

<table>
<thead>
<tr>
<th>Correct response</th>
<th>Incorrect response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct sequence for BLS: C-A-B (Compression-Airway-Breathing)</td>
<td>N 15 68 85</td>
</tr>
<tr>
<td>The most appropriate rate of CPR for an adult (chest compressions: breaths) is 30:2</td>
<td>29 36.3 51 63.8</td>
</tr>
<tr>
<td>Head tilt-chin lift maneuver can be used to open the airway</td>
<td>63 78.8 17 21.3</td>
</tr>
<tr>
<td>Pulse should be checked for no more than 10 seconds</td>
<td>33 41.3 47 58.8</td>
</tr>
<tr>
<td>If no pulse is present the next appropriate step is to begin chest compressions</td>
<td>51 63.8 29 36.3</td>
</tr>
<tr>
<td>If pulse is present the next appropriate step is to administer rescue breaths</td>
<td>54 67.5 26 32.5</td>
</tr>
<tr>
<td>Number of shocks delivered in each CPR cycle (shockable rhythm) is 1</td>
<td>23 28.8 57 71.3</td>
</tr>
<tr>
<td>The second shock level using a monophasic defibrillator is 360 J</td>
<td>10 12.5 70 87.5</td>
</tr>
<tr>
<td>During cardiac arrest correct administration of adrenaline in 1 mg given every 3-5 minutes</td>
<td>43 53.8 37 46.3</td>
</tr>
</tbody>
</table>

Table 6 compares CPR knowledge scores according to health worker cadre and attendance of life support course. Most consultants 10 (55.6%) scored at least 50% on CPR knowledge compared
to residents 14 (35.9%) and radiographers 9 (39.1%). Knowledge was however not significantly associated with health worker cadre (p = 0.364).

Out of the participants who had attended any life support course 28 (41.8%) scored at least 50% on CPR knowledge compared to 5 (38.5%) of those who had not attended any course who also scored 50% of CPR items correct (p = 0.823). Duration during which participants had attended BLS (p = 0.439) or ACLS (p = 0.128) was not significantly associated with their CPR knowledge (table 6).

Table 7: CPR knowledge score by cadre and life support training

<table>
<thead>
<tr>
<th>Cadre</th>
<th>CPR knowledge</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;50%</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>Consultant</td>
<td>10(55.6)</td>
<td>8(44.4)</td>
</tr>
<tr>
<td>Radiology resident</td>
<td>14(35.9)</td>
<td>25(64.1)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>9(39.1)</td>
<td>14(60.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attended any life support course</th>
<th>CPR knowledge</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>28(41.8)</td>
<td>39(58.2)</td>
</tr>
<tr>
<td>No</td>
<td>5(38.5)</td>
<td>8(61.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent BLS course</th>
<th>CPR knowledge</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 to 2006</td>
<td>7(43.8)</td>
<td>9(56.3)</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>2(20.0)</td>
<td>8(80.0)</td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>9(50.0)</td>
<td>9(50.0)</td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>10(50.0)</td>
<td>10(50.0)</td>
</tr>
<tr>
<td>Never done</td>
<td>5(31.3)</td>
<td>11(68.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent ACLS course</th>
<th>CPR knowledge</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 to 2006</td>
<td>4(57.1)</td>
<td>3(42.9)</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>2(100.0)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>4(25.0)</td>
<td>12(75.0)</td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>8(57.1)</td>
<td>6(42.9)</td>
</tr>
<tr>
<td>Never done</td>
<td>15(36.6)</td>
<td>26(63.4)</td>
</tr>
</tbody>
</table>
CPR knowledge was significantly associated with years of practice within the radiology unit (p = 0.016). Table 8 compares the CPR Knowledge scores according to years of practice. Most of participants with 10 or more years’ experience scored at least 50% compared to those with 1-4 years (38.2%) and 5-9 years (0%).

Table 8: CPR knowledge scores according to participants’ years of practice

<table>
<thead>
<tr>
<th>Years of practice</th>
<th>CPR knowledge score</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;50%</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>1-4 years</td>
<td>21(38.2)</td>
<td>34(61.8)</td>
</tr>
<tr>
<td>5-9 years</td>
<td>0(0.0)</td>
<td>7(100.0)</td>
</tr>
<tr>
<td>10-15 years</td>
<td>4(50.0)</td>
<td>4(50.0)</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>7(77.8)</td>
<td>2(22.2)</td>
</tr>
</tbody>
</table>

Table 9 compares knowledge on the correct sequence of BLS and appropriate rate of CPR with the time period for BLS training. There is no significant association (p>0.05) between the time period for BLS training and the likelihood of the respondents to give a correct response.

Table 9: Changes in CPR training and CPR knowledge

<table>
<thead>
<tr>
<th>Time period for BLS training</th>
<th>Correct sequence of BLS</th>
<th>Appropriate rate of CPR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correct</td>
<td>Incorrect</td>
</tr>
<tr>
<td>Correct sequence of BLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>1(6.3)</td>
<td>15(93.7)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>4(22.2)</td>
<td>14(77.8)</td>
</tr>
<tr>
<td>Time period for BLS training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>5(25.0)</td>
<td>15(75.0)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>2(12.5)</td>
<td>14(87.5)</td>
</tr>
<tr>
<td>Time period for BLS training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>8(44.4)</td>
<td>10(55.6)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>8(40.0)</td>
<td>12(60.0)</td>
</tr>
<tr>
<td>Never done</td>
<td>4(25.0)</td>
<td>12(75.0)</td>
</tr>
</tbody>
</table>
4.6 Knowledge on Anaphylactic Reaction

Out of the six anaphylaxis items poor performance was reported for two items: 24 (30%) of health workers correctly identified epinephrine was important in treatment of anaphylaxis and 23 (28.8%) stated the correct dose for hydrocortisone in severe allergic reaction (table 10). For the remaining for items good performance was noted with at least 80% of participants correctly responding to the items: pruritus is a symptom of mild anaphylactic reaction, laryngeal oedema is a symptom of severe anaphylactic reaction, asthma is a risk factor for contrast reaction and IV administration is preferred route for administration of the epinephrine in severe allergic reaction.

Table 10: Radiology and imaging consultants, residents and radiographers responses to anaphylactic reaction knowledge items

<table>
<thead>
<tr>
<th></th>
<th>Correct response</th>
<th>Incorrect response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Pruritus is a symptom of mild anaphylactic reaction</td>
<td>64</td>
<td>80</td>
</tr>
<tr>
<td>Laryngeal oedema is a symptom of severe anaphylactic reaction</td>
<td>65</td>
<td>81.3</td>
</tr>
<tr>
<td>Asthma is a risk factor for contrast reaction</td>
<td>69</td>
<td>86.3</td>
</tr>
<tr>
<td>Epinephrine is an important medication in severe allergic reaction</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>IV administration is preferred route for Epinephrine in severe allergic reaction</td>
<td>66</td>
<td>82.5</td>
</tr>
<tr>
<td>Epinephrine dose for severe reactions is 1ml of 1:10000 dilution (0.1mg)</td>
<td>23</td>
<td>28.8</td>
</tr>
</tbody>
</table>
4.7 Anaphylaxis Knowledge and Health Provider Characteristics

There was a significant association between health worker cadre and knowledge of anaphylaxis (p < 0.001). The majority of radiology residents 35 (89.7%) and consultants 15 (83.3%) score at least 50% compared to 7 (30.4%) of radiographers who also scored 50% and above (table 11).

Attending any life support course was not significantly associated with anaphylaxis knowledge (71.6 versus 69.2%, p = 0.86) neither was the duration of time since attending the BLS course (p = 0.251)

Table 11: Anaphylactic reaction knowledge score by cadre and life support training

<table>
<thead>
<tr>
<th>Anaphylaxis knowledge score</th>
<th>&gt;50%</th>
<th>&lt;50%</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cadre</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultant</td>
<td>15(83.3)</td>
<td>3(16.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Radiology resident</td>
<td>35(89.7)</td>
<td>4(10.3)</td>
<td></td>
</tr>
<tr>
<td>Radiographer</td>
<td>7(30.4)</td>
<td>16(69.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Attended any life support course</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>48(71.6)</td>
<td>19(28.4)</td>
<td>0.860</td>
</tr>
<tr>
<td>No</td>
<td>9(69.2)</td>
<td>4(30.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Last BLS course attended</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004 to 2006</td>
<td>13(81.3)</td>
<td>3(18.8)</td>
<td>0.251</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>9(90.0)</td>
<td>1(10.0)</td>
<td></td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>12(66.7)</td>
<td>6(33.3)</td>
<td></td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>11(55.0)</td>
<td>9(45.0)</td>
<td></td>
</tr>
<tr>
<td>Never done</td>
<td>12(75.0)</td>
<td>4(25.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Last ACLS course attended</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004 to 2006</td>
<td>6(85.7)</td>
<td>1(14.3)</td>
<td>0.025</td>
</tr>
<tr>
<td>2007 to 2008</td>
<td>0(0.0)</td>
<td>2(100.0)</td>
<td></td>
</tr>
<tr>
<td>2009 to 2011</td>
<td>15(93.8)</td>
<td>1(6.3)</td>
<td></td>
</tr>
<tr>
<td>2012 to 2014</td>
<td>8(57.1)</td>
<td>6(42.9)</td>
<td></td>
</tr>
<tr>
<td>Never done</td>
<td>28(68.3)</td>
<td>13(31.7)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 7: Knowledge on pharmacologic management of anaphylaxis according to cadre

Among the anaphylactic reaction knowledge items that showed poor health worker understanding, the radiographers had the least knowledge scored. Figure 5 shows that 21.7% of radiographers knew that epinephrine is the drug of choice compared to 33.3% of residents and radiologists. Similarly, 17.4% of radiographers were aware of the correct dose of epinephrine compared to 27.8% of radiologists and 35.9% of residents.

Table 12 compares contrast anaphylaxis knowledge scores according to years of practice among the participants. All health workers with >15 years experience scored at least 50% compared to 1-4 years and 10-15 years. Contrast anaphylaxis knowledge is significantly (p<0.05) associated with the years of practice.
Table 12: Duration of practice and anaphylaxis knowledge

<table>
<thead>
<tr>
<th>Years of practice</th>
<th>Anaphylaxis knowledge score</th>
<th>&lt;50%</th>
<th>&lt;50%</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4 years</td>
<td>42(76.4)</td>
<td>13(23.6)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>5-9 years</td>
<td>1(14.3)</td>
<td>6(85.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-15 years</td>
<td>5(62.5)</td>
<td>3(37.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>9(100.0)</td>
<td>0(0.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.8 Resuscitation Practices

Table 13 shows reported practice in the radiology unit. Out of the 80 participants 32 (40%) reported that they had ever seen a patient experiencing an adverse reaction to contrast within the radiology and imaging department. Seven (20.6%) of the health workers who had managed a patient experiencing an adverse reaction indicated that they had done so according to ACR guidelines.

There were 31 (38.8%) participants who had ever seen a patient experience cardiopulmonary arrest in radiology department and in 23 (71.9%) of cases BLS/ACLS guidelines were applied in patient management. Most 51 (63.8%) health workers reported that they knew where the emergency trolley was located within the department and 10 (12.5%) checked it before performing radiological procedures.
Table 13: Resuscitation practices reported by participants in radiology unit

<table>
<thead>
<tr>
<th></th>
<th>n (positive response)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever seen a patient experiencing an adverse reaction to contrast in radiology</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td>department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managed the patient according to ACR guidelines</td>
<td>7</td>
<td>20.6</td>
</tr>
<tr>
<td>Ever seen a patient experiencing cardiopulmonary arrest in radiology department</td>
<td>31</td>
<td>38.8</td>
</tr>
<tr>
<td>Managed patient according to BLS/ ACLS guidelines</td>
<td>23</td>
<td>71.9</td>
</tr>
<tr>
<td>Do you know where the emergency trolley is located within radiology department?</td>
<td>51</td>
<td>63.8</td>
</tr>
<tr>
<td>Do you check emergency trolley before performing a procedure in the department?</td>
<td>10</td>
<td>12.5</td>
</tr>
</tbody>
</table>
5.0 CHAPTER FIVE : DISCUSSION:

The purpose of this study was to determine the levels of knowledge on CPR and anaphylactic reactions among health workers within the radiology and imaging setting where these events could occur, and secondly, to document practice during resuscitation. The study found that knowledge on CPR is moderate to poor with most participants 58.8% (47 out of 80) scoring less than 50% of the 9 items related to CPR. For anaphylaxis knowledge the performance was good and 71.3% (57 out of 80) of the health workers responded correctly to at least four of the six questions on adverse reactions.

Medical emergencies in the radiology department are rare, especially those that occur as a result of contrast media reactions. The scarcity of these events could be related to the use of non ionic contrast media. Despite this observation, radiologists, residents and radiographers still need to be able to provide high quality CPR and rapid defibrillation when required. They may not be required to provide extensive ALS and post cardiac arrest care but their rapid recognition of cardiac arrest and activation of the emergency response team and rapid administration of correct lifesaving practices improves victims’ chances of survival greatly.

5.1 Knowledge of CPR

This research has shown the theoretical knowledge of BLS and ACLS pertaining to the management of CPA among radiologists, residents and radiographers in KNH and UoN is poor to moderate. Most (57.8%) of the respondents scored <50% in assessment of CPR knowledge and none answered all questions correctly. This was an unexpected finding but available evidence from high quality systematic reviews suggests that ALS knowledge and skills decay by 6 months to 1 year after training and that skills decay faster than knowledge[49].

The mean score on the knowledge questions was 52.4%, a finding that is similar to that of O’Neill et al who reported that participants had a mean score of 50% which was below the acceptable levels set at 70%[50]. This was due to inadequate training and lack of refresher courses as is the same in our study area where 50.6% of the staff had not done any ACLS training.
The attendance of life support courses was not significantly associated with knowledge \( (p > 0.05) \) neither was duration since last training. This is consistent with Tariq Alam et al who found that only 28\% of those who had attended a life support course more recently were more likely to respond correctly\[46\]. In addition the lack of an effect of course attendance on knowledge in the present study could be explained by two factors, rapid decay of knowledge and high overall attendance on these courses. More than 80\% of participants reported having attended BLS course resulting in a relatively homogenous group but with regard to time since training less than one in every four participants had been to the course within the last two years.

Recent changes in guideline recommendation impacted on the performance on knowledge assessment. For example in the year 2000, AHA changed the recommended ratio of chest compressions: ventilation from 15:2 to 30:2\[32\]. From the study only 36\% answered this correctly and those who had attended life support training before 2005 were more likely to indicate a ratio of 15:2. Tapping et al also found that respondents who had done life support training prior to 2005 stated the CPR ratio to be 15:2\[47\]. CPR steps are another area of resuscitation training that was recently revised and also examined in this study. In the year 2010 the AHA re-arranged the order of CPR steps from A-B-C (Airway- Breathing-Compression) to C-A-B (Compression-Airway-Breathing)\[20\]. This question was amongst the most poorly answered with only 15\% giving the correct response.

The current findings highlight the need for refresher training due to the constant evolution of the ALS algorithms with significant changes and the documented rapid decay of knowledge acquired in life support courses. The is of particular concern in this study as most of the participant who had attended BLS had done so more than 5 years before this study. The same applied to ACLS attendance. Schellhammer et al found that only 41.8\% of the radiologists had ever attended training courses and of these, 69\% had trained >5 years prior to the study\[48\]. Tapping et al found that a significant number of radiologists had not done refresher courses for >5 years after training\[47\].

The fact that the knowledge of these life saving skills is not adequate among the health workers in the radiology department is alarming and there is need for formal BLS and ACLS training as well as regular in service training and re-certification to ensure retention of knowledge. The AHA recommends that the interval between initial CPR training and refresher course should be
no more than 2 years, however studies done to evaluate the deterioration of CPR skills among medical personnel have shown a decline at 2-12 months following completion of training[51-53]. There is no consensus on the ideal duration or frequency of the refresher courses, however in view of the rapid deterioration of these knowledge and skills some authors recommend 6monthly refresher training[54, 55]. This study reported a positive association between duration of employment and level of knowledge for both CPR and adverse reactions. In literature the evidence for an association between work experience and knowledge is equivocal. Hamid et al found a correlation (r-0.317) between work experience and technical knowledge of CPR amongst radiographers[40]. This suggests that being in an environment where emergencies occur and are managed may increase the knowledge of the staff despite not having attended a training course. Conversely, Tapping et al didn’t find any significant difference between years of experience and likelihood to get a correct answer[47].

5.2 Knowledge of Contrast Media Reactions and Management

Most of the radiologists, residents and radiographers performed relatively well in the identification of mild and severe anaphylactic reactions to contrast media and the risk factors of their occurrence. At least 80% of health workers correctly identified a symptom of mild reaction, a symptom of severe reaction and a risk factor for anaphylactic reaction. However, responses on pharmacological management of severe reactions was poor. Health workers commonly indicated they would administer hydrocortisone as the drug of choice (60%), with 30% correctly identifying epinephrine as the drug of choice and 28.8% stating the correct dose.

This shows that there is a great misconception as to the drug of choice in emergency management of severe anaphylaxis. The practice of corticosteroids use in the immediate anaphylactic period has persisted despite emphasis in recent clinical guidelines that its benefits is not proven[26, 56]

Indeed the effect of hydrocortisone is realized 6-12 hours after administration, thus its primary role may be in prevention of recurrent or protracted anaphylaxis. (ACR Guidelines) Conversely, the recommended drug epinephrine is a vasopressor which stimulates adrenergic receptors producing vasoconstriction causing an increase in blood pressure and heart rate and thus improving perfusion to the brain[57].
Our findings are in contrast to Lightfoot et al who had 91% of the radiologists choosing epinephrine as the most important medication in management of a severe contrast reaction; however none gave the correct dose of the epinephrine[44]. The disparity in findings could be due to the fact that our study included radiographers (28.8%) with majority being diploma and higher diploma holders. In the training of radiographers there is limited emphasis on pharmacological management of contrast reactions. In our data this cadre consistently scored lower than radiologists and residents in identifying the recommended drug of choice for contrast reaction and its dose. Even after excluding radiographers the clinicians (residents and radiologists) in our setting were at approximately 60% less likely to correctly identify the most important medication compared to Canadian radiologists, possibly reflecting inadequate recent training in BLS and ACLS.

In general radiology staffs are not involved in the practice of acute clinical medicine do not manage emergencies on a day to day basis unlike their physician counterparts. This can explain why the question on knowledge of the recommended drug—epinephrine and its correct dose was poorly answered in both studies.

Furthermore previous studies have shown that despite training on contrast reactions and their management, the limited frequency of occurrence of these reactions means that the rate of application of the skill learnt is low. This translates to low retention of the vital knowledge and skill and for this reason, Andrew trout et al recommended that reinforcement of the knowledge of contrast reaction management be done at no more than 6 month intervals in addition to an annual training course[45]. This is however not what occurs in the radiology residency program in UoN where a single lecture is given in the first year of the course with no refresher courses.

5.3 Practice of Management of CPA and Anaphylactic Reactions

The need for prompt and effective CPR and management of CPA cannot be over emphasized as it is known to significantly decrease morbidity and mortality. Of the patients brought to the radiology department some may deteriorate and suffer CPA due to their primary condition or as a result of a severe anaphylactic reaction to contrast media.

From this study majority of the respondents who had witnessed CPA within the department (71.9%) managed the patient according to BLS/ACLS guidelines. This is similar to the study by
Schellhammer et al who had most of the radiologists having performed at least 1 CPR in their time of practice[48].

Few (38.8%) of the respondents had witnessed a patient experiencing an adverse reaction to contrast media and most did not provide management according to the guidelines provide by the American college of radiology.

The low rate of observation of these reactions is attributed to the use of non ionic contrast media thus fewer reactions occur. Also most of the respondents were radiology residents who have been in the radiology department for less than 4 years and thus were more likely to have witnessed fewer if any reactions. The low response on use of the recommended ACR guidelines is due to the infrequent and inadequate training on these reactions and their management.

Most (63.8%) of the participants knew where the emergency trolley was located in the department and these findings are similar to Lightfoot et al where 62% knew the location of the emergency-drug epinephrine in the computed tomography imaging rooms[44]. Despite knowing the location of the emergency trolley, very few of the respondents (12.5%) checked it before performing a procedure in the department. This translates to lack of knowledge on the contents of the trolley and may create a crisis when an emergency arises. Lightfoot et al also found that only 11% knew the concentration of the epinephrine in their emergency trolleys and the type of equipment stocked for its administration[44].

5.4 Study Strengths

There was low risk of selection bias in the current study because 80 out of the 95 radiology staff who were approached responded. This is contrast to Schellhammer et al who approached 650 radiologists and only 12.6% responded and they felt it was due the perceived limited importance of the CPR to the population surveyed[48].

A major improvement of the findings reported here in comparison to other studies done in Africa, is the broad range of respondents which include radiologists, residents and radiographers with varying years of practice and training. This is comparable to V.Rachapalli et al who had an even wider range of respondents that included the entire staff of the radiology department at the
university of Wales namely secretarial, nursing, administrative staff, helpers and porters in addition to the consultants, registrars and radiographers[58].

Additionally, the CPR and anaphylactic knowledge questions used to assess knowledge covered the key areas based on the current international guideline recommendations for life support and contrast media reaction management.

The study also incorporated recent revisions to recommendations regarding BLS procedures thus providing an opportunity to document common errors and misconceptions with regard to the technique of administering CPR, the drugs used in cardiac arrest and the shock levels in defibrillation.

In this regard, the general misconception that hydrocortisone is the drug of choice in management of acute anaphylaxis has come out clearly and through feedback to the respondents and future training this will be addressed and corrected.

5.5 Study Limitations

The current study’s external validity is limited due to the setting in which it was conducted, a university radiology department mainly serving a tertiary referral hospital. These departments are not representative of the radiology departments in Kenya both in terms of staffing and equipment. These limitations had implication on the generalizability of the findings and may be overcome by future studies extending the study area to include lower level facilities that provide most radiological services within the health system.

Separately, the responses on practices and attendance of life support training were self-reported. Such responses can give rise to information bias in situations where respondents tend to over-report appropriate practices. The potential for this limitation was reduced by piloting the tools to ensure internally valid responses are obtained, explaining the study objectives carefully to each respondent during the consenting process, and providing guidance during data collection to ensure information accuracy. The overall knowledge of health providers reported here are conservative because only 22% of the respondents were qualified radiologists, with the remaining providers being residents in training or radiographers. This is supported by the
demonstrated evidence of lower knowledge among radiographers in specific knowledge areas for example pharmacological management of contrast reactions.

5.6 Conclusion

The health providers within the radiology unit had knowledge on identifying both mild and severe symptoms of anaphylactic reactions to contrast media. There were however knowledge gaps on management of such reactions. They also demonstrated inadequate knowledge of the fundamental and critical components of basic life support and advanced cardiac life support. Study findings highlight the need to focus on improving provider knowledge and awareness of evidence based recommendations contained in clinical guidelines. There is need for an extensive study covering more health facilities in the country. This will lead to focused continued medical education in life support and contrast anaphylaxis management.

5.7 Recommendations

BLS and ACLS training should be offered as part of the initial training during the first year of study for residents and thereafter, regular refresher courses to ensure retention of knowledge. For the radiologists and radiographers, life support training should be made mandatory upon employment and thereafter have at least 3 yearly refresher courses as mandated by American heart association (AHA).

Structured continuous training with regular refresher courses on contrast reactions and their management should be incorporated in the residency and radiography training programs and for the qualified staff, annual continuous medical education (CME) seminars be held to ensure continued learning.

The department should consider purchasing of material and organizing CME seminars on advanced radiology life support (ARLS). ARLS is a course that is fashioned from BLS and ACLS that focuses on life threatening emergencies that are unique to the radiology department. It has been successful in the United States and Canada in training of radiologists, residents, radiology technologists and nurses, on the prompt recognition and treatment of contrast reactions and management of CPA.
Protocols and standard operating procedures regarding the management of CPA and contrast anaphylaxis need to be set up and clearly labeled charts put up in the departments especially where contrast is administered so as to facilitate proper management. Furthermore, all radiology staff should familiarize themselves with the location of the emergency trolleys within the department and daily checking of these trolleys is made mandatory to ensure constant stocking of proper working equipment and valid drugs.

Future studies evaluating these life saving knowledge and skills can be done in other facilities within the regions giving a better representation of Kenyan radiology units.
REFERENCES


APPENDICES

Appendix I: Consent Form For Participation in the Study

CONSENT EXPLANATION FORM

Study Identification Number: _____________

Date: ________________________________

This informed consent form has two parts:

Consent explanation form (To inform you about the research)

Certificate of consent (For signatures if you agree to take part in the study)

STUDY TITLE: ASSESSMENT OF THE KNOWLEDGE AND PRACTICES AMONG, RADIOLOGISTS, RADIOLOGY RESIDENTS AND RADIOGRAPHERS IN MANAGEMENT OF CARDIOPULMONARY ARREST AND ANAPHYLACTIC REACTIONS IN RADIOLOGY DEPARTMENT OF UNIVERSITY OF NAIROBI AND KENYATTA NATIONAL HOSPITAL

Investigator’s Statement

My name is Dr Sarah Kemunto Osiemo, a postgraduate student at the University of Nairobi – department of diagnostic radiology and radiation medicine. I am conducting a study on the knowledge and practices among radiologists, radiology residents and radiographers in resuscitation of patients during radiological emergencies in University of Nairobi and Kenyatta national hospital. I am requesting you to participate in a research study. The purpose of this consent form is to help you decide whether you can participate in this study or not. Please read through this form carefully. You are free to ask any questions about the study. The investigator will be available to answer any queries that come up during the study and thereafter.
**Brief Description of Study**

Emergencies in the radiology department can occur in critically ill patients brought to the department for imaging and in patients who develop severe anaphylactic reactions after receiving intravenous contrast media during an imaging procedure.

Radiologist, residents and radiographers are usually the first responders to such emergencies and the immediate care they give can determine whether the patient will survive or not. Their knowledge of basic life support, advanced cardiac life support and management of contrast media reactions is thus very important. The aim of this study is to evaluate the proficiency of radiographers, residents and radiologists in managing radiological emergencies.

You will be required to fill in a questionnaire on your knowledge and practice in relation to the management of radiological emergencies.

Through your participation I hope to come up with ideas on how to improve the emergency care of patients who attend the radiology departments at the UoN and KNH.

**Procedure and Protocols**

If you agree to be part of this study, I will ask you questions about basic life support(BLS), Advanced cardiac life support(ACLS) and management of anaphylactic reactions to contrast media.

**Benefits**

Findings of this study will be availed to you. If a gap is found, a recommendation will be made to organize continuous medical education (CME) sessions to improve knowledge on basic life support and management of contrast media reactions.

**Duration Of The Study**

6 months.

**Compensation**

You will receive no compensation for participating in this study.
Right to Refuse or Withdraw

You are free to choose whether or not you wish to participate. You will suffer neither penalties nor loss of any benefit should you decide not to participate.

Confidentiality

If you agree to be part of this study, the information you provide will be held strictly confidential and only used for the purpose of the study. Information obtained will be kept under lock and key and soft copy information shall be password protected. No specific information of any participant will be revealed to any person without their permission in writing. Your name will not appear on any of the records used for this study.

Risks

There will be no risks to you during the study.

Voluntariness

This study will be fully voluntary and there will be no financial rewards for participation. Participants are free to withdraw at any point during the study. Refusal to participate will not compromise the participants’ integrity.

Who To Contact

If you have any questions about the study or your participation in the study you can contact the main investigator on;

Dr Sarah Kemunto Osiemo

Department of Diagnostic Imaging and Radiation medicine

University of Nairobi

P.O Box 15167- 00100

Nairobi

Telephone number: 0713908980 Email address: skosiemo@gmail.com
If you have any questions on your rights as a research participant you can contact the Kenyatta National Hospital Ethics and Research Committee whose task is to ensure research participants are protected from harm.

**Kenyatta National Hospital And University Of Nairobi Ethics And Research Review Committee - KNH/UON/ERC**

University of Nairobi  
College of Health Sciences  
P.O Box 19676 - 00202  
Tel: (254) 020 2726300 Ext 44355

Kenyatta National Hospital  
P.O Box 20723 - 00202  
Tel: (254) 020 726300 EXT 44102, 44355  
Fax: 725272

Contact Person  
**Esther Wanjiru Mbuba**  
e-mail: uonknh_erc@uonbi.ac.ke
Consent Form and Participant’s Statement

I confirm I have explained to the respondent all relevant data about the discipline as indicated above.

Interviewer’s name  ……………………… Interviewer’s Signature…………………………

Date  ……………………………

I confirm the above study has been explained to me. I freely give consent to take part in the study conducted by Dr Sarah Kemunto Osiemo, the nature, effect and procedure of which she has explained to me. My participation is entirely voluntary. I have had a chance to take questions about the research, to which satisfactory answers have been presented. I understand I can withdraw from the study at any time without any penalty. The results of this study will be of benefit to me as a clinician, other clinicians and the patients.

Respondent’s Signature  ………………… Respondent’s Code  …………………

Date  ……………………………
KIBALI CHA KUSHIRIKI KATIKA UTAFITI


Haki zako zitalindwa, habari utakazotoa au zitakazopatikana kukuhusu, zitakuwa siri wakati wote na zitatumika katika utafiti huu tu.

Ni muhimu kuelewa ya kwamba ushiriki wako ni wa kujitolea, sio lazima kushiriki katika huu utafiti, na pia waweza kubadili nia yako wakati wowote kuhusu kuendelea kushiriki, bila ya kuathiri masomo au ajira yako.

Asante sana kwa ushirikiano wako.

Jina la Mtafiti ……………………….. Sahihi ya Mtafiti ………………………………

Tarehe ……………………………

Nimekubali kwamba nimeelezewa kikamilifu kuhusu utafiti huu na nakubali kushiriki.

Sahihi ya Mshiriki ……………………….. Nambari ya Mshiriki…………………………

Tarehe ……………………………
Appendix II: Questionnaire

Dear Respondent,

This is a questionnaire for the research work “ASSESSMENT OF THE KNOWLEDGE AND PRACTICES AMONG, RADIOLOGISTS, RADIOLOGY RESIDENTS AND RADIOGRAPHERS IN MANAGEMENT OF CARDIOPULMONARY ARREST AND ANAPHYLACTIC REACTIONS IN RADIOLOGY DEPARTMENT OF UNIVERSITY OF NAIROBI AND KENYATTA NATIONAL HOSPITAL”.

All information given shall be treated as confidential and used only for the objective of the study. Thank you for your anticipated favorable response.

Instruction: Please tick [✓] for any option(s) chosen or write in the space provided for additional answers.

SECTION A: DEMOGRAPHIC DATA

1. Age: (In years) ......................
2. Sex: Male......................... Female.........................

3. Cadre: Consultant ☐

   Years of practice: .........................

   Resident ☐ Year of study 1 2 3 4

   Radiographer ☐

   Years of practice: .........................

4. Last basic life support (BLS) course attended

5. Last advanced cardiac life support (ACLS) course attended
SECTION B: KNOWLEDGE

6. The correct sequence for BLS is:
   (A) C-A-B (Compression- Airway- Breathing)
   (B) A-C-B (Airway- Compression - Breathing)
   (C) B-C-A (Breathing- Compression- Airway)
   (D) A-B-C (Airway- Breathing -Compression)
   (E) Don’t know

7. The most appropriate rate of CPR for an adult (chest compressions : breaths):
   (A) 5: 2, (B) 10: 2, (C) 15: 2, (D) 30: 2 (E) Don’t Know

8. Check for pulse for no more than
   (A) 10 seconds, (B) 5 seconds, (C) 15 seconds. (D) Don’t Know

9. Which maneuver can be used to open the air way?
   (A) Sweep finger in mouth, (B) head tilt-chin lift, (C) chin tilt-head lift. (D) Don’t Know

10. If no pulse is present, the next appropriate step is to:
    (A) Begin chest compressions, (B) ask for help, (C) administer 2 breaths (D) Don’t know

11. If pulse is present, the next appropriate step is to:
    (A) Administer rescue breaths, (B) begin compressions, C) no intervention required
        (D) Don’t know

12. Number of shocks delivered in each cycle of CPR (if “shockable” rhythm):
    (A) 1 (B) 2 (C) 3 (D) Don’t know
13. The second shock level/energy given using a monophasic defibrillator (if rhythm is “shockable”):

(A) 200 J    (B) 260 J    (C) 300 J    (D) 360 J    (E) don’t know

14. The correct administration of adrenaline given during cardiac arrest;

(A) 1 mg adrenaline given every 3–5 minutes
(B) 10 mg adrenaline given every 3–5 minutes
(C) 1 mg adrenaline given every 2–3 minutes
(D) 10 mg adrenaline given every 2–3 minutes
(E) Don’t know

15. The following are symptoms of MILD anaphylactic reactions to contrast

A. Pruritus
B. Dyspnea
C. Bronchospasm
D. Convulsions
E. Don’t know

16. The following are symptoms of severe anaphylactic reaction to contrast

A. Pruritus
B. conjunctivitis
C. nasal congestion
D. laryngeal edema
E. Don’t know

17. What is are the risk factors for contrast reactions?

(A) Fever
(B) Diabetes mellitus
(C) Obesity
(D) Black race
(E) Don’t Know
18. You have a patient that has just received intravenous contrast material for an imaging study and is now stridorous, in severe respiratory distress with angioedema and diffuse urticaria consistent with a severe allergic reaction.

I. What is the most important medication to be immediately administered to this patient?

A. Epinephrine  
B. Lasix  
C. Atropine  
D. Hydrocortisone  
E. Don’t Know

II. What is the preferred route of administration of this medication?

A. Oral  
B. Inhaled  
C. Intravenous  
D. Subcutaneous  
E. Don’t Know

III. What is the dose of this medication?

A. 1ml of 1:10,000 dilution (0.1mg)  
B. 1ml of 1:1000 dilution (1mg)  
C. 0.6-1.0mg  
D. 20-40mg  
E. Don’t Know
Section C: Practice

19. Have you ever seen a patient in the radiology department experiencing an adverse reaction to contrast?

Yes ☐ No ☐

If yes, go to question 20
If no go to question 21

20. Did you manage the patient according to ACR guidelines?

Yes ☐ No ☐

21. Have you ever seen a patient undergoing cardiopulmonary arrest in the radiology department?

Yes ☐ No ☐

If yes, go to question 22
If no go to question 23

22. Did you manage the patient according to the BLS/ACLS guidelines?

Yes ☐ No ☐

23. Do you check the emergency trolley before performing a procedure in the department?

Yes ☐ No ☐
Appendix III: KNH/UON-ERC Letter of Approval

Ref: KNH-ERC/A/51

Dr. Sarah Kemunto Osiamo
Reg. No. H58/67555/2013
Dept. of Diagnostic Imaging and Radiation Medicine
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Osiamo,

Revised research proposal: Assessment of the Knowledge and Practices among Radiologists, Radiology Residents and Radiographers in Management of Cardiopulmonary Arrest and Anaphylactic Reactions in Radiology Department of University of Nairobi and Kenyatta National Hospital (P763/12/2015)

This is to inform you that the KNH-UoN Ethics & Research Committee (KNH-UoN ERC) has reviewed and approved your above proposal. The approval period is from 8th February 2016 – 7th February 2017.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH-UoN ERC within 72 hours.
e) 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).
f) Clearance for export of biological specimens must be obtained from KNH-UoN ERC for each batch of shipment.
g) Submission of an executive summary report within 90 days upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

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

PROF. M. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
     The Deputy Director, CS, KNH
     The Chair, KNH-UoN ERC
     The Assistant Director, Health Information, KNH
     The Dean, School of Medicine, UoN
     The Chair, Diagnostic Imaging and Radiation Medicine, UoN
     Supervisors: Dr. Angeline A. Aywak, Dr. Callen Onyambu