

A MODEL FOR TRAINING RADIOGRAPHERS IN IMAGE INTERPRETATION IN KENYA

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Radiography in the Faculty of Health Sciences at the Durban University of
Technology

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Declaration

This is to certify that the work is entirely my own and not of any other person unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or any other institution for assessment or any other purpose.

Signature of student

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Abstract

Background

In Kenya, there is an acute shortage of radiologists, particularly in the County and Sub-county hospitals in the rural and remote areas. Radiographs are sent to national and referral hospitals for radiological reports. This often results in a delay in the treatment of patients. According to the Kenya government's strategic Plan of Vision 2030, it is set to provide equitable and affordable healthcare to all her citizens. This vision may not be realized in the radiology sector due to the shortage of radiologists.

Aim

This study aimed to explore the perceptions of Kenyan radiographers about training in image interpretation of the chest and musculoskeletal systems, to supplement the shortage of radiologists.

Methodology

An exploratory sequential mixed methods design was used to conduct this study in two phases. Phase 1 was conducted through focus group discussions interviews with thirty radiographers employed in five public hospitals in Uasin-Ngishu County. The findings of Phase 1 were used to develop the questionnaire for Phase 2 of the study. A self-administered questionnaire was used to collect data from participants in thirty-five purposively selected public hospitals. A total of 336 questionnaires were distributed. Three hundred and eleven questionnaires were completed and returned. The questionnaires were analyzed resulting in a response rate of 93%. The results of the two phases were integrated. Thematic analysis of the qualitative data was used to identify themes. SPSS Statistics Version 26 was used to analyze quantitative data.

Findings

The results from the two phases of data collection indicated that there was an acute shortage of radiologists in Kenya, resulting in a huge gap in the provision of radiological reports. It was the perception of the participants that if radiographers were trained in image interpretation of the chest and musculoskeletal systems, patients would receive prompt image interpretation reports. Hence, a model for training radiographers in image interpretation to supplement the shortage of radiologists was developed.

Conclusion

This study has revealed that there is a gap in the provision of radiological reports due to the shortage of radiologists. There is a need to train radiographers in image interpretation to supplement the shortage of radiologists. Therefore, the radiography education curriculum needs to be reviewed to incorporate image interpretation.

Key words: Radiographers, radiologists, images interpretation, musculoskeletal, chest.

Dedication

This study is dedicated to my family, particularly my lovely wife Ms Mary Rugut and my children Noreen Jebichii Rugut, Onesmas Kimutai Rugut, Cyrus Kibiwott Rugut and Ben Paul Daniel, for their support during this daunting journey of PhD studies. I also take this opportunity to thank my late father Mr Benjamin Sigira and my mother Rebecca Sigira for taking me to school for my elementary education and High School, my dear brothers Zachariah Ng'asora, Richard Rugut and the late Kennedy Sigira. To my dear sisters Helen Chemutai, Esther Koskei, Mary Sigira, Jane Sigira and Beatrice Jemeli and my dearest friend Fredrick Clement Chirchir. Thank you.

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List of acronyms

Acronym	Meaning
A & E	Accident and Emergency
AIR	Australian Institute of Radiologists
CAMRT	Canadian Association of Medical Radiation Technologists
CE	Continuous Education
CT	Computerized Tomography
CTC	Computed Tomography Colonography
Dr	Doctor
DUT	Durban University of Technology
EU	European Union
GI	Gastrointestinal
HIV	Human Immunodeficiency Virus
IAM	Internal Auditory Meati
ICT	Information and Communication Technology
IREC	Institutional Research and Ethics Committee
ISR	International Society of Radiologists
KMTC	Kenya Medical Training College
MR	Magnetic Resonance
MRI	Magnetic Resonance Imaging
MSc	Master of Science
NACOSTI	National Commission for Science, Technology and Innovation
NHS	National Health Systems
NMT	Nuclear Medicine Technologist
PET	Positron Emission Tomography
RANZCR	Royal Australian and the New Zealand College of Radiologists
ROF	Radiographer opinion form
RR	Rural Radiology
RSSA	Radiological Society of South Africa
RTA	Road Traffic Accident
SORK	Society of Radiographers in Kenya
SR	Senior radiographer
SSA	South Saharan Africa
UHNS	University Hospital of North Staffordshire
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

Glossary of terms

Appendicular skeleton: The appendicular skeleton consists of the bones of the limbs and the limb girdles (Carson 2014:1).

Dislocation: A dislocation is the displacement of an articular surface from another so that apposition between them is lost (Mark and Patterson 2002: 31).

Fracture: A fracture is either a complete break in the continuity of a bone or an incomplete break or crack (Mark and Patterson 2002: 32).

Interventional radiology: Interventional radiology is a subspecialty of radiology in which minimally invasive procedures are carried out under image guidance (Armstrong *et al.* 2009: 437).

Musculoskeletal system: The musculoskeletal system includes bones, cartilages, muscles and ligaments that gives the body structure and creates ability for movement (Kerkman *et al.* 2018: 1).

Radiograph: An image produced by the action of x-rays upon a suitable sensitive material (Ramamohan 2011: 512).

Radiographer: A person trained and engaged in making radiographs or carrying out radiotherapy (Ramamohan 2011: 512).

Radiologist: A radiologist is a specialist in radiology (Ramamohan 2011: 513).

Teleradiology: Teleradiology is the use of medical information exchanged from one site to another via electronic communications, for the health and education of the patient or health care provider, and for the purpose of improving healthcare (Yeboa *et al.* 2003: 1).

Trauma: Trauma is a non-infiltrating injury of the body caused by a fall or actual assault with a dull item (Cecilia 2021: 1).

Radiographic interpretation report: It is the preliminary clinical evaluation report of radiographs (Beardmore 2013: 11).

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

The advent of new technology in radiology worldwide has increased the demand for radiological services, particularly the provision of radiological reports (May *et al.* 2008: e24). The delivery of radiological reports to patients has been curtailed by the shortage of radiologists especially in remote and rural hospitals (Mukhwana 2013:4; Smith *et al.* 2009: 1-2). The number of radiologists worldwide has dwindled necessitating the role of radiographers to be extended to supplement the shortage of radiologists (Miller *et al.* 2011: 10; Hlongwane and Pitcher 2013: 1; Page *et al.* 2014:1; Mubuke 2018: 1). In Kenya most county and rural hospitals with x-ray departments do not have radiologists to report on plain images. Plain images are sent to provincial, academic institutions and national hospitals for radiological reports. The critical shortage of radiologists in Kenya results in delayed reports making it difficult for very sick patients to timeously receive treatment (Mubuke 2018: 1).

According to the Kenya Government's Strategic Plan of Vision 2030, it is set to provide equitable and affordable health care to all her citizens (Kenya Vision 2030 2007: 12). This vision may not be realized in the radiological sector in the provision of radiological services due to the shortage of radiologists. Studies that have been conducted elsewhere in the world indicate that radiographers' experiences have been explored and that some of the plain image reporting workloads have been delegated to suitably qualified radiographers as a measure to resolve the problem (Price 2006: 18; Williams 2009: 15; Kyei 2010: 17; Woznitza 2014: 66; Kekana *et al.* 2015: 2; Culpán *et al.* 2019: 1). Based on the literature reviewed, Kenyan radiographers with the necessary experience and relevant training could interpret and provide a definitive report of images of the chest and musculoskeletal systems.

In the Conference held in Cape Town in September 2006, Dr Wanga, the then Head of the Kenya Society of Radiologists is quoted saying that there was a great shortage of radiologists in the country. He said that only 80 radiologists were serving a population of 32 million people in 2006 (Williams 2006: 15). By the year 2008, Kenya had only 248 radiologists and the radiologist to patient ratio was 1: 400 000 people (Andronikou *et al.* 2010: 2081-2088). This situation has not changed proportionally with the increase of the Kenyan population. In 2010, the Kenyan population was 40 million, according to the then Minister for Planning, Wycliffe Oparanya. In 2017, the Kenyan population

was estimated to be 45.8 million people (Kenya National Council for Population and Development 2015: 17). Considering the current growth rate of 2.9%, the Kenyan population is expected to reach 65 million people by the year 2030 (Kenya National Council for Population and Development 2015: 17). To provide better health care services, as envisioned in the Kenya Government's Strategic Plan of Vision 2030, interventions aimed at improving the radiology services must be implemented. As established earlier, the shortage of radiologists requires interventions aimed at the training of radiographers in image interpretation and in writing relevant reports (Kawooya 2012: 37).

Empirical studies that have been conducted elsewhere in the world indicate that radiographers' experiences have been explored and that some of the reporting workloads have been delegated to suitably qualified radiographers as a measure to resolve the problem (Brealey and Scuffhan 2005: 1; Williams 2009: 15; Squibb *et al.* 2015: 1; Milner *et al.* 2016: 1; Elkhadir and Saeed 2018: 1). Based on the literature reviewed, Kenyan radiographers with the necessary experience and relevant training could interpret and provide a definitive report of images of the chest and musculoskeletal systems (Smith, Traise and Cook 2011: 1-4; Gqweta 2012: 22; Motto and Chipeya 2015: 307).

A study conducted in Kenya found that Kenyan radiographers are willing to train in image interpretation of the chest and musculoskeletal systems to supplement the shortage of radiologists (Rugut and Motto 2016: 15). According to the participants in the study, training radiographers in image interpretation would bridge the gap created by the shortage of radiologists. The participants believed that the provision of radiological reports by radiographers would reduce patient waiting time. They also believed that the training would improve radiological services to patients and allow for radiologists to perform more complex examinations.

1.2 PROBLEM STATEMENT

Radiologists have a significant role to interpret radiographic images to provide a radiological report to aid in the diagnosis and treatment of a patient (The Royal College of Radiologists 2015: 1). The demand for diagnostic imaging services has grown faster than the supply of radiologists' worldwide. Following this, there is an acute shortage of radiologists. For example, the number of radiologists graduating each year from the three universities that train radiologists in Kenya is about twenty. In 2017, only five radiologists graduated from Moi University (Registrar Moi University 21 November 2018). In 2018, only eight radiologists graduated from Nairobi University (Registrar Nairobi University 15 November 2018) and only four radiologists graduated from Aga Khan University (Registrar Aga Khan University 19 November 2018).

Therefore, the small number of radiologists graduating each year is not commensurate with the fast growth of the Kenyan population. As a result, in remote and rural hospitals, particularly in the sub-county (Level 2) hospitals with radiology departments, there are no radiologists to report on plain images. Most of the sub-county hospitals with radiology departments are manned by radiographers without radiologists (Chief Radiographer Ministry of Health 28 November 2018). Patients wait for weeks for their results to be sent from the referral hospitals where radiologists are available. In principle, reporting of emergency department plain images should be done within 12 hours when the patient is still in the hospital after the examination has been performed, but this rarely happens, thus compromising diagnosis and the management of the patient (McConnell and Smith 2008: 6). On many occasions, radiographers are asked to provide their opinion on plain images in the absence of a radiologist. These radiographers do not have proper training to interpret images and it is out of their scope to interpret images and provide a definitive radiological report (Smith and Baird 2007: 629; Smith *et al.* 2008: e23). Previous research studies revealed that plain image interpretations supplied by properly trained radiographers are accurate and similar to radiological reports of radiologists (Robinson *et al.* 1999: 549; Moran and Warren- Forward 2011: 270-271; Beardmore 2013: 4; Woznitza 2014: 66). Rugut and Motto's (2016: 58) study showed that radiographers are willing to train in image interpretation.

The number of radiographers graduating each year from Kenya Medical Training Colleges is between 120-130 (Registrar KMTC 18 November 2018). Each year, about 40 radiographers graduate from Jomo Kenyatta University of Agriculture and Technology with a Bachelor's Degree in Radiography (Registrar Jomo Kenyatta University 23 November 2018). Therefore,

radiographers can be trained in image interpretation to offset the shortage of radiologists, considering the higher numbers by which they graduate each year in comparison with that of radiologists.

1.3 AIM OF THE STUDY

This study aimed to explore the perceptions of radiographers employed in public hospitals in Kenya about the training of radiographers in image interpretation of the chest and musculoskeletal systems, and ultimately develop a model for training radiographers in image interpretation of the chest and musculoskeletal systems.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study were to:

- 1.4.1 Explore the perceptions of Kenyan radiographers regarding training in image interpretation of the chest and musculoskeletal systems to supplement the shortage of radiologists.
- 1.4.2 Identify a gap in the provision of radiological reports regarding image interpretation of the chest and musculoskeletal systems.
- 1.4.3 Establish if the radiography education curriculum supports training in image interpretation of the chest and musculoskeletal systems.
- 1.4.4 Develop a model for training radiographers in image interpretation of the chest and musculoskeletal systems.

1.5 RESEARCH QUESTIONS

The following research questions would address the aim of the study:

- 1.4.5 What are the perceptions of Kenyan radiographers regarding training in image interpretation of the chest and musculoskeletal systems to supplement the shortage of radiologists?
- 1.4.6 What is the gap in the provision of radiological reports regarding image interpretation of the chest and musculoskeletal systems?
- 1.4.7 How does the radiography education curriculum support training in image interpretation of the chest and musculoskeletal systems?
- 1.4.8 How will a model be developed for training radiographers in image interpretation of the chest and musculoskeletal systems?

1.6 JUSTIFICATION OF THE STUDY

It is estimated that globally, 1.2 million people die annually from road traffic accidents (Sisimwo *et al.* 2015: 2). Kenya is one of the leading countries in fatal road traffic accidents (RTA) in the world. In every 35 road accidents that

occur, at least seven people lose their lives (Sisimwo *et al.* 2015: 2). The number of Kenyans who die due to road accidents range between 3000 to 13000 people every year (Odero *et al.* 2003: 53). Road traffic accidents are the third leading cause of death after malaria and Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome and present major health problems in terms of morbidity and disability (Odero *et al.* 2003: 53). Motorcycle accidents are the cause of most injuries on the Kenyan roads particularly in the rural areas, where they are the common mode of transportation. The accidents can be attributed to reckless driving, overloading, possible use of alcohol and inappropriately trained drivers. Victims of motorcycle accidents suffer injuries that involve the chest and musculoskeletal systems such as fractures to the long bones of the legs and hands, dislocation of the shoulder joints, sprains to the joints and crush injuries to the chest, which involve fractures of the ribs (Nduta 2015: 4). Victims of road traffic accidents are examined at the accident scene and emergency department. Due to crush injuries, it is necessary that the victims be imaged to determine the extent and severity of the injuries. In addition, fractures particularly of the appendicular skeleton remain the most missed injuries if reporting is not done within 24 hours of occurrence. Therefore, the absence of a radiologist in trauma radiograph reporting can have a significant clinical impact, especially in rural areas where motorcycle accidents are prevalent (Plessis and Pitcher 2015: 1-2).

The rationale for this study was to create a platform to train several radiographers who will be able to interpret radiographs of the chest and musculoskeletal systems, to compensate for the shortage of radiologists. If Kenyan radiographers train in image interpretation of the chest and musculoskeletal systems, the service provided to patients will be enhanced as the time they spend waiting for radiological reports will be minimized. There will be a reduction in the number of unreported images that are returned to clinicians, as 'hot' reporting by radiographers will enable patients to receive treatment timeously (Paterson 2010: 8). Training radiographers in image interpretation of the chest and musculoskeletal systems will enhance the efficiency of the health care systems while providing the same care at lower costs. The health care systems capacity will increase, allowing for a more cost-effective way to provide safer, faster, more flexible service to patients (Price and Miller 2010: 5).

Training in image interpretation of the chest and musculoskeletal systems, will open windows of opportunity for radiographers, attain job satisfaction and professional recognition. With role extension, future recruitment and retention

of radiographers can be realized. Radiographers can use their advanced knowledge and understanding to act as transformational leaders in their facilities (Eddy 2010: 3). Role extension by radiographers will enable medical specialists to identify the need for earlier intervention, thereby enhancing patient management and care. Radiologists will benefit from role extension because of workload reduction, improved efficiency and will have more time to work on the subtler, complex cases that require their more advanced skills (Canadian Association of Medical Radiation Technologists 2010: 9).

1.6 STRUCTURE OF THE THESIS

This thesis is presented in ten chapters as outlined in Table 1.1 below.

Table 1.1: Structure of the chapters

Chapter	Title	Content Description
1	Orientation to the study.	This chapter presents the background to the study, problem statement, the aim of the study, research questions and objectives of the study.
2	Literature review.	This chapter presents a review of relevant literature to the study.
3	Theoretical framework.	This chapter provides and explains the conceptual framework for the study.
4	Research design and methodology.	This chapter presents the research design and methods of data collection and analysis.
5	Presentation of results: Phase 1 (Qualitative	Presents the results of Phase 1 of the study.
6	Presentation of results: Phase 2 (Quantitative data).	Presents the results of Phase 2 of the study.
7	Integration of results from Phase 1 and Phase 2.	Presents the integrated results from both phases of the study.
8	Discussion of findings	Presents the discussion of the study.
9	A model for training radiographers in image interpretation of the chest and musculoskeletal systems.	This chapter presents a model for training radiographers in image interpretation of the chest and musculoskeletal systems.
10	Limitations, conclusions and recommendations.	This chapter concludes the research and presents the limitations and recommendations.

1.7 SUMMARY OF THE CHAPTER

Chapter one discussed the background of the study. Chapter 2 presents the literature review and reviewed studies that indicate that radiographers with appropriate training can interpret images not only of the chest and musculoskeletal systems but also of other parts of the body.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review discussed issues related to the shortage of radiologists globally, resulting from the advent of new technology in radiology. The reviewed literature is consistent with the research problem and the objectives of the study. The literature has reviewed and proposed solutions to the problem based on empirical studies. The literature has provided evidence that if radiographers are given adequate support by the relevant institutions and stakeholders, they are willing to train in image interpretation and provide reports to supplement the shortage of radiologists.

2.2 PROCESS OF REVIEWING THE LITERATURE

The literature search was initiated in 2018 using Google Scholar, Wiley online Library and Medline. During the literature search, two main sources of data were consulted, the primary sources and the secondary sources. Primary sources that are original articles consisting of the information about this study were examined. Secondary sources that summarize the work of other researchers in research articles were referenced. When searching the literature keywords were used such as image interpretation, chest, musculoskeletal, radiographers and radiologists.

During the search, articles on image interpretation were identified. The articles were on image interpretation of the chest, musculoskeletal, mammography, computerized tomography (CT), internal auditory meati, barium meal, and barium swallow and barium enema. However, literature was scarce on image interpretation of the chest and musculoskeletal systems. Most of the literature on image interpretation was from the United States of America (USA), United Kingdom (UK), Australia, South Africa and Uganda. Little has been written on image interpretation in Kenya (Rugut and Motto 2016: 58), nevertheless, literature on the willingness of Kenyan radiographers to train in image interpretation of the chest and musculoskeletal systems could be found.

2.3 THE GLOBAL CONTEXT OF IMAGE INTERPRETATION

The demand for diagnostic imaging services has grown faster than the supply of radiologists' worldwide. The number of patients in need of radiological services has increased and overstretched the small number of radiologists available

(May *et al.* 2008: e24). The shortage of radiologists worldwide has caused medical officers to report trauma images in the private sector in well-resourced countries. Where there is a shortage of medical officers, images are unreported.

Involving radiographers in image interpretation had many benefits in the delivery of radiological service globally. For example, in the UK, an average consultant radiologist reports between 18000 and 20000 examinations (Smith and Baird 2007: 629). Chest reporting by radiographers was introduced to reduce the turnaround time for chest radiographs and to free up radiologists' time to perform more complex radiology such as CT imaging and magnetic resonance image (MRI) (Kelly *et al.* 2012: 90-95). Since the introduction of the training programme in 2012, two senior radiographers have obtained post-graduate certificates in clinical reporting in adult chests. The radiographers each have an allocation of eight hours of reporting per week as consultants (Todd 2014: 1). Many UK reporting radiographers are issuing reports on axial, appendicular skeletal fractures of the skeletal system and can report on pathologies. In many cases, the radiologist has been relieved of his duties altogether (Tidey 2014: 1). New research conducted at the University of Bradford, showed that patients who received immediate reporting by radiographers received more appropriate management by doctors. It also demonstrated that there were no recalls to Accident and Emergency (A & E) and immediate reporting by radiographers saved an average of \$200,000 to a hospital Trust (Hardy and Snaith 2013; Beardmore 2013).

In the USA, the demand for radiological services is higher compared to the available number of radiologists. The workload of an average full-time working radiologist in the USA has increased by 25% between 1992 and 2002, which is 11000 to 13000 procedures a year (May *et al.* 2008: e24). The shortage of radiologists and the continuing rise of radiological services have provided a climate for encouraging the development of role extension for radiographers in report writing. Role extension for radiographers in the USA and the UK has increased radiographers' job satisfaction, enhanced their standing and radiologists have had free time to perform other more specialists and complex investigations (Brealey *et al.* 2005: 499-501).

In Australia, the estimate of the workload per year for a full-time working radiologist is between 13 000 to 14 000 examinations a year, yet the number of radiologists in the workforce increased by only 11% with an average annual rate of 2.7% (Smith and Baird 2007: 629). According to Smith *et al.* (2011: 1-4), to supplement the shortage of radiologists, Australian rural radiographers were exposed to a short-term intensive continuing education programmes to improve

their accuracy in the interpretation of musculoskeletal images. After training, radiographers in regional and rural remote areas of Australia worked with members of the acute care team to interpret radiographs when no radiologist is available (Smith *et al.* 2011: 1-4).

In Canada, radiologists are overstretched due to work overload. They feel that radiographers should be trained to focus on doing some of the tasks so that they can have time to undertake relevant and newer tasks; such as breast cyst aspiration, biopsies, Hickman Catheter placement, and liver biopsies and attend ward rounds. Consequently, in the absence of trained radiologists as suggested, some of the tasks relevant to them have been lost to other physician specialists (Stevenson 2000: 79-84). To supplement the shortage of radiologists, Australian rural radiographers were exposed to continuing education to improve their accuracy in the interpretation of musculoskeletal images.

A study was conducted at Bispebjerg University Hospital in Denmark, comparing the diagnostic and clinical validity of reporting radiographers with that of trainee radiologists. The radiographers had recently joined the trainee radiologists in the emergency room to report on plain images of the appendicular skeleton after a postgraduate training session in the musculoskeletal system at Bispebjerg University Hospital in Denmark. A thousand plain images of the appendicular skeleton were included in the study. Five hundred were reported by trained radiographers and another five hundred by trainee radiologists. The final report was given by a consultant radiologist. The sensitivity for reporting radiographers was 99% and that of trainee radiologists was 94%. The specificity for radiographers was 97% and for trainee radiologists 99%. The final report showed that trained radiographers can report accident images of the extremities with high accuracy and can help meet increasing workloads and demands with quality standards (Buskov *et al.* 2013: 55-58).

Furthermore, introducing radiographer reporting saved the x-ray department \$361 per annum and more savings could be made as the radiographer gained more experience similar to that of a radiologist. The study concluded that selectively trained radiographers can accurately report A & E plain radiographs; x-ray departments can make savings and the re-attendance of patients to A & E minimized (Brealey *et al.* 2005: 504).

In the European Union (EU), radiographers with no specific training have been proven to be more accurate than medical officers in trauma images_reporting. Empirical reports indicate that EU radiographers with additional training can

report appendicular skeleton trauma radiographs accurately and their reports were comparable to that of radiologists. Consequently, in the EU the role of radiographers has been extended to include trauma radiographs reporting (Plessis and Pitcher 2015: 1).

2.4 IMAGE INTERPRETATION IN THE AFRICAN CONTEXT

According to Kawooya (2012: 37), over 80% of the population in South Saharan Africa (SSA) is rural, which is in dire need of rural radiology. The majority of the SSA countries are facing human resource shortages, especially radiologists. The shortage will impede the attainment of the global health goals, particularly in the provision of radiological services in rural areas; unless a training intervention, such as the training of radiographers in plain image interpretation and in writing a relevant radiological report, is implemented (Kawooya 2012: 37). Telemedicine can provide access to scarce specialists' care, especially in the provision of radiological reports (teleradiology), thus improving the quality of care in rural areas. This will also reduce the need for rural patients to travel to cities and metropolitans, where radiologists are available, for radiological reports. However, telemedicine and particularly teleradiology, is facing certain challenges in the implementation thereof (Yeboah *et al.* 2003: 27; Mars 2013: 327). Therefore, the status of reporting by radiographers in the global context based on empirical evidence will be discussed.

A study by Mars (2013: 32) reported that in Africa, poverty is abundant and governments' tax bases are low and therefore governments have less to spend on healthcare, provision of information and communication technology (ICT) infrastructure for healthcare such as telemedicine. Furthermore, only 6.7% of households have internet in their homes, 16.3% use the internet and broadband access is only 0.3%. Also, telecommunication costs are the most expensive; making it the lowest developing region in the world as far as internet access is concerned. Also, Africa's telecommunication infrastructure is poor and connectivity costs are very high. In addition, healthcare workers have limited awareness of telecommunication and governments lack the will for its implementation (Alhajeri *et al.* 2017: 182).

In Uganda, the country's health policy has allowed non-physician medical personnel (radiographers) to train in image interpretation to supplement radiologists. Twenty-five radiographers have been trained in plain image interpretation at the Ernest Cook Ultrasound Research and Education Institute to work in rural radiology departments. They train in medical imaging at a Master's degree level (Kawooya 2012: 37). Williams (2006: 15) reported that in South

Africa, the health sector is facing a critical shortage of radiologists. The majority are working in the private sector, leaving the public sector with an acute shortage.

A study was conducted to assess the ability of South African radiographers to utilize image interpretation terminologies when commenting on musculoskeletal images after training (Hazell *et al.* 2015: 304). The study used nine radiographers as the sample. The radiographers were exposed to lectures, tutorials and hands-on workshops on image interpretation of the musculoskeletal images. A bank of 100 different radiographs of the appendicular skeleton was used during the lectures to assist them to accurately identify the normal from the abnormal patterns. The images were acquired from different hospitals, except for the one in which they worked. The radiographs included were those of the upper and lower limbs excluding the skull. The results indicated that the radiographers were able to differentiate the abnormal from the normal after the training. The radiographers' accuracy increased after the training and showed that the radiographers could fluently utilize image interpretation terminologies when commenting and could provide a description of the image (Hazell *et al.* 2015: 307).

In another study carried out at a South African hospital between November 2013 and April 2014, comparing medical officers and senior radiographers in the reporting of plain trauma images of the appendicular skeleton, the results showed that senior radiographers scored significantly higher in reporting accuracy than medical officers. The study concluded that senior radiographers can provide an important resource in an acute trauma images reporting in a health care sector (Plessis and Pitcher 2015: 1-2).

2.5 BENEFITS ASSOCIATED WITH INVOLVING RADIOGRAPHERS IN IMAGE INTERPRETATION

The contribution of radiographers in image interpretation has increased the volume of reported radiographs and reduced the backlog of unreported images (Adams and Schofield 2009: 19). Radiographers' participation in image interpretation has improved the speed at which reports are provided, for the benefit of referrers and the patient (Paterson 2010: 6). Studies have shown that reports provided by radiographers are accurate with the sensitivity and specificity of 90% (Kelly *et al.* 2012: 90-95). The accuracy in reporting of medical images by radiographers has also extended to other modalities such as Swallow, barium meal, barium enema, internal auditory meati (IAM) CT, MRI, mammography and nuclear medicine (Paterson 2010: 6; Kelly *et al.* 2012: 90-95). An empirical

report from the University Hospital of North Staffordshire England indicates that after using an experienced radiographer for reporting on plain images with the support of its consultant radiologist, the hospital has increased its capacity and the ability to provide safer, faster and more flexible service to patients (Turner 2014: 1).

2.6 SUMMARY OF THE CHAPTER

This chapter discussed the increased demand for radiological services that has overwhelmed the small number of radiologists, and thus the necessity to train radiographers to supplement the shortage of radiologists. In the next chapter three, the theoretical framework that guided this study is discussed.

CHAPTER 3: THEORETICAL FRAMEWORK

3.1 INTRODUCTION

A theoretical framework is the application of a theory that explains an event or a research problem (Imenda 2014: 6). It is a blueprint that is often 'borrowed' by a researcher to build his/her research inquiry. It serves as the foundation upon which research is constructed (Adom *et al.* 2018: 2). For this study, the Social Constructivism Theory and the Social Learning Theory was applied. The Social Constructivism Theory states that people acquire knowledge and learn by interacting with others. The Social Learning Theory proposes that people can learn new behaviors by observing others (Duke *et al.* 2013; Nabavi 2012; Edinyang 2016). Both theories apply to radiographers when they acquire knowledge through observation and interaction with others during interpretation.

3.2 THEORETICAL FRAMEWORK AS A GUIDE

The Social Constructivism Theory (as illustrated in Figure 3.1) was used to guide this study. The Social Constructivism Theory illustrates how people can acquire knowledge and learn by interacting with others (The University of Sydney School of Education and Social Work 2018: 1). Woollard and Pritchard (2009: 219-221) states that learning is gained through mental construction; it takes place when new information is built into and added onto an individual's current structure, understanding and skills. When learning, new ideas are acquired and new skills are procured.

The Social Learning Theory stipulates that people can learn new behaviors by observing others (Edinyang 2016: 40). This also refers to the reciprocal relationship between social characteristics of the environment, how they are perceived by individuals, and how motivated and able a person is to reproduce behaviors they see happening around them. According to Nabavi (2012: 7), this theory is based on the idea that we learn from our interactions

with others in a social context. Independently, by observing the behaviors of others, people develop similar behaviors. After observing the behavior of others, people assimilate and imitate that behavior, especially if their observational experiences are positive ones or include rewards related to the observed behavior. Constructivism suggests that learners create knowledge as they attempt to understand their experiences (Olusegun 2015: 66). Behaviorisms and cognitivism view knowledge as external to the learner and the learning process as the act of internalizing knowledge. Learners are actively attempting to create meaning, as they often select and pursue their learning. Constructivist principles acknowledge that real-life learning is more effective in preparing learners for life-long learning. Social Constructivists hold that learning is a socially enacted process which promotes the principality of the individual physical that is brain-based learning (Siemens 2005: 3).

The Social Constructivism Theory states that people acquire knowledge and learn by interacting with others while the Social Learning Theory asserts that people can learn new behaviors by observing others. According to Nabavi (2012: 7), the theory is based on the idea that we learn from our interaction with others in a social context. Both the Social Constructivism Theory and the Social Learning Theory are sociological theories which advocate learning. The social constructivists believe that learning is through interaction, while the Social Learning Theorists believe that learning is by observation. Both theories are applicable to this study because radiographers will learn interpretation through interaction and observation.

3.3 THEORETICAL UNDERPINNING

Social Constructivism Theory is a sociological theory of knowledge whereby knowledge is constructed through interaction with others (Nabavi 2012: 7). The Social Learning Theory states that people learn from one another via observation, imitation and modelling (Nabavi 2012: 7). This theory was applied when UK radiographers attended a Computed Tomography Colonography (CTC) course supervised by radiologists and interacted with

multi-disciplinary CTC teams to acquire knowledge. The course entailed practical techniques and hands-on training, whereby through observation radiographers learnt how to perform CTC examinations. A study conducted after the completion of the course indicated that after the training, radiographers had gained knowledge and skills in both performance and interpretation of CTC examinations. It also showed that radiographers could safely perform CTC and potentially detect significant pathology (Haycock *et al.* 2010: 997-1001).

In the application of the Bandura's Social Learning Theory which emphasizes imitation and modelling, radiographers in the USA, through interaction with others have acquired knowledge on how to report on CT images of the brain. To address the increase in demand of out-of-hours cranial CT image reporting due to a shortfall of radiologists, some radiology departments in the USA have allowed trained radiographers in CT image interpretation to provisionally report CT image studies. A study conducted after radiographers training in CT reporting indicated that appropriately trained neuro-radiographers could be competent at reporting CT radiographs (Gallagher *et al.* 2011: 1040-1045).

A study carried out in York Hospital, England to assess the accuracy in the reporting of knee and lumbar spine MRI examinations by comparing MR trained radiographers, MR consultant radiologist and non-musculoskeletal consultant radiologist, is a perfect application of the Social Constructivism Theory on how people can acquire knowledge and learn by interacting with others. The comparison was between MR trained radiographers and MR consultant radiologist and non-musculoskeletal consultant radiologist. The reports produced by MR trained radiographers compared well with that of a MR consultant radiologist, when compared with that of a non-musculoskeletal consultant radiologist (Brealey *et al.* 2013: e597-e605). The Social Constructivism Theory was applied in the Western Pacific when radiographers interacted with patients and gave opinions on interpretation as they worked as solo practitioners in isolation from radiologists (Smith *et al.* 2008: e23). The Social Constructivist Theory is a Learning Theory where learning takes place

when new information is built into and added onto individual's current structure of knowledge, understanding and skills (Woollard and Pritchard 2009: 219-221). The application of this theory was applied in the UK NHS Trusts, when radiographers learnt how to administer intravenous injections, performed barium enemas in 147 trusts and barium meals in 19 Trusts after training in radiographic interpretation (Price and Le Masurier 2007: 18- 29). Radiographers have also learnt how to perform breast imaging, CT, MRI, IAM and barium enema after training in interpretation (Paterson 2010: 6; Kelly *et al.* 2012:90-95).

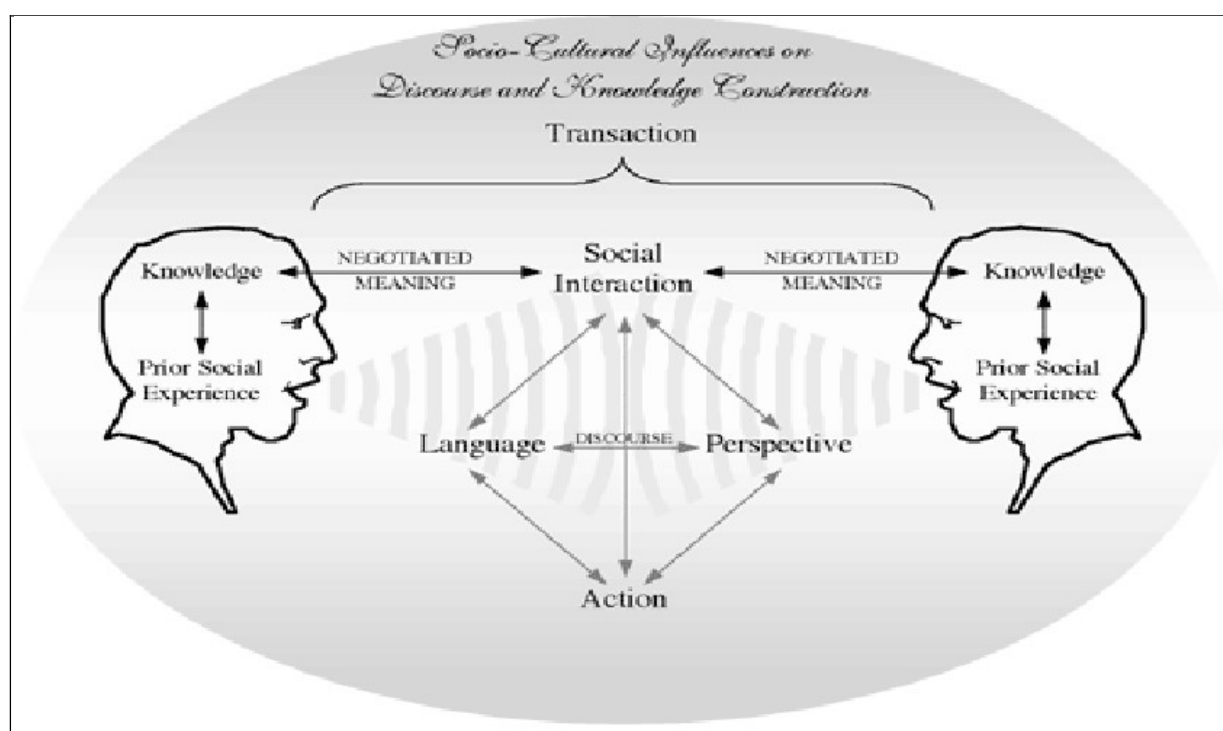


Figure 3.1: The Social Constructivism Theory

SOURCE: Adapted from Peter Doolittle (2001)

3.4 APPLYING THE THEORY IN THE STUDY

According to Edinyang (2016: 41), the Social Learning Theory is a field of study that focuses man in his environment, the relationship and interactions between man and his environment and seeks to equip him with skills, values, and attitudes needed to identify with and conquer the problems found in his environment to make his social life worthwhile. As Edinyang (2016: 41)

suggests, the application of this theory can have a positive impact on an individual's life or cause change to one's environment.

The Social Learning Theory will apply to radiographers in the training laboratories when viewing radiographs of the chest and musculoskeletal systems. As the theory states, learning is through observation and modelling (Nabavi 2012:7). The learner observes the behavior of the model and through imitation and emulation, the learner copies the behavior, the actions and attitudes of the model. During the viewing sessions of the radiographs of the chest and musculoskeletal in the laboratories, radiographers will apply the Social Learning Theory and through observation and modelling, they will be viewing the radiographs under the guidance of their lecturers as models, and by so doing, be able to distinguish between the abnormal and the normal chest radiographs. Eventually, the radiographers will acquire experience from their models and become like them. They will also apply the theory during their clinical areas and learn how to interpret radiographs of the chest and musculoskeletal, from their clinical instructors who will act as their models. During activities-based learning (ABL), radiographers will be seated in groups in the classroom doing discussions on interpretation of the chest and musculoskeletal. In this way, they will acquire knowledge and learn by interacting with each other, thus applying the Social Learning Theory (Edinyang 2016: 40).

Therefore, if this theory is applied appropriately, it can positively impact Kenyan radiographers training in image interpretation as well as the lives of patients (residents), radiologists, radiographers and hospitals. If the proposed model in this study for training radiographers in Kenya in image interpretation is approved, radiographers will acquire skills in image interpretation. The acquired skills by radiographers will enable patients to have easier access to radiological services thereby avoiding the unnecessary travelling from remote and rural areas to cities and cosmopolitans seeking radiological reports (Mukhwana 2013: 4). Furthermore, the quality of service that will be provided to patients will be enhanced, as patients' waiting time will be reduced. Many

plain radiographs that are returned to clinicians unreported will reduce as 'hot' reporting by radiographers will enable patients to receive treatment timeously (Paterson 2010: 8). Thus, if this theory is appropriately applied, it will cause positive change in the lives of patients as the resources used previously for travelling long distances seeking radiological services will be saved for other useful gains and their social status will be enhanced.

The Social Learning Theory proposes that when applied appropriately, change can be noticed in one's environment. In this regard, if radiographers trained in image interpretation, efficiency in health care systems will be enhanced. Health care systems will increase its capacity and provide safer, faster and more flexible service to patients (Price and Miller 2010: 5). That means the long queues by patients waiting for radiological reports will reduce (Paterson 2010: 8).

The image interpretation by radiographers will enable radiologists to identify the need for earlier intervention, thereby enhancing patient management and care. Radiologists will benefit from role extension because of workload reduction, improved efficiency and will have more time to work-up the subtler, complex cases that require their more advanced skills (Canadian Association of Medical Radiation Technologists 2010: 9). Radiologists will benefit from the application of Edinyang's Social Learning Theory if radiographers trained in image interpretation. Edinyang suggests that the Social Learning Theory be utilized to conquer the problems found in an individual's environment and make his social life worthwhile. This theory was applied in (UK) when a reporting radiographer was incorporated into teamwork with a radiologist. As a consequence, there was delivery of an effective and faster service as the radiographer reported the majority of the films (Woznitza *et al.* 2014: 258-263). The Social Learning Theory focuses on a man in his environment and seeks to equip him with skills, values and attitudes needed to identify with and conquer problems found in his environment. In pursuit of the Social Learning Theory, it is expected that after training in image interpretation, radiographers' window of opportunity will open, attain job satisfaction and professional

recognition. With role extension future recruitment and retention of radiographers can be achieved. With role extension, a radiographer can use their advanced knowledge and understanding to act as a transformational leader in his/her facility (Eddy 2010: 3). The Social Learning Theory is intended to change the situation of an individual and the environment. The application of this theory will have a positive impact by improving the efficiency of health care systems and the lives of radiographers if they are trained in image interpretation. It also indicates that it can cause more flexibility in the radiologists' work if radiographers were trained in image interpretation.

3.5 SUMMARY OF THE CHAPTER

Chapter 3 discussed the theoretical framework guiding this study. Chapter 4, presents the research design and the methodology that was used for data collection and analysis.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The methods chapter explains the research design, the setting, the population, measurement instruments, data collection procedures and data analysis that were used to conduct the study (Bui 2014: 138). The chapter concludes by discussing ethical issues related to the study.

4.2 RESEARCH DESIGN

A research design is a plan or procedure for research that incorporates methods of data collection, data analysis and interpretation (Polonsky and Waller 2010: 94; Creswell 2009: 30). For this study, a mixed-methods approach incorporating both qualitative and quantitative designs using the exploratory sequential strategy was employed (Creswell 2009: 204-205). The mixed design provided a greater understanding of the need to train Kenyan radiographers in image interpretation of the chest and musculoskeletal systems. The phenomenon of training radiographers in image interpretation was explored through qualitative data collection and analysis, after which the findings were used to develop a suitable instrument for the quantitative phase. The researcher then generalized the findings of the second phase to the population (Creswell 2009: 535).

4.3 PHILOSOPHICAL UNDERPINNING OF THE EXPLORATORY SEQUENTIAL DESIGN FOR THIS STUDY

An exploratory sequential strategy entails the first phase of qualitative data collection and analysis, of which the results were used to develop an instrument for the second quantitative phase. The purpose of an exploratory sequential design is to generalize qualitative findings using a small number of participants in the first qualitative phase to a larger sample collected in the second quantitative phase (Creswell and Plano Clark 2011:

86). An exploratory design consists of multiple worldviews, the constructivist and the post-positivist. The first phase comprises the qualitative strand and the design embraces the constructivist worldview, while the second quantitative phase embraces the post-positivism worldview. During the first qualitative phase, the researcher utilized the constructivist worldview to gain a deeper understanding and perspectives of the Kenyan radiographers on the need to train radiographers in image interpretation of the chest and musculoskeletal systems. In the quantitative phase, the post-positivist world view was used to identify the need to develop a model for training radiographers in image interpretation of the chest and musculoskeletal systems. Because the exploratory design utilizes multiple worldviews, the world views shifted from the constructivist worldview in the first phase to the post-positivist worldview in the second phase (Creswell and Plano Clark 2011: 87).

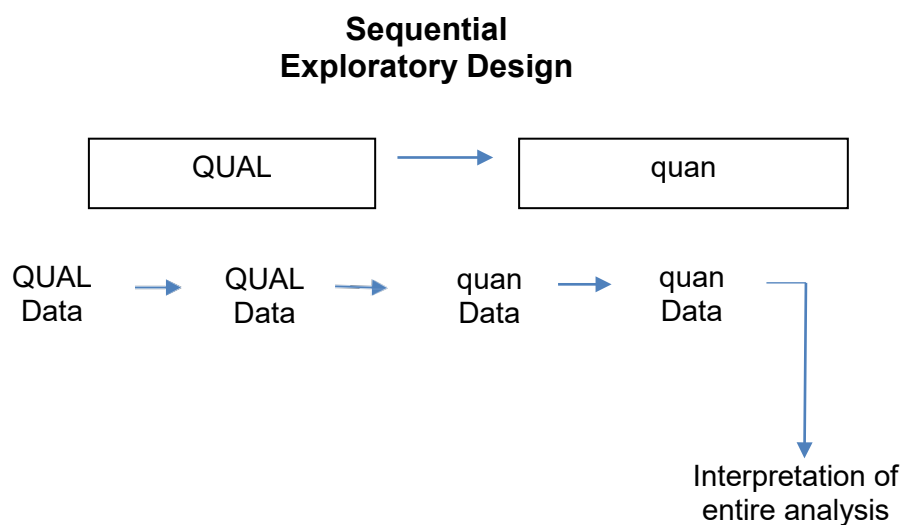


Figure 4.1: Sequential Exploratory Design

Source: Adapted from Creswell (2009).

4.4 RESEARCH PARADIGM

Research paradigms are assumptions and beliefs that provide direction or directs the activities of a researcher in a research process (Wahyuni 2012: 69). Guba (1990: 17) defines a paradigm as a set of beliefs or worldview that guides research action or investigation. According to Kivunja and Kuyini (2017: 26), a research paradigm determines the methods that would be used in data collection, analysis and interpretation. Based on Kivunja and Kuyini's (2017:26) argument, the research paradigm that guides this study is the pragmatic philosophical approach. Pragmatism is a pluralistic worldview that focuses on the use of multiple methods of data collection whereby the second phase of data collection builds on the first phase (Creswell and Plano Clark 2011: 41). According to Lincoln and Guba (1985: 108-109), a paradigm comprises of four elements. For this study, the pragmatic worldview in this stance embraces four elements of world views, which were used in this study (Creswell and Plano Clark 2011: 39). The four elements were epistemology, ontology, methodology and axiology.

4.4.1 Epistemology

Epistemology, which means knowledge in Greek, states that knowledge or the truth of what we know about the world is gained through research (Kivunja and Kuyini 2017: 7). It also states that knowledge can be acquired through research and communicated to other human beings (Kivunja and Kuyini 2017: 7). Knowledge is gained when a researcher investigates a phenomenon in qualitative research. During the investigation, the researcher interacts with participants in the field and extracts data which is then analyzed. The researcher makes meaning of the data and the information obtained is used to resolve a research problem (Kivunja and Kuyini 2017: 7). In this study, the researcher explored the perceptions of Kenyan radiographers concerning the training in image interpretation of the chest and musculoskeletal systems. Consequently, the information obtained from the data analysis was used to develop a model for training radiographers in image interpretation in Kenya.

4.4.2 Ontology

Ontology is a branch of philosophy concerned with the assumptions made to believe that something makes sense or is real. It is also concerned whether the data gathered in the research process makes meaning. It aids a researcher to determine the research problem, its significance and how to answer a research question after data analysis (Kivunja and Kuyini 2017: 27). In this study, the researcher investigated Kenyan radiographers and elicited views concerning the training of radiographers in image interpretation of the chest and musculoskeletal system. After data analysis, the findings were used to establish the need for training radiographers in images interpretation.

4.4.3 Methodology

Methodology is concerned with research design, methods, approaches and procedures used in an investigation that is well planned to find out something (Polonsky and Waller 2010: 98; Bui 2014: 138). Data gathering, participants, instruments used to collect data and data analysis are parts of the methodology. The methodology used in a research study brings about an understanding of a research problem and how to answer a research question and contribute to knowledge (Kivunja and Kuyini 2017: 28). It entails the assumption to be made in the research process, limitations to be encountered and how to minimize the limitations. It determines data to be gathered and how to answer the research question (Kivunja and Kuyini 2017: 28). To achieve the purpose of this research; the researcher used an exploratory sequential research design. The purpose of an exploratory sequential design was to generalize qualitative findings using a few participants in the first phase to a larger sample collected in the second quantitative phase (Creswell and Plano Clark 2011: 86).

Data was collected using qualitative and quantitative approaches. In the first qualitative phase which was intended to elicit views on the need to develop a model to train radiographers in images interpretation of the chest and musculoskeletal systems, data were collected using in-depth interviews and focus group discussions. In the second quantitative phase, data was collected using questionnaires. The researcher used purposeful sampling in the first phase and in the second phase, simple random sampling was used. Data in the first phase was analyzed thematically, while in the second phase, data was analyzed statistically. Data from the two phases were presented in tables and figures. In an exploratory design, the researcher first collects qualitative data and analyses it, and then uses the findings of the qualitative data to develop an instrument for a follow-up quantitative phase and therefore the connection (mixing) of the qualitative strand and the quantitative strand. The mixing occurs during the analysis of the qualitative data and the development of the instrument for the quantitative phase (Creswell and Plano Clark 2011: 67).

4.4.4 Axiology

Axiology is concerned with ethics, and the ethical issues that ought to be considered during a research process (Wahyuni 2012: 69). It defines concepts related to the right or wrong behavior in a research study (Creswell 2013: 20). It states the values that should be put upon the participants, the data and the audience (Creswell and Plano Clark 2011: 41). Therefore, axiology underscores the values that should guide a researcher during research and what should be done to respect the rights of the participants (Kivunja and Kuyini 2017: 28). When conducting this research, ethical principles or issues were considered: right to freedom of choice, expression and access to information, right to privacy, confidentiality and anonymity and the right to equality, justice, human dignity and protection from harm. These principles have been discussed in detail under ethical considerations.

4.5 SETTING

Kenya lies in the eastern coast of Africa and within the equator. Kenya shares its border with Tanzania to the south and Uganda to the west. South Sudan is to the north-west of Kenya and Ethiopia is to the northern part of Kenya. Somalia lies to the north-eastern part of Kenya. Kenya has a land area of about 586.600 square kilometers. Kenya's current population is about 45.8 million people. English and Kiswahili are the gazetted national languages of communication. Kenya consists of eight Provinces and 47 Counties (Kenya Political Map June, 2013).



Figure 4.1: Map of the provinces of Kenya

Source: Adapted from Kenya Political Map (2013)

Healthcare in Kenya is provided at three levels: dispensaries, sub-district, district, provincial and teaching and referral hospitals (Muga *et al.* 2005: 1-14). There are three major national and referral hospitals in Kenya namely Kenyatta National Hospital, Moi Teaching and Referral Hospital and The National Spinal Injury and Referral hospital, offering radiological services with state-of-the-art equipment such as CT and MRI. Radiological services in these hospitals are manned by radiologists. There are about ten referral hospitals in Kenya offering radiological services provided by resident radiologists. There are about 113 district hospitals which offer radiological services. Most of these district hospitals especially in rural areas are manned by radiographers without radiologists. There are about 86 sub-district hospitals and some of these hospitals provide x-ray services but are managed by radiographers without radiologists. The study was conducted at Moi Teaching and Referral Hospital (MTRH), Iten County hospital, Kericho County hospital, Ziwa Sub-county hospital, Turbo Sub-County hospital, Burnt-forest Sub-County hospital, Kapkatet Sub-County hospital, Bomet County hospital, Naivasha county hospital and Kapsabet county hospital which are in the Rift Valley Province. The province is the largest of all the provinces in Kenya and covers an area of 182,505.1 square kilometers. It has a population of 10,006,805 people, making it the most populous province in the country (Muga *et al.* 2005: 1-14).

Moi Teaching and Referral Hospital consists of a large radiology department equipped with modern x-ray machines, such as CT and MRI. The department has about 30 radiographers serving in different units such as casualty, main x-ray, fluoroscopy, mammography, orthopantomography (OPG) and ultrasound. The hospital serves as a training centre for medical students, postgraduate radiology trainees (MMed radiology) and trainee radiographers from Kenya Medical Training College. Some of the county hospitals have radiologists that pay occasional visits, but most of them are manned by radiographers without radiologists.

4.6 POPULATION

According to Brink (2012: 123), a population is a total collection of people or objects that are of interest to a researcher or meets the criteria for a study. Oso and Onen (2011: 79) describe a population as a total number of subjects or the total environment that is of interest to the researcher, from which he/she can draw a sample or accessible population out of the whole. The total number of radiographers serving in public hospitals in Kenya is estimated to be about two thousand (Society of Radiography in Kenya Secretariat, 12 February 2019). There are about one thousand one hundred (1100) registered radiographers with the Society of Radiographers of Kenya (SORK) (Kenya Health Workforce Report 2015: 37). To access the sample of the radiographers during data collection, the researcher sought the assistance of SORK to access registered radiographers captured in the society's database. The researcher also sought the assistance of the chief radiographer in the Ministry of Health to access radiographers that provide health services in the Ministry of Health who are not SORK members. The researcher also sought the assistance of SORK's Secretariat and the Chief Radiographer in the Ministry of Health to obtain contact details of radiographers in charge of the said hospitals to assist with data collection.

4.7 SAMPLING PROCESS

Sampling is the process of choosing particular participants who represent a particular group of people or objects. Sampling is done when a researcher is conducting a survey or an interview in research to obtain particular information (Walliman 2011: 184-185). To achieve the aim of this study, the researcher used different sampling processes for the quantitative and qualitative phases.

4.7.1 Phase 1: Qualitative phase

The researcher used purposeful sampling in Phase 1 of the study. Purposeful sampling involves choosing participants who the researcher knows that have

information that will contribute directly to answering the research questions or the objectives of the study (Plowright 2011: 42-3). According to Polonsky and Waller (2010: 140) and Creswell (2013: 154-55), sample members are purposefully selected based on the researcher's experience considering the objectives of the study. In purposeful sampling, items for the sample are selected deliberately by the researcher and his/her choice concerning the items remains supreme. Also, the researcher chooses a sample on the basis that the small number selected out of a huge one, will be typical or representative of the whole (Kothari 2004: 59; Oso and Onen 2011: 85). In Phase 1 (qualitative phase), data was collected through focus group discussions and in-depth interviews. Five focus groups with six participants in each group participated in the study. The discussions were guided by unstructured questions, which were intended to elicit views and opinions from radiographers about the phenomena under study. Data from the focus group discussions were audio recorded and transcribed verbatim (Creswell 2009: 181).

During the in-depth interviews, 30 participants were interviewed face to face at convenient venues at the agreed date and time, using semi-structured interviews. According to Brink (2012: 158), semi-structured interviews provide in-depth information about the beliefs and attitudes of participants about a phenomenon under study than any other data collecting technique. Radiographers in this study were asked to provide their opinion on the need to train Kenyan radiographers in images interpretation of the chest and musculoskeletal, to ease the shortage of radiologists. The interviews were audio recorded and transcribed verbatim (Creswell 2009: 181). In Phase 2 (quantitative phase), data was collected through survey questionnaires. Before the researcher began data collection in Phase 2, the statistician was consulted for assistance in determining the sample size.

4.7.2 Phase 2: Quantitative phase

In the second phase (quantitative phase), data was collected through questionnaires. According to Walliman (2011: 14), to produce statistically significant results, quantitative research demands that 20-30 participants are considered to be about the minimum. For this study, a sample of 336 radiographers was selected. The sampling was done based on the target population of 1500 radiographers registered with the SORK, working in public hospitals. The sample size was calculated by the statistician. The following formula was used to select the sample size of 336 radiographers who participated in the study.

The population size for the study is 1500.

The formula used is:

(maximum possible proportion (.5) * 1 - maximum possible proportion (.5) produces maximum possible sample size).

Where \underline{d} = acceptable margin of error for proportion being estimated = .05 (error researcher is willing to except).

Therefore, for a population of 1,679, the required sample size is 384. However, since this sample size exceeds 5% of the population ($1,679 * .05 = 84$), Cochran's (1977) correction formula should be used to calculate the final sample size. These calculations are as follows:

$$\underline{n} = \frac{\underline{n}_0}{(1 + \underline{n}_0 / \text{Population})}$$

$$\underline{n}_0 = \frac{(\underline{t})^2 * (p)(q)}{(\underline{d})^2}$$

$$\underline{n}_0 = \frac{(1.96)^2 (.5)(.5)}{(.05)^2} = 384$$

Where \underline{t} = value for selected alpha level of .025 in each tail = 1.96.

(the alpha level of .05 indicates the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error).

Where $(p)(q)$ = estimate of variance = .25.

So, for the population of 1500, the sample size was:

$$384 / (1 + 384/1500) = 306$$

To this, 10% is added to counter any non-response that may occur. So, the sample size was 336 completed questionnaires.

4.8 CRITERIA FOR SELECTING PARTICIPANTS

The criteria for inclusion and exclusion of the participants were as follows:

Inclusion criteria

- Radiographers with a working experience of more than five years with experience of the phenomena, willing to participate in the study.
- Radiographers who worked in public hospitals in Kenya by the time the study was conducted.
- Radiographers registered with the Society of Radiography in Kenya by the time the study was conducted.

4.8.1 Exclusion criteria

- Radiographers who had worked for less than five years were excluded from the study, because of inexperience of the phenomena.
- Student radiographers did not participate in the study though they were doing their clinical rotation at the time the study was conducted.
- Radiographers who were not employed in the public hospitals.
- Radiographers who were not members of the Society of Radiography in Kenya.

4.9 DATA COLLECTION PROCESS

Approval to conduct this study was sought from the Institutional Research and Ethics Committee of Durban University of Technology (DUT). After obtaining ethical clearance (IREC 026/19) from DUT for Phase 1 and Phase 2 (Appendix 1a) and (Appendix 1b) respectively, the researcher also applied for permission to conduct the study in Kenya from the National Commission for Science, Technology and Innovation (NACOSTI) (Appendix 2a). Permission to collect data from NACOSTI (Appendix 2b), was granted. Data was collected in two phases, qualitative Phase 1 and quantitative Phase 2. The data collection tools were developed based on the literature as there was no pre-existing

interview schedule for the focus group discussion, interview schedules and questionnaires that would be used for data collection. The focus group schedules, interview schedules and the questionnaires were developed for this study to ensure that they answered the research questions and objectives of the study.

The questions on the focus group discussions (Appendix 9) and the interview schedule for the face to face interviews (Appendix 7b) were pre-tested for content validity (Squibb 2013: 140) through piloting before they were used for data collection (O'Leary 2010: 185; Walliman 2011:190-191). During the designing of the interview schedules and questionnaire, the research questions and objectives were revisited to ensure that they reflected the purpose of the study for construct validity (Squibb 2013: 138). The procedure for the development and pre-testing of the interview schedules and questionnaire and data collection is discussed below.

4.9.1 Phase 1: Qualitative Phase

In the qualitative phase, data collection was done through focus group discussions and interviews. During focus group data collection, radiographers were interviewed at a convenient venue at the agreed date and time, using semi-structured interviews. The venue of the focus group interviews was at Moi Teaching and Referral Hospital and Kapsabet County hospital. Five focus group discussions with six participants in each group were conducted where two groups each were from Moi Teaching and Referral Hospitals and one from Kapsabet County Hospital. To identify the potential participants from the hospitals, the researcher approached the radiographer in-charge and requested to interview the radiographers. They were briefed about the study and then informed to contact the researcher via WhatsApp if they were willing to participate in the study. Upon receiving their WhatsApp messages, the researcher contacted them to inform them who should participate, at what time and the location of the meeting in view of the participants' convenience and where there was free noise interference. The participants were interviewed in

the staffroom and in groups of six participants so that each participant may have enough opportunity to talk during the interview.

The researcher welcomed the participants and gave them the letter of information (Appendix 5b). The participants were informed that their personal information will be confidential and that their names will be anonymous. Also, they were informed that their participation is voluntary and they can withdraw at any time during the interview if they so wish without any penalty. The researcher informed them that they would not receive any remuneration for participating in the study. If the participants agreed to be interviewed, they were given a consent form (Appendix 6) to sign before the commencement of the interview.

The researcher started the session with a greeting and some transitional period to put participants at ease by engaging them in small talk. Furthermore, the objectives of the study and how it would benefit patients and radiographers explained to the participants. As the process develops, using the interview guide with open ended questions (Appendix 7), questions were introduced one by one. To facilitate the interaction between the group members, the researcher constantly provided probes and pauses, and involved people in discussion without expressing any value on the answers received. The researcher used an interview guide with open-ended questions which would facilitate probing for more information. The participants were asked to provide their opinion on the need to develop a model for training radiographers in image interpretation to supplement the shortage of radiologists.

The interviews ended when the data collection reached saturation. Data saturation is a point where the researcher finds no more new information from the participants. The researcher informed them that he might contact them later in case he required further clarification. The participants were thanked for participating in the study and for their valuable contributions to the research. Audio-recording with the permission of participants and notes-taking were used to record the participants' responses. The interviews lasted between 60-90

minutes in each group. The heads of departments did not participate in the interviews to avoid uneasiness of the participants during the interviews.

4.9.2 Phase 2: Quantitative phase

In the quantitative phase (second phase), data collection was through questionnaires. To collect data in this phase, a questionnaire was used (Appendix 8). During the data collection, questionnaires were distributed to the sample of 336 participants. The researcher distributed the questionnaires by mail and where possible, the questionnaires were delivered by hand. These were collected by the researcher on completion. Telephonic follow-ups were made to improve the return rate of the questionnaires. Self-addressed and stamped envelopes were included in the mail to facilitate ease of the return of the questionnaires. Three hundred and eleven (311) completed questionnaires were returned to the researcher in sealed envelopes (Brink 2012: 157).

4.10 PRE-TESTING OF DATA COLLECTION TOOLS

This section discusses how the tools that were used in this study for data collection were pre-tested before they were used to collect data. The purpose of pre-testing the tools was to refine questions to ensure that the questions are not ambiguous, leading, confronting, offensive, double-barrelled and pretentious. It was also meant to make sure that the questions were simple and could be understood by the respondents (O'Leary 2010:200).

4.10.1 Phase 1 of pre-testing of data collection tools

This entailed pre-testing of the interview schedule questions (Appendix 5a), using six purposefully selected participants from the study population with experience of the phenomena (Brink 2012: 159). Participants were asked to comment on the validity and suitability of the questions and propose any necessary adjustments to ensure clarity and objectivity of the questions, and

that the questions were not confusing, leading, offensive, problematic to the interviewees (O'Leary 2010: 200). The participants were provided with sheets of paper to comment on the suitability of the questions or propose any amendments or adjustments before the interview schedules were used for the interviews. These participants did not participate in the focus group discussions and the survey during data collection.

4.10.2 Phase 2 of pre-testing data collection tools

This consisted of pre-testing of the self-developed questionnaire before the questionnaires were administered to the participants (Appendix 8). The self-developed questionnaire was constructed based on the literature. The questionnaire consisted of closed-ended questions to elicit biographical information from the participants. A Likert scale to measure the opinion of radiographers concerning the training in image interpretation of the chest and musculoskeletal systems was used. For this study, a group of 6 participants were purposefully selected by the researcher, and were asked to comment on the suitability of the questions and to propose any necessary adjustments to ensure clarity, objectivity and that the questions that would be posed were not ambiguous. The participants who were used to pilot the questionnaire did not participate during data collection. According to Kabiru and Njenga (2009: 125), a group of participants who are part of the study population can be purposely selected by the researcher numbering about 6-10 for piloting a questionnaire. To enhance the response rate, the questionnaire was kept as short as possible and questions were simplified (Walliman 2011: 191). These participants did not participate in the focus group discussions and the survey during data collection.

4.11 DATA ANALYSIS

Data analysis in qualitative research is in the form of text which entails examining the data, reading through it, coding, organizing it into themes and making sense of it. Quantitative data, which is in numerical form, is analyzed statistically (Creswell 2013: 182-187). Both the qualitative and quantitative

data were analyzed in two phases.

4.11.1 Phase 1: Qualitative Phase

This section explains how thematic analysis was used to identify themes and the findings of the study. Thematic analysis was used to organize, prepare explored, identify codes and reduce the codes into themes and eventually the findings, in order to understand the opinion of radiographers regarding image interpretation of the chest and musculoskeletal. The researcher employed Tesch's (1990: 142-145) method of data analysis which involves eight steps as follows:

- Read through all data to obtain the required background, and get the essence of the whole data.
- Begin with one document, and ask themselves a question "What is this about", with regard to the topic.
- Complete this procedure for several documents, and make a list of all topics. Compare all the topics and group the same topics together. Write those groups in columns with headings that represent the main topics, unique topics and remnants.
- Abbreviate the topics as codes so that the researcher could write next to the appropriate segments of the text. Anticipate the emergent of new codes, and write them down if there are any.
- Identify the descriptive words for the topics that have started to form categories. Reduce the categories by grouping together those that are related. Identify any subcategories.
- Finalise the abbreviations of each category and arrange them alphabetically to ensure that there are no duplications.
- Insert the data belonging to each category together, and conduct preliminary analysis. Focus on the content of each category, while keeping the research questions in mind in order to discard irrelevant data.
- Record the existing data where necessary.

4.11.2 Phase 2: Quantitative Phase

Quantitative data from the questionnaires was analyzed statistically with the assistance of a statistician using Statistical Package for Services Software (SPSS), version 26, which is suitable for descriptive analysis because it uses number codes for the analysis of descriptive variables. Because quantitative data was descriptive in this study, the mean, the frequency and the standard deviation were used to describe the data (Bui 2014: 156). Data on the opinion of radiographers, for the need to develop a model to train radiographers in image interpretation, was divided into two groups. The data, with the opinion of radiographers that supported the development of a model to train radiographers in image interpretation, were grouped, and the data with the opinion of radiographers that did not support the development of the model were put in another group for data analysis. The data was now in two separate groups. This was to facilitate in identifying the range, the mean and the standard deviation for the two groups. A t-test was then conducted to compare the mean scores and identify whether there was a significant difference of opinion among the two groups of radiographers concerning the development of a model to train radiographers in image interpretation. The results were then analyzed descriptively by the researcher by looking at the responses in line with each research question.

4.12 TRIANGULATION

Triangulation is defined as a process and/outcome which involves the combination and comparison of multiple data sources, data collection and analysis procedures, research methods and inferences that occur at the end of the study. Triangulation is the utilization of multiple and different sources, methods and investigators to validate findings. Creswell (2013: 251) further argues that triangulated data sources are assessed against one another to cross-check data and interpretation. Triangulation is the comparison of data collected from different sources using different methods for example from structured interviews, participant observation and life histories so that the information obtained from these sources can be confirmed (Krefting 1990:

219).

In this study, triangulation was performed by using multiple sources and methods of data collection. Data analysis from the focus group discussion and the questionnaires were member checked to determine the accuracy of the research findings and results, respectively (Creswell 2009:191). The four themes that emerged from the focus group discussion in phase 1 of the study were verified using a questionnaire in phase 2 of the study for credibility. During triangulation, the researcher adopted a neutral position and did not impose his own preconceived perceptions during data collection and analysis, with regard to the training of radiographers in image interpretation of the chest and musculoskeletal. To achieve this, the researcher ensured that the themes were linked to the data from the participants and that was confirmed by peer debriefing (Squibb 2013:173).

4.13 TRUSTWORTHINESS

Trustworthiness is the criteria used to ensure quality when conducting qualitative research, by employing procedures that ascertain the accuracy of the findings (Loh 2013: 4; Brink 2012: 171). This can be achieved by the employment of multiple strategies to determine data quality or rigour in qualitative research (Brink 2012: 172). According to Connelly (2016: 435), four criteria determine trustworthiness in a qualitative study: credibility, dependability, confirmability and transferability.

4.13.1 Credibility

These are procedures or steps that a researcher employs in a study to ensure that the findings are accurate and credible (Creswell 2009: 190). One of the steps of ensuring credibility is prolonged engagement in the field by the researcher so that he can acquire an in-depth understanding of the participants' perceptions and views concerning image interpretation of the chest and musculoskeletal systems. Prolonged engagement can also promote rapport between the participants and the researcher for gathering rich data

and obtain accurate or valid findings (Shenton 2004:65; Krefting 1990:218). To achieve the purpose of this study, the researcher had to spend more time in the field to establish rapport with radiographers working in the public hospitals to obtain an in-depth understanding of the views concerning the training in image interpretation of the chest and musculoskeletal systems. The researcher also ensured credibility in the study by using triangulation in the form of various methods of data collection such as in-depth interviews, focus group discussion and questionnaires. Data from these sources were then cross-checked by the researcher during data interpretation. The importance of using triangulation is to minimize distortion when a single source of data is used or to minimize biases from a researcher if one source of data is used (Krefting 1991: 219). Another procedure of ensuring credibility is member checking. According to Shenton (2004: 68), member checking is paramount in strengthening credibility. The researcher employed member checking to determine the credibility of the findings by taking back the final report or themes to the participants (Creswell 2009:91; Brink 2012:172). The researcher also replayed the recorded interviews and focus group interviews to informants to verify the accuracy of the findings (Lincoln and Guba 1985: 314). The credibility of this study was also enhanced by peer debriefing. The researcher used a colleague, an expert in qualitative research, to ask questions regarding the study (Creswell 2009:192; Brink 2012:172). The researcher also used rich and thick descriptions of the themes to validate the findings (Creswell 2009: 191).

4.13.2 Dependability

In qualitative research, dependability is the consistency of the findings. That means if the study is repeated by another researcher in the same context using the same methods and the same participants, the same results would be achieved. In addressing dependability, the procedure of conducting the study should be reported in detail so that another researcher can replicate the work and achieve the same results (Shenton 2004:71; Krefting 1990:221). Dependability can also be achieved through triangulation so that the

weakness of one method can be compensated by using other data gathering methods. Using a colleague who is experienced in qualitative research to question or audit the procedures or methods used in the study is another way of enhancing dependability (Krefting 1990: 221). To address the issue of dependability in this study, the researcher reported in detail the entire procedure used to conduct this research so that the study could be replicated by another researcher in the future. In this study, the researcher used multiple methods of data collection for example interviews, focus group discussion and questionnaires to triangulate data from these sources to achieve dependability. He also used a colleague experienced in qualitative research to question or audit the procedures used in this study.

4.13.3 Confirmability

When data is accepted as accurate, relevant and appropriate in presenting the views of the participants and not those of the researcher, then confirmability is established (Brink 2012:172; Shenton 2004:72). One of the methods of establishing confirmability is the auditing of the procedure of the entire study, by keeping detailed notes of all the stages of the research. The notes are then reviewed by a colleague experienced in qualitative research (Lincoln and Guba 1985: 318-327). Confirmability can also be established through peer-debriefing by an expert in qualitative research who can question every step of the study. Peer-debriefing can minimize bias from one person's perspective in a study (Shenton 2004: 72). Another method of establishing confirmability by a researcher is through member checking. Member checking entails taking back the final report to the participants to ascertain from the participants whether the report reflects their views (Creswell 2009: 191). Triangulation of multiple methods of data sources can also be used to enhance confirmability (Connelly 2016: 435). To address the issue of confirmability in this study, the researcher provided documentation for every interpretation from at least two sources to support the researcher's analysis and interpretation (Krefting 1990: 221).

4.13.4 Transferability

Transferability in qualitative research is the replication of the findings of one study to another study (Shenton 2004: 69; Connelly 2016:435-436; Brink 2012:175). Transferability can be enhanced through thick descriptions, purposive sampling and member checking. Thick descriptions entail provision of detailed information about the study, the setting and the participants by the researcher. Transferability is increased by providing detailed descriptions of the interviews by the researcher. The researcher should also ensure that the data collected represents the views of the participants. To enhance transferability in this study, the researcher used purposive sampling to select experienced participants to provide specific information about the phenomena (Brink 2012:173; Krefting 1990:220). The researcher provided thick descriptions of the procedures carried out in the study, the setting, the participants and the data for transferability (Lincoln and Guba 1985: 316).

4.14 ETHICAL CONSIDERATIONS

Approval to conduct this study was sought from the Durban University of Technology Institutional Research and Ethics Committee (Appendix 1a) for phase 1 and (Appendix 1b) for phase 2. A request to conduct the study was sought from the following gatekeepers:

- Permission and approval letters to the National Commission for Science, Technology and Innovation (Appendices 2a and 2b).
- Permission and approval letters to the County Director of Health Services (Appendices 3a and 3b).
- Permission and approval letters to the radiographer-in-charge (Appendices 4a and 4b).

In fulfillment of the ethical requirements, the following documents were provided to the participants: Letter of information to the participants for the focus group participants and participants in the survey (Appendices 5a and 5b).

- Consent forms to audio-record the interviews by the researcher (Appendix 6).
- Demographic data for the focus group participants (Appendices 7).
- Interview guide for the focus group (Appendices 8).
- A questionnaire that was used in phase 2 (Appendix 9).
- Sample of the interview transcript (Appendix 10).

When conducting this research ethical principles or issues were considered: right to freedom of choice, expression and access to information, right to privacy, confidentiality and anonymity and the right to equality, justice, human dignity and protection from harm.

4.14.1 Right to freedom of choice, expression and access to information

It is the responsibility of the researcher to ensure that participants invited to participate in the study are not unduly influenced or coerced or feel that he/she must participate in the study (Brink 2012: 37). Polonsky and Waller (2010: 70) states that a researcher should not force or put undue pressure on respondents to participate in a study. A researcher should bear in mind that respondents are assisting him and therefore a participant should be invited to participate in the study since they are under no obligation to do so. The researcher should also assure participants that there will be no consequences if they do not participate in the study. A consent form (Appendix 6) explaining to the participants the freedom of choice to participate, benefits and risks of the study was attached to the interview and focus group schedules. In addition, the information sheet contained details of the supervisors so that the participants would report any procedure deemed to violate their rights (Walliman 2011: 261-62).

4.14.2 Right to privacy, confidentiality and anonymity

Privacy and confidentiality are salient in research, and a researcher should ensure that participants or their organizations are not named in the research process (Plowright 2011: 156). The respondent has a right to determine the extent to which his or her information is shared with others (Brink 2012: 35). In this research, the right to the participants' privacy was assured by informing them that they should not mention their names or the names of their organizations during the study process or write their names on the questionnaire. Participants were also assured that the information they provided would be kept private and confidential and not be shared with non-research members.

4.14.3 Right to equality, justice, human dignity and protection from harm

Even though conducting this research was not invasive, because no intervention was applied, the researcher intruded into the lives of the participants (Brink 2012: 33). In this study, the researcher avoided psychological harm to participants by ensuring that the questions were well structured, offensive questions, sensitive questions regarding culture, religion and questions related to gender bias were not included in the questionnaire or interview schedules (Walliman 2011: 261).

4.15 SUMMARY OF THE CHAPTER

Chapter 4 presented the research design, methods of data collection and analysis. The next chapter presents the findings of the study.

CHAPTER 5: PRESENTATION OF FINDINGS: PHASE 1 (QUALITATIVE DATA)

5.1 INTRODUCTION

This chapter reports a narrative description of the findings of this study and presents results from the focus group and interview data which were collected from 30 radiographers. The data was analyzed thematically. The demographic data has been analyzed and presented in the form of a table. The findings were reported concerning the research questions. The findings are based on the focus group discussions and interviews that were conducted to elicit the views of Kenyan radiographers on the need to develop a model for training radiographers in images interpretation of the chest and musculoskeletal systems in Kenya.

5.2 DEMOGRAPHIC DATA

In this study, a sample of 30 participants was interviewed. They were purposively selected from Moi Teaching and Referral Hospital, Uasin Ngishu District Hospital, Burnt Forest Sub-County Hospital, Turbo Sub-county Hospital and Ziwa Sub-County Hospital, Kapkatet Sub-county hospital, Kericho County hospital, Provincial General Hospital Nakuru and Naivasha County hospital. Out of the 30 participants who participated in the study, 21 were males and 9 were females. All the participants in the study were senior radiographers with clinical experiences of more than five years. Table 5.1 provides the demographic characteristics of the participants.

Table 5.1: Demographic characteristics of the study sample (n=30)

Participant Code	Gender	Age in years	Experience in Radiography (Years)	Experience in current position (Years)
SR 1	Female	38	15	5
SR 2	Female	42	17	4
SR 3	Female	38	15	6
SR 4	Female	40	20	7
SR 5	Male	44	21	8
SR 6	Female	49	25	10
SR 7	Female	32	10	4
SR 8	Female	31	9	3
SR 9	Female	36	14	5
SR 10	Male	43	21	8
SR 11	Female	42	19	7
SR 12	Male	35	15	4
SR 13	Male	37	16	3
SR 14	Male	42	19	8
SR 15	Male	45	15	4
SR 16	Male	44	17	5
SR 17	Male	43	16	6
SR 18	Male	37	11	4
SR 19	Male	27	15	5
SR 20	Male	42	19	7
SR 21	Male	30	8	3
SR 22	Male	41	16	5
SR 23	Male	46	16	4
SR 24	Male	34	10	3
SR 25	Male	40	16	5
SR 26	Male	46	19	6
SR 27	Male	31	18	7
SR 28	Male	40	18	6
SR 29	Male	28	15	4
SR 30	Male	40	14	3

Key: SR=Senior Radiographer.

5.3 PRESENTATION OF FINDINGS AS THEMES

Participants offered their opinions regarding training Kenyan radiographers in image interpretation of the chest and musculoskeletal systems. The qualitative data from the voice recordings of the focus group discussion and interviews were transcribed verbatim. Each transcript was read carefully several times by the researcher to obtain the meaning of each focus group and interview data. Using thematic analysis, the researcher then organized the focus group and interview data and grouped it into categories or themes. From the data analysis, four major themes emerged as listed in Table

5.2 below:

- Theme 1: Benefits associated with training of radiographers in images interpretation
- Theme 2: Impact of training radiographers in image interpretation.
- Theme 3: Gaps in the provision of radiological reports.
- Theme 4: A need for curriculum review.

Table 5:2: Emerged themes and sub-themes

Major theme	Sub-theme
5.3.1 Benefits associated with training of radiographers in image interpretation.	1.1 Reduction of patient waiting time. 1.2 Facilitation of patient treatment. 1.3 Instant provision of radiology reports. 1.4 Costs of travelling long distances can be minimized. 1.5 Appropriate management of patients. 1.6 Assurance of reports to clinicians.
5.3.2 Impact of training radiographers in image interpretation.	2.1 Minimal repeats of images thus reducing costs. 2.2 Costs of transferring patients could be minimized.
5.3.3. Gaps in the provision of reports.	3.1 Shortage of radiologists. 3.2 Overworked radiologists.
5.3.4. Radiography curriculum on training radiographers in image	4.1 A need for curriculum review. 4.2 Laboratories should be established.

5.3.1 BENEFITS ASSOCIATED WITH TRAINING RADIOGRAPHERS IN IMAGE INTERPRETATION

Most interviewees indicated that training radiographers to do image interpretation of the chest and musculoskeletal system would benefit the hospitals with no radiologists. On probing the benefits, they highlighted those indicated in the following six sub-themes as follows:

Sub-theme 1.1: Reduction of patient waiting time.

Sub-theme 1.2: Facilitation of patient treatment.

Sub-theme 1.3: Prompt reports.

Sub-theme 1.4: Costs of travelling long distances can be minimized.

Sub-theme 1.5: Appropriate management of patients.

Sub-theme 1.6: Assurance of reports to clinicians.

5.3.1.1: Sub-theme 1.1: Reduction of patient waiting time

The participants indicated that if radiographers were trained in image interpretation, they could perform imaging procedures and provide image interpretation reports at the same time, thus reducing patient waiting time. They further stated that currently, patients can wait for up to six months for special examinations. Training radiographers in image interpretation would reduce long bookings and waiting times as they would perform the imaging procedures and provide image interpretation reports. The following extracts affirmed this:

“.....instead of waiting for the radiologists and they are not there, which is time-consuming, if a radiographer is trained in image interpretation, patients will get prompt reports and therefore reduce patient waiting time”.
(Participant 15, Male, SR).

“.....patients will be treated on time and will not overstay in the hospital”.
(Participant 2, Female, SR).

“...patients will benefit because reports will be timely if radiographers train in image interpretation”. (Participant 23, Male, SR)

5.3.1.2: Sub-theme 1.2: Facilitation of patient treatment

Participants said that the training would be important because it would facilitate patient treatment. The following quotes demonstrated this:

“If radiographers are informed (trained in image interpretation), at least they will be able to give better diagnosis, like as we are saying, being experts in the field they (radiographers) can come up with alternative views and will be in a better position to decide what next for the patient. Requests made by clinicians are often not clear, at times you wonder, is this request from this doctor meant for an x-ray, ultrasound, CT or MRI? If a radiographer is empowered in image interpretation and after taking an x-ray, he will be able to decide whether the patient should proceed for an ultrasound, CT or MRI; this will save time for patients and it will be easier for clinicians to make a diagnosis”. (Participant 4, Female, SR).

“...at least so many patients will come (more savings for the hospital) knowing that the services are real-time, it is not like the way they come (patients) for CT and then they are told to come for the report the following day, you know it is demoralizing, if you knew (patient) you would get your services once and for all then you would be satisfied. You know clinicians do not know how to interpret radiographs, and so it will help clinicians to make a diagnosis because every patient going to the clinician will have a report because as the radiographer will be acquiring radiographs, he will at the same time write reports”. (Participant 1, Female, SR).

5.3.1.3: Sub-theme 1.3: Prompt radiology reports

Participants also stated that presently, reporting took too long and patients' lives could only be saved if radiographers trained in image interpretation.

They said that radiographers were the ones who interacted with patients and were the ones who first saw the abnormality. If they were allowed to interpret radiographs, the report could be available to the physicians almost immediately and therefore the lives of patients could be saved. The following extracts affirmed this:

“....yes if radiographers train in image interpretation, patients will receive timely reports and management of patients will be enhanced”. (Participant 16, Male, SR).

“...and hospitals will benefit because of prompt provision of reports by radiographers”. (Participant 25, Male, SR).

“...if a patient is having spinal injury, a patient will receive timely report and therefore the life of the patient will be saved if a radiographer will be the one to provide reports”. (Participant 6, Female, SR).

5.3.1.4: Sub-theme 1.4: Costs of travelling long distances can be minimized

The participants indicated that the costs for patients would reduce, because currently, patients travelled long distances seeking radiological reports at national and referral hospitals where radiologists are available. The following excerpts illustrated this:

“....yes I think the cost of patients travelling to referral hospitals will reduce if radiographers are trained in image interpretation”. (Participant 20, Male, SR).

“....there will be minimal travelling expenses incurred by patients travelling to big towns seeking radiological reports.” (Participant 26, Male, SR).

5.3.1.5: Sub-theme 1:5: Appropriate management of patients

The participants indicated that there would be a change in the management of patients if radiographers trained in image interpretation. They stated that if radiographers trained in image interpretation, rural and remote hospital would be able to manage their patients better and referrals to hospitals would be reduced. The following quotes illustrated this:

“...if radiographers train in image interpretation reports to clinicians will be available on time and diagnosis by clinicians will be faster and thus proper management of patients.” (Participant 18, Male, SR).

“...it will minimize congestion in the hospitals and will also reduce cross infection.” (Participant 17, Male, SR).

5.3.1.6: Sub-theme 1:6: Assurance of reports to clinicians

The participants expressed that training radiographers in image interpretation would guarantee image interpretation reports being submitted to clinicians in the rural and remote hospitals thereby boosting their confidence in the treatment of patients. The following excerpt demonstrated this:

“In the rural setup, the confidence of clinicians will be enhanced because they will be assured of reports.” (Participant 30, Male, SR).

5.3.2 Impact of radiographers training in image interpretation

Some interviewees indicated that training of radiographers would reduce hospital costs. On probing, they mentioned that training would result in a reduction of costs of radiographs and patients' transfers to hospitals for radiology reports. Two sub-themes emerged from the major theme as follows:

Sub-theme 2.1: Costs due to repeats of radiographs

Sub-theme 2.2: Costs of transferring patients can be minimized.

5.3.2.1: Sub-theme 2. 1: Costs due to repeats of images

Participants indicated that the training of radiographers in image interpretation would reduce repeats of radiographs and ultimately reduction of operational costs. The participants asserted that clinicians frequently order incorrect imaging requests, resulting in radiologists requesting further requests to make a correct diagnosis. This results in increased radiographs' costs due to repeats. The following excerpts illustrate this:

"...hospitals will save a lot of money because there will be no more wastage due to repeated radiographs." (Participant 12, Male, SR).

5.3.2.2: Sub-theme 2.2: Costs of transferring patients can be minimized

Participants stated that the costs of transferring of patients to referral hospitals for radiological examinations and reports would reduce if radiographers are trained in image interpretation as they would provide the necessary image interpretation reports. They said that remote and rural hospitals would be able to better manage their patients as referrals would reduce. The following extracts confirmed this:

"...rural and remote hospitals will be able to manage their patients well and referrals will reduce." (Participant 9, Female, SR).

"Because of the logistics involved in transferring of patients from remote and rural hospitals, these will reduce if radiographers train in image interpretation." (Participant 8, Female, SR).

5.3.3 Gaps in the provision of reports

The participants also argued that the training would reduce the gap as far as the provisions of image interpretation reports are concerned. They said that radiologists were only found in large hospitals and were concentrated only in urban areas leaving remote and rural areas without specialists. They also

stated that there were no radiologists in the county and sub-county hospitals, thus it was important for radiographers to train in image interpretation particularly of the chest, which is the most common examination requested. They commented that radiographers should train in image interpretation to fill the gap created by the shortage of radiologists. The workload was excessive for radiologists, leading to delays and backlogs in them providing radiological reports. Radiologists work as lecturers at the same time and so patients do not get timely reports. Two sub-themes emerged from the major theme. The two sub-themes were:

Sub-theme 3. 1: Shortage of radiologists.

Sub-theme 3. 2: Overworked radiologists.

5.3.3.1: Sub-theme 3.1: Shortage of radiologists

Participants stated that training of radiographers in image interpretation would reduce the huge gap in the provision of radiological reports. The participants argued that the few available radiologists were not able to clear the backlog of unreported radiographs. They reported that in the county hospitals radiologists were only available twice in a week. The following excerpt affirmed this:

“A patient can be x-rayed on a Friday and the radiologist comes on a Monday. When a radiologist is available the patient has already left.” (Participant 5, Male, SR).

Participants articulated that in most county hospitals there were no radiologists. They maintained that radiographers were consulted by clinicians because there were no radiologists to provide reports and therefore there was a gap in the provision of radiological reports. Furthermore, the participants expressed that most of the accident and emergency (A & E) images were not reported by radiologists and were left to be interpreted by clinicians. Participants stated that clinicians were not conversant with images interpretation and these often resulted in misdiagnosis. They remarked that

the phenomenon was common in the remote and rural hospitals where clinicians interpreted radiographs due to the shortage of radiologists.

Participants asserted that there was a shortage of radiologists in the rural areas because radiologists were mostly found in big towns and were unavailable to provide reports because they worked both as lecturers in teaching institutions and also in public and private hospitals. Participants remarked that there was a shortage of radiologists and the impact was mostly felt in the remote and rural areas of Kenya. The following excerpts confirmed this:

“If you went to (name of hospital withheld) and did an x-ray today, you will not get a report on the same day, there are piles of radiographs and yesterday’s radiographs are reported today. So, there is a great shortage of radiologists and only a few counties have radiologists. Radiographs are sent to hospitals in big towns for reports where radiologists are available. (Participant 10, Male, SR).

“...there is a shortage of radiologists in Kenya as result patients are sent to big towns for radiological reports where radiologists are available.” (Participant 21, Male, SR).

The participants stated that there was a huge gap concerning the provision of radiological reports. They asserted that patients did not get instant reports after examinations have been performed. They stated that reports were only available after 24 hours. The participants remarked that if radiographers trained in images interpretation patients would get instant images interpretation reports and patients’ lives would be saved. The following excerpts confirmed this:

“For example, if the kidney has a heavy contusion, the patient can be taken to theatre on time and the rightful correction done provided that the radiology report was instantly available, but this is not possible due to the shortage of

radiologists. Therefore, there is a shortage of radiologists creating a big gap." Participant 13, Male, SR).

"Most patients are x-rayed and go away without reports because radiologists are not available to provide reports." (Participant 15, Male, SR).

5.3.3.2: Sub-theme 3.2: Overworked radiologists

Participants argued that there was a huge gap in the provision of radiological reports because of the shortage of radiologists. They remarked that radiologists only worked in big towns leaving the rural and remote areas without radiologists. They asserted that radiologists did not provide timely reports even in the public hospitals where they work, they were inundated with work because they also offered their reporting and teaching services in private hospitals. The following quotes confirmed this:

"...radiologists work in many hospitals and also work as lecturers at the same time." (Participant 19, Male, SR).

"The workload is too much for radiologists, they take too long to respond when called to provide reports." (Participant 29, Male, SR).

5.3.4 Radiography education curriculum

Participants stated that the radiography education curriculum at the institutions providing radiography education in Kenya did not support the training of radiographers in images interpretation. They remarked that image interpretation should be incorporated into the curriculum. They believed that the current curriculum should be reviewed as no review of the curriculum had been done for a long time. The participants asserted that images interpretation should be introduced during the third year of the training, after students have been taught all the modalities, for example CT and MRI. They also insinuated that the subjects should also be examined. They responded that radiologists can be involved in the training of images interpretation. They

maintained that in Uganda, radiologists trained radiographers in images interpretation. Two sub-themes emerged from this major theme. The sub-themes were a need for curriculum review and the establishment of laboratories. The two sub-themes were:

Sub-theme 4.1: A need for curriculum review.

Sub-theme 4.2: Laboratories should be established.

5.3.4.1 Sub-theme 4.1: A need for curriculum review

It was the opinion of the participants that the current curriculum did not support training in images interpretation at the institutions that provided radiography education in Kenya. They said that a curriculum should be developed to train radiographers in images interpretation of the chest and musculoskeletal.

The participants articulated that radiographers should be trained and be able to provide images interpretation reports. They remarked that the current subjects taught at the institutions training radiographers in Kenya did not support training in images interpretation. They verbalized that more institutions (universities) should be established to train radiographers in images interpretation at a Master's Degree level. The participants asserted that the government needs to sponsor radiographers to train in images interpretation, like for example USA, Australia, UK and South Africa. Participants remarked that the current curriculum can be reviewed to incorporate images interpretation. The following excerpts demonstrated this:

“They don’t teach image interpretation; more emphasis should be given to pathology and anatomy that are relevant to image interpretation. Laboratories should be established for training in image interpretation. A curriculum should Be put in place for training radiographers in image interpretation.” (Participant 20, Male, SR)

“The curriculum needs a review as the same has not been done for a long time.” (Participant 4, Female, SR).

Participants remarked that radiographers should be trained to train other radiographers in image interpretation. They said that currently students are examined on image pattern analysis of which they learn on their own without being taught. They responded that image interpretation should be taught instead of image pattern analysis. The participants asserted that the curriculum should be reviewed to incorporate image interpretation. The participants maintained that most of the training is technical on how to operate x-ray machines rather than in image interpretation. The following quotes confirmed this:

“...the current curriculum used for training radiographers in Kenyan institutions does not support training in image interpretation.” (Participant 6, Female, SR).

“...a curriculum should be developed to train radiographers in image interpretation particularly in general x-ray, interventional radiology, fluoroscopy, CT, MRI, radiotherapy and nuclear medicine.” (Participant 3, Female, SR).

Participants alluded that radiologists can be involved in the training of radiographers in image interpretation. For example, in Uganda, radiologists train radiographers in image interpretation. In Uganda the country's health policy allows radiographers to train in image interpretation and write reports. The following extracts confirm this:

“.... Radiologists should be incorporated in image interpretation” (Participant 10, Male, SR).

“Radiologists can be involved in the training of image interpretation, for example in Uganda; radiologists train radiographers in image interpretation.” (Participant 12, Male, SR).

“Radiologists should support the training so that the radiographers and the radiologists can work as a team for the benefit of the patient.” (Participant 13, Male, SR).

5.3.4.2 Sub-theme 4.2: Laboratories should be established

Participants indicated that laboratories (radiology units with x-ray equipment for demonstration in training campuses) should be established to train radiographers in image interpretation of the chest and musculoskeletal.

“Laboratories need be established for the training of radiographers in image interpretation.” (Participant 7, Female, SR).

“.... currently, there are no laboratories that could be used to train radiographers in image interpretation”. (Participant 5, Female, SR).

5.4 SUMMARY OF THE CHAPTER

This chapter discussed the findings of the study. It explored the benefits associated with training radiographers in image interpretation. Participants indicated that the training would benefit hospitals, by reducing the costs of films and patient transfer to hospitals for radiology reports. The participants asserted that the costs incurred by patients of travelling long distances seeking radiological reports at national and referral hospitals where radiologists were available would reduce. Participants illustrated that currently there was a huge gap in the provision of radiological reports resulting from the shortage of radiologists. The participants argued that the few available radiologists could not clear the backlog of unreported radiographs. They remarked that the current radiography curriculum used for training radiographers in Kenya does not support training in image interpretation. They asserted that the curriculum should be reviewed to incorporate images interpretation. The next chapter presents the results from the quantitative phase of the data accumulation.

CHAPTER 6: PRESENTATION OF RESULTS: PHASE 2 (QUANTITATIVE DATA)

6.1 INTRODUCTION

This chapter presents results from the quantitative data that was collected using a self-administered and posted questionnaire. Three hundred and thirty-six questionnaires were distributed personally and by posting to radiographers who worked in public hospitals in Kenya. Self-addressed and stamped envelopes were included for participants to return the questionnaires. Telephonic follow-ups were made to improve the return rate of the questionnaires. In instances where the researcher could not personally distribute the questionnaires, due to logistical problems, electronic mails (e-mail) and telephone calls were used. To increase the response rate, emails were sent weekly to remind participants to respond.

The questionnaire was categorized into three sections, where Section A comprised seven closed-ended questions intended to elicit demographic information from the participants. Section B comprised of 17 closed-ended questions intended to draw the perceptions of radiographers towards training for image interpretation of the chest and musculoskeletal systems in Kenya, and Section C consisted of six closed-ended questions intended to draw opinions of radiographers regarding gaps and the provision of image interpretation reports.

The data from the questionnaires were analyzed statistically using SPSS Statistics version 26. Statistical tests were used in the analysis of the data included the following:

- Descriptive statistics including means and standard deviations, where applicable. Frequencies were represented in tables.
- Analysis of Variance (ANOVA): A test for several independent samples that compares two or more groups of cases in one variable.

- One sample t-test: Tests whether a mean score is significantly different from a scalar value.
- Independent samples t-test: A test that compares two independent groups of cases (Ramlaul 2010: 195).

The objectives of the study were to:

- (a) Explore the perceptions of Kenyan radiographers concerning training in image interpretation of the chest and musculoskeletal systems to supplement the shortage of radiologists.
- (b) Identify a gap in the provision of radiological reports concerning image interpretation of the chest and musculoskeletal systems.
- (c) Establish if the radiography education curriculum supports training in image interpretation of the chest and musculoskeletal systems.
- (d) Develop a model for training radiographers in image interpretation of the chest and musculoskeletal systems.

6.2 SECTION A: DEMOGRAPHICS OF RESPONDENTS

To address objectives “B”, “C” and “D” in this study, the questionnaire was distributed to 336 radiographers who worked in public hospitals in Kenya. Of the 336 radiographers, 93% (n=311) responded to the questionnaire.

6.2.1 Gender (n=311)

The majority of the participants were males 72.3% (n=225) and females constituted only 27.7% (n=86). Table 6.1 describes the gender of the participants.

Table 6.1: Gender

Gender	Frequency	Per cent
Male	225	72.3
Female	86	27.7
Total	311	100.0

6.2.1 Age of participants

The majority of the participants, 46.9% (n=146) were aged between 43-49 years, followed by 45.7% (n=142) within the age group of 21-33 years and 7.4% (n=23) were 50 years and older. Table 6.2 shows the age groups of the participants.

Table 6.2: Age

Age	Frequency	Percent
21-33	142	45.7
43-49	146	46.9
50+	23	7.4
Total	311	100.0

6.2.2 Race

The majority of the participants, 99.7% (n=310) were blacks and 0.3% (n=1) was Indian. Table 6.3 describes the race of the participants.

Table 6.3: Race

Race	Frequency	Per cent
Black	310	99.7
Indian	1	0.3
Total	311	100.0

6.2.3 Marital status

The results revealed that most of the participants 74.3% (n=231) were married, 21.5% (n=67) were single, 2.9% (n=9) were divorced or separated and 1.3% (n=4) were widowed. Table 6.4 depicts the marital status of the participants.

Table 6.4: Marital status

Marital status	Frequency	Percent
Single	67	21.5
Married	231	74.5
Divorced/Separated	9	2.9
Widowed	4	1.3
Total	311	100.0

6.2.4 Number of years as a qualified radiographer

The majority of the radiographers, 58.2% (n=181), had worked between 1-10 years, 30.9 % (n=96) had worked for more than 10-20 years and 10.9% (n=34) had worked for more than 20 years. Table 6.5 shows the number of years that radiographers had worked.

Table 6.5: Number of years as a qualified radiographer

Number of years as a qualified radiographer	Frequency	Percent
1-10 years	181	58.2
>10 - 20 years	96	30.9
>20 years	34	10.9
Total	311	100.0

6.2.5 Current position occupied

Most of the participants, 41.2% (n=128), were Grade 3 radiographers, 37% (n=115) were Grade 1 radiographers, 13.2% (n=41) Grade 2 radiographers and the minority, 8.7% (n=27) were Assistant Directors. Table 6.6 below portrays positions occupied by the participants.

Table 6.6: Current position occupied

Current position occupied	Frequency	Percent
G1 Radiographer	115	37.0
G2 Radiographer	41	13.2
G3 Radiographer	128	41.2
Assistant Director	27	8.7
Total	311	100.0

6.2.6 Occupation

The majority 73.6% (n=229) were Diagnostic Radiographers, 2.3 % (n=7) were Mammography Radiographers, 1.6% (n=5) were Nuclear Medicine Radiographers, 17.7% (n=55) were Sonographers and 4.8% (n=15) were Radiation therapists. Table 6.7 depicts the occupation of the radiographers.

Table 6.7: Occupation

Occupation	Frequency	Percent
Diagnostic radiographer	229	73.6
Mammography radiographer	7	2.3
Nuclear medicine radiographer	5	1.6
Sonographer	55	17.7
Radiation therapist	15	4.8
Total	311	100.0

6.3 SECTION B: BENEFITS OF TRAINING IN IMAGE INTERPRETATION OF THE CHEST AND MUSCULOSKELETAL SYSTEMS

6.3.1 One-sample t-test

This section of the questionnaire was intended to enquire about the perceptions of radiographers about training in image interpretation of the chest and musculoskeletal systems. A 6-point Likert scale ranging between strongly disagree, disagree, slightly disagree, slightly agree, agree and strongly agree, was used to rate their opinion.

- Strongly disagree – 100% disagrees with the statement; I always disagree with the statement and I definitely disagree with the statement.
- Disagree- 80-90 % disagrees with the statement; I sometimes disagree with the statement; I partially disagree with the statement.
- Slightly disagree – 40% somehow disagrees with the statement. I somewhat disagree with the statement. I disagree with the statement to some extent.
- Slightly agree – 60% I somehow agree with the statement.
- Agree- 80 – 90% agrees with the statement; I sometimes agree with the statement. I sometimes agree with the statement; I partially agree with the statement.
- Strongly agree – 100% agrees with the statement; I always agree with the statement; I always agree with the statement and I definitely agree with the statement.

One sample t-test was performed to determine whether a mean score was significantly different from a scalar value. A level of significance was set at $p < .0005$ to determine the degree of agreement in opinion among the radiographers, concerning the training in image interpretation of the chest and musculoskeletal systems. If the majority of the radiographers were supportive of an opinion, then the level of agreement was significant and would be reported as $p < .0005$. If the majority were not supportive of the opinion, then

the level of agreement was insignificant and would be reported as $p > .05$. Statements below indicate a significant level of agreement with the statements that were posed to radiographers.

6.3.2 Significant agreement

- Item B1: There is significant agreement ($M=5.76$) that training in chest- and musculoskeletal image interpretation will benefit patients, $t(310) = 92.420$, $p < .0005$.
- Item B2: There is significant agreement ($M=5.68$) that training in chest and musculoskeletal image interpretation will improve the efficiency of healthcare institutions, $t(310) = 77.252$, $p < .0005$.
- Item B3: There is significant agreement ($M=5.67$) that training in chest- and musculoskeletal systems will facilitate improved patient treatment, $t(310) = 74.611$, $p < .0005$.
- Item B4: There is significant agreement ($M=5.73$) that training in chest and musculoskeletal systems will benefit patients by providing prompt reports, $t(310) = 83.565$, $p < .0005$.
- Item B5: There was significant agreement ($M=5.65$) that training in chest- and musculoskeletal image interpretation will minimize the cost of long-distance travelling to seek radiological reports from national and referral hospitals, $t(310) = 70.043$, $p < .0005$.
- Item B6: There is significant agreement ($M=5.58$) that training in chest and musculoskeletal image interpretation will result in appropriate management of patients by clinicians, $t(310) = 67.360$, $p < .0005$.

- Item B7: There is significant agreement ($M=5.68$) that training in the chest and musculoskeletal image interpretation will benefit patients by reducing the backlog of unreported radiographs $t(310) = 73.870$, $p < .0005$.
- Item B8: There is significant agreement ($M=5.66$) that training in the chest and musculoskeletal image interpretation will ensure that clinicians will receive reports (because radiographers will be able to do them at the time of the x-ray), $t(310) = 73.841$, $p < .0005$.
- Item B9: There is significant agreement ($M=5.66$) that training in chest and musculoskeletal image interpretation will have a positive impact on the service provided by the radiology department, $t(310) = 66.880$, $p < .0005$.
- Item B10: There is significant agreement ($M=5.33$) that training in chest and musculoskeletal image interpretation will enable healthcare institutions to charge for the reports as well as the x-ray and hence increase their income, $t(310) = 36.596$, $p < .0005$.
- Item B11: There is significant agreement ($M=5.18$) that training in the chest and musculoskeletal image interpretation will minimize radiographic repeats, $t(310) = 32.504$, $p < .00005$.
- Item B12: There is significant agreement ($M=5.36$) that training in the chest and musculoskeletal image interpretation will minimize costs incurred in transferring patients to referral hospitals, $t(310) = 40.471$, $p < .0005$.
- Item B13: There is significant agreement ($M=5.62$) that training in the chest and musculoskeletal images interpretation will enable remote and rural hospitals to give their patients the service and

treatment that is needed at the time of their visit, $t(310) = 64.981, p < .0005$.

Item B14: There is significant agreement ($M=5.46$) that training in the chest and musculoskeletal image interpretation will reduce the number of referrals of patients from remote and rural hospitals, $t(310) = 48.221, p < .0005$.

Item B15: There is significant agreement ($M=5.52$) that training in chest and musculoskeletal image interpretation will reduce the workload of radiologists, $t(310) = 50.961, p < .0005$.

Item B16: There is significant agreement ($M=5.58$) that training in chest and musculoskeletal image interpretation will benefit my hospital, $t(310) = 63.967, p < .0005$.

Item B17: There is significant agreement ($M=5.60$) that training in the chest and musculoskeletal image interpretation will give radiologists more time to perform more complex examinations, $t(310) = 53.057, p < .0005$.

6.4 FACTOR ANALYSIS

Factor analysis is a tool for investigating concepts that are not easily measured directly but by collapsing many variables into a few interpretable underlying factors (Pearson and Mundform 2010: 359). In this study, Promax rotation was applied to 17 items to extract factors. The process grouped and reduced the items into the number of statements that were related. In this study, Kaiser- Meyer- Olkin (KMO) and Bartlett's Test of Sphericity were used to measure the strength of the relationship among the variables. The KMO of .903 indicated that the data in the study was adequate for successful and reliable extraction. Bartlett's Test indicated that the correlation between the items was not too low $p < .05$. KMO recommends 0.5 (value for KMO) as a

minimum (barely acceptable), values between 0.7-0.8 acceptable and values above 0.9 as superb. Therefore, according to the KMO and Bartlett's test that was conducted in this study, the measure of sampling adequacy of .903 was acceptable. The KMO and Bartlett's test of reliability and correlation was performed between the items. Two factors were extracted which account for 44.45%. Table: 6.9 gives the loadings of each item on the variance in the data.

Table 6.8: Loadings of each time on the 2 factors

	Factor	
	1	2
1.4 will benefit patients by providing prompt reports.	.720	
1.1 will benefit patients.	.714	
1.8 will ensure that clinicians will receive reports (because the radiographers will be able to do them at the time of the x-ray).	.662	
1.7 will benefit patients by reducing the backlog of unreported radiographs.	.657	
1.3 ... will facilitate patient treatment.	.610	
1.5 ... will benefit patients by minimizing the costs of long-distance travelling to seek radiological reports from national and referral hospitals.	.548	
1.9 ... will have a positive impact on the service provided by the radiology department.	.512	
1.2 ... will improve the efficiency of healthcare institutions.	.437	
1.6 ... will result in the appropriate management of patients by clinicians.	.387	
1.11 ... will minimize repeats of radiographs		.741
1.12 ... will minimize costs incurred in transferring patients to referral hospitals		.713
1.16 ... will benefit my hospital		.642
1.14 ... will reduce the number of referrals of patients from remote and rural hospitals		.594
1.15 ... will reduce the workload of radiologists		.480
1.13 ... will enable remote and rural hospitals to give their patients the service and treatment that is needed at the time of their visit		.443
1.10 ... will enable health institutions to charge for the reports as well as the x-ray and hence increase their income.		.409
1.17 ... will give radiologists more time to perform more complex examinations		.363

The factors are represented by the following items in the questionnaire:

Factor 1: Benefit to patients

- Training in the chest and musculoskeletal image interpretation will benefit patients by providing prompt reports.
- Training in the chest and musculoskeletal image interpretation will benefit patients.
- Training in the chest and musculoskeletal image interpretation will benefit patients by reducing the backlog of unreported radiographs.

- Training in the chest- and musculoskeletal image interpretation will facilitate patient treatment.
- Training in the chest and musculoskeletal image interpretation will benefit patients by minimizing the costs of long-distance travelling to seek radiological reports from national and referral hospitals.

Factor 2: Benefit to hospitals

- Training in the chest and musculoskeletal image interpretation will benefit my hospital.
- Training in the chest and musculoskeletal image interpretation will enable remote and rural hospitals to give their patients the service and treatment that is needed at the time of their visit.
- Training in the chest and musculoskeletal image interpretation will enable healthcare institutions to charge for the reports as well as the x-ray and hence increase their income.
- Training in the chest and musculoskeletal image interpretation will improve the efficiency of healthcare institutions.
- Training in the chest and musculoskeletal image interpretation will reduce the number of referrals of patients from remote and rural hospitals.
- Training in the chest and musculoskeletal image interpretation will have a positive impact on the service provided by the radiology department.
- Training in the chest and musculoskeletal image interpretation will minimize repeats of radiographs.
- Training in the chest and musculoskeletal image interpretation will result in appropriate management of patients by clinicians.

6.4.1 Analysis of constructs

Single measures were formed for the two factors by averaging scores for the items in the factor. A one-sample t-test was applied to these single measures to test for significant agreements or disagreements.

Factor 1: Benefit to patients

There was significant agreement ($M=5.6731$) that the training of radiographers in the chest and musculoskeletal image interpretation reporting would benefit patients, $t(310) = 111.263, <.0005$.

Factor 2: Benefit to hospitals

There was significant agreement (5.4566) that the training of radiographers in the chest and musculoskeletal image interpretation reporting would benefit hospitals, $t(310) = 73.216, p < .0005$.

Factor 3: Benefit to patients and hospitals

There was no significant disagreement that the training in the chest and musculoskeletal image interpretation would benefit both patients and the hospitals. Figure 6.1 below depicts the analysis of benefits to patients and hospitals.

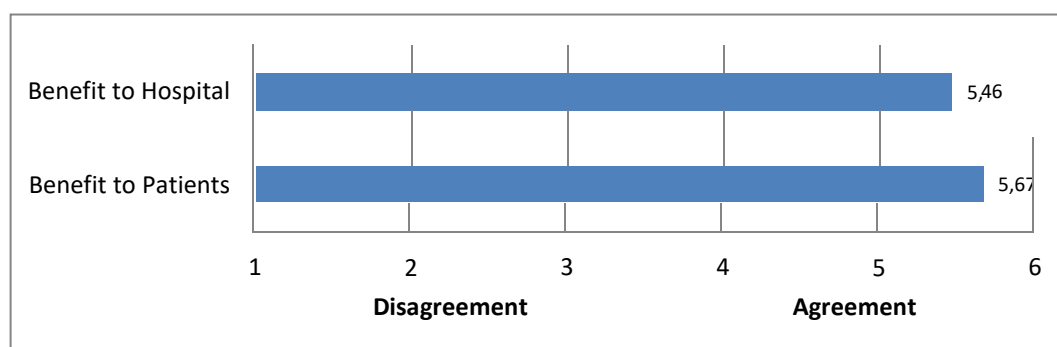


Figure 6.1: Factor analysis level of agreement

6.4.2 Independent samples t-test on gender

The independent samples t-test was performed to determine significant differences across gender. When the independent t-test was performed on gender, it was observed that there were no significant differences across gender in the perceived benefit to both patients and hospitals from the training, (M=5.6765, SD=.33500) for the males and (M=5.4628) for the females.

6.4.3 Analysis of Variance (ANOVA) test on age

The ANOVA test was conducted to determine significant differences across gender on the perceived benefit to both patients and hospitals. There was a significant difference across age groups in the perceived benefit to patients from the training, $F(2,308) = 3.222$, $p = .041$. The 43-49 age group show significantly more agreement than the 21-33 age groups. There was a significant difference across age groups in the perceived benefit to hospitals from the training, $F(2,308) = 2.422$, $p = .090$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

6.4.4 ANOVA test on race

The ANOVA test was conducted to determine the perceived benefit to patients and hospitals across the race. After the performance of the ANOVA test to determine whether there was any difference of opinion across race on the perceived benefit to both patients and the hospitals from the training, it was observed that there was no significant difference of opinion across the blacks on the perceived benefit to patients (M=5.6720, SD=.34449) as opposed to the perceived benefit to hospitals (M=5.4548, SD=.47102).

6.4.5 ANOVA test on marital status

The ANOVA test on marital status was performed to determine whether there was a significant difference across marital status concerning the perceived benefit to both patients to hospitals from the training. It was observed that after the performance of the ANOVA test across marital status, it was observed that there was no significant difference in the perceived benefit to patients ($M=5.6418$, $SD=.34045$) and no significant difference in the perceived benefit to hospitals ($M=5.4254$, $SD=.48610$).

6.4.6 ANOVA test on years qualified

The ANOVA test was performed to determine whether there was a significant difference across the years qualified, concerning the perceived benefit to both patients and hospitals from the training. It was observed that after performing the ANOVA test across years qualified, there were no significant differences as it pertained to the perceived benefit to patients ($M=5.6501$, $SD=.35379$) and no significant differences in the perceived benefit to hospitals ($M=5.4579$, $SD=.47034$).

6.4.7 ANOVA test on positions

The ANOVA test was performed to determine if there was a significant difference across positions held by radiographers in the perceived benefits to patients and hospitals from the training. It was observed that there was a significant difference across positions held by radiographers in the perceived benefit to patients from the training, $F(3,307) = 3.108$, $P=.027$. The G3 radiographers showed significantly more agreement than G1 radiographers and G2 radiographers than assistant directors in the perceived benefit to patients, $F(3, 307) = 5.811$, $p=.001$.

6.4.8 ANOVA test on occupation

The ANOVA test was performed to determine if there was a significant difference across occupations by radiographers in the perceived benefits to patients and hospitals from the training. After the performance of the ANOVA test, it was observed that there was a significant difference across occupation in the perceived benefit to patients from the training, $F(4,306) = 1.236$, $p = .295$; and the perceived benefit to hospitals $F(4,306) = 3.147$, $p = .015$.

Diagnostic radiographers showed significantly more agreement than mammography radiographers in the perceived benefit to patients from the training ($M = 5.6943$, $SD = .33856$) and diagnostic radiographers showed significantly more agreement than radiation therapist in the perceived benefit to hospitals ($M = 5.4907$, $SD = .44037$).

6.5 SECTION C: OPINIONS OF RADIOGRAPHERS REGARDING GAPS AND THE PROVISION OF IMAGE INTERPRETATION REPORTS

6.5.1 One-sample t-test

This section of the questionnaire was intended to enquire about the opinions of radiographers regarding gaps and the provision of radiological reports. A 6-point Likert scale ranging between strongly disagree, disagree, slightly disagree, slightly agree, agree and strongly agree, was used to rate their opinion.

Significant agreements

Item C1: There is significant agreement ($M = 5.53$) that the opinion of radiographers is sought in remote and rural hospitals where radiologists are not available, $t(310) = 7.558$, $p < .0005$.

- Item C2: There is significant agreement ($M=4.26$) that the training in radiographic interpretation should be at a Master's degree level, $t(310) = 7.558$, $p < .00005$.
- Item C3: There is significant agreement ($M=5.41$) that radiologists need to be incorporated in the training of radiographers in image interpretation, $t(310) = 41.371$, $p < .0005$.
- Item C4: There is significant agreement (5.62) that if radiographers are given an opportunity to train in image interpretation, they will take it up, $t(310) = 63.167$, $p < .0005$.
- Item C5: There is significant agreement (5.55) that there are gaps in the provision of radiological reports, $t(310) = 60.847$, $p < .0005$.
- Item C6: There is significant agreement (5.45) that the gaps in the provision of radiological reports are as a result of radiologists being overworked, $t(310) = 43.987$, $p < .0005$.

6.5.2 Demographic analysis

6.5.2.1 The ANOVA test on gender

The ANOVA test was performed to determine any significant differences across gender regarding the opinions of radiographers being sought in remote and rural hospitals where radiologists were not available. After the ANOVA test was performed, it was observed that the males showed significantly more agreement ($M=5.53$, $SD=.891$) when compared to females ($M=5.53$, $SD=.954$). When the ANOVA test was performed to determine any significant differences across gender whether the training in image interpretation should be at a Master's degree level, it was observed that the males showed significantly more agreement ($M=4.17$, $SD=1.840$) when compared to the females ($M=4.50$, $SD=1.607$).

The ANOVA test was performed to determine whether there were any significant differences of opinion across gender regarding the training of radiographers in image interpretation and that if given an opportunity they would take it up. After the performance of the ANOVA test, it was observed that there was significantly more agreement among the males ($M=5.61$, $SD=.617$) than the females ($M=5.65$, $SD=.526$).

The ANOVA test was performed to determine if there were any significant differences of opinion across gender regarding gaps in the provision of image interpretation reports. After the performance of the ANOVA test, it was observed that there was significantly more agreement of the opinion among the males ($M=5.52$, $SD=.620$) when compared to the females ($M=5.62$, $SD=.513$).

The ANOVA test was performed to determine if there were any significant differences of opinion regarding the gaps in the provision of radiological reports being as a result of radiologists being overworked. After the performance of the test, it was observed that there was significantly more agreement among the females that the gaps were as a result of the radiologists being overworked ($M=5.45$, $SD=.812$) when compared to the males ($M=5.44$, $SD=.696$).

6.5.2.2 The Welch test on age

The Welch test was performed to determine whether there were significant differences across age regarding the opinions of radiographers being sought in remote and rural hospitals where radiologists were not available. When the Welch test was done it was observed that the 43-49 age groups showed significantly more agreement than the 21-33 age group $W(2, 55.882)=6.262$, $p=.004$.

The Welch test was performed to determine if there were significant differences across age regarding the training in image interpretation at a Master's degree level. When the test was performed, it was observed that the 43-49 age groups

showed significantly more agreement than the 21-33 age groups, $W(2,61.023) = .607$, $p = .548$.

The Welch test was performed to determine if there were significant differences across age groups regarding the need to incorporate radiologists in the training of radiographers in image interpretation. The Welch test revealed that the 43-49 age groups showed significantly more agreement than the 21-33 age groups, $W(2, 57.537) = .459$, $p = .634$. The Welch test was performed to determine if there were any significant differences of opinion across age groups regarding the training of radiographers in image interpretation and that if given an opportunity they would take it up. The test revealed that the 43-49 age groups showed significantly more agreement than the 21-33 age groups, $W(2, 61.727) = 1.882$, $p = .161$.

The Welch test was performed to determine if there were any significant differences of opinion across age groups concerning gaps in the provision of radiological reports. The Welch test revealed that the 43-49 age groups showed significantly more agreement than the 21-33 age groups, $W(2,63.753) = 4.430$, $p = .016$. The Welch test was performed to determine if there were any significant differences of opinion across age groups if the gaps in the provision of radiological reports were as a result of radiologists being overworked. The test revealed that there was more agreement across the 43-49 age groups that the gaps were as a result of radiologists being overworked, $W(2,56.410) = 3.118$, $p = .052$.

6.5.2.3 ANOVA test on race

The ANOVA test was performed to determine if there were any significant differences across race on whether the opinions of radiographers are sought in remote and rural hospitals where radiologists are not available. The test revealed that there were no significant differences across the race.

6.5.2.4 ANOVA test on marital status

The ANOVA test was performed to determine if there were any significant differences across marital status on whether the opinions of radiographers are sought in remote and rural hospitals where radiologists are not available. The ANOVA test revealed that the married participants showed significantly more agreement than the unmarried ones across the marital status, $W(3, .289) = .718, p = .834$.

6.5.2.5 ANOVA test on years qualified

The ANOVA test was performed to determine whether there were any significant differences of opinion across years qualified regarding the opinions of radiographers being sought in remote and rural hospitals where radiologists were not available. After the ANOVA test, it was observed that the 1-10 years showed significantly more agreement than the 10-20 years of years qualified.

6.5.2.6 ANOVA test on position

The ANOVA test was performed to determine whether there were any significant differences of opinion across different grades of radiographers, regarding the opinion of radiographers being sought in remote and rural hospitals where radiologists are not available. The test revealed that the G3 radiographers showed significantly more agreement than G1 radiographers about the opinion ($M = 5.68, SD = .874$).

6.5.2.7 ANOVA test on occupation

The ANOVA was performed to determine whether there were any significant differences of opinion across occupations regarding the opinion of radiographers being sought in remote and rural hospitals where radiologists are not available. The test revealed that there was significantly more agreement of the opinion among the Diagnostic Radiographers than Sonographers ($M = 5.58, SD = .883$).

6.5.2.8 The Welch Test on the opinion of radiographers regarding gaps and provision of radiological reports

The Welch Test was performed on the seven constructs because the conditions for ANOVA were not met; all the seven constructs had significant differences:

There is significant agreement across age groups that the opinions of radiographers are sought in remote and rural hospitals, Welch (2, 55.882) = 6.262, $p = .004$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

There is significant agreement across age groups that the training in images interpretation should be at a Master's degree level, Welch (2, 61.023) = .607, $p = .548$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

There is significant agreement across age groups that radiologists need to be incorporated in the training of radiographers in image interpretation, W (2, 57.5370) = .459, $p = .634$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

There is significant agreement across age groups that if radiographers are allowed to train in image interpretation, they would take it up, W (2, 61.727) = 1.882, $p = .161$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

There is significant agreement across age groups that there are gaps in the provision of radiological reports, W (2, 63.753) = 4.430, $p = .016$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

There is significant agreement across age groups that gaps in the provision of radiological reports are as a result of radiologists being overworked, W (2,

56.410) =3.118, $p=.052$. The 43-49 age group show significantly more agreement than the 21-33 age groups.

6.6 SUMMARY OF THE CHAPTER

This chapter presented the quantitative results of the study. The next chapter, the discussion, will integrate both the quantitative and the qualitative databases, of which the outcome will be a formulation of a model for training radiographers in image interpretation of the chest and musculoskeletal image interpretation in Kenya.

CHAPTER 7: INTEGRATION OF RESULTS FROM PHASE 1 AND PHASE 2

7.1 INTRODUCTION

This chapter presents integration of the results from phase 1 and phases 2 of the study, where phase 1 was qualitative and phase 2 quantitative. Phase 1 utilised focus group discussion to collect the data. The findings of Phase 1 presented in Chapter 5 were then used to develop a questionnaire to collect data for Phase 2 where the results were presented in Chapter 6. This chapter presents the integration of Phase 1 and Phase 2 results.

7.2 INTEGRATION OF RESULTS

The objectives of the study were to:

- (a) Explore the perceptions of Kenyan radiographers concerning training in image interpretation of the chest and musculoskeletal image interpretation to supplement the shortage of radiologists.
- (b) Identify a gap in the provision of radiological reports concerning image interpretation of the chest and musculoskeletal image interpretation.
- (c) Establish if radiography education curriculum supports training in image interpretation of the chest and musculoskeletal image interpretation.
- (d) Develop a model for training radiographers in image interpretation of the chest and musculoskeletal image interpretation.

To achieve objective (a), open-ended questions were used to collect data in Phase 1 of the study. Four themes emerged from the analysis that was used to develop a questionnaire to address objectives (b), (c) and (d) in Phase 2 of the study. The four themes that emerged from the qualitative data were:

- Benefits associated with training of radiographers in image interpretation.
- Impact of radiographers training in image interpretation.
- Gaps in the provision of radiological reports.
- Radiography education curriculum.

This section integrates the results of the qualitative and quantitative phases of the study. The findings of Phase 1 are presented, followed by the statements that were used to generalize the findings of Phase 1 and the results of Phase 2.

7.3 BENEFITS ASSOCIATED WITH TRAINING OF RADIOGRAPHERS IN IMAGE INTERPRETATION

The theme of the perceptions of radiographers towards image interpretation comprised the following sub-themes: reduction of patient waiting time, facilitation of patient treatment, prompt image interpretation reports, costs of travelling long distances could be minimized, appropriate management of patients and assurance of image interpretation reports to clinicians.

7.3.1 Reduction of patient waiting time

It was the opinion of the interviewed radiographers that the training in image interpretation would benefit their hospitals by reducing patient waiting time. This would be possible because radiographers could perform procedures and provide image interpretation reports at the same time, thus reducing patient waiting time. They stated that if radiographers trained in image interpretation, patients would be treated on time and would not overstay in the hospital as radiographers could perform the examinations and provide prompt image interpretation reports. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Training in the chest and musculoskeletal image interpretation will benefit patients by providing prompt image interpretation reports.
- Training in the chest and musculoskeletal image interpretation will benefit patients by reducing the backlog of unreported radiographs.
- Training in the chest and musculoskeletal image interpretation will facilitate improved patient treatment.

The factor analysis of the constructs indicated a significant agreement that training in chest and musculoskeletal image interpretation would benefit patients as prompt image interpretation reports would be provided, thus reducing patient waiting time. Besides, the ANOVA test performed across gender indicated that the 43-49 age groups showed significantly more agreement that the training in image interpretation would benefit patients. When the ANOVA test was conducted across positions held by radiographers, the G3 radiographers showed significantly more agreement that the training in image interpretation would benefit patients. The ANOVA test also showed a significant difference across the occupation that patients would benefit from the training. Also, the test showed that diagnostic radiographers showed significantly more agreement that the training would benefit patients.

7.3.2 Facilitation of patient treatment

Participants agreed that the training in image interpretation was important for radiographers. Participants believed that radiographers were experts in radiography and would provide alternative views that would facilitate patient treatment. Participants stated that junior doctors were not knowledgeable in image interpretation and often made the wrong diagnosis which resulted in the delay of patient treatment (McConnell and Smith 2008: 7). Participants believed that if they were trained in radiographic interpretation, many patients would be served within a shorter period as the same radiographers would perform the procedures and provide the image interpretation reports. Participants said that if they are trained in image interpretation, patients going back to the clinician would have image interpretation report from the radiographers acquiring the radiographs. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- If a radiographer is empowered in image interpretation he/she will be able to decide whether the patient should proceed for an ultrasound, CT or MRI; this will save time for patients and will be easier for clinicians to make a diagnosis.
- You know clinicians do not know how to interpret radiographs (Kawooya

2013:37; McConnell and Smith 2008: 7; Smith *et al.* 2009: 2) and so it will help clinicians to make a diagnosis because every patient going to the clinician will have an image interpretation report.

The results of one sample t-test indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would facilitate improved patient treatment. In addition, the factor analysis of the constructs indicated that the training in the chest and musculoskeletal image interpretation would facilitate improved patient treatment.

7.3.3 Prompt radiology reports

The findings of Phase 1 indicated that radiology image reporting was delayed and patients' lives could only be saved, if radiographers were trained in image interpretation and provided a report in the absence of a radiologist. The findings indicated that radiographers had frequent interactions with patients and detected the disease first, because they were the ones who performed the radiographs and could see the abnormality before a physician. If they were allowed to provide image interpretation reports on radiographs, the radiology reports could be immediate and therefore the lives of patients could be saved, when the radiologists are not available to provide a report to the clinician for the treatment of the patient. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Yes, if radiographers train in image interpretation, patients will receive timely image interpretation reports and management of patients will be enhanced.
- Hospitals will benefit because of the prompt provision of image interpretation reports by radiographers.
- If a patient is having a spinal injury, a patient will receive a timely image interpretation report and therefore the life of the patient will be saved if a radiographer will be the one to provide reports.

The factor analysis of these constructs indicated that the training in chest and musculoskeletal image interpretation would benefit patients by providing prompt image interpretation reports. In addition, the one-sample t-test also suggested that the training in image interpretation would benefit patients by providing prompt image interpretation reports.

7.3.4 Costs of travelling long distances can be minimized

The findings in Phase 1 of the study indicated that radiologists were not available in remote and rural areas and were only found in big towns. The participants said that radiographers are present in most hospitals and if trained in image interpretation patients would get instant image interpretation reports since the number of radiographers are more than that of radiologists. The participants said that the costs for patients would reduce as currently, they travel long distances seeking radiological reports at national and referral hospitals where radiologists are available. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Yes, I think the costs of patients travelling to referral hospitals will reduce if radiographers are trained in image interpretation.
- There will be minimal travelling expenses incurred by patients travelling to big towns seeking radiological reports.

The one-sample t-test of these constructs indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would minimize the costs of long-distance travelling seeking radiological reports from national and referral hospitals. In addition, the factor analysis of the constructs also indicated that the training in image interpretation would benefit patients by minimizing the costs of long-distance travelling seeking radiological reports from national and referral hospitals.

7.3.5 Appropriate management of patients

The findings of Phase 1 of the study indicated that there would be a change in the management of patients if radiographers are trained in image interpretation. Rural and remote hospitals would be able to manage their patients better and referrals would be reduced. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Rural and remote hospitals will be able to manage their patients better and referrals will be reduced.
- Yes, patients coming from far areas will receive timely treatment and will be able to get back to their homes on time if radiographers train in image interpretation.
- It will minimize congestion in hospitals and will also reduce cross-infection.

Exploratory factor analysis of these constructs indicated that the training in the chest and musculoskeletal image interpretation would result in appropriate management of patients by clinicians. Besides, the analysis also indicated that the training in image interpretation would enable remote and rural hospitals to render the service and treatment needed by patients at the time of their visit.

7.3.6 Assurance of image interpretation reports to clinicians

The findings of Phase 1 indicated that the confidence of clinicians in the rural and remote hospitals would be enhanced because they would be assured of image interpretation reports from radiographers. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- In the rural setup, the confidence of clinicians will be enhanced because they will be assured of image interpretation reports.
- If radiographers are trained in image interpretation, image interpretation reports to clinicians will be available on time and diagnosis by clinicians will be faster and thus the management of patients will improve.

The one-sample t-test indicated a significant agreement that the training in chest and musculoskeletal image interpretation would ensure that clinicians would receive image interpretation reports because radiographers would be able to provide them after completion of the imaging examination.

7.4 IMPACT OF TRAINING RADIOGRAPHERS IN IMAGE INTERPRETATION

The theme of the impact of training radiographers in image interpretation comprised the following sub-themes: instant provision of image interpretation reports, minimal repeats of radiographs and the costs of transferring patients could be minimized.

7.4.1 Instant provision of image interpretation reports

The findings in Phase 1 of the study indicated that if radiographers are trained in image interpretation, patients would get image interpretation reports on time because radiographers would be performing examinations and providing reports at the same time. The participants also felt that

hospitals would benefit because the backlog of unreported radiographs would reduce. There would be timely management of patients. The participants said that due to the availability of radiographers, they could provide immediate image interpretation reports especially in the case of haemothorax and the lives of patients would be saved. The participants said that confidence levels of patients would be enhanced because image interpretation reports would always be available. To attest to the findings in Phase 2 of the study, these were the responses from participants in Phase 1 of the study:

- Hospitals will benefit because participants will receive timely image interpretation reports.
- There will be timely management of patients. Confidence levels of patients will be enhanced because reports will be available.
- Because of the availability of radiographers, image interpretation reports will always be available.

The factor analysis of these constructs indicated that the training in chest and musculoskeletal image interpretation would benefit patients by providing instant image interpretation reports. However, neither the ANOVA test nor the one-sample t-test or the Welch test could find any significant correlation with the instant provision of image interpretation reports.

7.4.3 Minimal repeats of images

The findings in Phase 1 of the study indicated that if radiographers are trained in image interpretation, repeats of radiographs would reduce, operational costs would reduce and therefore ensure more savings for the hospitals. The participants affirmed that often clinicians requested for incorrect examinations resulting in radiologists making other requests, which is film wastage. The participants asserted that if radiographers are trained in image interpretation, their opinions would be sought by clinicians which would assist in requesting the right views. That would reduce film wastage that results from repeated examinations. To generalize the findings of Phase 1 in Phase 2 of the study,

the following statements in the questionnaire represent those factors:

- Repeats of examinations resulting from inappropriate projections requested by clinicians will reduce and therefore hospitals will save money because there will be no more films wasted.
- Hospitals will save a lot of money because there will be no more film wastage due to repeated radiographs.

Image interpretation would minimize radiographic repeats. In addition, the factor analysis indicated that the training in image interpretation would minimize repeats of radiographs. However, the ANOVA test and the Welch test could not find any significant correlation with the minimal repeats of radiographs.

7.4.4 Costs of transferring patients can be minimized

The findings of Phase 1 of the study indicated that if radiographers are trained in image interpretation, the costs of transferring patients would decrease because radiographers would provide image interpretation reports. They also asserted that remote and rural hospitals would be able to manage their patients better and referrals would reduce. They said that the costs incurred by county hospitals when transferring patients from rural hospitals to referral hospitals to seek radiological reports would reduce. They indicated that the costs of individual patients travelling long distances, seeking radiological reports at national and referral hospitals where radiologists are located, would reduce. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Rural and remote hospitals will be able to manage their patients well and referrals will reduce.
- Because of the logistics involved in the transferring of patients from remote and rural hospitals, these would reduce if radiographers are trained in image interpretation.

The One-sample t-test indicated that training radiographers in chest and musculoskeletal image interpretation would minimize costs incurred in transferring patients to referral hospitals. However, the ANOVA test and the Welch test could not find any significant correlation with costs of transferring patients could be minimized.

7.5 GAPS IN THE PROVISION OF RADIOLOGY REPORTS

The theme of gaps in the provision of image interpretation reports comprised the following sub-themes: Shortage of radiologists and overworked radiologists. The themes were tested in Phase 2 of the study for significance.

7.5.1 Shortage of radiologists

The findings of Phase 1 indicated that there was a huge gap in the provision of radiology reports due to the shortage of radiologists and the training in image interpretation for radiographers, would reduce the gap. The participants asserted that the insufficient numbers of available radiologists resulted in a backlog of unreported radiographs. The participants stated that if radiographers trained in image interpretation, they would report on cases such as fractures and radiologists would spend most of their time reporting on specialized examinations such as CT and MRI. The participants emphasized that most county hospitals did not have radiologists and thus the gap in the provision of radiological reports. The participants said that in the county hospitals radiologists were only available twice in a week. The participants asserted that radiographers were consulted by clinicians due to the huge gap in the provision of radiological reports. The participants expressed that most of the A & E were not reported by radiologists and were left to be reported by clinicians, who were not knowledgeable in image interpretation resulting in misdiagnosis. The participants remarked that the phenomenon was common in the remote and rural hospitals. The participants maintained that clinicians interpreted radiographs in remote and rural hospitals since there were no radiologists. The participants confirmed that the shortage of radiologists was

acute in the remote and rural areas, as radiologists were mostly found in big towns. They said that radiologists were not readily available to provide radiological reports because they were overwhelmed with work, as they also worked as lecturers in teaching institutions and the public and private hospitals. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- If you went to (name of hospital withheld) and did an x-ray today, you will not get a report on the same day, there are piles of unreported radiographs and yesterday's radiographs are reported today. So, there is a great shortage of radiologists and only a few counties have radiologists. Radiographs are sent to hospitals in big towns for reports where radiologists are available. This results in reports delaying up to one week.
- There is a shortage of radiologists in Kenya and patients are sent to big towns for radiological reports where radiologists are found.
- For example, if the kidney has a heavy contusion, the patient can be taken to theatre on time and the rightful correction is done, but this is not possible due to the shortage of radiologists. Therefore, there is a shortage of radiologists creating a big gap.
- Most patients are x-rayed and go away without radiology reports because radiologists are not available to provide reports.
- There is a gap in the provision of radiology reports because of the shortage of radiologists, particularly in remote and rural areas.
- Image interpretation will assist in rural areas where there are no radiologists.

Image interpretation would reduce the backlog of unreported radiographs. The factor analysis indicated that training in image interpretation would enable remote and rural hospitals to provide patients with the service and treatment needed at the time of their visit. The factor analysis of the constructs indicated that training in image interpretation will have a positive impact on the service provided by the radiology department. However, the ANOVA and Welch tests could not find any significant correlation with the shortage of radiologists.

7.5.2 Overworked radiologists

The findings of Phase 1 of the study indicated that radiologists only worked in big towns leaving the rural and remote areas without radiologists. The participants asserted that radiologists did not provide reports promptly in the public hospitals where they worked due to the large amount of work and that they also worked in private hospitals. To attest to the findings of Phase 2 of the study, these were the responses from the participants in Phase 1 of the study:

- Radiologists work in many hospitals and work as lecturers at the same time and so patients do not get timely reports.
- Where there are radiologists in the country, they come only twice in a week.
- The workload is too much for radiologists, they take too long to respond when they are called to provide reports.

The ANOVA test indicated that, across gender, there was significantly more agreement among the females than the males that gaps in the provision of radiological reports were as a result of the radiologists being overworked. In addition, the Welch test indicated that there was significantly more agreement across the 43-49 age groups that the gaps were as a result of radiologists being overworked. However, the one-sample t-test could not find any significant correlation with the overworked radiologists.

7.6 RADIOGRAPHY EDUCATION CURRICULUM

The theme of the impact of radiographers training in image interpretation comprised the sub-themes: The need for curriculum review and the establishment of laboratories.

7.6.1 A need for curriculum review

The findings in Phase 1 of the study indicated that the education curriculum at the institutions training radiographers in Kenya did not support training in image interpretation. The participants said that the curriculum at the institutions did not provide a baseline for training radiographers in image interpretation. They asserted that image interpretation should be incorporated into the curriculum of the institutions. They said that the current curriculum should be reviewed as it is outdated. They emphasized that image interpretation should be introduced during the third year of the training. They suggested that the subjects needed to be examined. They supported that radiologists be involved in the training. They maintained that in Uganda, radiologists trained radiographers in image interpretation. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- They do not teach image interpretation; more emphasis should be given to pathology and anatomy which are relevant to image interpretation. Laboratories need to be established for training in image interpretation. A curriculum needs to be put in place for training radiographers in image interpretation.
- The curriculum needs a review as the same has not been done for a long time.
- The current curriculum used for teaching radiographers in medical training institutions in Kenya does not support training in image interpretation.
- A curriculum should be developed to train radiographers in image interpretation of the chest and musculoskeletal systems.

The one-sample t-test, the ANOVA and the Welch did not find any significant correlation with a need for curriculum review.

7.6.2 Laboratories should be established

The findings of Phase 1 of the study indicated that there were no laboratories for the training of radiographers in image interpretation. Participants argued that there was a need to establish laboratories for training radiographers in image interpretation. To generalize the findings of Phase 1 in Phase 2 of the study, the following statements in the questionnaire represent those factors:

- Laboratories need to be established for the training of radiographers in image interpretation.
- Currently, there are no laboratories that could be used to train radiographers in image interpretation.

However, the ANOVA and the Welch tests did not find any significant correlation with the need to establish laboratories for the training of radiographers in image interpretation.

7.7 SUMMARY OF THE CHAPTER

A mixed-methods approach incorporating both qualitative and quantitative design was used to guide the study, and therefore data were collected in Phase 1 and Phase 2 of the study. The findings in Phase 1 of the study indicated that there was an acute shortage of radiologists in Kenya and that there was a need to train radiographers in image interpretation to bridge the gap created by the shortage of radiologists. The findings indicated that there was a need to review the curriculum to incorporate image interpretation at the institutions training radiographers in Kenya. The participants maintained that radiologists in Kenya should be involved in the training of radiographers in image interpretation as their counterparts in Uganda. The participants asserted that the shortage of radiologists in the country was most apparent in the remote and rural areas. This chapter discussed the integration of results from Phase 1 and Phase 2. The next chapter presents a discussion of the findings.

CHAPTER 8: DISCUSSION OF THE FINDINGS

8.1 INTRODUCTION

The goal of this exploratory sequential mixed methods approach was to explore the perceptions of radiographers employed in public hospitals in Kenya regarding the training of radiographers in image interpretation of the chest and musculoskeletal and ultimately develop a model for training radiographers in image interpretation of the chest and musculoskeletal systems. This chapter presents the discussion of the findings and interprets major findings in the context of previous research and describes the implications of the findings. The discussion in this study is based on the demographic profile of the respondents, the themes and sub-themes, the qualitative and quantitative findings and the objectives of the study.

8.2 THEMES AND SUBTHEMES

Four themes emerged in Phase 1 of the study and were tested for significance in Phase 2 of the study using a questionnaire. The themes were benefits associated with training of radiographers in image interpretation, the impact of radiographers training in image interpretation, gaps in the provision of radiological reports and a need for curriculum review. The themes and sub-themes will be discussed.

8.3 Benefits associated with training of radiographers in image interpretation

Six sub-themes related to the benefits of training radiographers in image interpretation emerged in Phase 1 of the study, and these sub-themes were also tested for significance in Phase 2 of the study. The subthemes were as follows: Reduction of patients waiting time, facilitation of patient treatment, prompt reports, and costs of travelling long distances could be minimized, appropriate management of patients and assurance of reports to clinicians.

8.3.1 Reduction of patient waiting time

Due to the acute shortage of radiologists in the remote and rural county and sub-county hospitals, patients' treatment is often delayed. They have to wait for their reports from the national and referral hospitals where radiologists are available, and this can take weeks. According to the participants who were interviewed in Phase 1 of the study, patients could be booked for special examinations and could wait up to six months before the examinations were done. The participants emphasized that training radiographers in image interpretation would enable them to perform the examinations and provide reports, thus reducing the long bookings and patient waiting time. The participants asserted that instead of patients waiting for radiologists who were not available, if a radiographer was trained in image interpretation patients would get prompt reports and therefore reduce patient waiting time. According to Kelly *et al.* (2012: 91), image interpretation for radiographers could improve performance and have the potential to save both money and time. A study conducted at Bispebjerg University Hospital in Denmark indicated that trained radiographers in image interpretation could report accident radiographs of the extremities with high accuracy and could help meet increasing workloads and demands with quality standards (Buskov 2013: 55-58). The statements by Kelly *et al.* (2012: 91) and Buskov (2013: 55-58) suggest that if radiographers are trained in image interpretation, patients waiting time could reduce. The remarks by the authors are supported by one of the participants who alluded that the training by radiographers in image interpretation would enable patients to be treated on time and would not extend their stay in the hospital. The statement is in line with another participant who remarked that patients would benefit from the training by receiving timely reports. Woznitza (2014: 258-263) concurs with the participants that if radiographers were trained in image interpretation, they would be able to report on the majority of plain radiographs. This would result in the delivery of an effective and faster service and shorter patient waiting time.

An empirical report from the University Hospital of North Staffordshire (UHNS) indicated that after using an advanced practitioner radiographer trained in images interpretation to report on plain films with the support of its consultant radiologist, the UHNS had increased its capacity and the hospital had provided safer, faster and more flexible service to patients (UHNS 2014: 1). The factor analysis conducted in Phase 2 of the study indicated a significant agreement that the training in the chest and musculoskeletal images interpretation would benefit patients by providing prompt reports and thus reducing patient waiting time. In addition, the ANOVA test indicated that the 43-49 age groups across gender showed a significantly more agreement that the training in images interpretation would benefit patients.

8.3.2 Facilitation of patient treatment

During the interviews, participants stated that the training radiographers in images interpretation coupled with them being experts in radiography would enable them to provide alternative views and prompt reports that would expedite patient treatment. According to Smith *et al.* (2008: 6), radiographic radiographs should be reported within 12 hours of the examination being performed, while the patient is still in the hospital so that radiological diagnosis is not missed. However, this rarely happens thus compromising diagnosis. To overcome this problem, radiographers could be trained in images interpretation to facilitate easier access to radiological reports. The participants asserted that if a radiographer was empowered in images interpretation, the radiographer would be able to decide after taking an x-ray, whether a patient should proceed for an ultrasound, CT or MRI, and this would be easier for clinicians to make a diagnosis, thus facilitating patient treatment. According to the interviewed participants, clinicians were not knowledgeable in images interpretation and having radiographers interpreting radiographs would ensure that every patient goes back to the clinician with a report.

The results of the t-test indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would facilitate patient treatment. In addition, factor analysis indicated that the training would assist patient treatment. According to Smith *et al.* (2008: e22), role extension for radiographers would provide quality patient care and improve departmental flow and efficiency. Woznitza *et al.* (2014: 258-263) is in support of the fact that if a radiographer is incorporated into an image interpretation team, there would be shorter patient waiting times as the radiographer would report the majority of the films. This is in line with Paterson (2010: 8) who argues that “hot” reporting by radiographers would influence patient management.

8.3.3 Prompt radiology reports

The findings of Phase 1 indicated that radiology reports took too long and patients’ lives could be saved if radiographers were trained in image interpretation. According to Paterson (2010: 8), many films that are returned to clinicians unreported would reduce, as “hot” reporting by radiographers would enable patients to receive treatment timeously. The foregoing statement is affirmed by Smith *et al.* (2008: e23), that due to the absence of radiologists in the small rural hospitals of Australia, radiographers x-rayed patients and provided comments on radiographs. The findings in Phase 1 of the study indicated that radiographers were the ones who interacted more with patients and detected the disease first and that if they were allowed to report on radiographs, radiology reports could be immediate and therefore the lives of patients could be saved. The factor analysis conducted in Phase 2 of the study indicated that the training in the chest and musculoskeletal image interpretation would benefit patients by providing prompt radiology reports. In addition, one sample t-test suggested that the training in image interpretation would benefit patients by providing prompt radiology reports. Eddy (2010: 3) concurs with the findings that “hot” reporting by radiographers would influence patient management. In the same argument, Meertens *et al.* (2013: e178) states that when radiographers carried out and interpreted Computed Tomography Colonography (CTC) radiographs, timely decisions of patient

management and reduction of call rates was achieved.

8.3.4 Costs of travelling long distances could be minimized

The findings in Phase 1 of the study indicated that radiologists were not available in remote and rural areas and were only found in big towns. The participants said that radiographers were found in most hospitals and if trained in image interpretation patients would get instant reports, since the number of radiographers countrywide overwhelmed that of radiologists. The participants said that the costs of patients travelling long distances seeking radiological reports at national and referral hospitals where radiologists were available would reduce. In Uganda, to mitigate issues of patients travelling long distances for radiological reports, the country's health policy has allowed non-physician medical personnel (radiographers) to train in image interpretation and posted to work in rural radiology departments (Kawooya 2012: 37).

The t-test conducted in Phase 2 of the study indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would minimize the costs of long-distance travelling seeking radiological reports from national and referral hospitals. In addition, the factor analysis indicated that the training in image interpretation would benefit patients by minimizing the costs of long-distance travelling seeking radiological reports from national and referral hospitals. Mukhwana (2013: 4) argues that people residing in remote and rural areas may have access to a general practitioner, but residents are forced to use abundant resources in the form of time and money to seek specialized medical care (radiological reports) from the few available specialists (radiologists) in cities and cosmopolitans.

8.3.5 Appropriate management of patients

The findings of Phase 1 of the study indicated that there would be a change in the management of patients if radiographers were trained in image interpretation. Rural and remote hospitals would be able to manage their

patients well and referrals would be reduced. The statement is in line with Hardy and Snaith (2013: 61), who argue that patients who received immediate reporting by radiographers received more appropriate management by doctors. Likewise, Todd (2014: 1) informs that in the Christie Specialist Cancer Centre in UK, chest reporting by radiographers was introduced to reduce the turnaround time for chest x-rays (the time from which examinations are performed to the time the report is made available for the referring clinicians). Cancer Research Centre in the UK (Cancer Research UK 2011:1) extended the role of radiographers to mitigate the increase in GI cancer examinations in the NHS that had increased by 50% in males over the past 25 years. The role extension for radiographers proved to save money for the NHS and improved efficiency. The factor analysis conducted in Phase 2 of the study indicated that the training in the chest and musculoskeletal image interpretation would result in appropriate management of patients by clinicians. Besides, the factor analysis also indicated that the training in image interpretation would enable remote and rural hospitals to give their patients the service and treatment needed at the time of their visit.

8.3.6 Assurance of radiology reports to clinicians

The findings of Phase 1 indicated that the confidence of clinicians in the rural and remote hospitals would be enhanced because they would be assured of reports when radiographers train in image interpretation. According to the participants interviewed in Phase 1 of the study, the confidence of clinicians in the remote and rural areas would be enhanced, because they would be assured of reports if radiographers trained in image interpretation. They emphasized that reports to clinicians would be available on time and diagnosis by clinicians would be faster and thus proper management of patients. The results of the t-test in Phase 2 of the study indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would ensure that clinicians receive radiology reports (because radiographers would be able to do them at the time of performing examinations).

In the Western Pacific Islands, radiographers worked without radiologists and were frequently asked for their opinion, yet they were not trained in image interpretation. To mitigate this problem, the WHO co-sponsored a project aimed at teaching radiographers elementary image interpretation and report writing course, which took three years (WHO 2008: e2008). The move was meant to aid referring clinicians in making the diagnosis and treatment of the patient (Smith *et al.* 2008: e23). The statement concurs with the participants interviewed in Phase 1 of the study that if radiographers trained in image interpretation, clinicians would be assured of radiological reports.

8.4 Impact of radiographers training in image interpretation

The sub-themes that emerged under the impact of radiographers training in image interpretation comprised: Instant provision of reports, minimal repeats of radiographs and costs of transferring patients could be minimized.

8.4.1 Instant provision of reports

The findings in Phase 1 of the study indicated that if radiographers were trained in images interpretation, patients would get reports on time because radiographers would perform examinations and provide reports at the same time. The participants also said that hospitals would benefit because the backlog of unreported radiographs would reduce, and patients would be managed well. The participants said that due to the availability of radiographers, they could provide immediate images interpretation reports especially in the case of haemothorax and the lives of patients could be saved. Smith *et al.* (2008: e21) concur with the opinion of the participants and asserts that in Australia frontline opinion of radiographers was valued in the rural and remote healthcare settings, even in regional and metropolitan centers when a radiologist was not available to provide an immediate report. Paterson (2010: 8) emphasizes that if radiographers trained in image interpretation, reports to referring clinicians would be sent on time and would inform clinical management and treatment of patients. Smith and Baird (2007:630) maintain that the contribution of radiographers in medical image interpretation has reduced patient waiting time and freed radiologists for other duties and it has been proven to be cost-effective. The statement by Smith *et al.* (2008: e21) is evident that if radiographers trained in image interpretation, they would provide instant radiological reports because their opinion was sought and valued in the absence of radiologists. Price and Miller (2010: 4) maintains that image interpretation by the consultant radiographer in clinical imaging at the National Health Services in the UK had facilitated and increased patient throughput and led to service improvements for patients. Blakeley and Hogg (2009: 3) argue that the number of reported examinations more than doubled and timelines of reports availability nearly halved, at the NHS when a reporting radiographer was involved in the reporting of accident and emergency imaging team. The factor analysis conducted in Phase 2 of the study indicated that the training in the chest and musculoskeletal image interpretation would benefit patients by providing instant images interpretation reports.

8.4.2 Minimal repeats of images

The findings in Phase 1 of the study indicated that if radiographers were trained in image interpretation, repeats of radiographs would reduce (operational costs would reduce and therefore more savings for the hospitals). The participants affirmed that often clinicians requested for wrong examinations that prompted radiologists to make other requests, which was film wastage. The participants asserted that if radiographers were trained in images interpretation, clinicians would seek assistance and opinions on requesting the right views. That would reduce film wastage that resulted from repeated examinations. The results of the t-test in Phase 2 of the study indicated that the training in the chest and musculoskeletal images interpretation would minimize radiographic repeats. In addition, the factor analysis indicated that the training in images interpretation would minimize repeats of radiographs (Plessis and Pitcher 2015:1; Hughes 2013:2; McConnell and Smith 2008: 7-8).

8.4.3 Costs of transferring patients could be minimized

The findings of Phase 1 of the study indicated that if radiographers were trained in image interpretation, they would provide image interpretation reports. Thus, reducing the costs incurred by county hospitals when transferring patients seeking radiological reports, from the rural hospitals to referral hospitals. They also asserted that remote and rural hospitals would be able to manage their patients well and referrals would reduce. Costs for individual patients travelling long distances, seeking radiological reports at national and referral hospitals, where radiologists were located would also reduce. Mars (2013: 327) and Yeboah, Sem and Asare (2003: 27) concur that training of radiographers in image interpretation would reduce the need to travel seeking radiological reports, in the referral and national hospitals where radiologists were available. The results of the t-test affirmed that the training of radiographers in the chest and musculoskeletal images interpretation would minimize costs incurred in transferring patients to referral hospitals.

8.4.4 Gaps in the provision of radiological reports

The sub-themes that emerged in Phase 1 of the study were: Shortage of radiologists and overworked radiologists.

8.4.5 Shortage of radiologists

The findings of Phase 1 indicated that there was a huge gap in the provision of radiology reports due to the shortage of radiologists. This is in line with the statement made by Doctor (Dr.) Wanga in 2006, the then head of the Kenya Society of Radiologists who was quoted in an International Society of Radiologists (ISR) Conference held in Cape Town, South Africa saying that there was a great shortage of radiologists in Kenya (Williams 2006: 15). He said that only 80 radiologists were serving a population of 32 million people (Williams 2006: 15). In the same conference, Dr. Taft, the then President of the RSSA was quoted saying that there were approximately 450 radiologists in South Africa serving a population of more than 42 million people, with the majority of them working in the private sector, leaving the public sector with an acute shortage (Williams 2006: 15). Similarly, Dr. Kawooya of Makerere University deplored Uganda's low radiologist-patient ratio of 1:1 million. He emphasized that over 80% of the population in South Saharan Africa (SAA) was rural and in dire need of rural radiology (RR). He said that the majority of SAA countries were facing human resource shortages especially radiologists and the shortage would impede the attainment of the global health goals unless a training intervention (training of radiographers in images interpretation) was implemented (Kawooya 2012: 37).

The critical shortage of radiologists in the UK led to the establishment of a role extension for radiographers to reduce the backlog of unreported radiographs created by the shortage of radiologists (Beardmore 2013: 1). Similarly, personnel shortages (radiologists) and the increased demand for radiological services prompted the Radiological and Radiologic Technology Organizations in the USA, to collaborate and develop an advanced clinical role for radiographers to interpret radiographs (May *et al.* 2008: e24-e25). The results

of the t-test indicated that the training in the chest and musculoskeletal images interpretation would reduce the backlog of unreported radiographs. The factor analysis pointed out that the training in images interpretation would enable remote and rural hospitals to provide patients with the service and treatment needed at the time of their visit. The factor analysis further indicated that the training in images interpretation would have a positive impact on the service provided by the radiology department.

8.4.6 Overworked radiologists

The findings of Phase 1 of the study indicated that radiologists only worked in big towns leaving the rural and remote areas without radiologists. Participants asserted that radiologists did not provide reports promptly in the public hospitals where they worked because they were overwhelmed with work as they also worked in private hospitals. In concurrence, the UK had to endorse radiographer reporting on selected images as a way of reducing radiologists' workload to enhance health care services to patients (Page and Davidson 2014: 143). Likewise, Smith *et al.* (2009: 1-2) argue that because of the unavailability of radiologists due to work overload, frontline reporting by radiographers was established to improve the healthcare of patients in rural and remote healthcare settings in Australia. Kelly *et al.* (2012:91) adds that following a statement by the Royal College of Radiographers in England that workload for radiologists had increased by 322% between 1968 and 1991, specialized courses were introduced to train radiographers to interpret images. Moran and Warren-Forward (2011: 126) affirm that in Australia, the number of women who were undergoing screening programmes for cancer had increased to 31% between 1996 and 2006. However, the number of radiologists in Australia had not correspondingly increased with this number. The Canadian Medical Radiation Technologists (CAMRT 2010: 9) agrees that radiologists would benefit from the training in images interpretation as their workload would be reduced. A survey conducted in 2004 in Australia by Smith and Baird (2007: 629) found that 65% of the radiologists felt there was a shortage leading to them working more hours when compared to their counterparts in other disciplines and wished the hours could be reduced so

that they could have time for personal lifestyle choices. Stevenson (2000:79-84) concurs with the participants that if radiographers were trained in images interpretation, radiologists would have ample time to do more complicated tasks.

Swinburne (Williams 2009:1) emphasized that diagnostic x-ray services could be improved, and workload reduced if radiographers were trained in distinguishing normal from abnormal pathology (Williams 2009: 15). In addition, the ANOVA test indicated that there were gaps in the provision of radiological reports as a result of the radiologists being overworked. Besides, the Welch test indicated that there was significantly more agreement across the 43-49 age groups that the gaps were as a result of radiologists being overworked.

8.5 Radiography education curriculum

The participants interviewed in Phase 1 of the study stated that radiography education curricula at the institutions that offer radiography training in Kenya needs a review as they did not support training in image interpretation. Participants said that the curricula at the institutions did not provide a baseline for training radiographers in image interpretation. They asserted that images interpretation should be incorporated in the curricula used in teaching radiography in the institutions.

Kawooya (2012: 37) asserts that due to the shortage of radiologists in Uganda, the country's health policy was changed to allow radiographers to train in images interpretation to supplement the shortage of radiologists. Similarly, in New Zealand, an organization was formed to work out a strategy to extend the role of radiographers to achieve more definitive patient care and improve departmental workflow and efficiency. Also, in the Western Pacific Islands radiographers worked without radiologists and were frequently asked for their opinion because radiologists were not always available, despite not been specifically trained in images interpretation. In mitigation, the World Health Organization co-sponsored a programme aimed

at teaching elementary radiological interpretation skills to radiographers (Smith *et al.* 2008: e22). In 2006 the Australian Institute of Radiography (AIR) and the Royal Australian and the New Zealand College of Radiologists produced a report proposing that radiographers be trained to a position of an advanced practitioner role to include reporting duties at Baccalaureate or Master's degree level.

Personnel shortages and increased demand for radiological services prompted the Radiology and Radiologic Technology Organizations in the United States to develop an advanced clinical role for radiographers (May *et al.* 2008: e24-e25). In addition, the participants said that the current curricula were outdated and should be reviewed. They emphasized that images interpretation should be introduced during the 3rd year of the training and the subjects thought should be examined. They added that the training in images interpretation should encompass general x-ray, interventional radiology, fluoroscopy, CT, MRI, radiotherapy and nuclear medicine. Participants believed that radiologists should be involved in the training. They maintained that in Uganda radiologists trained radiographers in images interpretation. In concurrence with the participants, a research conducted in South Africa seeking the opinion of radiologists' willingness to formally support the reporting and interpretation of trauma and emergency (T&E) images, showed that 68% of the radiologists supported role extension for radiographers. Radiologists were also willing to train radiographers in image interpretation (Williams 2009: 16).

8.6 DISCUSSION OF RESULTS IN RELATION TO THE STUDY OBJECTIVES

The study had four (4) objectives and all of them were achieved.

Objective 1: Explore the benefits associated with training of radiographers in image interpretation. The objective was achieved in Phase 1 of the study through one-on-one interviews and FGDS. The findings indicated that participants believed that the training in image interpretation would reduce patient waiting time. This would be possible because radiographers could perform procedures and provide reports at the same time, thus reducing patient waiting time. They stated that patients booked for special examinations could wait up to six months due to the unavailability of radiologists and that would not be the case if radiographers were trained in image interpretation. The findings were verified in Phase 2 of the study when factor analysis indicated a significant agreement that the training in the chest and musculoskeletal image interpretation would benefit patients by providing prompt reports.

Objective 2: Identify a gap in the provision of radiological reports concerning training radiographers in image interpretation of the chest and musculoskeletal image interpretation. This objective was achieved in Phase 1 of the study through one-on-one interviews and focus group interviews. The findings indicated that there was a huge gap in the provision of radiological reports due to the shortage of radiologists. According to the participants, the training in image interpretation for radiographers would reduce the gap. The participants emphasized that the few radiologists could not clear the backlog of unreported image. The participants asserted that most county and sub-county hospitals did not have radiologists and thus a gap in the provision of radiological reports. The findings were verified in Phase 2 of the study when t-test results indicated that the training in the chest and musculoskeletal image interpretation would reduce the backlog of unreported image. In addition, factor analysis indicated that the training would enable remote and rural hospitals provide patients with the radiological services and treatment needed

at the time of their visit.

Objective 3: Establish if radiography education curriculum supports training in image interpretation of the chest and musculoskeletal systems. The objective was achieved in Phase 1 of the study through one-on-one interviews and focus group discussions. The findings indicated that the radiography education curriculum at the institutions that train radiographers in Kenya did not support training in image interpretation. According to the participants, the curriculum at the institutions did not have a baseline for training radiographers in image interpretation. They emphasized that image interpretation should be incorporated into the curriculum. They asserted that the current curriculum should be reviewed to incorporate image interpretation. They said that radiologists should be involved in the training. They maintained that in Uganda radiologists trained radiographers in image interpretation. The statements by the participants were verified in Phase 2 of the study.

Objective 4: Develop a model to be used to train radiographers in image interpretation of the chest and musculoskeletal system.

8.7 SUMMARY OF THE CHAPTER

Chapter 8 provided a discussion of the study findings. In the next chapter, a model to train radiographers in image interpretation of the chest and musculoskeletal system will be presented.

CHAPTER 9: A MODEL FOR TRAINING RADIOGRAPHERS IN IMAGE INTERPRETATION IN KENYA

9.1 INTRODUCTION

The last objective of this exploratory, mixed-methods study was to develop a model that could be used for the training of radiographers in image interpretation of the chest and musculoskeletal in Kenya. The Social Constructivism Theory and the Social Learning Theory guided the development of the model. The Social Constructivism Theory was used to examine how radiographers would acquire knowledge through learning by interacting with others during their training in image interpretation. The Social Learning Theory explored how radiographers would gain knowledge through observation in their training in image interpretation. The discussion in this chapter focused on the development of the model.

9.2 PROCESS OF MODEL DEVELOPMENT

Walker and Avant (2011: 61) define a model as “any device that is used to represent something other than itself and parts of the model should correspond to the theory it represents”. In developing a model for training radiographers in image interpretation in Kenya, the researcher used processes followed in nursing theory development owing to the paucity of knowledge in radiography. It is worth noting that specific processes are designed for theory development but for this study, the researcher adapted the processes for model development. This process of theory adaptation from one field to another, or statements and redefining concepts is known as derivation (Walker and Avant 2011: 63). Walker and Avant (2011: 66) suggest different approaches that could be followed in developing a model. According to them, model development is a step by step process which has concepts, statements and theory derivation; concepts, statements, and theory synthesis; concepts, statements and theory analysis.

Chinn and Kramer (2011: 176) consider a four-step process of model development which is discussed below. Both these processes in model development have some similarities.

9.2.1 A MODEL FOR TRAINING RADIOGRAPHERS IN IMAGE INTERPRETATION

After exploring two possible processes that could be used for model development, the researcher predominantly followed the four-step process recommended by Chinn and Kramer (2011:176). According to Chinn and Kramer (2011:176), there are four (4) approaches that can be used for structuring and contextualizing theory development. These approaches are identifying and defining concepts; identifying assumptions; clarifying the context within which theory is placed and designing relationship statements. These four steps are clarified and their links to literature in the following text.

9.2.2 Identifying and defining concepts

Concepts are building blocks of any model and they are a mental image of a phenomenon, an idea or a construct in the mind about a thing or action (Walker and Avant 2011: 59). Chinn and Kramer (2011: 176) recommend that structuring a model requires identifying concepts that will form the building foundation of the model. The aim of this study was to explore the perceptions of Kenyan radiographers to train in image interpretation of the chest and musculoskeletal to supplement the shortage of radiologists. These two factors are the building foundation of the model. Chinn and Kramer (2011: 176) further add that assumptions that originate from cultural history will also affect the conceptual structure of model development and time will also determine the link that this factor will have with one another. There are four components of a time frame that determine the relationship between factors in model development and these are coincident, antecedent, intervening and consequent (Chinn and

Kramer 2011:176). The authors define antecedent concepts as those that come before other concepts (Chinn and Kramer 2011: 176). In this study, the findings in Phase 1 of the study indicated that there was shortage of radiologists causing a gap in the provision of radiological reports. This has introduced a causal relationship between the shortage of radiologists and the provision of radiological reports. In addition, the t-test indicated that there was a gap in the provision of radiological reports created by the shortage of radiologists.

Consequent concepts are defined by Chinn and Kramer (2011: 176), as those that follow other concepts. For this study, consequent concepts were identified as those concepts that were associated with a higher level of agreement on the Likert scale in the questionnaire that there was a shortage of radiologists causing a gap in the provision of radiological reports.

There are intervening concepts which are also described as coincident and have an influence on the relationship among concepts. Intervening concepts also influence the relationship between antecedent concepts and consequent concepts (Chinn and Kramer 2011: 176). In this proposed model, the consequent concepts that have been mentioned in the previous paragraph, which have both a negative and positive relationship between the shortage of radiologists and the provision of radiological reports. The consequent concepts have been proven to be the cause of the gap in the provision of radiological reports due to the shortage of radiologists.

Concept analysis was achieved through data collection over two phases. In Phase 1 data were collected through focus group discussions and one-on-one interviews using purposefully selected participants at the Moi Teaching and Referral Hospital. The sampled population involved senior radiographers with different levels of experience ranging between Grade 1 and assistant directors. The collected data in Phase 1 was analyzed using five steps of thematic analysis as suggested by Creswell and Plano Clark (2011: 129). The five steps of

thematic analysis are (a) Preparing the data for analysis, (b) Exploring the data, (c) Analyzing the data, (d) Representing the data for analysis and (e) Validating the data. A total of four themes emerged which were categorized as:

Theme 1: Benefits associated with training in image interpretation.

Theme 2: Impact of training radiographers in image interpretation.

Theme 3: Gaps in the provision of radiological reports.

Theme 4: A need for curriculum review.

These themes were used to develop a tool for Phase 2 of data collection. In Phase 2 of the study, a questionnaire was developed and was distributed to purposively selected public hospitals in Kenya. The questionnaire had 30 statements posed to the participants and it used a Likert scale of 1-6, where 1 was strongly disagreed and 6 was strongly agreed. During data analysis, factor analysis was performed and a total of 17 factors emerged. Factor analysis was used to group different factors based on their conceptual appropriateness. These 17 factors were: The training in image interpretation by radiographers:

- Would benefit patients by providing prompt image interpretation reports;
- Would benefit patients;
- Would ensure that clinicians would receive image interpretation reports;
- Would benefit patients by reducing the backlog of unreported radiographs;
- Would facilitate patient treatment;
- Would benefit patients by minimizing the costs of long-distance travelling seeking radiological reports from national and referral hospitals;
- Would have a positive impact on the service provided by the radiology department;
- Would improve the efficiency of healthcare institutions;
- Would result in appropriate management of patients by clinicians; would minimize repeats of radiographs;

- Would minimize costs incurred in transferring patients to referral hospitals; would benefit my hospital;
- Would reduce the number of referrals of patients from remote and rural hospitals;
- Would reduce the workload of radiologists;
- Would enable remote and rural hospitals to give their patients the service and treatment that is needed at the time of their visit;
- Would enable health institutions to charge for the reports as well as the radiographs and hence increase their income; and
- Would give radiologists more time to perform more complex examinations.

9.2.3 Identifying assumptions as part of the model

The shortage of According to Chinn and Kramer (2011: 178), assumptions are underlying givens that are assumed to be true. The authors further clarify that there are empirical and philosophical assumptions, which must be challenged according to the knowledge they present. Empirical models may be challenged philosophically, and they can be assessed empirically. However, philosophical assumptions form the grounding for a model and must therefore be challenged under philosophical knowledge. The philosophical assumption for the development of this model was that the training of radiographers in image interpretation would supplement radiologists.

9.2.4 Clarifying the context

According to Chinn and Kramer (2011: 179), theoretical relations must be placed within a context if the model is to be used in practice and that the applicability of the model is dependent on the broadness or narrowness of the context. A model that is too broad may not apply to all settings, whereas a model that is too narrow may not be applicable beyond that setting. The proposed model is

meant for radiographers employed in public hospitals in Kenya. However, it cannot be applied to the private sector since it is not governed by the same policies.

9.2.5 Designing relationship statements

The significance of the constructing statements as an integral part of model development are recommended by Walker and Avant (2011: 60). They further describe statements as relational and non-relational. A relational statement suggests that there is some form of relationship between two or more concepts. Furthermore, relational statements either confirm the association or causality of statements. Associational statements group similar concepts and causal statements demonstrate the cause and effect relationship (Walker and Avant 2011: 60). Non-relational statements assert the existence of concepts and are used by model developers to clarify the meaning of the model. In the development of the model, these were the statements that constructed and were found to have a causal relationship between the shortage of radiologists and a gap in the provision of radiological reports:

- Shortage of radiologists and a gap in the provision of radiological reports.
- There is a shortage of radiologists in Kenya and patients are sent to big towns for radiological reports where radiologists are found.
- Most patients are x-rayed and go away without radiology reports because radiologists are not available to provide reports.
- There is a gap in the provision of radiology reports because of the shortage of radiologists, particularly in remote and rural areas.
- If you went to (name of hospital withheld) and did an x-ray today, you would not get a report on the same day, there are piles of unreported radiographs and yesterday's radiographs are reported today. So, there is a great shortage of radiologists and only a few counties have radiologists. Radiographs are sent to hospitals in big towns for reports where radiologists are available. This results in reports delaying up to

one week.

The training of radiographers in image interpretation would ensure that patients received prompt image interpretation reports. These were statements that were found to have a causal relationship between the training of radiographers in image interpretation and the provision of image interpretation reports. With the training of radiographers in image interpretation:

- Hospitals would benefit because patients would receive timely radiology reports.
- There would be time management of patients. Confidence levels of patients would be enhanced because reports would be available.
- Because of the availability of radiographers, image interpretation reports would always be available.

Therefore, the training of radiographers in image interpretation would ensure that patients would receive prompt reports and thus timely treatment.

9.3 DESCRIPTION OF THE MODEL

The model is divided into two concepts: The shortage of radiologists and the training of radiographers in image interpretation. To elucidate the two concepts, two models Figure 9.1 explaining the shortage of radiologists and Figure 9.2 explaining the training of radiographers have been provided. The shortage of radiologists has caused a gap in the provision of radiological reports. If radiographers train in image interpretation the gap will reduce.

9.3.1 Shortage of radiologists

The findings of Phase 1 indicated that there was a huge gap in the provision of radiology reports due to the shortage of radiologists. The participants asserted that the available radiologists were not able to clear the backlog of unreported radiographs. The participants emphasized that most county hospitals did not

have radiologists and thus the gap in the provision of radiological reports. They insinuated that in the county hospitals radiologists were available only twice in a week. The participants asserted that radiographers were consulted by clinicians to provide reports in the absence of radiologists. The participants expressed that most of the A & E were not reported by radiologists and were left to be reported by clinicians, who were not knowledgeable in image interpretation resulting in misdiagnosis. The participants remarked that the phenomenon was common in remote and rural hospitals. The participants maintained that clinicians interpreted radiographs in remote and rural hospitals because there were no radiologists. The participants stated that the shortage of radiologists was acute in the remote and rural areas because radiologists were mostly found in big towns. They said that radiologists were not readily available to provide radiological reports because they were overwhelmed with work as they worked as lecturers in teaching institutions, and the public and private hospitals.

9.3.2 Training of radiographers in image interpretation

The findings in Phase 1 of the study indicated that if radiographers are trained in image interpretation, patients would receive image interpretation reports as radiographers would be performing examinations and providing reports at the same time. The participants also said that hospitals would benefit as the backlog of unreported radiographs would reduce. There would be timely management of patients. The participants said that due to the availability of radiographers, they could provide immediate image interpretation reports especially in the case of haemothorax and thus patient management would be improved. The participants said that confidence levels of patients would be enhanced because image interpretation reports would always be available. Participants asserted that if radiographers are trained in image interpretation, repeats of radiographs would reduce, operational costs would reduce and therefore more savings for the hospitals. The costs of transferring patients would reduce because radiographers would provide image interpretation reports. They also asserted that remote and

rural hospitals would be able to manage their patients well and referrals would be minimized.

The elements in this model are radiologists and radiographers. Radiologists are medical doctors who are specialists in diagnostic imaging. Radiologists use medical imaging techniques such as x-rays, CT, MRI, nuclear medicine, positron emission tomography (PET) and ultrasound to diagnose and treat diseases. A radiographer is a medical imaging technologist who assists doctors in diagnosing diseases and injuries. Radiographers complete a university Bachelor's Degree in x-rays, CT, MRI, nuclear medicine, PET and ultrasound for the diagnosis and treatment of patients (Oxford Advanced Learner's Dictionary 2005: 1196). Based on their postgraduate training, radiographers in the UK, USA, Australia and Uganda can provide a preliminary clinical evaluation (image interpretation) on a wide range of examinations (Hughes 2013: 4). The same could be accomplished by Kenyan radiographers if provided with the necessary support to train in image interpretation. Figure 9.2 presents a model for training radiographers in image interpretation of the chest and musculoskeletal in Kenya.

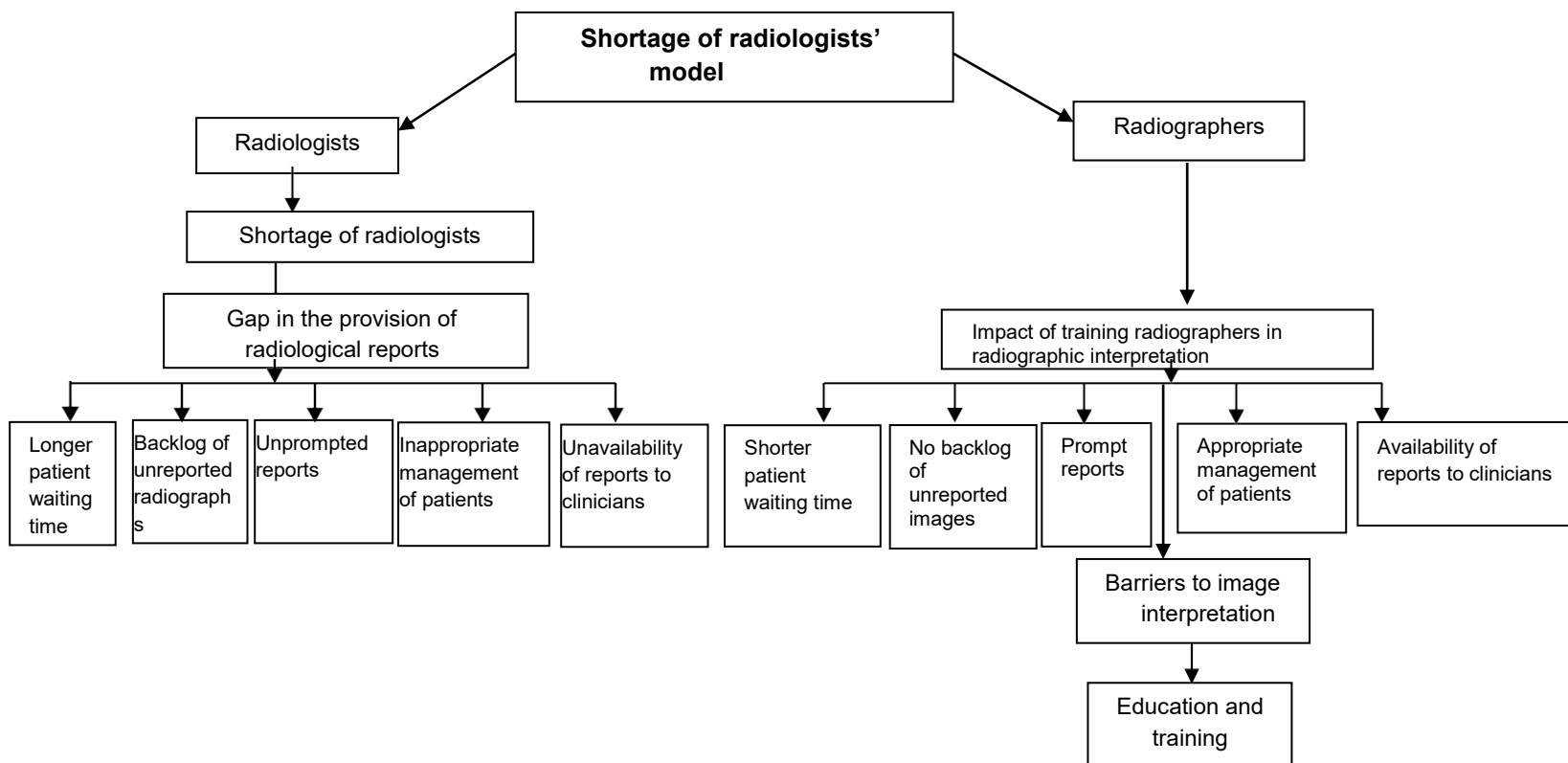


Figure 9.1: The model depicts the shortage of radiologists in Kenya.

Figure 9.1: The model is diagrammatic representation of the shortage of radiologists in Kenya, affecting the remote and rural areas. This study has revealed that there is a gap in the provision of radiological reports and has therefore proposed training of radiographers in radiographic interpretation of the chest and musculoskeletal to supplement the shortage of radiologists. It has also been proposed that there is need to review the curriculum used to train radiographers in Kenya, to incorporate image interpretation.

9.5 SUMMARY OF THE CHAPTER

This chapter presented the process of model development. The data that was used to develop the model was collected in two Phases. In Phase 1, focus group discussion and one-on-one interviews were used in data collection; in Phase 2 a questionnaire was used. Chapter 10 presents limitations, conclusion and recommendations.

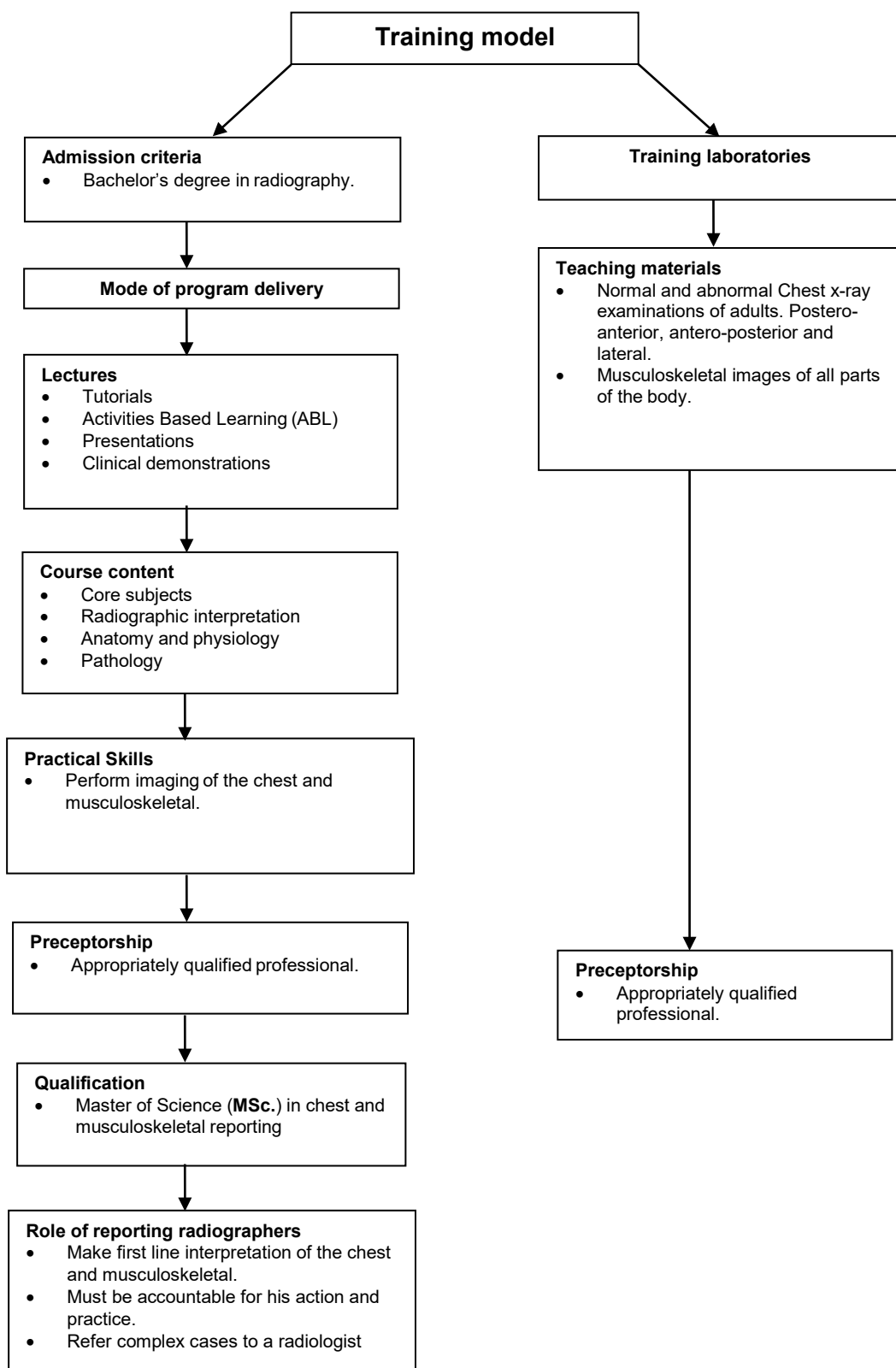


Figure 9.2: A model for training radiographers in image interpretation

Figure 9.2: The model is a diagrammatic representation of the training of radiographers in image interpretation of the chest and musculoskeletal to supplement the shortage of radiologists in the remote and rural areas in Kenya.

CHAPTER 10: LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

10.1 INTRODUCTION

The study aimed to explore the perceptions of Kenyan radiographers regarding training in image interpretation of the chest and musculoskeletal systems. This was achieved in two phases of data collection and a model for training radiographers in image interpretation in Kenya was developed. The final chapter is used to acknowledge the limitations that were encountered, areas that still need to be researched in the future and recommendations that were guided by the findings of the study.

10.2 LIMITATIONS OF THE STUDY

Limitations are hindrances or constraints that weaken the study or potential weaknesses that occur during the study (Oso and Onen 2009: 108). According to Polonsky and Waller (2010: 235), limitations are methodological problems, mistakes or unforeseen errors that arise during the study period. According to Bui (2014: 202), limitations must be evaluated objectively so that other researchers could learn from the researcher's mistakes and improve on future research. The limitations experienced in this study were:

- The researcher received no funding in Phase 1 and Phase 2 of the study and data collection took much longer to complete; however, the study was completed, and it achieved its objective.
- The radiography education curriculum as a variable was omitted in Phase 2 of the study in the questionnaire and therefore a smaller sample provided their opinion in Phase 1 of the study during interviews.
- The study was only conducted in the public sector and therefore the findings cannot be generalized to the private sector.

- Due to logistical issues and lack of funding, the researcher could not access all radiographers in the rural and remote areas of Kenya.

10.3 CONCLUSIONS DRAWN FROM THE STUDY

The results of this mixed-methods study established four major conclusions from the study. The first conclusion was that if radiographers trained in image interpretation patients would receive prompt image interpretation reports, as radiographers would report on them at the time of the x-ray examination. Currently, radiology reporting took too long, as patients must wait for their results from the national and referral hospitals, where radiologists are available.

The second conclusion was that there was a gap in the provision of radiological reports due to the shortage of radiologists. The few available radiologists were not able to clear the backlog of unreported images. Most county hospitals did not have radiologists and the radiologists in the counties were only available twice in a week, causing delays in the treatment of patients.

The third conclusion was that radiography education curricula used to train radiographers in Kenyan institutions did not support training in image interpretation. The curricula did not provide a baseline for training radiographers in image interpretation. Therefore, the current curricula should be reviewed to incorporate image interpretation.

The fourth conclusion is that laboratories should be established for the training of radiographers in image interpretation. Currently, there are no laboratories that could be used to train radiographers in image interpretation.

10.4 RECOMMENDATIONS

The recommendations are based on the findings of the study and underpin the training of radiographers in image interpretation. The recommendations will be submitted to the Ministry of Health, higher institutions that trained radiographers in Kenya, the Society of Radiographers in Kenya and the Kenya Association of Radiologists and Radiographers.

10.4.1 Recommendations to the Ministry of Health

The Ministry of Health has improved the quality of healthcare to all Kenyans. According to the Government's Strategic Plan of Vision 2030, it is set to provide equitable and affordable healthcare to all her citizens. This goal may not be realized particularly in the radiology sector due to the shortage of radiologists. In most county and sub-county hospitals, there are no radiologists to report on radiographic images and the images are sent to national and referral hospitals for radiological reports. Recently, the government of Kenya equipped most county and sub-county hospitals with modern digital x-ray machines which are operated by radiographers but there are no radiologists to provide radiological reports. It is therefore, important to train radiographers to alleviate the non-reporting caused by the shortage of radiologists. To achieve this, the government would need to change the country's health policy on healthcare to allow radiographers to train in image interpretation. If the same is not implemented, the shortage of radiologists may impact negatively on the Vision 2030 strategic plan.

10.4.2 Recommendations to Higher Institutions conducting training for Radiographers in Kenya

Based on the findings of this study, it is necessary to train radiographers in image interpretation to counteract the shortage of radiologists. Radiography education curricula for training radiographers in the institutions of higher learning need to incorporate image interpretation at Bachelor's and Postgraduate level of training. The current curriculum does not provide a baseline for training radiographers in image interpretation. Laboratories need to be established for training radiographers in image interpretation.

10.4.3 Recommendations to the Society of Radiographers in Kenya

Based on the findings of this study, it is necessary to train radiographers in image interpretation to compensate for the shortage of radiologists. This study now provides the Society of Radiographers in Kenya (SORK) and the body that oversees training, a mandate to liaise with the Ministry of Health and the institutions that train radiographers to ensure that the radiography education curriculum is reviewed, to facilitate the training of radiographers in image interpretation. The Society of Radiographers in Kenya should ensure that laboratories for the training radiographers in image interpretation have been established.

10.4.4 Recommendation to the Kenya Association of Radiologists

Based on the findings of this research, it is recommended that radiologists provide the necessary support and preceptorship to enable radiographers to train in image interpretation. Radiologists are experts in radiological reporting considering their lengthy period of training and are therefore the “gold standard” as far as image interpretation is concerned. The notion that radiographers will replace radiologists if they are trained in image interpretation is a misplaced conception. Only limited tasks in image interpretation will be transferred to radiographers by radiologists to meet the rising demand for immediate reporting. Radiographers will provide descriptive reports, while radiologists will provide diagnostic reports and will be responsible for the holistic management of patients. Some radiologists in Kenya are very supportive of radiographers training in image interpretation, particularly in ultrasound. The same gesture could be extended to radiographers who will be training in image interpretation of the chest and musculoskeletal systems.

10.4.5 Recommendation to radiographers

The findings in this study indicated that radiographers must train in image interpretation to counteract the shortage of radiologists. Radiographers need

to pursue this inspiration of training in image interpretation, to facilitate patient access to image interpretation reports. In the meantime, radiographers could register in international institutions that offer lessons in image interpretation in countries like the UK, USA and Australia, as they await local institutions to implement solutions. Studies indicate that apart from supplementing the shortage of radiologists, if radiographers trained in image interpretation their window of opportunity will open, attain job satisfaction and professional recognition. Empirical evidence has shown that training in image interpretation can earn a radiographer advanced knowledge and understanding and he/she can act as a transformational leader in a facility.

10.4.6 Future research

Adequate funding should be made available in the future so that a researcher can access radiographers working in public hospitals in the remote and rural areas, as this was not well accomplished in this study. In the future, radiographers working in the private sector should be included in the study because this study did not include that category of radiographers. Radiography education curriculum should be explored using a questionnaire as this was only done using a small sample during interviews in the study. The Government of Kenya needs to explore how other countries implemented image interpretation so that the same can be done in Kenya.

10.4.7 Conclusion of the study

This study aimed to investigate the perceptions of Kenyan radiographers concerning training in image interpretation of the chest and musculoskeletal systems, thereafter develop a model for training radiographers in image interpretation in Kenya. The study established four major conclusions from the study based on the four objectives. The first conclusion was that the training in image interpretation of the chest and musculoskeletal systems would benefit patients by providing prompt reports, thus reducing patient waiting time. The second conclusion was that there was a gap in the provision of radiological

reports due to the shortage of radiologists and the training in image interpretation by radiographers would reduce the gap. The third conclusion was that radiography education curriculum in the institutions that train radiographers in Kenya did not support training in image interpretation. Therefore, the curriculum should be reviewed to incorporate image interpretation. The fourth conclusion was that a model for training radiographers in image interpretation of the chest and musculoskeletal image interpretation in Kenya was established.

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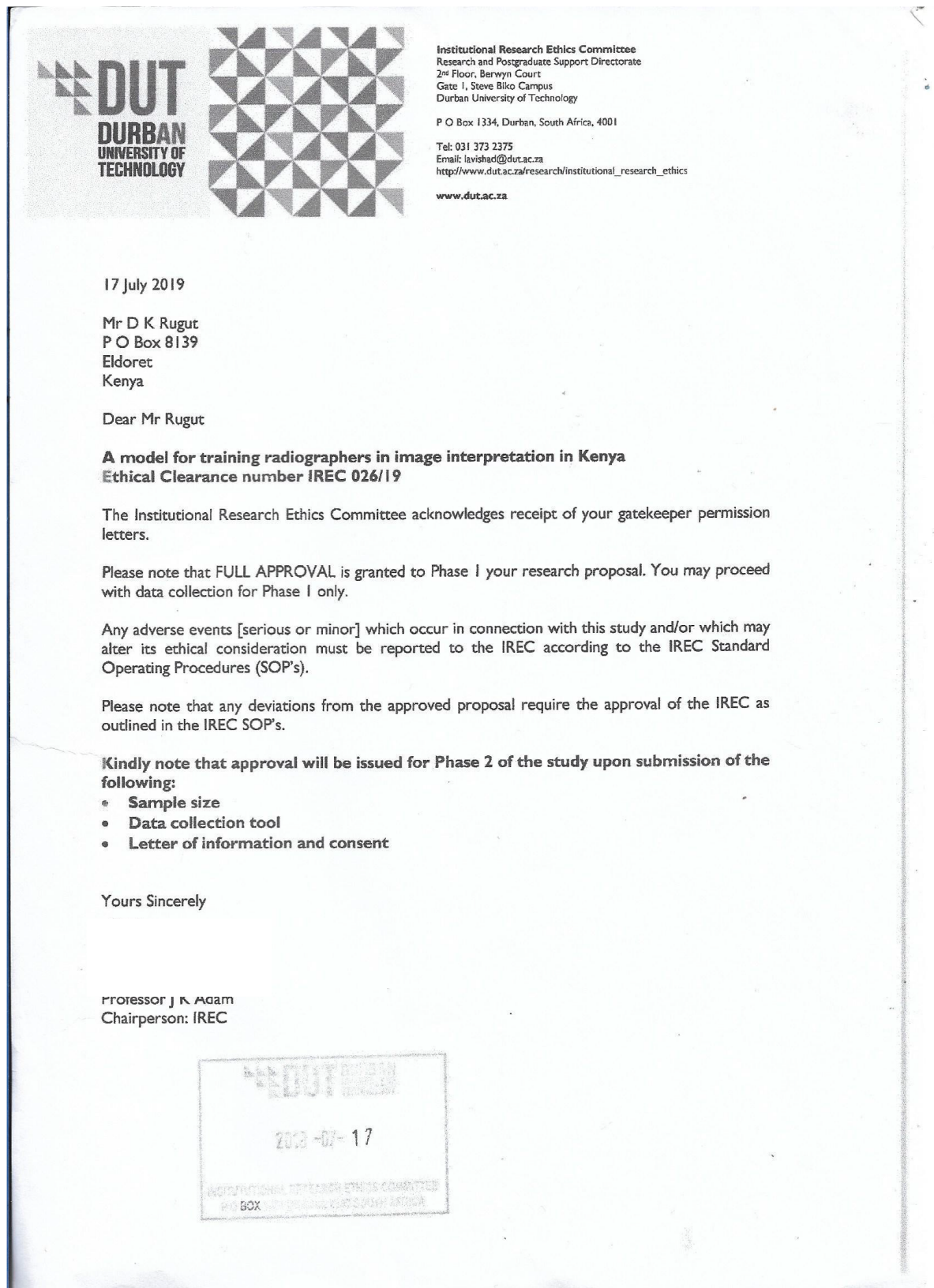
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APPENDICES

Appendix 1a: University ethics clearance for Phase 1



Appendix 1b: University ethics clearance for Phase 2



Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375

Email: lavishad@dut.ac.za

http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

10 December 2019

Mr D K Rugut
P O Box 8139
Eldoret
Kenya

Dear Mr Rugut

A model for training radiographers in image interpretation in Kenya
Ethical Clearance number IREC 026/19

The Institutional Research Ethics Committee acknowledges receipt of your data collection tool, sample size and letter of information and consent for phase 2 of your study.

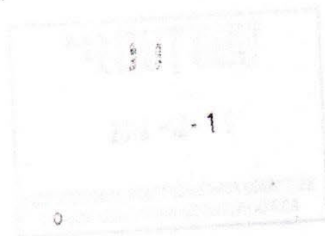
Please note that FULL APPROVAL is granted to Phase 2 your research proposal. You may proceed with data collection for Phase 2.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Professor J K Adam
Chairperson: IREC



**Appendix 2a: Permission letter to the National Commission for Science,
Technology and Innovation**

P.O. Box 8139-30100
Eldoret
Date

National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
Nairobi-Kenya

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Dear Sir/ Madam

My name is Daniel Kipkemoi Rugut, a Doctoral thesis student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis involves, "*A model for training radiographers in image interpretation in Kenya*". I am hereby seeking your consent to research public and private hospitals that provide radiological services in Kenya.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC). If you require any further information, please do not hesitate to contact my supervisor, Prof Sibiya on +27 31-373 2704. Her email address is nokuthulas@dut.ac.za. Thank you for your time and consideration in this matter.

Yours sincerely,

.....
Daniel Kipkemoi Rugut
Tel: 060848 7982
Email: danrugut@gmail.com

Appendix 2b: Approval letter from the National Commission for Science, Technology and Innovation



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 3310571, 2219420
Fax: +254-20-318245, 318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/73237/30647**

Date: **20th June, 2019.**

Daniel Kipkemai Rugut
Durban University of Technology
SOUTH AFRICA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***“A model for training radiographers in image interpretation in Kenya.”*** I am pleased to inform you that you have been authorized to undertake research in **Uasin Gishu County** for the period ending **14th June, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Uasin Gishu County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

DR. MOSES RUGUTT., PhD, OGW
DIRECTOR-GENERAL/CEO

Copy to:
The County Commissioner
Uasin Gishu County.

The County Director of Education
Uasin Gishu County.

Appendix 3a: Permission letter to the County Director

P.O. Box 8139-30100
Eldoret
Date

Office of the County Director of Health Services
P.O. Box 5665- 30100
Eldoret

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Dear Sir/ Madam

My name is Daniel Kipkemoi Rugut, a Doctoral thesis student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis involves, "*A model for training radiographers in image interpretation in Kenya*". I am hereby seeking your consent to research public and private hospitals that provide radiological services in Kenya.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC). If you require any further information, please do not hesitate to contact my supervisor, Prof Sibiya on +27 31-373 2704. Her email address is nokuthulas@dut.ac.za. Thank you for your time and consideration in this matter.

Yours sincerely,

.....
Daniel Kipkemoi Rugut
Tel: 060848 7982
Email: danrugut@gmail.com

Appendix 3b: Approval letter from the County Director

**REPUBLIC OF KENYA
COUNTY GOVERNMENT OF UASIN GISHU
DEPARTMENT OF HEALTH SERVICES**



Email: info@uasingishu.go.ke
Website: www.uasingishu.go.ke

When Replying, Please Address to:
Director Health Services
Uasin-Gishu County
P.O. Box 40 – 30100
ELDORET, KENYA.

UGC/DPP/EXT/25/19

8th July, 2019

Daniel Kipkemoi Rugut
Durban University of Technology
South Africa

Dear Sir,

RE: RESEARCH AUTHORIZATION

Following your application for authorization to carry out research on “A model for training radiographers in image interpretation in Kenya.”

I am pleased to inform you that you have been authorized to undertake research in Uasin Gishu County.

Kindly note that, this authorization letter only applies to the public health facilities in the County, and the specific staff your research is targeting namely radiographers.

The facilities that have radiographers are as follows:

1. Uasin Gishu District Hospital
2. Burnt Forest Sub County Hospital
3. Turbo Sub County Hospital
4. Ziwa Sub County Hospital

On submission of this letter, the facilities in charges are instructed to permit you to engage their radiographers.

Thank you.

Sincerely,



Dr. Reuben K...

Ag. County Director Health Preventive Promotive

Appendix 4a: Permission letter to the radiographer-in-charge

P.O. Box 8139-30100
Eldoret
Kenya
18/7/2019.

Radiographer-in-charge
Uasin Ngishu County Hospital
Radiology Department
P.O. Box 542, 30-100
Eldoret

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Dear Radiographer-in-charge

My name is Daniel Kipkemai Rugut, a Doctoral thesis student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis involves, "*A model for training radiographers in image interpretation in Kenya*". I am hereby seeking your consent to research with the radiographers in your unit.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC). If you require any further information, please do not hesitate to contact my supervisor, Prof Sibiya on +27 31-373 2704. Her email address is nokuthulas@dut.ac.za. Thank you for your time and consideration in this matter.

Yours sincerely,

.....
Daniel Kipkemai Rugut
Tel: 060848 7982
Email: danrugut@gmail.com

Appendix 4b: Approval letter from the radiographer-in-charge



The County Government of Uasin Ngishu
Department of Health Services
P.O. BOX 40-30100
Eldoret, Kenya.
9th September 2020

Daniel Kipkemai Rugut
Durban University of Technology
South Africa

Dear Sir,

RE: RESEARCH AUTHORIZATION

Upon your request for authorization to conduct research in the department of radiology and imaging within Uasin Ngishu County entitled, "A model for training radiographers in image interpretation in Kenya," I am pleased to inform you that you have been authorized to undertake the research.

Thank you.

Sincerely,



Radiographer in-charge Uasin Ngishu County Department of Radiology and Imaging.

Appendix 5a: Letter of information for the FGD participants



Dear Participant

Thank you for agreeing to participate in the study. The information about the study is as follows:

Title of the Research Study: A model for training Radiographers in image interpretation in Kenya.

Principal Investigator/s/researcher: Mr D.K. Rugut, Doctor of Radiography Candidate.

Co-Investigator/s/supervisor/s: Prof M.N. Sibiya, D Tech: Nursing and Dr P.B. Nkosi, PhD: Health Sciences.

Brief Introduction and Purpose of the Study: There is an acute shortage of radiologists in Kenya particularly in the remote and rural areas, and as a result, radiographic images are sent to national, provincial, referral and academic institutions where radiologists are available. This causes a delay in the treatment of patients. My study aims to develop a model for training radiographers in image interpretation in Kenya to supplement the shortage of radiologists.

Outline of the Procedures: You are kindly requested to participate in the focus group discussion. The discussion will be conducted at convenient venues, at the agreed date and time. The discussion will be facilitated by the researcher and permission is requested to record the discussion for record purposes. The discussion will take an hour to 90 minutes in each session.

Risks or Discomforts to the Participant: There is no anticipated risk or discomfort for participating in this study.

Benefits: The training of radiographers in image interpretation will enhance cooperation between radiologists and radiographers in research activities. Radiographers will achieve professional recognition and their window of opportunity will open.

Reason/s why the Participant May Be Withdrawn from the Study: You have the right to withdraw from the study at any time without penalty.

Remuneration: There is no remuneration for participating in the study.

Costs of the Study: There are no financial expenses that are expected from you by participating in this study.

Confidentiality: All information and data will be kept strictly confidential. Your name will not be used in the research documents; instead, a code will be used to identify the interview guide.

Research-related Injury: There is no anticipated research-related injury for participating in this study.

Persons to Contact in the Event of Any Problems or Queries: If you have any questions, concerns or problems at any time about the study or the procedures feel free to contact the researcher, Daniel Rugut: telephone no. +27 60 848 7982, danrugut@gmail.com or my supervisor Prof M.N. Sibiya on 031-373 2704 or the Institutional Research Ethics Administrator on +27 31-373 2375. Complaints can be reported to the Director: Research and Postgraduate Support, Prof C. Napier on +27 31-373 2577 or carinn@dut.ac.za

Appendix 5b: Letter of information for the survey participants



Dear Participant

Thank you for agreeing to participate in the study.

Title of the Research Study: A model for training radiographers in image interpretation in Kenya.

Principal Investigator/s/researcher: Daniel Rugut, Doctor of Radiography Candidate.

Co-Investigator/s/supervisor/s: Prof M.N. Sibiya, D Tech: Nursing and Dr P.B. Nkosi, PhD: Health Sciences.

Brief Introduction and Purpose of the Study: There is an acute shortage of radiologists in Kenya particularly in the remote and rural areas, and as a result, radiographic images are sent to national, provincial, referral and academic institutions where radiologists are available. This causes a delay in the treatment of patients. My study aims to develop a model for training radiographers in image interpretation in Kenya to supplement the shortage of radiologists.

Outline of the procedures: You are kindly requested to participate in the study by completing the questionnaire. The time for completing the questionnaire is about 30 minutes. I will personally distribute and collect the questionnaire. In order to ensure confidentiality, please do not write your name on the questionnaire. A box will be made available for you to deposit the completed questionnaire.

Risks or Discomforts to the Participant: There is no anticipated risk or discomfort for participating in this study.

Benefits: Participants will benefit from publications.

Reason/s why the Participant May Be Withdrawn from the Study: You have the right to withdraw from the study at any time without penalty.

Remuneration: There is no remuneration for participating in the study.

Costs of the Study: There are no financial expenses that are expected from you by participating in this study.

Confidentiality: All information and data will be kept strictly confidential. Your name will not be used in the research documents; instead, a code will be used to identify the interview guide.

Research-related Injury: There is no anticipated research-related injury for participating in this study.

Persons to Contact in the Event of Any Problems or Queries: If you have any questions, concerns or problems at any time about the study or the procedures feel free to contact the researcher, Daniel Rugut: telephone no. +27 60 848 7982, danrugut@gmail.com or my supervisor Prof M.N. Sibiya on +27 31-373 2704 or the Institutional Research Ethics Administrator on +27 31-373 2375. Complaints can be reported to the DVC: Research, Innovation and Engagement, Prof S. Moyo on +27 31-373 2577 or moyos@dut.ac.za

Appendix 6: Consent



Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr D.K. Rugut about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

- _____
Full Name of Participant / Right Thumbprint **Date** **Time** **Signature**

- I, Daniel K. Rugut herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

- _____
Full Name of Researcher **Date** **Signature**

- _____
Full Name of Witness (If applicable) **Date** **Signature**

- _____
Full Name of Legal Guardian (If applicable) **Date** **Signature**

Appendix 7: Demographic data for the FGD participants

PERSONAL INFORMATION

Participant No:

Name of hospital:

Date.....

Age.....

Gender.....

Race:

Years of experience.....

Position held.....

Appendix 8 Focus group discussion guide

QUESTIONS

- 1. What are your perceptions regarding training of radiographers in image interpretation of the chest and musculoskeletal image interpretation?** *Probing question*

How will the training benefit your hospital?

- 2. What would be the impact of radiographers training in image interpretation of the chest and musculoskeletal image interpretation?** *Probing question*

Will patients receive timely treatment if radiographers trained in image interpretation?

- 3. What is the gap in regard to the provision of radiological reports of the chest and musculoskeletal image interpretation?**

Probing question

Is there a shortage of radiologists in the country?

- 4. How does the radiography education curriculum support training of radiographers in image interpretation of the chest and musculoskeletal image interpretation?**

Probing question

What subjects are you taught that you think are in line with image interpretation?

Appendix 9: Questionnaire

Section A: Demographics

This section refers to background or biographical information. Please indicate the relevant answer by placing a cross (X) in the box provided below.

1. Gender

Male	
Female	

2. Age

21-33	
34-49	
50 years and older	

3. Race

Black	
Indian	
Coloured	
White	
Other	

4. Marital Status

Single	
Married	
Divorced/Separated	
Widowed	

5. Number of years as a qualified radiographer

Less than 1 year	
1 – 10 years	
>10 – 20 years	
More than 20 years	

6. Current position occupied (Select **ONE** option only)

Grade 1 radiographer	
Grade 2 radiographer	
Grade 3 radiographer	
Assistant Director	

7. Occupation (In case of dual practice, select the **ONE** you currently practice).

Diagnostic radiographer	
Mammography radiographer	
Nuclear medicine radiographer	
Sonographer	
Radiation therapist	

Section B: Perception of radiographers towards image interpretation

1. Indicate your level of agreement with the following statements regarding the effect of training radiographers in image interpretation:

Training radiographers in chest and musculoskeletal image interpretation	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
1.1 ... will benefit patients.						
1.2 ... will improve the efficiency of healthcare institutions.						
1.3 ... will facilitate patient treatment.						
1.4 ... will benefit patients by providing prompt reports.						
1.5 ... will benefit patients by minimizing the costs of long distance travelling to seek radiological reports from national and referral hospitals.						
1.6 ... will result in appropriate management of patients by clinicians.						
1.7 ...will benefit patients by reducing the backlog of unreported radiographic images.						
1.8 ... will ensure that clinicians will receive reports (because the radiographers will be able to do them at the time of the x-ray).						
1.9 ... will have a positive impact on the service provided by the radiology department.						
1.10 ... will enable health institutions to charge for the reports as well as the x-ray and hence increase their income.						

Training radiographers in chest and musculoskeletal image interpretation	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
1.11 ... will minimize repeats of radiographic images						
1.12 ... will minimize costs incurred in transferring patients to referral hospitals						
1.13 ... will enable remote and rural hospitals to give their patients the service and treatment that is needed at the time of their visit						
1.14 ... will reduce the number of referrals of patients from remote and rural hospitals						
1.15 ... will reduce the workload of radiologists						
1.16 ... will benefit my hospital						
1.17 ... will give radiologists more time to perform more complex examinations						

Section C: Opinions of radiographers

2. Indicate your agreement with the following statements:

Statements	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
2.1 The opinions of radiographers are sought in remote and rural hospitals where radiologists are not available.						
2.2 The training in image interpretation should be at master's level.						
2.3 Radiologists need to be incorporated in the training of radiographers in image interpretation.						
2.4 If given an opportunity to train in image interpretation, I would take it up.						
2.5 There are gaps in the provision of radiological reports						
2.6 The gaps in the provision of radiological reports are as a result of radiologists being overworked						

3. How many days, on average, is the gap between having an x-ray of the chest and musculoskeletal system taken and receiving the radiologist's report?

_____ days

Thank you for your time and participation

Appendix 10: Sample of a transcript

Interview transcript

Interviewer: Daniel K. Rugut

Participant: 3

Date: 8/8/2019

Time: 12:05 pm

Place: Moi Teaching and Referral Hospital

1. Interviewer: I'm pleased to meet you! My name is Daniel K. Rugut, am a researcher. Am here to interview you on the training of radiographers in image interpretation.

Participant: Am pleased to be interviewed by you.

2. Interviewer: Why would radiographers be trained in image interpretation of the chest and musculoskeletal image interpretation?

Participant: I think that the hospitals will benefit.

3. Interviewer: How would training of radiographers in image interpretation of the chest and musculoskeletal image interpretation benefit the hospital?

Participant: Additionally, the radiology reports to clinicians will be available on time and diagnosis by clinicians will be faster and thus proper management of patients. Usually patients take x-rays and are told to come once radiology is available. The x-rays are then sent to hospitals which provide radiology reports. This results in high workloads of radiology reports.

Training of radiographers in image interpretation will result in the reduction of the backlog of unreported images.

Hospitals will also benefit because rural and remote hospitals will be able to manage their patients well and referrals will be reduced. This will minimize congestion in the hospitals and will also reduce cross infection.

4. Interviewer: How would training of radiographers in image interpretation of the chest and musculoskeletal image interpretation benefit the patients?

Participant: Eh... In many ways.... For example ... If a patient has a spinal injury, the patient will receive timely radiology reports because the radiographers will be the ones providing them (radiology reports). This can enhance the management of the patient because the doctors will provide appropriate treatment for the spinal injury.

There will not be any referrals of patients to hospitals where they can get radiology reports immediately, therefore patients coming from far areas will be able to get to their homes on time. Also the costs of travelling long distances can be minimized? Patients will be treated on time and will not overstay in the hospital”.

5. Interviewer: How would training of radiographers in image interpretation of the chest and musculoskeletal image interpretation benefit the radiographers?

Participant: After training in image interpretation, radiographer's window of opportunity will open, attain job satisfaction and professional recognition.

6. Interviewer: How would training of radiographers in image interpretation of the chest and musculoskeletal image interpretation benefit the radiologists?

Participant: Often clinicians requested for wrong examinations that prompted radiologists to make other requests, which is wastage of films and addition of workload for the radiologists. Thus, training of radiographers in image interpretation will alleviate workload for the radiologist and reduce wastage of films. Hospitals will save a lot of money because there will be no more film wastage due to repeated images. Radiologists did not provide timely reports even in the public hospitals where they work, because they are overwhelmed with work as they also offer their services in private hospitals and also work as lecturers at the same time and so patients don't get timely reports.

7. Interviewer: How would training of radiographers in image interpretation of the chest and musculoskeletal image interpretation influence daily operations in the hospitals?

Participant: Most county hospitals do not have radiologists and thus have a gap in the provision of radiological reports. They only come twice in a week. For example, a patient can be x-rayed on a Friday and the radiologist comes on a Monday. When a radiologist is available the patient has already left. This gap can be closed if radiographers train in image interpretation because radiology reports will be readily available.

8. Interviewer: How does radiography education support the training of radiographers in image interpretation of the chest and musculoskeletal image interpretation?

Participant: The radiography education curriculum at the institutions that provide radiography education in Kenya does not support the training of radiographers in image interpretation. They don't teach image interpretation; more emphasis should be given to pathology and anatomy that are relevant to image interpretation. Laboratories should be established for training in image interpretation. A curriculum should be put in place for training radiographers in image interpretation. Laboratories should be established for training in image interpretation.

9. Interviewer: Do you have anything else to say?

Participant: No, that is all...

10. Interviewer: Thank you for participating.

Interview ends at: 1:05 pm.

Appendix 11: Letter from the statistician

Gill Hendry B.Sc. (Hons), M.Sc. (Wits), PhD (UKZN)
Mathematical and Statistical Services

Cell: 083 300 9898
Email: gillhendrystats@gmail.com

6 October 2020

Re: Assistance with statistical aspects of the study

Please be advised that I have assisted Daniel Rugut (Student number 21856353), who is currently studying for a Doctor of Radiography at DUT, with the questionnaire development, sampling and data analysis for his study.

Yours sincerely

Gill Hendry (Dr)

Appendix 12: Letter from the professional editor

DR NELLIE NARANJEE: LECTURER

Doctorate Nursing, MBA, MCur (Health Sciences)

28 Protea Road Kloof ,3610

Freelance academic editor: Blackford Institute, UK

Contact details

Office: 031 3732036

After hours: 031 7643815

Mobile: 0825776126

Email naranjeen@gmail.com

NellieN1@dut.ac.za

EDITING / PROOFREADING CERTIFICATE

Re: **Mr Daniel Kipkemoi Rugut (21856353)**

Masters/Doctoral thesis: **A model for training radiographers in radiographic interpretation in Kenya**

I confirm that I have edited this thesis for writing style, clarity, language, sentence structure and layout. The document is formatted according to the prescribed guidelines. I returned the document to the author with track changes. The author remains responsible for the correct application of the changes in the text and references.

I am a freelance editor specializing in proofreading and editing of academic documents. I have a Doctorate Degree in Nursing from Durban University of Technology. I have a Master's Degree in Business Administration (Public Health) and a Master's Degree in Health Sciences. I have a Diploma in Proofreading and Copy Editing with Distinction from the Blackford Institute, UK. I have supervised numerous Master's degree dissertations.

I wish Mr Rugut all the best.

DR NELLIE NARANJEE

18 October 2020

DATE