KNOWLEDGE, CLINICAL COMPETENCIES AND MEDICO-LEGAL RESPONSIBILITIES REQUIRED BY DIAGNOSTIC RADIOGRAPHERS FOR THE INTERPRETATION OF RADIOGRAPHS

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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is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources).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 to any other institution for assessment or for any other purpose.

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Abstract

Background

In SA, image interpretation and reporting by diagnostic radiographers have yet to be validated. Currently, the only training exposure and formalized education that diagnostic radiography students get in the four-year undergraduate degree relates to pattern recognition and pathological conditions However, a review of the regulations on the scope of practice of radiographers is currently being undertaken by the Health Professions Council of South Africa (HPCSA) to include formal reporting in South Africa.

Aim

The aim of the study was to explore the knowledge, clinical competencies and medico-legal responsibilities required by diagnostic radiographers for the interpretation of radiographs and ultimately, to recommend training guidelines for radiographers in the interpretation of radiographic images.

Methodology

A qualitative descriptive study employing criterion sampling of qualified radiologists practicing within the eThekwini district of KZN province was conducted. Ethics approval to perform this study was obtained from the Durban University of Technology's (DUT's) Institutional Research Ethics Committee (IREC). All the participants were contacted in their personal capacity. The research tool used for this study was face-to-face, one-on-one, semi-structured and in-depth interviews, which included various questions related to radiographic image interpretation. The data from the interviews were analysed by the researcher using Tesch's eight steps for analysing qualitative data. Moreover, all the data obtained from this research study was kept confidential and under password protection by the researcher.

Findings

Findings reveal that Radiologists support the interpretation of radiographic images by radiographers in rural settings, and for the radiographer's scope of practice to be restructured to include the chest and the musculoskeletal system. Extension in the scope of practice would result in increased job satisfaction, as the overall costs, rates and turnaround time will be affected if radiographers interpret images. Moreover, image interpretation training should begin 3-5 years post degree. An in-depth knowledge of anatomy, radiological anatomy and pathophysiology is required to understand pattern recognition during image interpretation. The training would be between 6 months and 5 years. Findings also indicated that there should be continuous monitoring and accreditation for image interpretation courses, with accreditation being in the form of a diploma for each system, a degree or a certificate of competence. Assessments for image interpretation should be carried out by radiologists. The participants of this study found that clinical competency for radiographers who are performing image interpretation has to do with the assessment of the patient, with assessment determining the history, the background, the past medical history of relevance and the current presenting symptoms. The study also suggested that apart from having stringent criteria for radiographers entering the image interpretation course, radiographers must be able to triage patients and all assessments should be done by a radiologist. The findings also indicated that no harm is to be done to the patient; patient information must not be disclosed to others; radiographers should be covered in the event of adverse outcomes when interpreting images; there should be decision-making regarding the radiologic/radiographic report; and the rights of a healthcare provider are to be protected.

Key words:

Radiographers, role extension, image interpretation, knowledge, clinical competencies, medico-legal responsibilities

Dedication

This dissertation is dedicated to the most important person in my life, my dad, Javen – “Thank you Daddy for giving me the strength to complete this degree. I love you”

and

This dissertation is dedicated to my late mum, Seema, and my late brother, Ryan. Their unconditional love, support and encouragement will always be one of my biggest blessings and I pray that they will guide me through my future studies.

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Table of contents

List of Tables

List of Figures

List of Appendices

Glossary of Terms

Scope of practice

The actions, procedures and processes that a radiographer is permitted to undertake in keeping with the terms of their professional licence (Van der Venter and Ham-Baloyi 2019: 179)

Role extension

The acquisition of supplementary responsibilities and skills that extend beyond the statutory competencies and responsibilities at the point of professional registration (Hardy and Snaith 2006: 328).

Advanced radiographer practice

This refers to autonomous and expert duties, independent of radiologists (Moran, Taylor and Warren-Forward 2013: 131).

Practice Standards

Published statements from individual professions about what their members are competent to do and what others can expect them to do (Chiu 2013: 19).

List of Acronyms

D	Diagnostic
US	Ultrasound
RT	Radiotherapy
NM	Nuclear Medicine
HPCSA	Health Professions Council of South Africa
SA	South Africa
PBRCT	Professional Board for Radiography and Clinical Technology
UK	United Kingdom
SoP	Scope of Profession
KZN	Kwa-Zulu Natal
USA	United States of America
MRPBA	Medical Radiation Practice Board of Australia
ASMIRT	Australian Society of Medical Imaging and Radiation Therapy
PIE	Preliminary image evaluation
RRA	Registered radiology assistant
ARRT	American Registry of Radiologic Technologists
ECUREI	Ernest Cook Ultrasound Research and Education Institute
DoH	Department of Health
HEI	Higher Education Institution
WPBA	Workplace based assessments
AIDET	Acknowledge, Introduce, Duration, Explanation and Thank you
SATS	South African Triage Scale
EMS	Emergency Medical Services
RCS	Radiographers Competence Scale

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

The radiography profession consists of four sub-categories, which include Diagnostic (D), Ultrasound (US), Radiotherapy (RT) and Nuclear Medicine (NM) (Koch 2016: 1). Mammography, which is a specialized field, is included in the profession of radiography (Strøm, Pires Jorge, Richli Meystre, Henner, Kukkes, Metsälä, and Sàdos Reis 2018: 45). Mammography is a procedure used in imaging to detect and diagnose breast pathologies (Strøm *et al*. 2018: 41). Radiography training is offered at various Universities of Technology and Universities across South Africa (SA) (Health Professions Council of South Africa (HPCSA) 2020: list). For that reason, the only training exposure and formalized education that Diagnostic Radiography students get in the four-year undergraduate degree relates to pattern recognition and pathological conditions (Van der Venter and Ham-Baloyi 2019: 179). Consequently, the interpretation of images by radiographers is not permitted.

In SA, image interpretation and reporting by diagnostic radiographers have yet to be validated. The Professional Board for Radiography and Clinical Technology (PBRCT) stated in their guidelines for examinations of sonographers, in the category 'diagnostic ultrasound', that ultra-sonographers are to provide a report of their findings from scans to referring clinicians (Health Professions Council of South Africa (HPCSA) Form 300 2008: 3). The clinicians can then make a diagnosis from the information provided to them. Therefore, a review of the regulations of the scope of practice of radiographers is currently being undertaken by the Health Professions Council of South Africa (HPCSA) to include formal reporting in South Africa (Bwanga, Mulenga and Chanda 2019: 216). In radiography, 'scope of practice' describes the actions, procedures and processes that a radiographer is permitted to undertake in keeping with the terms of their professional licence (HPCSA 2020: 1). Current regulations state that radiographers are only permitted to provide a verbal,

voluntary opinion on the examination that was performed (Van der Venter and Ham-Baloyi 2019: 179).

Annexure 10 of the HPCSA's Ethical Rules of Conduct pertaining to the profession of Radiography states that radiographers may only work at the request of a registered practitioner and may not exceed the limits of the category under which he/she is registered (HPCSA 2020: 48-49). This means that radiographers may only perform professional acts pertaining to the profession of Radiography and, in particular, the category which they are registered for with the HPCSA. Currently, the interpretation of images and reporting by radiographers is not allowed. According to Holdt and Pitcher (2019: 1511), there is an increasing request for radiological examinations, globally, with the assumption that all such examinations will be timeously reported. However, due to the radiologist shortage, untimely reports are resulting, which cannot positively influence patient management (Williams 2009: 15). As a solution, the United Kingdom (UK) has delegated the plain film reporting workload to suitably trained radiographers. Support from radiologists for the role extension of radiographers is thus of utmost importance.

In SA, the responsibilities and duties of a radiographer involve continuous interactions with the patient, general public, as well as other healthcare professionals. These interactions occur before, during and after offering medical imaging services (Sethole, Deventer and Chikontwe 2019: 272). The additional responsibilities, such as image interpretation, by radiographers have been termed 'skill-mixing' or 'role extension' (Williams 2009: 15). In fact, Kekana, Swindon and Mathobisa (2015: 1115) highlighted that the interpretation of planar radiographs by South African radiographers has been well-documented in literature as a key area that needs to be included in the scope of practice for Radiographers in SA. Van der Venter and Ham-Baloyi (2019: 184) highlighted that radiographers taking on this role must be adequately and appropriately trained, preferably at a post-graduate level. It is also wise to note that radiographer-led reporting in clinical practice is a viable option in the attempt to curb the burdens facing the South African healthcare system (Van der Venter and Ham-Baloyi 2019: 184).

The regulations defining the scope of radiographers should allow for formal image interpretation by diagnostic radiographers as radiographers possess basic knowledge to contribute considerably in the clinical environment in interpreting images. However, role clarifications regarding the practice of radiographers taking up an image interpretation role result in formal, intensive educational programmes being required (Van der Venter and Ham-Baloyi 2019: 184).

Speelman and Mdletshe (2018: 8) state that the Professional Board for Radiography and Clinical Technology (PBRCT) is currently seeking Ministerial approval to change the Scope of the Profession (SoP) for Radiography. The changes in the SoP are able to address the needs of the profession; the needs of the country; the changing educational landscape of the country, as well as to align the scope with international best-practice. The Board was solemnly engaged and ensured that it fulfilled the mandate of protecting the guiding professions and the public, as well as achieving the stated strategic objectives. The only outstanding objective that the Board wished to achieve in the reporting period was for the promulgation of the Revised Scope of Profession for Radiography by the Minister of Health (HPCSA Annual Report 2018/2019: 149).

This research study aimed at exploring the knowledge, clinical competencies and medico-legal responsibilities required for South African radiographers according to radiologists, in order for these radiographers to interpret images. With the data from the research, the researcher attempted to determine the South African radiographer's future scope of training for the interpretation of images. Radiologists already have image interpretation training in their scope of practice. Hence, they were best-suited to provide the essential data required for this research study.

1.2 PROBLEM STATEMENT

A radiological report is one of the most important means of communication between a referring medical doctor and the radiologist. Hence, all radiologists wish to produce reports that are accurate and that also interpret the

investigation for a particular patient in a way that assists with the patient's further management and care (European Society of Radiology 2011: 93). Van der Venter, Du Rand and Grobler (2017: 129) stated that the shortage of radiologists has led to the under-reporting of radiographic images in South Africa, thus leading to the mismanagement and inappropriate treatment of patients. Moreover, up to 67% of South African radiologists were considering emigrating (Moodley 2017: vi), which means that there may be even fewer radiologists available to South Africans. Hardy and Snaith (2006: 328) stated that when applied to healthcare practice, role extension can be defined as the acquisition of supplementary responsibilities and skills that extend beyond the statutory competencies and responsibilities at the point of professional registration. Consequently, role extension involves the post-qualification development of skills and responsibilities, with resultant professional accountability. The question then arises as to what images are suitable for radiographers to interpret and what knowledge, clinical competencies and medico-legal responsibilities are required by radiographers to interpret images. All of these elements have not been documented.

1.3 AIM OF THE STUDY

The aim of the study is to explore the knowledge, clinical competencies and medico-legal responsibilities required by diagnostic radiographers for the interpretation of radiographs, and to ultimately recommend training guidelines for radiographers in the interpretation of radiographic images.

1.4 RESEARCH QUESTIONS

1.4.1 Main research question: What are the perceptions of radiologists with regard to the knowledge, clinical competencies and medico-legal responsibilities required by diagnostic radiographers in the interpretation of radiographic images?

1.4.2 Sub-questions:

- What are the opinions of radiologists with regard to the scope of practice in the interpretation of radiographs by radiographers?

- What is the knowledge required by diagnostic radiographers for the interpretation of radiographs, as perceived by radiologists?
- What are the clinical competencies required by diagnostic radiographers for the interpretation of radiographs, as perceived by radiologists?
- What medico-legal responsibilities are required by diagnostic radiographers for the interpretation of radiographs, as perceived by radiologists?
- What recommendations can be made to the Health Professions Council of South Africa and the Department of Health to train radiographers in image interpretation?

1.5 SIGNIFICANCE OF THE STUDY

A study carried out in KwaZulu-Natal (KZN) has identified a need for further training of radiographers with regard to role extension (Gqweta 2014: 15). The South African radiographer's role extension is further motivated by the fact that in selected countries abroad, radiographers are permitted to interpret images following the completion of further training and certification. The United Kingdom (UK) has re-shaped their radiographer practice to include clinical reporting and other countries such as Norway and Denmark have developed models of advanced radiographer practice, which includes definitive clinical reporting (Woznitza 2014: 66). In Australia, radiographers must communicate significant clinical findings to the appropriate clinicians with associated record-keeping (Murphy, Ekpo, Steffens, T. and Neep 2019: 270). In the United States of America (USA), radiographers have undertaken role extension training to provide preliminary technical reports to assist clinical radiologists and referrers (Royal Australian and New Zealand College of Radiologists 2018: 5).

It is therefore evident from international literature that SA is not yet on par with the advanced practices of the Radiography profession. New radiography qualifications that may include some elements of role extension are currently being implemented at Universities of Technology across SA (Koch 2016: 6). The need was therefore expressed for local research to be conducted in order to provide scientific input within a local context for the development of national

training guidelines for the interpretation of images by radiographers. In a Radiography Day seminar held in Durban, SA on 07 November 2014, it was indicated that the training provided abroad is unique to each country and may be due to the legal boundaries and specific needs of those countries. For this reason, it is essential to obtain local South African data (Kekana 2014). Burch (2016: 146) highlighted that the Editor-in-Chief of the African Journal of Health Professions Education (AJHPE) had also emphasized the need for local research to be conducted in order to meet the training needs of all healthcare professionals. It is anticipated that the outcome of this research study would assist in formulating the future scope of practice and scope of the profession for image interpretation by radiographers in SA.

1.6 STRUCTURE OF THE DISSERTATION

This dissertation is presented in six chapters as outlined in Table 1.1 below.

Table 1.1: Summary of the chapters of the dissertation

Chapter	Topic	Content description
1	Overview of the study	Provides an introduction and background to the study.
2	Literature Review	Provides an in-depth review of literature related to the interpretation of radiographs by radiographers.
3	Research design and methodology	Justifies the research design and methods that were used to guide the study.
4	Findings of the study	Presents the findings of the study as themes.
5	Discussion of findings	Presents the discussion of the findings.
6	Conclusion, limitations and recommendations	Concluding remarks, limitations and recommendations for future research are presented.

1.7 SUMMARY OF THE CHAPTER

The introductory chapter provided the background to the research study, as well as the problem statement. The significance of the research study was explained and linked to the research aim and research questions. Additionally, this chapter outlined the content of subsequent chapters.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This literature review aims to identify a gap that the research question could address, with its purpose being to introduce readers to the research phenomenon. In this study, the data collected was the knowledge, clinical competencies and medico-legal responsibilities required by diagnostic radiographers for the interpretation of radiographs, according to radiologists, The literature review in this research study focuses on seven different areas, namely: i) Radiography as a profession, ii) the role of radiologists, iii) the global view of radiographic image interpretation, iv) Radiography in Africa, v) Radiography in South Africa, vi) previous methodology regarding the topic and 7) the theory that motivates this study.

The profession of radiography is changing as radiographers in selected countries have extended their legal practice boundaries (Van de Venter and Friedrich-Nel 2021: 45). Thus, the researcher hopes that this research study can provide input into the development of national training guidelines for the interpretation of images by South African radiographers from the data obtained from radiologists, that is, people who already have image interpretation in their scope of training and practice.

2.2 PROCESS OF REVIEWING LITERATURE

The process of reviewing the literature is made up of seven sections: i) Radiography as a profession, ii) the role of radiologists, iii) the global view of radiographic image interpretation, iv) Radiography in Africa, v) Radiography in South Africa, vi) previous methodologies regarding the topic and vii) the theory that motivates this study.

In the first area, *Radiography as a profession*, the reader is introduced to the field of radiography and the skills required in this profession. Moreover, the concept of radiographic role extension/ advanced radiographic practice in

South Africa and the United Kingdom was introduced, and the impact of radiographer role extension and radiographer training was discussed. The keywords of this area were Radiography profession, skills, role extension and radiographer training. The second area discussed the *role of radiologists*, with the keywords being the Radiology profession. The third area, *global view of radiographic image interpretation*, focused on the global scope of practice; global training for advanced radiographer practice; the global radiologist to population ratio; and the training aspects required by radiographers. Important keywords were global scope of practice, global radiographer training, global radiologist to population ratio and radiographer clinical competencies, knowledge and medico-legal responsibilities.

The fourth area, *Radiography in Africa*, focused on radiographer training; the radiologist to population ratio in African countries; and the training offered to radiographers for advanced practice. Important keywords were African radiographer training, African radiologist to population ratio and African training offered for advanced practice. The fifth area, *Radiography in South Africa*, focused on the South African scope of practice; South African radiologist to population ratio; radiographer role extension in South Africa; South African radiologists' views on radiographer role extension; the recommendations for the future scope of practice of radiographers and previous theory and methodologies regarding the topic. Important keywords were: The South African radiographer scope of practice, South African radiologist to population ratio, South African radiographer role extension, recommendations for role extension and past research regarding the topic.

The sixth area discusses the previous methodologies regarding the topic. Important keywords are: theory and methodology for role extension. The seventh area discusses the theory that the researcher found most fitting for the study. Here, the most important keyword was 'theory'.

2.3 RADIOGRAPHY AS A PROFESSION

The profession of Radiography is constantly evolving to meet the need of modern times. In Radiography, patient care and technology envelopes all the categories of medical imaging. According to Etheredge (2011: 9), the four categories of radiography in South Africa are therapeutic, diagnostic, ultrasound and nuclear medicine, but StrØm *et al*. introduced a fifth category in Radiography: mammography (2018: 45). A general aspect of Radiography is its combination of human communication and patient care with operationally complex machinery (Lundvall, Dahlgren and Wirell 2014: 48). In fact, according to Fridell, Aspelin, Edgren, Linskold, and Lundberg (scope: 121), a radiographer's skills in the image production process has changed from just knowing exposure parameters to operating computers and post-processing images. Gqweta (2012: 22) highlighted that radiographers have gained theoretical knowledge and additional clinical skills, which were previously the domain of the radiologist. Hence, the concept of role extension of radiographers came about. Since the inception of role extension in countries such as the UK, there has been a reduced volume of unreported images, an improvement in service delivery and a more efficient turnaround for reports to referring doctors (Essay sauce 2014: 1). In order to understand the concept of role extension better, it can be explained as additional responsibilities and tasks undertaken by radiographers at the request of the radiologist, while advanced practice implies autonomous and expert duties, independent of radiologists (Moran, Taylor and Warren-Forward 2013: 131). In agreement with this, Gqweta (2012: 22) stated that role extension means the adoption of duties that were previously only within the radiologist's scope of practice.

Absent or delayed radiograph reporting may adversely impact patient clinical management and care (Hlongwane and Pitcher 2013: 638). Additionally, there is an increasing demand for radiological services by the population, which cannot be overcome due to a decreasing availability of radiologists (Gqweta 2012: 22). Role extension for the profession of Radiography is essential to support patients and society for better healthcare and services. For careful consideration and proper plans to be invested in role extension, the support and cooperation of radiologists are vital. In addition, educational providers will

need to structure their programmes to support role extension. Higher authorities and professional bodies will also need to support role extension with improved training, guidelines and scope of practice for radiographers to work within legal boundaries. This implies the proper adoption of role extension whereby South African radiographers can transform the demands of this powerful profession.

2.3.1 Radiographer Training

Typically, radiographer training courses are focused on the radiographer's traditional scope of practice around image acquisition and image presentation prior to image interpretation and diagnosis by a clinical radiologist. In addition to learning about radiographic techniques and methods, radiographers learn about radiation physics and safety, human biology, how to handle patient needs and how to communicate effectively (Royal Australian and New Zealand College of Radiologists 2018: 13). Most accreditation models are based on graduates achieving an acceptable level for entry to practice as Radiographers. The curricula of these models are cross- referenced to scopes of practice and/or competencies, which are well-defined and have been formulated by practitioners. The application of knowledge or the clinical/ academic collaboration is the main feature of these models (Cowling 2013: 90).

2.3.2 Impact of Radiographer role extension/ image interpretation

Advanced roles in Radiography may provide motivation for young radiographers to take a new interest in Radiography, instead of changing professions (Moran and Warren-Forward 2011: 274). Therefore, with education post qualification and the correct training, there may be new career pathways for South African radiographers. Role extension also has the ability to enhance job satisfaction. Inevitably, it will then aid in recruitment into the medical imaging profession. Moran, Taylor and Warren-Forward (2013:135) stated that the most identified advantage of role extension was job variety. Variety referred to an increase in Radiographer responsibilities (Moran, Taylor and Warren-Forward 2013: 133), as well as the alleviation of repetition when scanning patients (Moran, Taylor and Warren-Forward 2013: 135). However, the overall benefit of role extension in Radiography is to keep society stable and fit in terms of the rapid response of medical imaging professionals to above-average healthcare

delivery, less waiting times for diagnosis, as well as the treatment and prevention of disease. Gqweta (2012: 22) reported that the impact of radiographer role extension is one of the most documented topics in Radiography literature. He further stated that the advantages of reporting radiographers were: a) recognition of radiographers' attempts, which was coupled with job satisfaction; b) reduction of waiting times for patients; and c) rapid service delivery, amongst other things. These advantages were also noted in studies done internationally.

2.4 THE ROLE OF RADIOLOGISTS IN SOUTH AFRICA

The Radiological Society of South Africa (RSSA) states that Radiologists are the medical specialists who make a diagnosis by interpreting radiographic images, which are produced by radiographers (Radiological Society of South Africa 2019: para. 5 line 2). These doctors concentrate on examining the medical images of patients and make recommendations for treatment to the care physicians. The main educational requirement for a doctor specializing in radiology is a medical degree from an accredited university. Additionally, the radiologist must be board-certified in this area of expertise and must maintain all continuing education requirements and recertifications that are needed. A radiologist must be able to balance the needs of a referring physician with the comfort of the patient, to get the most informative images possible. The radiologist generally works during regular business hours, although in some hospital and clinic environments, after-hours and on-call work may be needed as well (Payscale 2022: para 1-4).

2.5 GLOBAL VIEW OF RADIOGRAPHER IMAGE INTERPRETATION

The Radiography profession is expanding globally as radiographers in selected countries have extended their legal practice boundaries (Koch 2016: 12). The United Kingdom has revolutionized their Radiographer practice to include clinical reporting, and other countries such as Norway and Denmark have developed models of advanced Radiographer practice, which includes definitive clinical reporting (Woznitza 2014: 66).

2.5.1 Global scope of practice

In Radiography, scope of practice can be defined according to regulatory documents as the full range of roles, functions and responsibilities that Radiographers are educated, competent and authorized to perform (Health Professions Council of South Africa (HPCSA) 2020: 2). In the UK, the scope of practice includes a variety of examinations (Culpan, Culpan, Docherty and Denton 2019:157). These examinations are as follows: Musculoskeletal system, chest (studies limited to adults), abdomen, CT head, CT sinus and facial bones, CT colonography, contrast enhanced chest CT for pulmonary embolus, MRI head, MRI Knee and lumbar spine. In Norway, sonographers are able to differentiate negative from positive findings in the upper abdomen, and demonstrate accuracies similar to experienced radiologists (Hofman and Vikestad 2013: 188).

2.5.2 Global Radiographer training for advanced practice

The United Kingdom (UK) seems 'above board' with its full range of recognized Radiographer positions, from assistant practitioner to consultant Radiographer (Cowling 2013: 91). In the UK, in order to become a reporting Radiographer, one must complete a post-graduate training and education programme approved by the College of Radiographers (Bwanga, Mulenga and Chanda 2019: 16).

In Australia, the Medical Radiation Practice Board of Australia (MRPBA) has specified that Radiographers must communicate significant clinical findings to the appropriate clinicians with associated record-keeping. In addition, the Australian Society of Medical Imaging and Radiation Therapy (ASMIRT) is presently developing a process to certify Radiographers to engage in radiographic image evaluation, with a written component known as a Preliminary Image Evaluation (PIE). A PIE is a written description of clinical findings and a means of communication to the referring physician in the absence of a radiologist report (Murphy *et al.* 2019: 270).

In the United States of America (USA), Radiographers who have undertaken role extension training are known as Registered Radiology Assistants (RRA).

RRAs have extended roles to provide preliminary technical reports to assist clinical radiologists and referrers, but sole responsibility for the final report remains with the interpreting physician (Royal Australian and New Zealand College of Radiologists 2018: 5). RRAs have to be certified and registered with the American Registry of Radiologic Technologists (ARRT) and have one year of acceptable clinical experience before pursuing a RRA credential (American Registry of Radiologic Technologists 2020).

2.5.3 Population to Radiologist ratio in international countries

Techsmart (2015: para 3 line 1-3) stated that: "the European average is 10 radiologists per 100 000 people in the population and the United Kingdom (UK) has about 3 000 registered radiologists with a ratio of 4.7 specialists per 100 000 people in the population". In the United States of America, the number of radiologists fluctuated by 39.2% between 1995 and 2011 (from 27,906 to 38,875) (Rosenkrantz, Hughes and Duszak 2016: 178). These figures suggest 10-12 radiologists per 100,000 people in the population. In Australia, the ratio of radiologists per million people in the population has increased from 57 per million in 2000 to 77.6 per million in 2012 (Royal Australian and New Zealand College of Radiologists Workforce Census 2013: ii).

2.5.4 Clinical competencies, knowledge and medico-legal responsibilities abroad

It was stated that clinical competency should be made explicit through alignment with occupational practice standards. Practice Standards are published statements from individual professions about what their members are competent to do and what others can expect them to do (Chiu 2013: 19). From a review of literature concerning image interpretation, the most recent non-UK papers describe developments in commenting and pattern recognition, as well as 'red dot' schemes (Culpan *et al.* 2019: 157). Wensing and Grol (2019: 5) posit that the main aim of research on knowledge implementation in healthcare is for the improvement of healthcare practice to become more effective, thus leading to better care and outcomes for patients and populations.

Medico-legal responsibilities refer to the statutory duty placed upon Radiographers to maintain and continuously improve clinical standards through clinical governance, but standards sometimes fall short and patients may turn to the courts for redress (Aung and Chandalia 2011: 48). According to Koch (2016: 33), the international training offered to Radiographers does not include an independent section for medico-legal study units. The study of medico-legal issues and legislation is however integrated into the theoretical training for Radiographers in the UK (Koch 2016: 33). In fact, in Australia, Radiographers have concerns regarding the potential medico-legal consequences of the Radiographer image evaluation system (Murphy *et al.* 2019: 282). Squibb, Bull, Smith and Dalton (2015: 26) explain concerns as the manner in which rural Radiographers disclose their radiographic opinion to their patients. Squibb *et al.* (2015:26) add that Radiographers admitted that there are circumstances where they might not be completely truthful. This relates to the ambivalent legal standing of Radiographers disclosing diagnostic data; ethical matters of 'protection' and 'advocacy'; and essentially, the 'medico-legality' of disclosure, whilst hoping to protect themselves and the patient from the effects of a frightening diagnosis.

2.6 RADIOGRAPHY IN AFRICA

In Ghana, Wuni, Courtier and Kelly (2019: e123) stated that suitably trained Radiographers can perform reporting to the same standards as radiologists. However, Bwanga, Mulenga and Chanda (2019: 216) claimed that Uganda was the first country in Africa to have introduced reporting Radiographers, but there is scarcity of literature on this.

2.6.1 Training of Radiographers in African countries

It was found that training programs in the developing countries were somewhat isolated from the profession because even though they were rigorous in academic content, they lacked the essential work-integrated learning component. One notable exception to this issue was Uganda because radiographers, radiologists, the university which offered Radiography training and the Health Ministry had agreed to include image interpretation in their Radiography degree programme (Cowling 2013: 90). The motivation for this

was the recognition that the sparseness of radiologists would not be easily solved and that role extension of Radiographers would be a valuable asset to the healthcare service (Cowling 2013: 90).

In Zambia, degree programs for Radiography offered by the Lusaka Apex Medical University and the University of Zambia have added image interpretation. Additionally, a qualification in Radiography offered by Evelyn Hone College included X-ray pattern recognition (Bwanga Mulenga and Chanda 2019: 218). After graduating with these qualifications, Radiographers are able to perform the Red Dot system, as well as evaluate images appropriately during examinations. This is still regarded as basic training with specialized and postgraduate training being needed by Radiographers for them to formally report on diagnostic images (Bwanga Mulenga and Chanda 2019: 218) The 'red dot' system is used as a method for radiographers to identify potential abnormalities on plain radiographs prior to reporting by radiologists (Brown and Leschke 2012: 510).

Other African literature reviewed was from South Africa and Nigeria (Wuni, Courtier and Kelly 2019: e122). Articles discussed the factors that are likely to influence the successful implementation of role extension; the accuracy of reporting; future Radiography education requirements and the potential to improve access to quality healthcare.

2.6.2 Population to Radiologist ratio in African Countries

Ghana has a population of about 25 million people, with only 35 radiologists (Wuni, Courtier and Kelly 2019: e121). Uganda has a population of about 44 million people, with only 70 radiologists (Bwanda, Mulenga and Chanda 2019: 216). In addition, Zambia has a population of about 17 million people, with only 5 radiologists (Bwanda, Mulenga and Chanda 2019: 216). The South African population is 60 142 978 (Republic of South Africa 2021: vii) and there are 650 registered radiologists in South Africa (Techsmart 2015: para 3 line 1-2).

2.6.3 Advanced Radiographer Practice in Africa

The first discussion of Radiographers' role extension in image reporting took place at the Radiology Conference held in South Africa in 2006. Here, the negative impact of the shortage of radiologists in most African countries was highlighted by delegates. As a result, radiologists realized the need to use the services of trained radiographers by allowing them to provide formal written reports on radiographs (Bwanda, Mulenga and Chanda 2019: 216).

In Africa, Radiographers in Ghana can report on a wide range of chest pathologies (Wuni, Courtier and Kelly 2019: e121). Even though no literature was found regarding role extension in Ghana, differences in professional structures suggest that the adoption of existing practice models may not be successful. The area of professional practice that is most aligned with local resources and the improvement in the healthcare sector in Ghana is radiographers' interpretation of images. To establish confidence in stakeholders or organisations, which make, role extension possible, education and regulation of reporting as well as developments in professional perceptions are required (Wuni, Courtier and Kelly 2019: e121). The most notable drivers for role extension are a shifting health policy, an expanding workload to radiologists, technological advancements and a deficit of radiologists. The evidence of patient and economic benefits through audit and research should support planning for further role extension opportunities in Africa and contribute to Radiographer role extension in developing countries (Wuni, Courtier and Kelly 2019: e124). In Uganda, the Ernest Cook Ultrasound Research and Education Institute (ECUREI) launched a one-year intensive course in plain X-ray film interpretation, according to Kawooya (2012: 4).

2.7 RADIOGRAPHY IN SOUTH AFRICA

Radiography forms an integral part of the healthcare process in South Africa. When patients present at a healthcare facility, they are usually referred to the relevant Radiography department for procedures. These procedures are performed by a radiographer or radiologist, with a radiographer in assistance. However, it is beyond the scope of the radiographer to disclose the scan results to patients (Etheredge 2011: 9). Rather, the process entails that a radiologist writes a report and sends it to the referring doctor, who will then communicate

the results to the patient. Even though this system is praiseworthy, in terms of ensuring that the margin for misdiagnosis is minimized and promotes patient-centered care, this system does not afford Radiographers much room for professional development in their working environment. This means that Radiographers are in a delicate situation when there are no radiologists present to issue the necessary instructions. The absence of radiologists and the restrictions on communications put radiographers in a difficult position when patients ask questions relating to the results of their scans (Etheredge 2011: 9).

2.7.1 Current scope of practice

Annexure 10 of the HPCSA's Ethical Rules of Conduct pertaining to the profession of Radiography states that Radiographers may only work at the request of a registered practitioner and may not exceed the limits of the category under which he/she is registered (HPCSA 2019: 48-49). This means that Radiographers in South Africa are ethically and legally bound to practice within their level of competence and the scope of their educational training (Koch 2016: 15). However, such information is lacking in radiographic image interpretation by Radiographers. Therefore, image interpretation and reporting by South African Radiographers still need to be validated. Presently, the only formalized education and training that students are acquiring in their undergraduate degree relates to pathological conditions and pattern recognition (Van der Venter and Ham-Baloyi 2019: 179).

2.7.2 South Africa's radiologist to population ratio

In South Africa, there is presently a shortage of Radiologists because the South African radiologist per population ratio is 1.2 radiologists per 100 000 people in the population (Techsmart 2015: para 3 line 1-2).

2.7.3 Radiographer role extension

Local studies have identified the need for South African Radiographers to close the gap between themselves and international practice. For example, Gqweta (2012: 25) highlighted that some factors negatively impacting service delivery in the South African primary healthcare system are: (i) an absence of

radiologists; (ii) failure of Radiography education to prepare Radiographers for radiographic image interpretation; and (iii) the legal restriction placed on radiographers who want to respond to these current healthcare needs. In response, Koch (2016: 16) suggested that national training guidelines should be developed through benchmarking in order to allow control through the monitoring of the national training guidelines against international standards. The emerging themes were: the types of radiographic images suitable for radiographers to report, knowledge, clinical competencies and medico-legal responsibilities required for the interpretation of images. In South Africa, there are currently no reporting Radiographers (Bwanga, Mulenga and Chanda 2019: 216).

2.7.4 South African radiologists' views on Radiographer role extension from past research

Williams (2009: 15) performed a study in the Western Cape (WC) province of SA and mentioned that a deficiency of radiologists resulted in many radiographs being returned unreported to the referring clinicians or poorly timed reports which cannot facilitate patient management. The results of the study indicated that 68% of radiologists were favourable in relation to the professional role development of reporting Radiographers and 93.7% of radiologists employed in the public sector indicated that the deficit of radiologists was only present in the public sector (Williams 2009: 16).

2.7.5 Recommendations from past studies on Radiographer role extension

2.7.5.1 Scope of Practice

In South Africa, Williams (2009: 16) emphasized the need to extend the professional role of Radiographers to include emergency and trauma plain-film radiograph reporting to benefit trauma patients, particularly in public sector hospitals. The interpretation of images and reporting is already being practiced in countries such as the United Kingdom, Australia and the United States of America (Woznitza 2014: 66; Murphy *et al*. 2019: 270 and Royal Australian and New Zealand College of Radiologists 2018: 5). Studies been carried out in Cape Town, South Africa (Gqweta 2012: 23) and the eThekwini district of Kwa-

Zulu Natal, South Africa (Gqweta 2014: 3; Gqweta and Naidoo 2014: 015) have identified a need for the further training of Radiographers with regard to role extension. A review of the regulations of the scope of practice of Radiographers is currently being undertaken by the Health Professions Council of South Africa (HPCSA) in order to include formal reporting in South Africa (Bwanga, Mulenga and Chanda 2019: 216). It is therefore noticeable from international literature that SA is not yet on par with the advanced practice and the role of the Radiography profession. This study aimed to provide information on the knowledge, clinical competencies and medico-legal responsibilities required by diagnostic Radiographers for the interpretation of images and reporting, according to the opinions and perceptions of public sector radiologists. The researcher hopes that the study results would provide input for the development of training curricula for advanced Radiographer practice/ role extension.

2.8 PREVIOUS METHODOLOGY REGARDING THE TOPIC

When Gqweta (2012: 25) conducted a survey on role extension in 2007 amongst Cape Town Radiographers in primary healthcare, Radiographers indicated that there were no on-site radiologists in their institutions and that a radiologist's report took approximately 14 days to be produced for patient management. It was stated that a multidisciplinary team which could function under several roles was essential if the needs of the patients were to be addressed (Gqweta 2012: 23). Consequently, Gqweta (2012: 23) compiled a report on the Radiographers and placed significance on their experiences, understanding and meaning with regard to the need for role extension.

In addition, Mung'omba and Botha (2017: 1) conducted a mixed method study on Radiographers in KwaZulu-Natal, identifying and investigating the core competencies of Radiographers working in the rural sector. The aim of this study was only to propose a Continuous Professional Development (CPD) strategy (Mung'omba and Botha 2017: 1), but the researcher identified that a majority of the identified responsibilities and competencies of Radiographers were beyond the statutory competencies and responsibilities required for professional registration (Mung'omba and Botha 2017: 6). Some of these responsibilities and competencies were the execution of basic ultrasound

scans; carrying out specialized procedures such as contrast injections; and reporting on emergency and accident radiographs, all within the rural hospital context (Mung'omba and Botha 2017: 6). Hence, in an effort to empower rural Radiographers, Mung'omba and Botha (2017: 7) suggested that those who were involved in the transformation of the profession of Radiography in South Africa, namely the Department of Health (DoH), training institutions and the Professional Board for Radiography and Clinical Technology (PBRCT) under the HPCSA, would have to pay heed to the information from their study and other related studies.

Most recently, Van der Venter and Ham-Baloyi (2019: 178) conducted a review investigating the impact of training on patient management when diagnostic Radiographers in South Africa carry out image interpretation/reporting. The authors recognized Radiography as an emerging profession, with a legal requirement to justify the behaviour and conduct of its practice (Van der Venter and Ham-Baloyi 2019: 179). Furthermore, Van der Venter and Ham-Baloyi (2019: 184) concluded that in order to assist proper patient treatment and management, regulations defining the scope of radiographers should permit for formal image interpretation by diagnostic radiographers, as these healthcare workers possess basic knowledge to contribute greatly in the clinical environment in relation to the interpretation of images.

Thus far, limited literature is available on national training guidelines for the role extension of South African Radiographers pertaining to the interpretation of images. Hence, this study was different because it employed radiologists, and not radiographers, as the target population and used a qualitative approach to gather data that could provide information for the development of Diagnostic Radiography training curricula. The aim was to explore the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs.

2.9 THEORY GUIDING THIS STUDY

Theories are formulated to predict, explain and understand phenomena and, in many cases, to extend and challenge the existing knowledge (Muredzi 2018:

2). The theoretical framework is the structure that can hold or support a theory of a research study. The theoretical framework introduces and describes the theory, which explains why the research problem under study exists (Sacred Heart University Library n.d. para. 1: line 1-4). The theories that serve as a guide to this study are the Theory of Structural Empowerment and the Professional Identity Theory.

2.9.1 Theory of Structural Empowerment

Kanter's Theory of Structural Empowerment communicates that the features of a circumstance can either encourage or constrain ideal work performance, disregarding personal susceptibilities or tendencies (Orgambídez-Ramos and Borrego-Alés 2014: 29). Kanter believed that power is explained as the capacity to use resources or assets to get things done. Hence, power is switched 'on' when workers have entry to support, resources, lines of information and chances to develop and learn. Conversely, power is switched 'off' when resources are unavailable, thereby making productive work impossible (Orgambídez-Ramos and Borrego-Alés 2014: 29). In simpler terms, these lines of power are sources of structural empowerment within an organisation.

It is stated that a superior level of structural empowerment can be obtained when there is access to the following structures:

- Opportunity referring to the likelihood of movement and development within an organisation, thereby increasing the acquisition of skills and knowledge;
- Access to resources, thereby allowing a person to obtain the materials, supplies, time and finances to do the work;
- Access to formal and informal information, allowing a person to comprehend the organisation's decisions and policies, thereby allowing the person to be successful in the workplace and to accomplish tasks efficiently; and
- Access to support means obtaining guidance and feedback from peers, subordinates and superiors (Orgambídez-Ramos and Borrego-Alés 2014: 29).

Realistically, Kanter's theory supplies guidance for understanding empowered employees and a guide to empowering workplaces (Orgambídez-Ramos and

Borrego-Alés 2014: 35). The Theory of Structural Empowerment is for the radiologists and explains that empowerment is encouraged in the workplace when employees are given access to support, resources and essential data with the chance to develop and learn (Larkin, Cierpial, Stack, Morrison and Griffith 2008: 1).

2.9.2 Professional Identity Theory

An individual's professional identity is a vital perception mechanism that influences workers' behaviour and attitudes in work settings and beyond. Consequently, comprehension of how professionals regard themselves has been the focal point of several past research studies (Caza and Creary 2016: 4). Of utmost importance, identity is not explained as some concept of objective reality of the 'true self', but is rather defined by one's subjective psychological experience. The meanings that individuals link to themselves in the work context are known as 'work identities'. This is because individuals draw from work roles, social group membership and personal qualities in what they do and who they are in the workplace (Caza and Creary 2016: 4).

Professional identification has been delineated from both Social Identity Theory and Identity Theory perspectives. The Social Identity Theory postulates that individuals rank others and themselves into different social groups, and this viewpoint is complemented by proposing that people are motivated towards identification with their professions due to it providing self enhancement and reducing uncertainty. The Identity Theory, on the other hand, postulates that an individual's various identities (non-work and work) are arranged hierarchically according to their central roles. Therefore, the power of professional identification is the respective rank of one's professional self-definition in relation to social group memberships, or to the individual's other roles in the individual's self-hierarchy (Caza and Creary 2016: 8).

Professions and organisations frequently pressurize people to enact multiple professional roles. For example, many organisations are forming hybrid or dual roles that are generated to assist in bridging professional tasks and boundaries within the organisation (Caza and Creary 2016: 14). So not only will one have

parachuted from a narrow focus on people in very specific professions, but one will also move away from setting dull behavioural expectations for people who take up particular roles. Instead, people will proceed towards comprehending professional identity as being a distinctive construction of who one is when one is finding ways to give significantly to society (Caza and Creary 2016: 31). The Professional Identity Theory is for the Radiographers because their identity is built around their effective role within a vital work environment and even though Radiography is regarded as a profession, it is frequently expanding and its role will continue to be impacted by the healthcare systems and dynamic social norms within society (Decker 2006: 162).

2.9.3 Link between selected theories and this study

Radiographers need to expand their knowledge and skills to improve their careers (Henderson, Mathers, McConnell and Minnoch 2016: 191). However, Radiographers in South Africa are ethically and legally bound to practice within their level of competence and the scope of their educational training (Koch 2016: 15). Thus, the purpose of this study is to explore the Radiologists' +opinions and perceptions on these factors in support of role extension, which can improve the number of reported images and ultimately can address the shortage of radiologists. This will inevitably improve the Radiographers' professional identities. Therefore, the amalgamation of the Theory of Structural Empowerment and the Professional Identity Theory will contribute to the formation of an essential concept, which is a goal-oriented, motivated, enthusiastic and exceptionally knowledgeable Radiographer. The relationship between these is depicted in Figure 1 below.

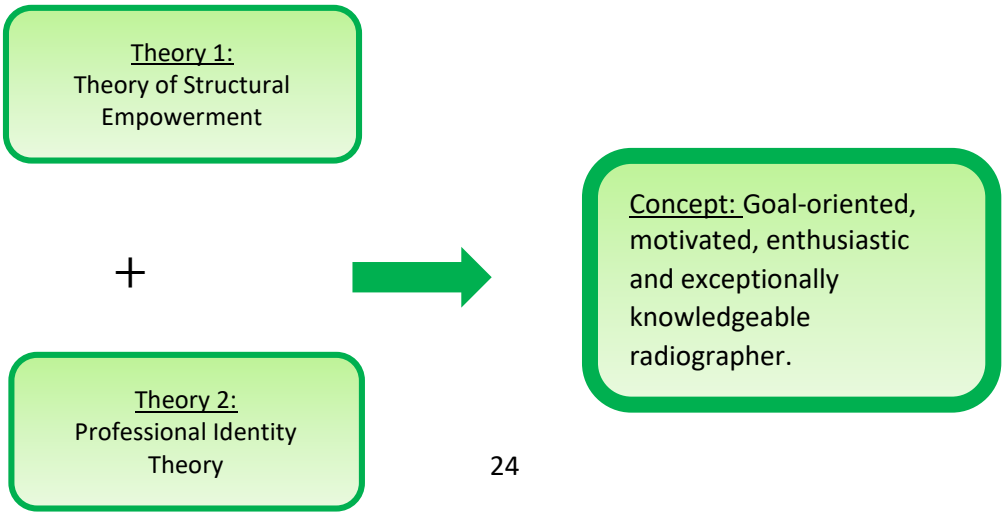

Figure 2.1: Theory Equation

2.10 SUMMARY OF THE CHAPTER

Globally, the role of Radiographers is expanding. In fact, in some countries overseas, Radiographers are permitted to interpret images after completing the necessary training. In other countries in Africa, Radiographers have also shown the potential to interpret images. However, in South Africa, Radiographers are not legally permitted to interpret images and write reports. The PBRCT is currently reviewing the South African Radiographer's scope of practice to include the interpretation of images. Studies have highlighted the importance for South African Radiographers to close the gap between international practice and South African practice. The importance of determining the training requirements before receiving HPCSA accreditation has also been highlighted. To date, limited literature identifies the training requirements. Therefore, this was imperative that there was inquiry in this area through scientific research. By addressing the training needs for Radiographers in South Africa for image interpretation, there may be an improvement in the number of reported images and ultimately, the shortage of radiologists.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Research methodology can be described as the track that researchers take when conducting their research. It delineates the path that researchers use to formulate their problem and the way in which they present the results of their findings, which makes the study visible and transparent to the reader (Sileyew 2019: 1). In this way, the research design and methodology demonstrate how the research outcome at the end of the study will be achieved, whilst addressing the aim of the study or research questions. This chapter will therefore discuss the research methods that were used during the research process. Emphasis will be placed on the research paradigm, design, study setting, target population and sampling process, data collection process, data analysis and ethical considerations.

3.2 RESEARCH PARADIGM

A research paradigm is a system of scientific and academic ideas, values and assumptions (Jarvie and Zamora-Bonilla 2011: 292). In other words, a paradigm is a framework containing all the usually accepted views about a topic; protocols about what needs to be obeyed during the research process and the way in which the research should be carried out (Shuttleworth and Wilson 2008: para. 1 lines 1-3). The research paradigm of this study will be constructivist. To understand the constructivist paradigm, Kivunja and Kuyini (2017: 33) state that it is worthy to note that reality is socially constructed. This approach makes an effort to ‘get into the head of the participant being studied’, and to understand the meaning a participant is making of the context (Kivunja and Kuyini 2017: 33). All possible endeavours are made to try to understand the viewpoint of the participant being observed, rather than the viewpoint of the researcher (Kivunja and Kuyini 2017: 33).

The research paradigm has three major dimensions, namely ontology, epistemology and methodology (Jarvie and Zamora-Bonilla 2011: 292). The research paradigm is a system of interrelated practice and thinking that defines

the nature of enquiry along these three dimensions (Antwi and Hamza 2015: 218).

3.2.1 Ontology

This is the 'study of being', which is concerned with what actually exists in the world about which humans can acquire knowledge (Blackman and Moon 2017: para. 5 lines 1-5). In this study, the researcher was concerned with the knowledge, clinical competencies and medico-legal responsibilities required by Radiographers for Radiographic Image Interpretation. Thus, the use of multiple forms of evidence in themes using the actual words of different individuals and different perspectives addressed the ontology of this study. Since the interviews were audio recorded, it was possible to repeat the actual statements of the radiologists.

3.2.2 Epistemology

This is the 'study of knowledge' (Blackman and Moon 2017: para. 7 lines 1-2). According to Blackman and Moon (2017: para. 7 lines 1-2), Epistemology is concerned with all aspects of the validity, scope and methods of acquiring knowledge. In the context of this study, the radiologists were trained in image interpretation and thus had information on the knowledge, clinical competencies and medico-legal responsibilities required by Radiographers in order to interpret radiographs. During the interviews, demographic information regarding the number of years of experience as a radiologist and confirmation of membership with the Health Professions Council of South Africa was determined.

3.2.3 Methodology

Methodology is the term used to refer to the research design, approaches, methods and procedures used in an investigation (Kivunja and Kuyini 2017: 28). Moreover, during data analysis, the researcher followed a path of analysing the data to develop a more detailed knowledge of the topic being studied. In the next section, the researcher describes the methodology using the concepts in

the investigation. The researcher used the most recently available versions of text books to guide the methodology, as well as journal articles regarding the topic, not older than 15 years.

3.3 RESEARCH DESIGN

The research design refers to the strategy one chooses in order to put all the different components of the study together in a logical way, thereby ensuring that it will effectively address the research problem (Trochim 2020: para 1 line 1-3). This was an exploratory qualitative study using the case study approach. Exploratory research is primarily concerned with discovery and with building or generating theory (Jupp 2006: para 1 lines 1-2). According to Crowe *et al*. (2011: 1), the case study is a research approach used particularly in the social sciences to explore an in-depth, multi-faceted and complex issue in its natural context. This enabled the researcher to explore information about the most suitable images for Radiographers to report on, as perceived by the radiologists.

3.4 STUDY SETTING

Given (2008: para. 1 lines 1-3) defined a research setting as a social, cultural and physical place in which a researcher conducts a study. In qualitative research, the focus is on meaning-making and the researcher examines the participants in their natural setting. This study was conducted within the eThekwini district of KwaZulu-Natal (KZN). KwaZulu-Natal is one of South Africa's nine provinces and is divided into one metropolitan municipality (eThekwini Metropolitan Municipality) and 10 district municipalities (Municipalities of South Africa 2020: para. 5 line 1). The study was conducted in the eThekwini district because it is the largest district in KZN. The eThekwini district's population is estimated to be 3 853 278 (Ethekwini Municipality Annual Report 2017/2018: page 32). Currently, there are 18 public hospitals in eThekwini (Province of KwaZulu-Natal Department of Health n.d: Page 1).

Based on the services they provide, these hospitals are categorized into centralized hospitals, which have adopted a private/public partnership in their service delivery; are fully electronic (computerised), working on paperless

principles; and are designed to supply tele-medicine services (Inkosi Albert Luthuli Central Hospital); academic or tertiary hospitals, which provide tertiary services to the whole of KZN and part of the Eastern Cape. This is a teaching hospital for the University of KwaZulu-Natal's Nelson R. Mandela School of Medicine and it has a Nursing College (King Edward VIII Hospital); regional hospitals which provide post-graduate teaching in all major disciplines (Addington Hospital); district hospitals which provide services to patients being referred via their local clinics or regional hospitals (Wentworth Hospital); and specialized hospitals that provide specialized services such as Multi Drug Resistant (MDR) and complicated TB treatment, as well as orthopaedic spinal surgery, psychiatric and family planning (sterilization) services (King Dinizulu Hospital). The radiologists were placed at centralized, tertiary and regional hospitals and rotate through the district hospitals. For the purpose of the study, the researcher telephonically determined the presence and absence of consultant diagnostic radiologists at the different categories of hospitals.

3.5 TARGET POPULATION

The target population refers to the total number of individuals from which the sample might be chosen (Mcleod 2019: 4). Public sector radiologists will be used as the target population. Consultant Diagnostic Radiologists, instead of registrar radiologists, were chosen because they are qualified to report on radiographic images. Therefore, they would be able to give some guidance on what kinds of images are most suitable for Radiographers to report on, as well as their opinions of the education or training that would be required for Radiographic Image Interpretation. There are currently 87 radiologists in the eThekwini District of KZN (Health Professions Council of South Africa iRegister 2020). However, it is not documented how many of these radiologists are employed by the public sector. The province of KwaZulu-Natal is separated into one metropolitan municipality, which is the eThekwini Metropolitan Municipality, and 10 district municipalities (Municipalities of South Africa 2020: para. 5 line 1).

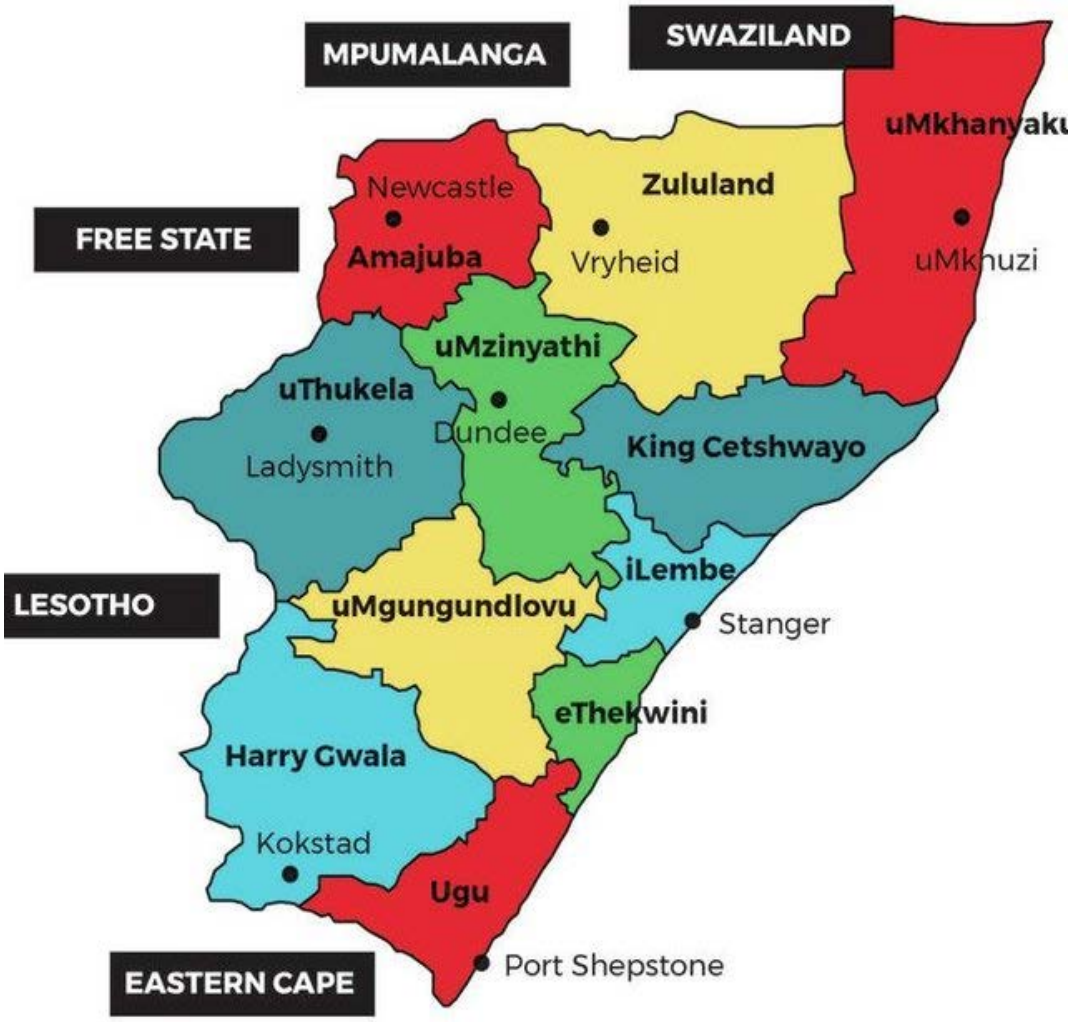

Figure 3.1: Map of KwaZulu-Natal showing districts with neighbouring provinces and countries (Christie and Monyokolo 2018: 20)

3.6 SAMPLING

In an attempt to answer the research questions, it is uncertain if the researcher would be able to collect data from all the members of the population. Therefore, a need arises to select a sample. The total number of participants, radiologists in this study, from which the researcher's sample is drawn in called the population. In consideration of the fact that most researchers neither have the resources nor time to analyse the entire population, they apply a sampling technique to reduce the number of cases (Taherdoost 2016:18).

3.6.1 Sampling technique and sample size

Sampling occurs when researchers examine a portion of a larger group of potential participants and use the results to make statements that apply to this broader group or population (Salkind 2010: para. 1 lines 1-2). To better understand sample size in qualitative research, Patton (1990: 186) explains that the sample size is merely a solution to negotiation and judgment. Thus basically, the researcher merely specifies a minimum sample at the beginning of the study for budgetary and planning purposes. As the fieldwork unfolded, the researcher changed the sample size, indicating that the design of the study was emergent and flexible. Thus, the minimum sample is based on expected reasonable coverage of the phenomenon given the purpose of the study and one may change the sample if new information emerges, which is indicative of inadequacies in the original sampling approach and/or size (Patton 1990: 186). Dworkin (2012: 1319) suggested that between 5 to 50 participants are regarded as adequate in qualitative research. Therefore, it is evident that different authors have different suggestions regarding sample size. For example, Patton (1990:186) suggested a minimum of one participant, while Dworkin (2012: 1319) stated 5 to 50 participants.

For the purpose of this study, the criterion purposive sampling was used to select one hospital. When the researcher telephonically enquired how many radiologists were present at the hospital, she was told that there were 5 radiologists. The same sampling strategy used to select 3 radiologists. The maximum sample size was determined by data saturation. According to Austin and Sutton (2014: 438), this is when no new information is coming forth to identify new themes.

3.6.2 Inclusion and exclusion criteria

3.6.2.1 Inclusion criteria

- Consultant Diagnostic Radiologists in the public sector employed in the eThekwini district;
- Practicing Consultant Diagnostic Radiologists; and

- Employed Consultant Diagnostic Radiologists.

3.6.2.2 Exclusion criteria

- Registrars.
- Consultant Diagnostic Radiologists in the private sector.

3.7 RECRUITMENT PROCESS

Recruitment is usually a three-step process that involves (i) initially identifying potential participants against inclusion and exclusion criteria; (ii) approaching or contacting them about the study prior to (iii) seeking their agreement to join the study (including obtaining their consent) (Preston *et al*. 2016: 3).

However, due to the Covid-19 pandemic, researchers were confronted with the issue of engaging with communities due to them not being able to link up with the gatekeepers, and sometimes mediators, of specified research communities in the usual way. In this context, community refers to any group of participants that the researcher wishes to use to participate in a study using certain scientific grounds, based on their inclusion criteria (Patino and Ferreira 2018: 84). Before the pandemic, the qualitative researcher was accustomed to first building a connection with the gatekeeper through appointments and face-to-face contact. This was done in order to build trust and rapport and to have them help in identifying the most suitable mediators to reach out to the prospective participants. Even though it is presently more difficult to do so, this process was still possible through different strategies.

In terms of this study, contact was made with the gatekeepers via email and telephonic discussions. The gatekeepers indicated which mediators could be employed and these individuals were approached in a similar manner to that indicated above for the gatekeepers. Unfortunately, this took more time and effort on the part of the researcher, but it was do-able. Mediators, after obtaining permission from the possible participants and adhering to the inclusion criteria as set by the researcher, provided the researcher with either the email addresses or telephone numbers of the potential participants, depending on

which was most accessible for the participant. The researcher then had the opportunity to make contact with these possible participants.

It was the duty of the researcher to ensure that the participant was well-informed about the research study. The process of obtaining informed consent was time-consuming and complex during this time of physical distancing between the researcher and the participants. Therefore, internet access for both the researcher and the participants were essential in order to ensure that the informed consent documentation reached the participants via email. Since the researcher opted to make use of online platform interviewing, access to the internet was crucial. In this case, the informed consent documentation was emailed to the participants in advance. Thereafter, an appointment was set up between the participant and researcher via an online platform or telephone, whereby the research process could be discussed. The employment of an audio-visual option Zoom, which is a reliable cloud platform for audio and video conferencing, was favoured as it added visual contact between the participants and the researcher during the signing process. It was suggested by the supervisor that the researcher and participant each had a person present to witness and co-sign the signing process, hence four people were present during the signing process as being visibly undertaken over the video link. It was agreed that in the future, the researcher and the participant could confirm the informed consent process by signing the form together when both parties were allowed to be present. This was a type of delayed consent. Therefore, during this process, four parties signed from two different places at the same time. In the informed consent document, this process was clearly stated at the beginning of the document. After signing the document, the participant then faxed or scanned the signed document to the researcher and kept the original until they could meet in future to exchange the original document. Otherwise, the participant took a photograph of the document on their cellphone and sent it via WhatsApp to the researcher. During the actual interview, the process of obtaining informed consent remotely was repeated and the informed consent was confirmed by the participants verbally and then recorded. Having two witnesses present on both sides ensured that informed consent was obtained in a safe and fair manner.

3.8 DATA COLLECTION TOOL

Face-to-face, one-on-one, semi-structured and in-depth interviews would have been used as the favourable method to collect the primary data using the interview guide (Appendix 8). The interview guide consisted of two sections, for demographic information of the participants and the interview questions. The questions in the interview were open-ended, meaning that a lengthy response was acquired, requiring more thought from the radiologists. However, due to the present pandemic, online platform interviews (via the Zoom application) were employed. These were more synchronous in nature and consisted of computer-mediated interactions (Mouton 2020: para 1 lin1-2). A weakness of this method was that the use of video had to be limited often in order not to compromise voice quality, thus the genuineness of a direct interaction was sacrificed. Video contact was the preferred choice as the participant was visible and at least some non-verbal cues could be recorded to facilitate the interaction. The latter brought depth to the interviews. However, the challenge of this method, lay in being able to record this type of interview for future transcription. The quality of the sound should always be tested beforehand as this is extremely crucial in the process for clarity. If possible, backup recordings should be made. Unfortunately, not even the COVID-19 pandemic could allow the researcher to purely depend on memory, hence the transcription of the interviews remained of utmost importance.

Telephonic interviews were carried out where the participants did not have access to the internet. However, if this option was used, arrangements had to be made to record the telephonic interview for future transcription. Since transcription is a vital process, it is critical that the quality of the recording be tested first. It must be noted that one major disadvantage was that the richness of observation while interviewing was lost whilst using this method.

3.9 DATA COLLECTION PROCESS

Data collection is meant to be a well-organised process of gathering and interpreting specific data to suggest solutions to relevant questions and to evaluate the results (Formplus blog 2022). A researcher needs to develop data

collection guidelines to ensure that the results obtained will be accurate and reliable (Bhandari 2021: para 5-8). Before data collection, the researcher obtained ethical approval from the Institutional Research Ethics Committee (IREC), with an allocated Ethical Clearance number IREC 128/20 (Appendix 1). Gatekeeper permission was then requested from the KZN Department of Health (Appendix 2a), the eThekwini Health District Manager (Appendix 3a) and the Manager of King VIII Edward Hospital (Appendix 4a).

Once permission was granted by the KZN Department of Health (Appendix 2b), the eThekwini Health District Manager (Appendix 3b) and the Manager of King VIII Edward Hospital (Appendix 4b), contact was made with the gatekeepers via email and telephonic discussions. The gatekeepers indicated which mediators could be employed and those individuals were approached in a similar manner to that indicated above for the gatekeepers.

Each participant was emailed a Letter of Information about the study (Appendix 5) and the Consent Form (Appendix 6) to sign before data collection. Radiologists were told that their participation was voluntary and that they could withdraw at any time if they so wished during the study, without any penalty. Additionally, they were assured that their names would be anonymous and their information would be kept confidential. Radiologists were not remunerated for participating in the study. If they agreed to participate, they were emailed an Informed Consent form to sign, scan and return to the researcher via email or WhatsApp.

Each interview took approximately 30-45 minutes and took place when the participants felt comfortable. For the interview, the researcher telephoned the participants when they were off duty, on their cellphones, at home. The participants informed the researcher when they had free time via sms and also informed the researcher when to call. Several measures have been introduced in an effort to prevent the spread of coronavirus (COVID-19) which include social distancing restrictions of movement and mandatory use of masks (Denford *et al.* 2021: 509). Therefore, the researcher was glad that there were no precautionary measures that had to be taken for telephonic interviews and

made every effort made to recruit a diverse and representative sample. Data saturation was reached with each participant. Three participants were interviewed from one hospital. However, Radiologists from other same-level hospitals were not willing to participate in the study.

Interviews were audio-recorded with the permission of the radiologists. All radiologists gave permission to be audio-recorded. The transcripts of the interview data were stored on the computer and secured with a password known only to the researcher.

3.10 DATA ANALYSIS

Jarvie and Zamora-Bonilla (2011: 317) define qualitative data analysis as "working with the data, organising them, breaking them into manageable units, coding them, synthesizing them and searching for patterns". The data from the interviews were analysed by the researcher using Tesch's eight steps for analysing qualitative data (Creswell 2013: 198).

3.10.1 Tesch's Eight-Step Guide for data analysis

STEP 1: All the data were read carefully to obtain a sense of the whole. In this case, the whole was the entire transcribed interview. This gave the researcher the necessary background information and if something came to mind about the data, the researcher wrote these ideas down.

STEP 2: The researcher started with one document and whilst going through it, asked herself 'What is this about?' The question did not refer to the content of the document, but to the topic. These topics were written in the margin of the document.

STEP 3: After completing this procedure for several documents, the researcher made a list of all the topics, one column per data document, placing all the columns on the same sheet. The researcher needed to compare all the topics and group similar topics together. These groups in columns, with headings that represented the major topics, the unique topics and leftovers were written.

STEP 4: Next, the topics were abbreviated as codes. Then, with this list of codes, the researcher went back to the data and wrote the codes next to the appropriate segments of the text. The researcher was open to exploring new categories and codes that emerged. If any ideas about the data come to mind, the researcher wrote it down in her notes. This is known as 'analytic memos'.

STEP 5: The researcher found the most descriptive words for the topics, which were turned into categories. The categories were reduced by grouping together those that related to each other. This was the organising system for the data.

STEP 6: The researcher made a final decision on the abbreviation of each category and alphabetized the codes to ensure that no duplication occurred.

STEP 7: The data belonging to each category was put together and a preliminary analysis was performed, looking at all the material one category at a time. The focus was on the content of each category. During this process, the research question was kept in mind in order to discard irrelevant data.

STEP 8: If necessary, the existing data was re-coded. The organising system helped the researcher to give structure to the research report.

This may also be termed 'thematic synthesis'. Guest, MacQueen and Namey. (2012: 15) described thematic synthesis as being a rigorous set of procedures that are designed to examine and identify themes from textual data in a way that it becomes credible and transparent.

3.11 TRUSTWORTHINESS FOR A QUALITATIVE STUDY

In qualitative research, Trustworthiness is important because it allows researchers to describe the virtues of qualitative terms outside of the criterion that are typically applied in quantitative research. To ensure the trustworthiness of this research study, the researcher employed Guba and Lincoln's model. The principles suggested by this model are: dependability, transferability, conformability and credibility (Van Der Venter, Du Rand and Grobler 2017: 131).

3.11.1 Dependability

Dependability is analogous to reliability, which is the consistency of observing the same finding under similar circumstances (Jarvie and Zamora-Bonilla 2011: 321). This term guides the way in which a study is conducted. It should be consistent across time and analysis techniques. Thus, the way through which findings are derived should be repeatable and explicit as much as possible (Morrow 2005:252). Dependability in this study was achieved by providing a comprehensive description of the context in which the research was carried out; providing a description of the research method and the findings; using multiple data sources; and the use of coding to analyse data that was gathered. Some of these sources included interviews, participant observation, field notes, electronic data, as well as journal articles.

To ensure the dependability of the findings in the current study, the researcher employed an exploratory qualitative design to allow participants with rich information about the phenomenon to express themselves freely regarding the open-ended research questions in the interviews. The researcher probed the participants during the interviews to get clarity where needed. The interviews were audio recorded and transcribed verbatim for data analysis. For analysis, the researcher first read the interview transcript to identify themes, then she continued with identifying themes in the subsequent interviews until data saturation. Additionally, the researcher verified the analysis with the assistance of the supervisors to ensure that the findings were consistent and could be repeated when following the methodology used in the study. The findings of the study were presented as themes.

3.11.2 Transferability

This term refers to the extent to which research findings are transferable or generalizable only if they fit into new contexts outside the actual study context (Jarvie and Zamora-Bonilla 2011: 320). This was achieved when the researcher provided adequate information about the research context, self (researcher), participants, processes and researcher– participant relationships to enable the reader to decide how the findings may transfer (Morrow 2005:252).

Transferability in this study was achieved by providing a description of the sampling method, together with the inclusion and exclusion criteria used, providing a complete discussion of the research design and methodology used, as well as by providing an extensive description of the context in which the study was conducted.

To ensure the transferability of findings in the study, the researcher described the characteristics of the participants who were selected purposively based on the rich information they had about the phenomenon. The findings of the study were generalised to this population whilst allowing other researchers to review and examine the research process and data analysis in order to ensure that the findings were consistent and could be repeated.

3.11.3 Conformability

Conformability is the degree to which the research findings can be confirmed or corroborated by others (Jarvie and Zamora-Bonilla 2011: 322). This is based on the acceptance that research is never objective and that findings should represent the situation being researched rather than the beliefs, biases or pet theories of the researcher. According to Morrow (2005: 252), it is based on the view that the truth of findings lies in the data and that the researcher must appropriately join the data, analytic processes and findings in a manner that the reader is able to confirm the adequacy of the findings. Conformability in this study was achieved by using quotes of participants' utterances.

3.11.4 Credibility

This term refers to the idea of internal consistency, where thoroughness in the research process is ensured and this is communicated to others (Morrow 2005:252). Credibility was achieved in this study by prolonged engagement with participants (interviews), negative case analysis and participant checks, co-analysis or validation.

3.11.5 Reflexivity

Reflexivity is also known as self-reflection (Maguire 2016: para 6 line 1). One of the most beneficial ways is for the researcher to keep a self-reflective journal from the commencement to the completion of the study. In it, the researcher keeps a record of her or his reactions, experiences and emerging awareness of any biases or assumptions that become evident. Depending on the frame of mind of the researcher, the self-understandings of these records can then be consciously incorporated into the analysis or merely just set aside (Morrow 2005: 254). The researcher used an A4 counter book as her journal. It consisted of ideas that came to mind; notes from reading which could become/became beneficial at some point; dates to give the researcher an idea of her research journey; and records of experiences during the data collection process.

3.12 ETHICAL CONSIDERATIONS

During the process of designing and planning a research study, researchers need to consider what ethical issues might arise during the study and plan how these issues need to be addressed (Creswell and Poth 2017: 53). The researcher acquired ethical approval to conduct research from one hospital (Appendix 1). Only three radiologists from King Edward VIII Hospital agreed to partake in the study. Below is a list of ethical considerations for this study.

- Ethics approval to perform this study was obtained from the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (DUT).
- Participation in this study was voluntary and the principle of autonomy was maintained.
- The participants were provided with information letters informing them of the study background and purpose (Appendix 5).
- The participants indicated consent to participate in the interviews by completing a Letter of Consent (Appendix 6) and interviews were conducted using an Interview Guide (Appendix 8).
- The data was analysed and reported subjectively by the researcher.

- All the data obtained from this research study was kept confidential and will be stored for five years.
- No names or personal information of the participants were disclosed.
- The participants were able to withdraw from participating in the interviews at any point if they wished, without any penalty.
- The participants were withdrawn from the study if he/she left work at the hospitals of interest (relocated) and started work out of the eThekwini region. The participant was also withdrawn from the study if he/she de-registered from the Health Professional Council of South Africa (HPCSA) and stopped practicing Radiology.
- The participants were not exposed to any risks or discomfort and there was no remuneration.
- The ethical principles of beneficence and non-maleficence were considered for this research study.

3.13 SUMMARY OF THE CHAPTER

A qualitative descriptive study employing criterion sampling of qualified Radiologists practicing within the eThekwini district of KZN province was conducted. Ethics approval to perform this study was obtained from DUT's IREC. All participants were contacted in their personal capacity. The research tool used for this study was face-to-face, one-on-one, semi-structured and in-depth interviews, which included various questions related to Radiographic Image Interpretation. All the data obtained from this research study was kept confidential and under password protection by the researcher.

CHAPTER 4: PRESENTATION OF THE FINDINGS

4.1 INTRODUCTION

This chapter is a representation of the findings of the interview data obtained from three radiologists who are employed at a selected public hospital within the eThekwini district in the KZN province, South Africa. Data was obtained with the aid of semi-structured one-on-one and in-depth interviews, which were conducted telephonically with the participants. The interview data were analysed for their relevance to the study and thereafter clustered into relevant themes that addressed the research question of the study.

The aim of the study was to explore the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs and ultimately recommend training guidelines for Radiographers in the interpretation of radiographic images. The research questions were as follows:

4.1.1 Main research question

What are the perceptions of radiologists with regard to the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers in the interpretation of radiographic images?

4.1.2 Sub–questions

(a) What are the opinions of radiologists with regard to the scope of practice in the interpretation of radiographs by Radiographers?
(b) What is the knowledge required by Diagnostic Radiographers for the interpretation of radiographs, as perceived by radiologists?
(c) What are the clinical competencies required by Diagnostic Radiographers for the interpretation of radiographs, as perceived by radiologists?
(d) What are the medico-legal responsibilities required of Diagnostic Radiographers for the interpretation of radiographs, as perceived by radiologists?

(e) What recommendations can be made to the Health Professions Council of South Africa and the Department of Health to train Radiographers in image interpretation?

The interview guide comprised two sections, namely a demographic section to gather information on the characteristics of participants and an interview section with open-ended questions to collect data for the research questions. The findings of the study first described the participants' demographics, followed by themes, which are reviewed in terms of their sub-themes.

4.2 DEMOGRAPHICS OF THE PARTICIPANTS IN THE STUDY

The researcher captured the participants' demographic information, which included age, gender, race, work experience and HPCSA membership, as depicted in Table 4.1 below.

Table 4.1: Demographic data of study participants

Participant no.	Age (years)	Gender	Race	Work experience (years)	HPCSA membership
1	36-45	Male	Indian	4	Yes
2	36-45	Female	Indian	11	Yes
3	46-55	Female	Indian	12	Yes

No.= number

Of the three participants, two were in the age range of 36-45 years and one was in the age range of 46-55 years. All the participants were Indians. The participants had worked as radiologists for 4 years, 11 years and 12 years respectively. All participants were members of the Health Professions Council of South Africa (HPCSA).

4.3 CONCEPTUALISATION OF KNOWLEDGE, CLINICAL COMPETENCIES AND MEDICO-LEGAL RESPONSIBILITIES REQUIRED BY DIAGNOSTIC RADIOGRAPHERS IN THE INTERPRETATION OF RADIOGRAPHIC IMAGES

The thematic analysis yielded four themes, namely:

(a) Opinions and perceptions of the radiologists regarding the interpretation of radiographic images being carried out by Radiographers;
(b) Knowledge required by Radiographers in the interpretation of radiographic images;
(c) Clinical competency of Radiographers in the interpretation of radiographic images; and
(d) Medico-legal responsibilities of Radiographers in the interpretation of radiographic images.

From these themes, the researcher discussed the related sub-themes that emerged, as illustrated in Table 4.2. To legitimize the developed theme and sub-theme, quotations derived from the transcribed interviews are utilized. A sample of an interview transcript is attached (Appendix 5).

Table 4.2: Summary of themes and sub-themes

Theme	Subthemes
4.3.1 **Radiologists' perceptions regarding Radiographic Image Interpretation by Radiographers**.	4.3.1.1 Support interpretation of radiographs in rural settings. 4.3.1.2 Through training and supervision, Radiographers will be able to provide an interpretation report. 4.3.1.3 Scope of practice to include chest and musculoskeletal system. 4.3.1.4 Interpretation extends scope of practice and thus job satisfaction. 4.3.1.5 Role of radiologist and Radiographer should be clear. 4.3.1.6 Make patients aware of who will provide the report. 4.3.1.7 Cost, rates and turnaround time. 4.3.1.8 Radiographers should refer complex cases for radiological reporting.
4.3.2 **Knowledge and training required by Radiographers in the interpretation of radiographic images.**	4.3.2.1 Anatomy, radiological anatomy and pathophysiology, and understanding pattern recognition. 4.3.2.2 Training in image interpretation ranges between 6 months to 5 years and may be 6 months to a year for each system. 4.3.2.3 Assessment for image interpretation should be done by a radiologist. 4.3.2.4 Continuous monitoring and accreditation. 4.3.2.5 Accreditation should be a diploma for each system, degree or certificate of competence.
4.3.3 **Clinical competencies required by Radiographers in the interpretation of radiographic images.**	4.3.3.1 Clinical competency has to do with the assessment of one's patient. 4.3.3.2 Assessment includes the history, the background, the past medical history of relevance and the current presenting symptoms. 4.3.3.3 Ability to triage patients. 4.3.3.4 Criteria for Radiographers entering an image interpretation course. 4.3.3.5 Developing clinical competency is an ongoing process. 4.3.3.6 Assessment of clinical competencies should be done by a radiologist.
4.3.**4 Medico-legal responsibilities of radiographers in the interpretation of radiographic images**	4.3.4.1 Patients' rights and ethics. 4.3.4.2 No harm is to be done to the patient. 4.3.4.3 Patients' findings must not be disclosed to others. 4.3.4.4 Radiographer should be covered in the event of adverse outcomes when interpreting images. 4.3.4.5 Rights of a healthcare provider are to be protected.

4.3.1 Theme 1: Radiologists' perceptions regarding radiographic image interpretation by Radiographer

When the interviewees were asked their opinions regarding Radiographers' interpretation of radiographic images, they highlighted many views, such as those stated in 4.3.1.1 to 4.3.1.8 in Table 4.2.

4.3.1.1 Support interpretation of radiographs in rural settings

Participants highlighted that they support the interpretation of radiographs by Radiographers in rural settings. They believe that through training and supervision, Radiographers can be enabled to provide an interpretation report. The following excerpt supported this:

> *"…I agree that there is a huge shortage of radiologists, especially in rural areas and interpretation of radiographs is needed.*" **Participant 1, 36-45, male**

4.3.1.2 Through training and supervision, Radiographers can be enabled to provide an interpretation report

On participant believes that if Radiographers can be trained and supervised, they will be able to interpret radiographic images. The following quote affirmed this:

> "…*It's a complex issue but I think that if they have appropriate training and some kind of oversight committee then I think definitely radiographers especially in settings where we don't have radiologists, can provide some sort of report."* **Participant 2, 36-45, female**

4.3.1.3 Scope of practice to include chest and musculoskeletal system

Radiologists further stated that Radiographers can assist with the interpretation of fractures and dislocations in the musculoskeletal system only. Moreover, Radiographers can also perform an interpretation of the chest, but only after hours. The following statements illustrated this:

> "…*There is room for radiographers to assist in the musculoskeletal system, such as fractures and dislocations. Consultants should*

preferably interpret metacarpals as they are tricky. Cranio-facial radiographs can also be tricky.

……. Also, if we are looking at chest x-rays, I think after hours when there is no formal radiology report, we can get radiographers to give a first report." **Participant 1, 36-45, male**

"So I think it's basic things that we do, I think probably also the most of, is chest radiographs so I think that'll be probably the most important aspect to start off with, following that I think would be a trauma series, where I think in terms of acute management, that may be a bit more controlled." **Participant 3, 46-55, female**

4.3.1.4 Interpretation extends scope of practice and thus job satisfaction

Another participant's view was that Radiographers interpreting radiographs will result in an extension of their scope of practice and ultimately lead to job satisfaction. The subsequent quote affirmed this statement.

"…Radiographers scope of practice should definitely be expanded as radiographers will get better job satisfaction." **Participant 1, 36-45, male**

4.3.1.5 Role of Radiologist and Radiographer should be clear

Most interviewees indicated that the interpretation reports by Radiographers should be dissimilar to the radiological reports because to interpret radiographs, radiographers have limited knowledge in the radiographic interpretation. The next quotes supported this:

"…It should be noted that the role between a radiologist and radiographer cannot be misconstrued, chiefly because the medical school training of 5 years is completely different from what a radiographer is taught in 4 years." **Participant 2, 36-45, female**

"…*Radiologists have trained 5-6 years undergraduate, done 3 years clinical and some of them have done even more clinical and then 4 years'*

postgraduate. Some universities are 5 years postgraduate." **Participant 1, 36-45, male**

4.3.1.6 Make patients aware of who will provide the report

Some interviewees were of the opinion that patients should be informed when the Radiographers are providing reports on radiographs so that they (patients) can make an informed decision regarding their choice of report. The following excerpts confirmed this:

> *"…I also believe that the patient should be made aware that the reporting is being done by a radiographer*." **Participant 1, 36-45, male**

> *"…A patient has the right to decide whether or not his report, is reported by a radiographer or a radiologist. I mean there is a difference*." **Participant 3, 46-55, female**

4.3.1.7 Cost, rates and turnaround time

One of the interviewees was of the view that there may be a difference in terms of cost, rates and turnaround time if Radiographers provide a report, compared with when a radiologist provides the radiological report. The following statement illustrated this:

> *"…a patient has the right to decide whether or not his report, is reported by a radiographer or a radiologist. I mean there is a difference- I mean are you going to charge the same amount, in terms of the cost, who pays for what. Is the rates going to be the same, what is your turnaround times?"* **Participant 3, 46-55, female**

4.3.1.8 Radiographers should refer complex cases for radiological reporting

One interviewee specified that if Radiographers are to interpret radiographs, they have the same responsibility as that of radiologists in terms of providing the correct report. It is for this reason that that they should refer to the radiologists when the interpretation requires skills beyond that of a

Radiographer. This will assist in avoiding litigation. The following excerpt confirmed this:

> *"…Medico-legally, I believe that if radiographers are reporting, they should be held to the same level of responsibility as the radiologists who are reporting that same radiograph…if there is uncertainty, the image interpretation should be escalated to a radiologist."* **Participant 1, 36-45, male**

4.3.2 Theme 2: Knowledge and training required by Radiographers in the interpretation of radiographic images

When the interviewees were asked about the knowledge and training required by Radiographers in the interpretation of radiographic images, they highlighted points 4.3.2.1 to 4.3.2.5 as shown in Table 4.2.

4.3.2.1 Anatomy, radiological anatomy and pathophysiology and understanding pattern recognition

All participants indicated that for the interpretation of radiographs, Radiographers require knowledge regarding anatomy, radiological anatomy and pathophysiology. This will enable them to identify any non-conformity from the normal structure. The following quote supported this:

> *"…So I think the most important is anatomy, radiological anatomy, number 1, and number 2 is pathophysiology. And obviously the other thing is pattern recognition the whole thing about radiology is pattern recognition."* **Participant 3, 46-55, female**

4.3.2.2 Training in image interpretation ranges between 6 months to 5 years

When the participants were asked how long the training of Radiographers in Radiographic Image Interpretation should be, their opinions differed. They highlighted terms between six months to 60 months. The following excerpts confirmed these thoughts:

"…If you're going to do musculoskeletal training, maybe a year, if you doing chest X-rays, you could probably get away with it in 6 months." **Participant 3, 46-55, female**

"…Maybe a one-year post degree qualification may be of greater benefit" **Participant 2, 36-45, female**

"…My rough estimate is that radiographers need 3-5 years post degree to become comfortable with what their clinical work is. Essentially, this will be something similar to a Masters level. I would prefer for those to do courses in image interpretation." **Participant 1, 36-45, male**

4.3.2.3 Assessment for image interpretation should be done by a radiologist

One of the participants indicated that assessment for image interpretation should be performed by a radiologist and that theory should be supplemented with practical exposure, which is the intervention of radiologists in the training to ensure readiness to undertake the interpretation of images. The following quote confirmed this:

"…For assessment, it should be a joint establishment. Assessments should not be done by a radiographer- the final assessment and approval should be done by a radiologist. This should be the gold standard. So you will have formal diagnostic lectures and that can be done via university. But you going to have clinical and hands on experience and observing while working and mentorship and final approval done by a radiologist." **Participant 1, 36-45, male**

4.3.2.4 Continuous monitoring and accreditation

One of the participants further stated that along with accreditation, there should be continuous monitoring. The following quote illustrated this:

"…Obviously they have to be adequately trained and I think you have to have some form of accreditation- so some form of accreditation and

continuous monitoring and education in terms of that because radiology is a completely different field even for clinicians I think." **Participant 2, 36-45, female**

4.3.2.5 Accreditation should be a diploma for each system, degree or certificate of competence

Most of the interviewees indicated that accreditation in the form of a diploma, degree or certificate of competence can be awarded. The following excerpts indicated this:

"… A diploma and most likely if it is going to be a diploma, my opinion, is that it should be a diploma for a specific system." **Participant 1, 36-45, male**

"…I think it'll have to be almost like a diploma slash degree maybe for like another year or so of additional training." **Participant 3, 46-55, female**

"…Maybe something more like a certificate of competence maybe a post graduate diploma -some sort of board certification." **Participant 2, 36-45, female**

4.3.3 Theme 3: Clinical competencies required by Radiographers in the interpretation of radiographic images

When the interviewees were asked about the clinical competencies required by radiographers in the interpretation of radiographic images, they highlighted many views, such as those stated in 4.3.3.1 to 4.3.3.6 in Table 4.2.

4.3.3.1 Clinical competency has to do with the assessment of one's patient

One participant was of the view that clinical competency has to do with the assessment of a patient. The following quote illustrated this view.

"…Image interpretation is not just looking at images." **Participant 1, 36-45, male**

4.3.3.2 Assessment includes the history, the background, the past medical history of relevance and the current presenting symptoms

In agreement with the previous participant, one of the participants further explained that assessment includes the history, the background, the past medical history of relevance, as well as the current presenting symptoms. The next except supports this:

"So clinical competence I think, has to start right at the beginning so in terms of assessment of your patient, which will include, the history, the background, the past medical history of relevance, the current presenting symptoms and signs." **Participant 3, 46-55, female**

4.3.3.3 Ability to triage patients

One of the participants was of the opinion that clinical competency ensured the ability to provide aid on the basis of need for, or likely benefit from, medical treatment. The following excerpt demonstrates this:

"…Also being able to recognize almost triage your patient-is it urgent-is it a semi urgent-is it something that not very urgent that's important- I mean you can't have someone clinically competent if you miss a fracture for example as opposed to someone who's got some benign thing in their limb." **Participant 3, 46-55, female**

4.3.3.4 Strict criteria for Radiographers entering an image interpretation course

The interviewee indicated that there must be strict criteria for people entering image interpretation course. Radiographers must be assessed to ensure that their characteristics the match admission criteria, and that none of their characteristics match any single one of the exclusion criteria set up for entrance. The following excerpt indicated this:

"…*You also have to have criteria as to who is entering the system. There should be strict criteria in which you're going to be selected I don't think everybody's going to be able to do something like this*" **Participant 3, 46-55, female.**

4.3.3.5 Developing clinical competency is an ongoing process

Interviewees stated that developing clinical competency is an ongoing process and that the assessment of clinical competencies should be done by a radiologist. The next quote supported this:

"…Clinical competency doesn't come the day you pass your exam. It comes with the ongoing process that is developed over many years so someone cannot expect to have 6 months of advanced training and think that they are now clinically competent." **Participant 3, 46-55, female**

4.3.3.6 Assessment of clinical competencies should be done by a radiologist

One of the participants was of the view that the assessment for clinical competencies should be done by a radiologist, which should be the benchmark for all assessments. The following view supports this:

"…Assessments should not be done by a radiographer- the final assessment and approval should be done by a radiologist. This should be the gold standard." **Participant 1, 36-45, male**

4.3.4 Theme 4: Medico-legal responsibilities of Radiographers in the interpretation of radiographic images

When the interviewees were asked about the medico-legal responsibilities of Radiographers in the image interpretation of radiographic images, they highlighted many views, such as those stated in 4.3.4.1 to 4.3.4.5 in Table 4.2.

4.3.4.1 Patient's rights and ethics

When the interviewees were asked if patients' rights and ethics should be included in the image interpretation course, all were of the opinion that it is relevant and reinforced that no harm must be done to the patient. The following quote illustrated this:

> *"…Definitely!! This is an important aspect- it should be included in the potential training course because patients' rights are paramount to everything."* **Participant 1, 36-45, male**

4.3.4.2 No harm is to be done to the patient

One of the participants further elaborated on patients' rights. The following quote supports this:

"…With normal radiography, radiographers are cognizant of patients' rights and making sure that patients are not harmed. That you don't scan patients against their will so I don't think it's any different to what you would normally be trained to do. Make sure that you don't violate patient's rights and it's just the basic Hippocratic oath." **Participant 2, 36-45, female**

4.3.4.3 Patients' findings must not be disclosed to others

One of the participants indicated that apart from parents, relatives have *no* automatic right of access to the patients' findings. The following quote supports this:

> *"…Obviously you're going to do no harm, you don't disclose a patient's findings to other people including family members or the staff members*" **Participant 2, 36-45, female**

4.3.4.4 Radiographers should be covered in the event of adverse outcomes when interpreting images

Interviewees further stated that a Radiographer should be covered in the event of adverse outcomes when interpreting images, so the rights of a healthcare provider are to be protected. The next excerpt indicated this:

> "…*I think the radiographer needs to be covered if there are any adverse outcomes obviously from reporting because you're not a radiologist, so I think, they should be like obviously some kind of protection for them.*" **Participant 2, 36-45, female**

4.3.4.5 Rights of a healthcare provider are to be protected

One participant expressed that with image interpretation, a mishap, especially interpretation without a license, could lead to a legal intervention. The following quotes supported this:

> *"…There is going to be legal liabilities with regards to incorrect interpretation of a radiographic image, which is why it is important to have accredited programmes for radiographers when training for image interpretation.*" **Participant 1, 36-45, male**

> "…*The problem will come when to screen an x-ray prospectively, meaning where there is incidental pathology that is not related to the request. Therein lies the potential for medico-legal escalation issue."* **Participant 1, 36-45, male**

4.4 SUMMARY OF THE CHAPTER

If a training programme is to be developed or if Radiographers decide that they would want to interpret images, it is vital to acknowledge the perceptions of radiologists with regard to the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers in the interpretation of radiographic images. The participants believed that there was an opportunity for the radiographer's scope of practice to be expanded. The four main themes and sub-themes that arose during the data analysis will be discussed in Chapter Five.

CHAPTER 5: DISCUSSION OF FINDINGS

5.1 INTRODUCTION

The previous chapter presented the findings of the study as themes. Those findings will now be discussed based on an analysis and understanding of the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers in the interpretation of radiographic images. The researcher used the interview transcripts to analyse the data, which rendered the tools for the interpretation and organisation of the themes. The discussion of findings as themes is informed by Structural Empowerment and the Professional Identity Theory to strengthen Radiographer empowerment and to improve their professional identities.

The current chapter discusses the demographic profiles of the study participants in order to provide a contextual background of the radiologists interviewed. Thereafter, the themes that emerged are discussed, along with the sub-themes. To recap, the main themes that emerged were: Radiologists' perceptions regarding radiographic image interpretation by Radiographers; Knowledge and training required by Radiographers in the interpretation of radiographic images; Clinical competences required by Radiographers in the interpretation of radiographic images; Medico-legal responsibilities of Radiographers in the interpretation of radiographic images. This chapter also discusses the findings in relation to the aims of the study and concludes with the summary.

The researcher acknowledges that the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs was not the focal point of the academic work included in this discussion, and that research gathered may not have been published with the purpose that is now discussed.

5.2 DEMOGRAPHIC PROFILE OF STUDY PARTICIPANTS

Of the three participants, two were in the age range of 36-45 years and one was in the age range of 46-55. The participants had worked as radiologists for 4 years, 11 years and 12 years respectively, and were all registered with the Health Professions Council of South Africa (HPCSA) under the speciality of Diagnostic Radiology. They were permanently employed at the selected public hospital in the eThekwini District in Kwa-Zulu Natal.

Transferability and credibility for trustworthiness was achieved through the utilisation of the Delphi Technique. The Delphi Technique is shown to be effective in the theoretical or explorative phase of the research procedure because it can give rise to knowledge that can grow the evidence for the desired effect of an intervention (Niederberger and Spranger 2020: 457). In terms of this study, revising or creating curricula possibly requires input from representatives or experts with a background in the field (Sitlington and Coetzee 2015: 313). In this study, the experience of the radiologists would allow the provision of data for the development of a curriculum to guide Radiographers in image interpretation. Furthermore, Hammar (2011: 1) expressed that a meticulous description of the participants of a study permitted researchers and reviewers to establish the generalization of the study's findings and grants them the ability to make comparisons across other studies.

5.3 DISCUSSION OF FINDINGS AS THEMES

Radiographers in South Africa are ethically and legally bound to practice within their level of competence and the scope of their educational training (Koch 2016: 15). Though Radiography is regarded as a profession, it is frequently expanding and its role will continue to be impacted by the healthcare systems and dynamic social norms within society (Decker 2006: 162). To expand their role in interpretation of the radiographic images, they can be empowered by professionals whose scope includes image interpretation and those are the radiologists. Thus, the purpose of this study is to explore the Radiologists' opinions and perceptions on these factors in support of role extension, which can improve the number of reported images and ultimately can address the

shortage of radiologists. This will inevitably improve the Radiographers' professional identities. The two theories guiding the study are the Professional Identity Theory for the Radiographers because their identity is built around their effective role within a vital work environment and the Theory of Structural Empowerment for the radiologists and explains that empowerment is encouraged in the workplace when employees are given access to support, resources and essential data with the chance to develop and learn (Larkin, Cierpial, Stack, Morrison and Griffith 2008: 1). Therefore, the amalgamation of the Theory of Structural Empowerment and the Professional Identity Theory will contribute to the formation of an essential concept, which is a goal-oriented, motivated, enthusiastic and exceptionally knowledgeable Radiographer.

The present study explored the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs and to ultimately recommend training guidelines for Radiographers in the interpretation of radiographic images. The study was guided by the Theory of Structural Empowerment and the Professional Identity Theory which were explained in chapter 2. The themes that emerged from the analysis, namely radiologists' perceptions regarding Radiographic Image Interpretation by Radiographers; the knowledge and training required by Radiographers in the interpretation of radiographic images; clinical competences required by Radiographers in the interpretation of radiographic images; and the medico-legal responsibilities of Radiographers in the interpretation of radiographic images, are discussed in detail below.

5.3.1 Radiologists' perceptions regarding Radiographic Image Interpretation by Radiographers

The findings of the current study suggest that radiologists support the interpretation of radiographs by Radiographers in rural settings. However, they did not state why image interpretation by Radiographers should be done in rural areas. Alahmari (2021: 3) stated that whilst many countries experience a deficit of radiologists, it is vital to have more programs and advanced practice for Radiographers. For example, a previous study reported that in South Africa, the

radiologist per population ratio was 1.2: 100 000 (Techsmart 2015: para 3 line 1-2). Hazell, Motto and Chipeya (2015: 303) expressed that there is a deficit of radiologists in South Africa, which resulted in delayed reporting on images. They agreed that Radiographers might be capable of providing an initial comment on images, alleviating the impact that the shortage of radiologists has on South African radiologists (Hazell, Motto and Chipeya 2015: 303). This suggests that the interpretation of radiographic images should also be in urban areas due to the shortage of radiologists.

On the same wavelength, Mung'omba and Botha (2017:5) found that in rural areas, medical practitioners acquire viewpoints on plain x-rays from Radiographers. Similarly, Murphy *et al.* (2019: 270) stated that the provision of Preliminary Image Evaluation (PIE) or having an image interpreted supports treatment decisions for a patient in the absence of a radiologist and is not a replacement for a radiological report. In other words, image interpretation performed by a Radiographer would essentially be a source of timely communication of the appearance of irregularity to the referring physician.

Furthermore, Mung'omba and Botha (2019: 1) explained that a rural hospital is one that is secluded from metropolitan areas. When Smith, Traise and Cook (2009: 1) conducted a study to investigate the accuracy of rural Radiographers in interpreting musculoskeletal plain radiographs, they found that there was a positive effect in the ability of Radiographers to interpret plain x-rays (Smith, Traise and Cook 2009: 8). The authors were in accordance with the findings of the current study because they explained that when there is no radiologist present, something which is frequently the case in rural hospitals, the medical management of a patient is enriched since the inception of image interpretation by Radiographers (Smith, Traise and Cook 2009: 2). Also in agreement was Mabuuke, Busing and Kiguli-Malwadde (2019: 129), who more recently stated that around the world, there is a deficit in the number of radiologists in comparison with the number of patients who need their radiographic images to be interpreted. This is intensified in impoverished countries where the only available radiologists are generally based in urban areas at the tertiary

hospitals. As a consequence, rural regions generally have Radiographers who would have to provide an interpretation of radiological examinations.

In another example, it was reported in 2014 that in a population of more than 150 million, Nigeria only had 220 radiologists (Mabuuke, Busing and Kiguli-Malwadde 2019: 129). Data from the 2008 Demographic and Health Survey carried out in Nigeria relayed that about sixty-four percent of Nigerian people live in farms or rural areas, with the remainder living in the city (Reed and Mberu 2015: 321). Hence, the presence of a Radiographer who can carry out image interpretation would be beneficial in rural areas.

There is unanimity amongst the radiologists interviewed that with proper training and supervision, Radiographers would be able to provide an interpretation report. This could mean that despite the nature of radiographs, if Radiographers are sufficiently trained, they would be skilled at interpreting any image. In agreement, McConnell and Baird (2017: 322) stated that Radiographers are the most under-used category of healthcare workers because they have the most suitable education and background to give supportive guidance on the interpretation of musculoskeletal images, but rarely do so. Studies carried out by Smith, Traise and Cook (2009); Mabuuke, Busing and Kiguli-Malwadde (2019), as well as Piper (2014) and McConnell and Baird (2017) specify that Radiographers are capable of interpreting radiographic images, with a diagnostic reliability similar to that of radiologists. This can be of great assistance, especially in areas where there is a shortage of radiologists. In fact, Smith, Traise and Cook (2009: 3) did state that training programmes for Radiographers would be fruitful in enhancing their image interpretation skills. Culpan *et al.* (2019: 156) communicated that radiologic interpretations in the United Kingdom were created by well-trained and educated Radiographers with the Royal College of Radiologists, estimating that seventy-eight percent of Radiography departments in the country made use of the interpretation skills of Radiographers. In South Africa, Hazell, Motto and Chipeya (2015: 301) stated that there was no literature examining the kind of training needed to prepare Radiographers to acquire skills to correctly comment on images. Furthermore, their study communicated that the generation of comments through education

in pattern recognition would enhance the standard of descriptive comments on radiographic images (Hazell, Motto and Chipeya 2015: 307).

The interviewees were of the view that the scope of practice should include the interpretation of chest images and the musculoskeletal system. The radiologists explained that these were the most common body parts that needed interpretation, and their interpretation could assist workflow. Mabuuke, Busing and Kiguli-Malwadde (2019: 129) confirmed that the chest radiograph was the most prevalent radiographic request and used the chest radiographic image to evaluate the diagnostic accuracy of radiologic technicians. Furthermore, Piper *et al.* (2014: 94) stated that chest x-ray images are amongst the most difficult radiographs to interpret, with some writers revealing critical inaccuracies by professionals who are not in the respiratory or radiological sector.

A viewpoint was that the role extension of radiographers will inevitably lead to increased job satisfaction. Consistently, McConell (2012: 184) relayed that when Radiographers gave descriptions of the radiographic content, this relieved the pressure on healthcare teams, which gave them a sense of fulfilment. However, the role of the Radiographer and radiologist should not be misconstrued and it is vital for patients to be informed about who is providing the interpretation report. In fact, O'Mahony, McCarthy, McDermott, and O'Keeffe (2012: e1188) previously revealed that that there was ignorance amongst healthcare personnel as well as patients regarding the distinction between a radiographer and radiologist. When O' Mahony *et al.* (2012: e1184) conducted a study to investigate a patient's perceptions of the part of a radiologist in their healthcare, the deduction made from the study showed that there was a deficiency in knowledge amongst patients and colleagues with regard to the functions of the present-day radiologist Of the three hundred and six patients who were recruited for the study, almost forty percent did not view the radiologist as having a significant role in their healthcare; seventy-six percent of the patients were under the impression that radiologists were radiographers; and just fourteen percent of the patients knew that radiologists were actually medical doctors (O' Mahony *et al.* 2012: e1184). Hence, to avoid further confusion, action must be taken to increase society's knowledge about

Radiology so that there is a meticulous reflection of the scope and the value of the specialty.

The current study also found that patients need to be made aware about who is providing the interpretation of their examination. In other words, a patient's understanding must be sought and consent from the patient must be acquired. Patient informed consent means that patients receive sufficient information about the risks, alternatives and potential benefits of any treatment that they may receive. In terms of radiology, if their investigation is interpreted by a Radiographer, it may differ from that of a radiologist. It is not possible to guarantee positive outcomes in a healthcare setting, but informed consent allows patients to understand the possibilities, which is achieved by communication. When patients understand this, they are usually requested to sign paperwork indicating their comprehension. It is in this way that trust is created between a member of the healthcare team and a patient. This promotes a good understanding between the two parties and reduces risk for the reporting Radiographer as well as the patient. Thus, exceptional communication allows the patient to make decisions that are best for them and Radiographers face a reduced chance of legal action. This also gives the patient the opportunity to think about seeking a second opinion should they be unhappy with the interpretation of results from a Radiographer. To work efficiently, informed consent must permit patients to make decisions which are best suited for them. This means that healthcare personnel should provide sufficient information to patients in order to allow them to make a choice. Enough time must be given where possible, so patients do not feel pressured. Pain, medication and some medical conditions can affect comprehension and acumen, so healthcare personnel must be considerate of these factors when seeking consent from a patient (Gallagher Healthcare 2018: 1).

The findings of this study suggest that factors such as costs, rates and turnaround time for image interpretation will be impacted. Koong (2012: 39) communicated that for the interpretation of a radiographic image, a structured approach would be necessary. Hence, the belief that all lesions have a representative appearance and the "Aunt Minnie" approach to interpretation is

inadequate, leading to misdiagnosis and inaccurate interpretation. Dr Benjamin Felson, an esteemed lecturer in Radiology and specialist in the interpretation of radiographic images, explained that an “Aunt Minnie” is a case where the radiologic findings are so captivating that no differential diagnosis exists (Radiology Affiliates Imaging 2019: 1).

The concept explained, as well as the fact that the Radiographers do not possess a medical degree as the radiologists do, could be a reason why there are certain factors to consider when a Radiographer is interpreting an image. For this reason, the participants found that the interpretation carried out by a Radiographer is significantly different to the interpretation by a radiologist. Hence, excellent knowledge incorporated with sufficient training and enough experience is essential for the formation of outstanding interpretive skills in Radiology (Koong 2012: 39). It must be remembered that the interpretation report can be regarded as the most superior reflection of the patient’s condition and is the way in which the reporting Radiographer would contribute to patient care. The findings section of the report should not be repetitive; it should highlight factual and informative observations while avoiding ambiguity; and always use language that is understandable, memorable and actionable. Therefore, image interpretation skills need continuous attention and must adapt to the evolving patterns in medicine (Hartung, Bickle, Gaillard and Kanne 2020: 1658). In comparison to other medical personnel or doctors who directly see patients for their treatment, radiologists or radiographers who would provide an interpretation have a distinctive place on the medical team by providing a written appraisal of the patient's condition that is intended to be studied to influence other clinicians. Simply put, the report generated by the radiological department is chiefly a method of communication between the radiologist and the referring doctor about the patient. Therefore, even though the technical elements of reporting are important for the evaluation, the referring doctor is merely looking for a diagnosis or differential diagnosis and/ or recommendations (Hartung *et al.* 2020: 1661). As a result, the radiologists interviewed in this study are of the opinion that patients must be made aware of who will provide the report.

Even though there is backing for the roles of Radiographers to be evolved, the participants of this study concurred that composite cases should be referred to radiologists for a radiological report. Koong (2012: 39) concurred with the participants because he expressed that reporting Radiographers should be mindful where the radiographic image is outside of their interpretative skill. It is therefore realistic to deduce that a Radiographer who is interpreting images may encounter a difficult case. More recently, when Murphy *et al.* (2019: 269) conducted a study reviewing papers investigating radiologic interpretation by Australian Radiographers and the barriers to implementation, they found that reporting Radiographers did state that cases could be 'too easy' or 'too difficult'. As a result, differing levels of ability to find and report radiographic abnormalities, with performance metrics ranging from poor to excellent, were reported (Murphy *et al.* 2019: 280). The views of the participants of the current study regarding composite cases being referred were therefore significant.

One of the findings of the study was that cost, rates and turnaround time will be affected if Radiographers carry out image interpretation. Culpan *et al.* (2019: 157) were in disagreement with the participants of the study because they stated that there was uniformity in the reports generated by knowledgeable and well-trained Radiographers, when compared to radiologists. This implies that the turnaround time is similar and if the quality of the reports is the same, rates or cost to patients should not be changed. The authors further stated that when comparing employment costs, training time and availability, it is probable that employing radiologists to perform interpretation on simple radiographic images would cost more and reporting time will be increased, instead of enhancing the jobs of current radiographic personnel (Culpan *et al.* 2019: 162).

The participants also suggested that there must be legal protection for radiographers. Mir (2021: 12) shed light on this finding because he explained that mistakes in radiographic reports could possibly result in lawsuits for a variety of reasons. For example, ill-suited terminology and improper wording could result in ambiguity, leading to the mismanagement of patients. For this reason, a Radiographer who interprets images must be cognizant of the fact that errors give rise to false positives and false negatives, which can translate

into presumed harm or real distress for the patient, with accompanying legal repercussions (Olivetti, Fileni, De Stefano, Cazzulani, Battaglia, and Pescarini 2008: 607). There is certitude that if errors occur, there will be execution of rectification and that the most appropriate attitude to have, at least when an error is committed, is one which displays that the health worker acted accordingly to safeguard the health interests of the patient. Possessing this type of behaviour allows a person to calmly explain, if needed, the decisions made and the reason for making them, even beyond practice protocols and guidelines, and may promote an understanding of possible errors (Olivetti *et al.* 2008: 608). If this does not go too well, the finding stating that legal protection is needed for Radiographers will be applicable.

5.3.2 Knowledge and training required by Radiographers in the interpretation of radiographic images

The study found that in order for Radiographers to interpret radiographic images, a meticulous understanding of anatomy, radiological anatomy and pathophysiology, as well as pattern recognition, would be essential. Manning *et al.* (2006: 141) emphasised that training techniques which promoted a thorough understanding of disease pathology by exposing learners to an increased number of cases is vital (Manning *et al.* 2006:141). Koong (2012:33) agreed that a comprehensive understanding of anatomy is required and the person carrying out interpretation must be fully cognizant of pathosis which may manifest or arise in the area being interpreted. This pathosis may range from degenerative disease and internal derangement to synovial chondromatosis, chondrocalcinosis, erosive arthropathies, vascular lesions as well as various tumours (Koong 2012: 34). Since the presentation of ailments differs radiologically, they can offer differential diagnoses to the interpreter (Koong 2012: 34). Therefore, a detailed understanding of the appearances of anatomic structures in radiographs; an in-depth comprehension of disease processes and subsequently, behaviour or diseases in anatomical regions, form the central point of radiologic interpretation. In plain Radiography, awareness of the angle of projection, related geometry and having knowledge about the specific radiologic characteristics of various lesions is also critically important because

it can substantially assist in diagnosis (Koong 2012: 33). Koong (2012: 34) further elucidated that optimum viewing conditions are vital to allow the identification of all the main features in an image, including normal anatomy. In fact, the subtle non-appearance of a normal structure can be a crucial discovery, leading to the identification of a significant abnormality. Irrelevant light from a viewing box should be obscured and ambient light must be at the lowest level. This would allow the interpreter to optimally observe every feature of an image. Manipulation of digital images via magnification and windowing can be done on a computer monitor. Thus, the quality of the monitor is important and for analogue images, optical magnification and using a brighter light source for darker regions can be a necessity (Koong 2012: 34). In terms of radiographic images printed on paper, the quality of the paper and printer is of high importance. High-quality photographic paper generated from a high-quality printer does not demonstrate the same optical range as film or high quality monitors. Therefore, the interpretation of 2-D digital images is best performed on high-quality film or monitors. Moreover, during the transfer of electronic images, the level of compression of images must be kept at its lowest in an attempt to not lose crucial data (Koong 2012: 34). This tells one that the technical aspects of image interpretation also play a significant role.

One participant in the study recommended that the image interpretation course must be run by a Radiographer who has already passed the same course, and that training in image interpretation should begin 3-5yrs post degree. eIntegrity Healthcare (2014: 1) communicated that their image interpretation course, which is an online learning programme, was developed by the UK Society and College for Radiographers, with the learning content being written by specialist Radiographers and academics from an assortment of fields. In contrast, London South Bank University stated that the Reporting Programme was delivered by internal and guest specialists with over a decade of experience, from a variety of hospitals. There was no mention of Radiographers or experienced radiographic interpretation Radiographers. The researcher did not find any other information regarding this finding, especially about who ‘runs’ the course. Alahmari (2021: 1) relayed that a patient’s treatment plan, in the absence of radiologists, will be based on the interpretation of a radiographer. Furthermore,

this interpretation must be done by a Radiographer who had completed a course in the interpretation of radiographs.

The findings of the study suggest that learning courses to interpret chest and musculoskeletal systems could be 6 months and 1 year, respectively. The Norwich Image Interpretation Course (Nunn 2011: 1) states that each module should cover a specific anatomical area, with importance to the paediatric skeleton for each section included. This course was designed for Radiographers who provide a commenting service to the accident and emergency department, as well as those who wish to revamp their skills in image interpretation (Nunn 2011: 1). The course, which was designed for the musculoskeletal system, included:

- Typical and atypical anatomy,
- Usual fractures with their mechanism of injury,
- Prevalence of these fractures,
- Minute injuries which are typically missed on radiological examination, but are significant clinically,
- Soft tissue signs associated with a lack of apparent bony injury,
- Classification of fractures with their ordinary eponyms,
- Risk factors associated with pathological conditions, which may be an incidental finding or predisposition of the injury,
- Associated injuries which may come after an initial diagnosis is made, and
- Any radiographic projections which can assist non-radiographers when investigating (Nunn 2011: 1).

Sheffield Hallam University (n.d.: 1) communicated that by undertaking a module in chest image interpretation, radiographers would be able to:

- be aware of usual and unusual chest x-ray images,
- be able to work out a diagnosis or differential diagnosis,
- draw up and disseminate a written professional opinion, derived from the interpretation of the chest x-ray, as well as: i) be knowledgeable about acute respiratory conditions, ii) recognize chronic lung disease and malignancy, iii) recognize trauma to the chest, iv) be informed about the position of tubes,

lines and drains and v) develop technical skills for the image interpretation process.

The findings suggest that the radiographers should have formal lectures and be attached to a hospital for 6 months to a year, sitting with the radiologists doing plain film interpretations. Neep (2018: 4) described two very different formats for the delivery of image interpretation education. The first method was 13.5 hours over 2 consecutive days, which was known as the intense delivery format, versus the second method which was 90 minute tutorials, once a week over a 9-week period. This was known as the non-intensive delivery of education. In contrast to the findings of the study, and remembering that Radiographers interpreting images is not a regular practice, Peninsula Health, Frankston Hospital got the Department of Medical Imaging and Radiation Sciences at Monash University to provide a non-award 'Short Course in Advanced Radiographic Clinical Skills' as an experimental project for Radiographers. The intention of this short course was to expand the knowledge of Radiographers in the area of emergency image interpretation, with the focus being on common pathologies and trauma, represented on plain Radiography (Williams, Baird, Pearce and Schneider 2019: 15). The University of Newcastle in Australia has a new course that provides learners with the chance to further develop their knowledgebase and practical skills in the evaluation of radiographic images, and can be taken via an online activity or workshop. The online activity, as the description suggests, is online 2 hours per week for 9 weeks and the workshop is face-to-face on campus for 3 weeks, with 3 hours per week (The University of Newcastle 2021: 1). When Tay and wright (2018: e73) conducted a study on the value of an internal strategy devised over a two-year period, a Singapore hospital, they found that an internal blended program of on-line learning, seminars and clinical audits can inevitably grow a radiographer's image interpretation skills, and is excellent for preceptorship because an in-house training program, whilst carrying no academic credit towards post graduate awards, would offer inexpensive knowledge for all graduate Radiographers (Tay and Wright 2018: e73).

The findings of this study inferred that assessments for image interpretation should be done by a radiologist. The Norwich Image Interpretation Course and Sheffield Hallam University both described e-learning modules, which meant that Radiographers could study online, provided that they have a secure internet connection along with Google Chrome and Microsoft or Apple Mac Software. The modules were designed considering anatomy and pathology so that at the end of each module, a multiple choice assessment could be used to assess the concepts taught (Nunn 2011: 312). With Sheffield Hallam University, a phase test, which is a type of formal evaluation but which is subject to University rules, allows a participant to be credited (Sheffield Hallam University n.d.: f1). This method was not in accordance with the findings of this study. Tay and Wright (2018: e70) state that even though Radiography and Radiology are dissimilar professions, the image interpretations aspect would be common to both, hence the performance assessment should be alike. The Royal College of Radiologists (2021: 1) stated that assessments for Interventional and Clinical Radiology consisted of a coordinated package of developmental workplace-based assessments (WPBAs), as well as a cumulative examination of knowledge and radiological skills. These assessments will occur during the training programme, enabling trainees to constantly gather evidence of learning whilst yielding the feedback required to enhance clinical practice (Royal College of Radiologists 2021: 1).

The findings of the study indicate that there must be continuous monitoring and accreditation. Leishman (2013: 111) was somewhat in agreement with the participants because her study indicated that education for image interpretation is not entirely appropriate for electronic delivery, with some participants of their study opting for hybrid learning, where there is a combination of work-based learning with online classes. Further to this, the participants in Leishman's (2013: 111) study stipulated that the expansion of reporting skills is dependent on input from experts in the field and this is deemed as something crucial in the learning process. In other words, regular interaction with consultant radiologists would enhance the learning process for image interpreting Radiographers. Leishman (2013: 104) additionally described possible strategies that could

intensify continuous monitoring for image interpretation education by means of utilizing new technologies to enhance interactivity, such as discussion forums.

Participants stated that accreditation should be a diploma for each system, degree or certificate of competence. In agreement, Hardy and Snaith (2009: 103) mentioned that upon completion of a post-graduate image interpretation course at three Higher Education Institutions (HEIs), a certificate of competence would be awarded to allow Radiographers to formally interpret radiographs. However, the Graduate Certificate of X-Ray Image Interpretation is offered by Monash University (2021: 1) seems to be more in accordance with the findings of the study because it allows healthcare personnel, not just radiographers, but also other members of the healthcare team like general practitioners, nurses, physiotherapists and paramedics, to gain x-ray analysis skills by developing their clinical knowledge. This approach is ideal for remote and rural healthcare personal because it includes the foundations of radiographic interpretation and the interpretation of different body systems, thus complementing existing knowledge and thereby allowing graduates to execute well-informed interpretations (Monash University 2021: 1).

5.3.3 Clinical competencies required by Radiographers in the interpretation of radiographic images

When an enquiry was made about clinical competencies, the participants collectively agreed that clinical competency has to do with assessment of a patient- with assessment entailing history, background, apt medical history and current presenting symptoms. Itri (2015: 1836) was in complete accordance with the participants of the study because he explained that Radiographers play a vital role in the x-ray department due to many of their responsibilities being dependent on constructive and efficient communication with patients. This includes taking the history of the patient; confirming a patient's identity with the procedure to be performed; screening for safety e.g., determining pregnancy or

even the correct side of examination; providing concise and helpful instructions; and ensuring that patients understand all of the instructions, all whilst answering questions swiftly, explaining post examination care and coordinating patient care with the effective use of resources. As a result of Radiographers playing such a pivotal role, techniques that enhance their communication skills are supreme for ensuring a positive experience as well as the patient's safety (Itri 2015: 1836). AIDET is an acronym which effectively encompasses the skills that can be used to improve communication between the radiographer and patient. AIDET stands for ***a***cknowledge, ***i***ntroduce, ***d***uration, ***e***xplanation and ***t***hank you. When explained fully: *(a)* acknowledge is to greet and welcome the patient, also apologizing for any delays, and to acknowledge concerns; *(b)* introduce is to introduce oneself using one's name and explaining one's role in the patient's care; *(c)* duration is to describe the amount of time that the patient can expect to wait for a test or procedure; *(d)* explanation is to describe what is going to happen to the patient and what he or she can expect; and *(e)* thank you is for thanking the patient for his or her participation and cooperation (Itri 2015: 1836).

Similarly, Faraji, Karimi, Azizi, Janatolmakan, and Khatony (2019: 422) explained that clinical competencies in the healthcare sector included general characteristics such as professional skills, group performance, communication skills, management skills and the ability to provide healthcare services and specific competencies; such as performance monitoring, implementation of specific processes, quality care assessment and the ability to monitor disease and health. The authors further stated that clinical competency was made up of seven dimensions, namely i) being helpful, ii) having a diagnostic function, iii) disseminating knowledge, iv) being able to manage situations, v) performing therapeutic interventions, vi) providing quality and vii) having a proper work ethic (Faraji *et al.* 2019: 422). The researcher found the participants' explanation of clinical competency to be in disagreement with Hardy and Snaith (2009: 104), who suggested that clinical competence in the interpretation of radiographic images could be determined through summative assessment and the use of formative logbooks. On the other hand, as a whole, clinical competency is a matter of greatest importance in the health sector because the

quality of care is dependent on the clinical competency of healthcare professionals.

The findings of the study indicate that radiographers who perform image interpretation must also be able to triage patients. The main goal of triage is to make sure that patients obtain the most suitable level of care based on their clinical status (Massaut, Valles, Ghismonde, Jacques, Pierre Louis, Zakir, Van den Bergh, Santiague, Berly Massenat and Edema. 2017: 2). In the UK, triaging was achieved by the 'red dot' system, whereby radiographers used a red sticker for trauma triage (Hlongwane and Pitcher 2013: 638). However, when Van der Venter and Ham Baloyi (2019: 183) conducted a systemic review on image interpretation in South Africa, they stated that there is a grey area in literature in the changeable use of the terms: image interpretation, the red dot system and reporting, when determining the accuracy of the radiographers. Also noteworthy is the use of the South African Triage Scale (SATS). SATS is an approved triage tool utilized in South Africa, as well as numerous other low- and middle-income regions, for in-hospital care. When the first formal evaluation for pre-hospital triage was conducted by Emergency Medical Services (EMS) and reviewed by Mould-Millman, Dixon, Burkholder, Pigoga, de Vries, Moodley, Meier, Colborn, Patel, and Wallis (2021: 5), they found that SATS performed with less success than expected as a triage tool. It showed increased rates of under- triage, sub-standard validity and moderately good reliability, and attributed these results to clinical discriminators (Mould-Millman *et al* 2021: 6). In terms of the study, a triage system would help radiologists move swiftly on cases requiring immediate attention. The webpage, Radiology Triage System Improves Patient Care, communicated that a triage system would assure that studies of the most severely ill patients are interpreted first. Apart from looking at urgent cases immediately, this system allows whoever interpreted the image to communicate the findings of the patients for prompt medical attention and it constantly updates the radiology worklist, thereby guaranteeing that cases are interpreted in a more fitting order rather than first-in, first-out (Radiology Triage System Improves Patient Care 2005: 1).

The findings of the study indicate that developing clinical competency is an ongoing process. Whelan (2006: 1989) agreed with the participants of this study because they explained that the assessment of clinical competency is a continual process of early development, conservation of skills and knowledge and skills, educational intervention, remediation and re-development.

Additionally, the findings of the study expressed that the assessment of clinical competencies should be done by a radiologist. Despite the fact that the assessment of radiographers' clinical competencies is fundamental in guaranteeing professional ethic in imaging departments, Vanckavičienė, Macijauskienė, Blaževičienė and Andersson (2017: 1) was not in harmony with the participants of the study because they declared that self-assessment was reported to be the most common form of clinical competency assessment. The study carried out by Vanckavičienė *et al.* (2017: 1) examined the clinical competencies of Radiographers according to radiologists and radiographers with the application of the Radiographers Competence Scale (RCS). The results of their study declared that both groups of participants, the radiologists and radiographers, gave high evaluations when determining Radiographer' clinical competencies. These results also suggested that a radiographer's age and work experience were proportional to the evaluation of the competencies as well as to practical aspects (Vanckavičienė *et al.* 2017: 9). Vanckavičienė *et al.* (2017: 8) did state that a radiologist's opinion was essential in order to promote a more objective evaluation and disclosure of attitudes towards the clinical competencies of Radiographers. This is a means of warranting feedback from the radiologists. Even though the radiologists gave a high evaluation of the Radiographers' competencies, their evaluations were substantially lower compared to those presented by the Radiographers (Vanckavičienė *et al.* 2017: 8). In terms of image interpretation, Hazell, Motto and Chipeya (2015: 306) declared that since Radiographers did not possess the necessary vocabulary to comment, they could possibly make use of a tick-box form when giving a comment. This could increase the confidence levels of Radiographers. The researcher did not find any other literature stating that the

assessment of clinical competencies of Radiographers should be carried out by radiologists only.

5.3.4 Medico-legal responsibilities of Radiographers in the interpretation of radiographic images

The study found that patients' rights and ethics should be of utmost importance to radiographers who are interpreting images. Al-Saadi, Slimane, Al-Shibli and Al-Jabri (2019: e202) were in agreement with the findings of this study as they stated that assuring and promoting patients' rights is a crucial part of modern healthcare since patients are acknowledged as individuals with human rights. They also stated that a deficit of observance of these rights will erode trust between healthcare personnel and patients, leading to the endangerment of the patient. Farzianpour, Rahimi Foroushani, Shahidi Sadeghi and Ansari Nosrati (2016:7), also in accordance with the participants of this study, revealed that the awareness of patient rights by healthcare personnel has a positive influence on patient satisfaction.

The findings indicate that no harm is to be done to the patient. Ghaly and Knezevic (2018: 2) were of the belief that the objective in healthcare is to make a diagnosis and not engage in a 'trial and error' attitude. This statement tells us that the authors were in agreement with the participants of the study. The findings state that patient information must not be disclosed to others. Blightman, Griffiths and Danbury (2014: 52) were in agreement with this finding because they stated that patient confidentiality is central to the upholding of trust between patients and their doctors. The moral basis is consequentialist, with the upholding of patient welfare in mind (Blightman, Griffiths and Danbury 2014: 52). Blightman, Griffiths and Danbury (2014: 52) also expressed that negligence to withhold this respected commitment may lead to sub-optimal treatment. The sub-theme mentioning that patients' findings must not be disclosed to others adheres to the code of professionalism (Nortjé and Hoffman 2018: 113). This informs us that Nortjé and Hoffmann (2018: 113) shared a similar viewpoint.

Findings indicate that decision-making regarding the radiographer report or radiological report is crucial. Makanjee, Bergh and Hoffmann (2017: 8) concurred with the participants of the study because they explained how information is accrued in an attempt to fill in gaps in understanding the patient and their condition better. The authors further explained that in order to get clarity, Radiographers and/or radiologists scrutinise the request form for information and take a history or perform patient assessments (Makanjee, Bergh and Hoffmann 2017: 9). Similarly, Lam, Egam and Baird (2004: 137) stated that with the acquisition of clinical history documentation by Radiographers, clinical decision-making, patient diagnosis and patient care may be greatly strengthened.

The findings of the study suggest that radiographers should be covered in the event of adverse outcomes when interpreting images. Brady (2017: 171) shared a similar viewpoint because he stated that discrepancies and errors in the practice of Radiology are distressfully common, with an approximate rate of 3-5% daily and increased rates in other studies. The researcher found that the term ‘discrepancy’ could mean reasonable differences of opinion between diligent practitioners (Brady 2017: 172) and the term “error” insinuates that there is no room for disagreement regarding what is correct, and specifies that the person who carried out the interpretation should have been able to interpret correctly or diagnose correctly, but did not (Brady 2017: 171). Therefore, the researcher understood that Radiographers are not yet fully qualified to interpret images and therefore found it valid to say that in the event of errors when assisting the radiologists, cover would be a necessity.

In closing, research specifies that learning and reflective teaching has had a favourable impact on Radiographers’ medico-legal responsibilities. Furthermore, self-evaluation of their skill will permit Radiographers to review their abilities and knowledge and to give thought to their professional conduct with colleagues and patients (Vanckavičienė *et al.* 2017: 9).

5.4 FINDINGS IN RELATION TO THE AIMS OF THE STUDY

The current study aimed at exploring the knowledge, clinical competencies and medico-legal responsibilities required by South African Radiographers, according to radiologists, in order to interpret images. The aim of the study was achieved with the emergent themes discussed above. The research questions were answered as follows:

a. What are your views on reporting by Radiographers?

This study found that radiologists support the interpretation of radiographic images in rural settings. There was unanimity in the view that through training and supervision, the scope of practice should be extended to increase job satisfaction. The participants were adamant that the role of the radiologist and radiographer should be clear, with patients being aware of who is interpreting their image. Radiologists also stated that this affected the overall costs, rates and turnaround time. Radiologists also felt that when cases were complex, Radiographers should seek the assistance of radiologists.

b. What systems of the body are suitable for Radiographers to report on?

For the interpretation of radiographs, the participants expressed that the scope of practice can be restructured to include chest and the musculoskeletal system.

c. What type of education, knowledge and training are required by Diagnostic Radiographers for the interpretation of radiographs?

The findings of this study suggest that image interpretation training should begin 3-5yrs post degree and an in-depth knowledge of anatomy, radiological anatomy and pathophysiology is required to understand pattern recognition during image interpretation. The 3-5 years post degree will support Radiographers in gaining experience regarding radiographic techniques, as well as for the acquisition of knowledge prior to image interpretation training. The training would be between 6 months and 5 years. Findings also indicated

that there should be continuous monitoring and accreditation for image interpretation courses, with accreditation being in the form of a diploma for each system, a degree or certificate of competence. Assessments for image interpretation should be carried out by radiologists. This is not feasible because there is a shortage of radiologists. However, looking at international literature, Nunn and Nunn (2011: 312) communicated the efficiency of an e-Learning facility, which reflected specific pathological/anatomical areas. In the e-Learning facility, a multiple choice test exists for each section taught in the image interpretation course is used. Then Radiographers are able to register and evaluate themselves in the self-test section of the website. A score of over 95% enables one to print out a certificate as evidence of continuing professional development (Nunn and Nunn 2011: 312).

d. What is meant by 'clinical competencies' required by Diagnostic Radiographers for the interpretation of radiographs?

The participants in this study found that clinical competency for Radiographers who are performing image interpretation has to do with assessment of the patient, with assessment determining the history, the background, the past medical history of relevance and the current presenting symptoms. The study also suggests that apart from having stringent criteria for Radiographers entering the image interpretation course, they must be able to triage patients and all assessments should be done by a radiologist.

e. What are the medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs?

The results for this question are primarily connected to patients' rights and work ethics. The findings indicate that no harm is to be done to the patient; patient information must not be disclosed to others; Radiographers should be covered in the event of adverse outcomes when interpreting images; there should be decision-making regarding the radiologic/radiographic report; and the rights of a healthcare provider are to be protected

5.5 SUMMARY OF THE CHAPTER

This chapter presented the discussion of the study findings. In so doing, it discussed the demographic profile of the participants, the themes along with the sub-themes and the emergent themes of the study also showed how the research questions were answered. The following chapter concludes this research and outlines the limitations, recommendations and areas for future studies.

CHAPTER 6: STUDY LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

In this chapter, the findings of the study are summarised and the strengths and limitations are highlighted. The researcher's reflections are also presented and the chapter concludes with recommendations for future research.

6.2 SUMMARY OF FINDINGS

The aim of this study was to explore the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs, and to ultimately recommend training guidelines for Radiographers in the interpretation of radiographic images**.** Thematic analysis of the interview data provided by participants yielded four major themes, namely: radiologists' perceptions regarding Radiographic Image Interpretation by Radiographers; the knowledge and training required by Radiographers in the interpretation of radiographic images; clinical competencies required by Radiographers in the interpretation of radiographic images; and medico-legal responsibilities of Radiographers in the interpretation of radiographic images. Each of these themes are summarized below.

6.2.1 Radiologists' perceptions regarding Radiographic Image Interpretation by Radiographers

The participants support the interpretation of radiographs by Radiographers in rural settings. However, they did not state why image interpretation by Radiographers should be done in rural areas only. There was unanimity amongst the radiologists interviewed that with proper training and supervision, Radiographers can be enabled to provide an interpretation report. The radiologists were of the view that the scope of practice should include interpretations for the chest and the musculoskeletal system. There was a viewpoint that the role extension of Radiographers will inevitably lead to

increased job satisfaction, but the study found that patients need to be made aware about who is providing the interpretation of their examination because factors such as costs, rates and turnaround time for image interpretation would be impacted. Also noteworthy was that the participants suggested that there must be legal protection for Radiographers.

6.2.2 Knowledge and training required by Radiographers in the interpretation of radiographic images

In order for Radiographers to interpret radiographic images, a meticulous understanding of anatomy, radiological anatomy and pathophysiology, as well as pattern recognition, would be essential. The image interpretation course must be run by a Radiographer who has already passed the same course and that training in image interpretation should begin 3-5years post degree. Participants suggest that learning courses to interpret chest and musculoskeletal systems could be 6 months and 1 year, respectively. The study found that Radiographers should have formal lectures and be attached to a hospital for 6 months to a year, sitting with the radiologists doing plain film interpretations. The findings of this study conferred that assessments for image interpretation should be done by a radiologist and that there must be continuous monitoring and accreditation. For accreditation, there should be a diploma for each system, degree or certificate of competence.

6.2.3 Clinical competences required by Radiographers in the interpretation of radiographic images

The participants collectively agreed that clinical competence has to do with the assessment of a patient, with assessment entailing history, background, apt medical history and current presenting symptoms. Moreover, developing clinical competence is an ongoing process. The assessment of clinical competencies should be done by a radiologist and the radiographers who perform image interpretation must also be able to triage patients.

6.2.4 Medico-legal responsibilities of Radiographers in the interpretation of radiographic images

Patients' rights and ethics should be of utmost importance to Radiographers who are interpreting images, and no harm is to be done to the patient. The findings state that patient information must not be disclosed to others and that decision-making regarding the radiographer report or radiological report is crucial. Radiographers should also be covered in the event of adverse outcomes when interpreting images.

6.3 STRENGTHS OF THE STUDY

This qualitative study contributes to the scientific literature on the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs.

6.4 STUDY LIMITATIONS

A study's limitations are an indication of the weaknesses within a study which may have an impact on the conclusions and outcomes of the research (Ross and Bibler Zaidi 2019: 261). In the current study:

- The data collection was only conducted at one hospital in the eThekwini district of KwaZulu-Natal.
- The population for the current study was also minute due to a limited number of radiologists in the eThekwini district and their overwhelmingly high workload.
- Due to the Covid-19 pandemic, the researcher was confronted with the issue of engaging with communities due to them not being able to link up with the gatekeepers, and sometimes mediators, of specified research communities in the usual way.
- The richness of observation while interviewing was lost in using the telephonic interview method.

6.5 RESEARCHER'S REFLECTIONS

The researcher's reflections provide record of the thoughts of the researcher throughout the research process. In the current study:

- Findings suggest that assessments for image interpretation must be done by a radiologist, with continuous monitoring and accreditation. The researcher did not find this feasible because the question arises of how there can be continuous monitoring in the rural area, which was favoured by radiologists, if there is an absence of radiologists there already.
- The researcher suggests that all means should be made to ensure that image interpretation training should be sufficient, with assessment and competency standards, because radiologists are not always available to perform continuous assessments
- The researcher is of the view that more studies would need to be conducted involving triage being carried out by Radiographers, before it is used as a determinant of clinical competency.

6.6 RECOMMENDATIONS FOR FUTURE RESEARCH

- Similar studies to this one are required in the other districts of KwaZulu-Natal and other provinces of South Africa. This is because results from all South African provinces would strengthen the suggestions made in this study for the implementation of Radiographers to perform image interpretation. These suggestions would provide the Department of Health with a comprehensive profile of the radiology shortage nationally.
- A larger follow-up study could also test the trustworthiness of the findings of this study.

6.6 CONCLUSION

This qualitative study explored the knowledge, clinical competencies and medico-legal responsibilities required by Diagnostic Radiographers for the interpretation of radiographs and to ultimately recommend training guidelines for Radiographers in the interpretation of radiographic images**.** Based on the findings of the study, there is an opportunity for Radiographers to undergo role

extension via image interpretation. However, they must meet the prerequisite knowledge requirements, have sufficient experience after entering the radiography profession, must undergo the necessary training and assessments, be clinically competent and be well-versed in the rights of patients.

This research study will contribute to literature pertaining to role extension of Radiographers. However, data collection can be carried out on a larger scale since a larger follow up study will test the trustworthiness of this study.

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APPENDICES

Appendix 1: University Ethics Clearance

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

6 September 2021

Ms R Budhu
53 Palmiet Road
Clare Estate
Durban
4091

Dear Ms Budhu

Application for Amendment of Approved Research Proposal

Knowledge, clinical competencies and medico legal responsibilities required by diagnostic radiographers for the interpretation of radiographs
Ethical Clearance number IREC 128/20

I am pleased to inform you that your application for amendment has been approved.

Yours Sincerely

Prof J K Adam
Chairperson: IREC

Appendix 2a: Letter to the Health District Manager

53 Palmiet Road

Clare Estate

Durban

4091

Health District Manager
Highway House
83 Jan Smuts Highway
Mayville
Durban

Request for Permission to Conduct Research

Att: Mrs. TB Sakyi
Thabisile.Sakyi@kznhealth.gov.za Londiwe.Sikhonde@kznhealth.gov.za

I am a post graduate student at the Durban University of Technology (DUT), currently studying towards my Master's Degree in Health Science: Radiography. My topic is **The knowledge, clinical competencies and medico legal responsibilities required for interpretation of radiographs by diagnostic radiographers.** The purpose of the study is to explore the radiologists' perspective with regard to the knowledge, clinical competencies and medico legal responsibilities required by radiographers, for the interpretation of images in order to improve service delivery in the health care sector by providing recommendations to academic institutions, for the development of training guidelines for radiographers.

Your permission is requested to conduct individual interviews on radiologists in a public hospital in the eThekwini district of KwaZulu-Natal. Participants will be selected by means of purposive sampling and informed consent will be obtained from them to participate in the interviews. Having access to radiologists would be of great importance to complete the study. Ethics approval to perform this study will be obtained from the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (DUT).

I am attaching the research proposal with the necessary information sheet and informed consent that will be provided to participants. Participants will participate voluntarily and may withdraw, without fear or favour, from the study at any time. All information of the participants and the hospitals will be handled with confidentiality. The participants will remain anonymous and codes will be used to protect participants' identities. Information acquired during this research project will be shared with all participants prior to public dissemination. Results of the study will be published in an accredited journal or peer review journal.

If you require any further information, please do not hesitate to contact me telephonically on 083 277 1172 or via email address 21005783@dut4life.ac.za / reshelb@gmail.com or my supervisor Dr P.B. Nkosi on paulinen1@dut.ac.za .

Thank you for your time and consideration in this matter.

Yours sincerely,

Reshel Budhu
Durban University of Technology

Appendix 2b: Permission letter from the Health District Manager

KWAZULU-NATAL PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: Monitoring and Evaluation
Physical address: 83 King Cetshwayo Highway; Highway House; Mayville 4091
Postal Address: private Bag X 54318, Durban 4000 eThekwini District Office
Tel: 031 240 5306 Fax: 031 240 5555 Email: Ntombenhle.Ngcobo@kznhealth.gov.za
www.kznhealth.gov.za

Enquiries: Mrs. N.P Ngcobo
Date: 27/11/2020

Ms. R Buchu
Durban University of Technology
Institutional Research Ethics Committee

RE: SUPPORT FOR RESEARCH STUDY ON" KNOWLEGDE, CLINICAL COMPETENCIES AND MEDICO LEGAL RESPONSIBILITES REQUIRED BY DIAGNOSTIC RADIOGRAPHERS FOR THE INTERPERETATION OF RADIOGRAPHS"

I have pleasure in informing you that the District is granting you support to conduct the research study entitled "**Knowledge, Clinical Competencies and Medico Legal Responsibilities Required by Radiographers for the Interpretation of Radiographs**" at eThekwini Health District facilities.

Please note the following

1. Please ensure you adhere to all the policies, procedures, protocols and guidelines of the department of health with regards to this research.
2. This research will only commence once this office has received confirmation from the provincial health research committee in the KZN department of health.
3. Please ensure this office is informed before you commence your research.
4. The District office/facility will not provide any resources for this research.
5. You will be expected to provice feedback on your findings to the district office/facility.

Thanking you.
Sincerely,

Mrs. N.P. Ngcobo
(P. Monitoring and Evaluation Manager)
EThekwini Health District

GROWING KWAZULU-NATAL TOGETHER

Appendix 3a: Letter to KwaZulu-Natal Department of Health

53 Palmiet Road
Clare Estate
Durban
4091

Department: Health
Province of KwaZulu-Natal
330 Langalibalele (Longmarket) Street
Pietermaritzburg
3201

Request for Permission to Conduct Research

Dear Sir / Madam
Sandile.Bhengu@kznhealth.gov.za
Khanyisani.Khanyile@kznhealth.gov.za
Zamambo.Mkhize3@kznhealth.gov.za
Sbusisiwe.Mvuna@kznhealth.gov.za

I am a post graduate student at the Durban University of Technology (DUT), currently studying towards my Master's Degree in Health Science: Radiography. My topic is **The knowledge, clinical competencies and medico legal responsibilities required for interpretation of radiographs by diagnostic radiographers.** The purpose of the study is to explore the radiologists' perspective with regard to the knowledge, clinical competencies and medico legal responsibilities required by radiographers, for the interpretation of images in order to improve service delivery in the health care sector by providing recommendations to academic institutions, for the development of training guidelines for radiographers.

Your permission is requested to conduct individual interviews on radiologists in a public hospital in the eThekwini district of KwaZulu Natal. Participants will be selected by means of purposive sampling and informed consent will be obtained from them to participate in the interviews. Having access to radiologists would be of great importance to complete the study. Ethics approval to perform this study will be obtained from the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (DUT).

I am attaching the research proposal with the necessary information sheet and informed consent that will be provided to participants. Participants will participate voluntarily and may withdraw, without fear or favour, from the study at any time. All information of the participants and the hospitals will be handled with confidentiality. The participants will remain anonymous and codes will be used to protect participants' identities. Information acquired during this research project will be shared with all participants prior to public dissemination. Results of the study will be published in an accredited journal or peer review journal.

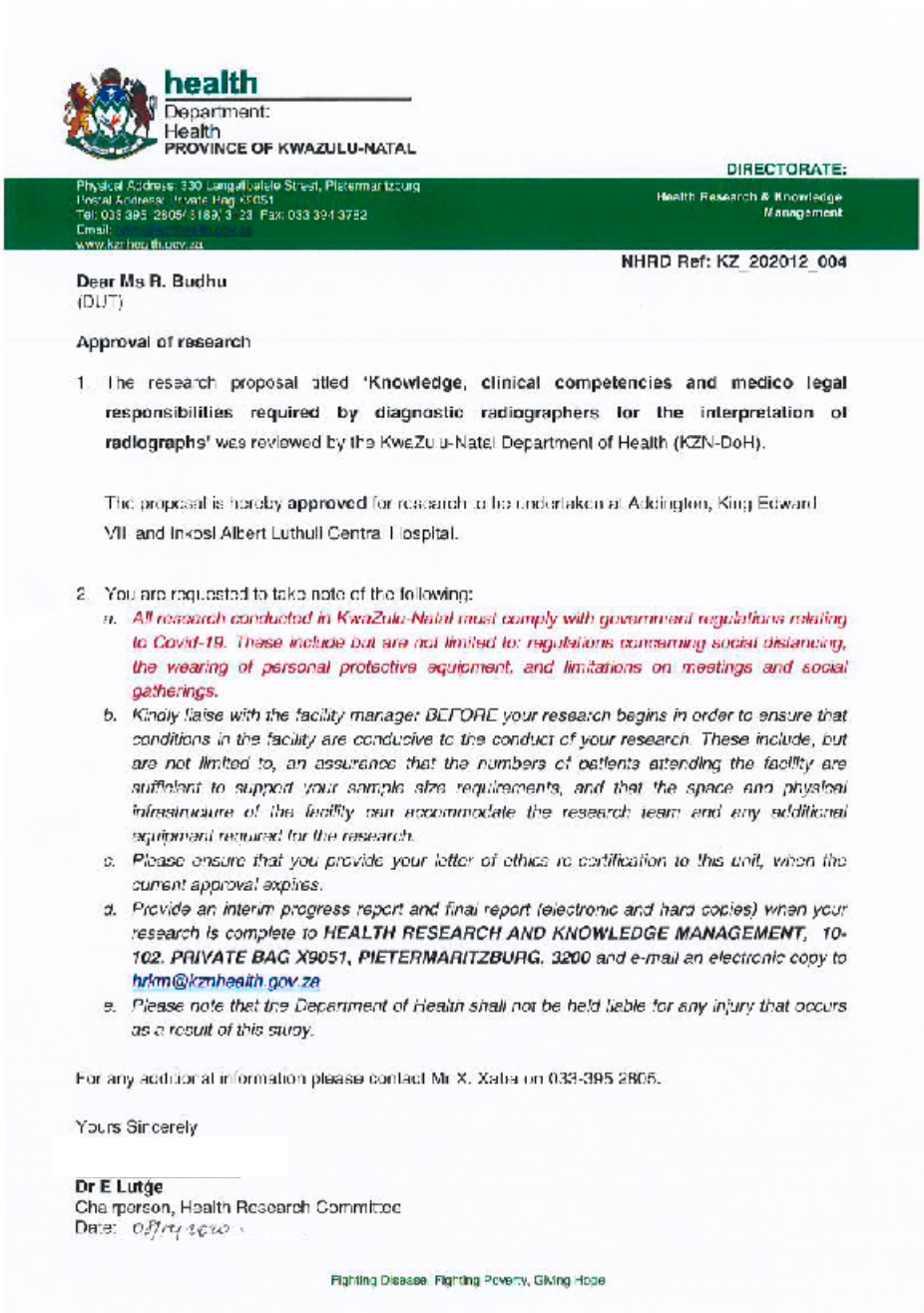
If you require any further information, please do not hesitate to contact me telephonically on 083 277 1172 or via email address 21005783@dut4life.ac.za / reshelb@gmail.com or my supervisor DR P.B. Nkosi on paulinen1@dut.ac.za .

Thank you for your time and consideration in this matter.

Yours sincerely,

Reshel Budhu
Durban University of Technology

Appendix 3b: Permission Letter from KwaZulu-Natal Department of Health



health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Physical Address: 330 Langalibalele Street, Pietermaritzburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3183/ 3 23 Fax: 033 3943782
Email:
www.kznhealth.gov.za

DIRECTORATE:
Health Research & Knowledge Management

NHRD Ref: KZ_202012_004

Dear Ms R. Budhu
(DUT)

Approval of research

1. The research proposal titled '**Knowledge, clinical competencies and medico legal responsibilities required by diagnostic radiographers for the interpretation of radiographs**' was reviewed by the KwaZulu-Natal Department of Health (KZN-DoH).

   The proposal is hereby **approved** for research to be undertaken at Addington, King Edward VIII and Inkosi Albert Luthuli Central Hospital.

2. You are requested to take note of the following:
   a. *All research conducted in KwaZulu-Natal must comply with government regulations relating to Covid-19. These include but are not limited to: regulations concerning social distancing, the wearing of personal protective equipment, and limitations on meetings and social gatherings.*
   b. *Kindly liaise with the facility manager BEFORE your research begins in order to ensure that conditions in the facility are conducive to the conduct of your research. These include, but are not limited to, an assurance that the numbers of patients attending the facility are sufficient to support your sample size requirements, and that the space and physical infrastructure of the facility can accommodate the research team and any additional equipment required for the research.*
   c. *Please ensure that you provide your letter of ethics re certification to this unit, when the current approval expires.*
   d. *Provide an interim progress report and final report (electronic and hard copies) when your research is complete to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za*
   e. *Please note that the Department of Health shall not be held liable for any injury that occurs as a result of this study.*

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

Dr E Lutge
Chairperson, Health Research Committee
Date: 07/12/2020

Fighting Disease, Fighting Poverty, Giving Hope

Appendix 4a: Permission Letter to King Edward VIII Hospital

53 Palmiet Road
Clare Estate
Durban
4091

King Edward VIII Hospital
Department: Health
Province of KwaZulu-Natal

Corner of Sydney and Francois Road,
Congella
Durban

Request for Permission to Conduct Research

Att: Dr T. Mayise
rejoice.khuzwayo@kznhealth.gov.za / lungile.mpanza@kznhealth.gov.za

I am a post graduate student at the Durban University of Technology (DUT), currently studying towards my Master's Degree in Health Science: Radiography. My topic is **The knowledge, clinical competencies and medico legal responsibilities required for interpretation of radiographs by diagnostic radiographers.** The purpose of the study is to explore the radiologists' perspective with regard to the knowledge, clinical competencies and medico legal responsibilities required by radiographers, for the interpretation of images in order to improve service delivery in the health care sector by providing recommendations to academic institutions, for the development of training guidelines for radiographers.

Your permission is requested to conduct individual interviews on radiologists at King Edward VIII Hospital. Participants will be selected by means of purposive sampling and informed consent will be obtained from them to participate in the interviews. Having access to radiologists would be of great importance to complete the study. Ethics approval to perform this study will be obtained from the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (DUT).

I am attaching the research proposal with the necessary information sheet and informed consent that will be provided to participants. Participants will participate voluntarily and may withdraw, without fear or favour, from the study at any time. All information of the participants and the hospitals will be handled with confidentiality. The participants will remain anonymous and codes will be used to protect participants' identities. Information acquired during this research project will be shared with all participants prior to public dissemination. Results of the study will be published in an accredited journal or peer review journal.

If you require any further information, please do not hesitate to contact me telephonically on 083 277 1172 or via email address 21005783@dut4life.ac.za / reshelb@gmail.com or my supervisor DR P.B. Nkosi on paulinen1@dut.ac.za .

Thank you for your time and consideration in this matter.

Yours sincerely,
Reshel Budhu
Durban University of Technology

Appendix 4b: Permission Letter from King Edward VIII Hospital

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

OFFICE OF THE HOSPITAL CEO
KING EDWARD VIII HOSPITAL

[redacted]

Ref.: KE 1/7/17 (04/2020)
Enq.: Miss W.C. Madondo
Research Programming

30 December 2020

Ms R. Budhu
59 Palmiet Road
Clare Estate
Durban
4091

Dear Ms Budhu

Protocol: "Knowledge, Clinical Competencies and Medico Legal Responsibilities required by Diagnostic Radiographers for the Interpretation of Radiographs"

Degree Purposes: IREC. NO. 128/20

Your request to conduct research at King Edward VIII Hospital has been approved.

Please ensure the following:

- That King Edward VIII Hospital receives full acknowledgment in the study on all publications and reports and also kindly present a copy of the publication or Report on completion.

Before commencement:

* Discuss your research project with our relevant Clinical Head/Assistant Nursing Manager
* Sign an indemnity form at Room9, CEO's Complex, and Admin. Block.

The Management of King Edward VIII Hospital reserves the right to terminate the permission for the study should circumstances so dictate.

Yours faithfully

SUPPORTED/NOT SUPPORTED

30/12/2020
DATE

DR. S RAMJI
ACTING MEDICAL MANAGER

Growing KwaZulu Natal Together

Appendix 5: Letter of information

Title of the Research Study: Knowledge, clinical competencies and medico legal responsibilities required by diagnostic radiographers for the interpretation of radiographs

Principal Investigator/s/researcher: (Reshel Budhu, 083 277 1172)

Co-Investigator/s/supervisor/s:
Supervisor: (Dr PB Nkosi, PhD: Health Sciences; MBL; MTech: Therapy; ND: Diagnostic Radiography)
Co-supervisor: (Dr TE Khoza, PhD: Health Sciences; MTech: Diagnostic Radiography)

Brief Introduction and Purpose of the Study: Good Day. How are you? My name is Reshel Budhu. I am a masters' student at DUT doing research for my Masters degree in Health Sciences. I would like to invite you to participate in the research. Research is a systematic search or enquiry for generalized new knowledge. You can ask as many questions as you wish because it is important that you fully understand the study. You are under no obligation to commit at this stage. For this purpose, kindly find the Letter of Information document to read.

The shortage of radiologists has led to the underreporting of radiographic images, thus leading to the mismanagement and inappropriate treatment of patients. This problem needs to be solved in order to improve service delivery in the healthcare sector which will be a direct benefit to patients. The underreporting of radiographic images by radiologists need to be addressed in order to improve care that is delivered to patients. Radiographer reporting is an element of role extension which can aid in combating this problem. Thus, the purpose of the study is to explore the knowledge, clinical competencies and medico legal responsibilities required by diagnostic radiographers, according to radiologists, for the interpretation of radiographs, in order to provide input for the development of training guidelines for radiographers.

Outline of the Procedures:
If you agree to participate in this study, at a mutually convenient venue, date and time, 10 minutes will be allowed for you to read the letter of information and ask questions if any. Thereafter you will be requested to be interviewed. This may take 30-45 minutes. We are required to adhere to COVID-19 Infection Prevention and Control Guidelines during the interview.

Researcher employed constructivist paradigm to conduct the study. Criterion purposive sampling with will be employed to select a minimum of one public hospital where the radiologists are placed. The same sampling will be used to select a minimum of three radiologists. Telephonic or mask to mask interviews may be carried out depending on the participants' preferences. Should mask to mask be the option, the researcher will adhere to COVID-19 Infection Prevention and Control Guidelines during the interview. Open ended questions will be used during the interview. Data collection will continue until data saturation.

Data will be analysed using Tesch's eight steps for analysing qualitative data to identify themes. The findings will be drawn from themes. Discussion, recommendations and conclusion will be made based on the findings. The approximate number of participants is 3.

Risks or Discomforts to the Participant: There will not be any risks of discomfort when participating in this study.

Explain to the participant the reasons he/she may be withdraw from the Study: You will not be advantaged or disadvantaged in any way should you choose to participate or not to in this study. You can withdraw from the study if they feel that they no longer wish to continue with the study. If you decide to do so, kindly inform the researcher. There is no obligation to complete the study.

Benefits: The results of this study will help alleviate the workload of radiologists in the radiology department so that radiologists can effectively provide reports promptly and improve the service delivery in the radiology departments.

Remuneration: There will not be any remuneration for participating in this study.

Costs of the Study: You are not expected to cover any costs towards the study, including treatment.

Confidentiality: All information and data will be kept strictly confidential. All interviews will be coded to facilitate recording but no names will be written on the answers.

Results: The results of the study will be published as an article in DHET accredited journal and or presented at an academic conference.

Research-related Injury: There will not be any research related injuries by participating in the study.

Storage of all electronic and hard copies including tape recordings: The list of participant's names and their corresponding answers will be kept on the computer which only the researcher has the password to access the information. The supervisor will only have access to the anonymous individual data on the researcher's computer and therefore will not be able to link the participant to this data. The research data, answers to questions and any other confidential information will be kept for five years thereafter it will be deleted by the researcher.

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, Reshel Budhu at 083 277 1172 or via email reshelb@gmail.com, or my supervisor at paulinen1@dut.ac.za (tel no. 031 372 2509) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Appendix 6: Letter of Informed Consent

Full Title of the Study: The knowledge, clinical competencies and medico legal responsibilities required for interpretation of radiographs by diagnostic radiographers.
Names of Researcher/s: Reshel Budhu, 083 277 1172
Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Reshel Budhu, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: IREC 128/20,
- 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	**Date**	**Time**	**Signature / Right Thumbprint**

I, Reshel Budhu (name of researcher) herewith confirm that the above participant has been fully

informed about the nature, conduct and risks of the above study.

Reshel Budhu		
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: Interview guide

Section A: Demographic Information

Gender

Tick appropriate box

Male	
Female	

Age in years

Tick appropriate box

25-35	
36-45	
46-55	
56-65	
66-75	

Race

Tick appropriate box

African	
White	
Indian	
Coloured	
Other	

Are you currently a member of HPCSA?

_____

In which year did you qualify as a radiologist?

_____

Section B: Interview Questions

(The questions with arrows are possible probing questions)

1. What are your views on reporting by radiographers?

2. What systems of the body are suitable for radiographers to report on? (eg. chest, abdomen, Musculoskeletal)

3. What type of education, knowledge and training are required by diagnostic radiographers for the interpretation of radiographs?
   - What knowledge is needed by diagnostic radiographers for the interpretation of radiographs?
   - What education is needed by diagnostic radiographers for the interpretation of radiographs?
   - At what level of study should training in the interpretation of radiographs begin?
   - How long should be the training in image interpretation?
   - Who should assess radiographers who are doing the course in image interpretation?
   - What type of accreditation should be awarded?
   - Comments.

4. What is meant by clinical competencies required by diagnostic radiographers for the interpretation of radiographs?
   - What are the clinical competencies required?
   - What is the assessment criteria for these competencies?
   - Comments.

5. What are the medico legal responsibilities required by diagnostic radiographers for the interpretation of radiographs?
   - **What medico-legal responsibilities** should be included as part of education and training?
   - **What patient rights and ethics** should be included as part of the training?
   - Which **rights and responsibilities of a health care professional** should be included as part of the training?
   - Comments.

Appendix 8: Sample of the Interview Transcript

Dr M Interview (Participant 2)

Gender: Female

Age: 36-45

Race: Indian

Member of HPCSA: Yes

Year qualified: 2010

Okay so Dr. M, globally, selected countries have extended their legal practice boundaries to include radiographers carrying out clinical reporting and have developed models of advanced radiographer practice. But with South Africa like with any medical profession, radiographers are legally and ethically bound to practice within their level of competence and the scope of the educational training so I guess that you would see here Dr M, there is a gap that needs to be closed between South Africa and international practice.

"Yes"

1.Tell me Dr M what are your views on reporting being carried out by radiographers.

"…*It's a complex issue but I think that if they have appropriate training and some kind of oversight committee then I think definitely radiographers especially in settings where we don't have radiologists, can provide some sort of report."*

2. Apart from this Dr M, what systems of the body is suitable for radiographers to report on. What is your opinion here?

*"**Obviously it'll depend on the level of training but I think the majority of the pathology would either be related to the muscular skeletal system in terms of a basic fractures and things like that. In our setting, chest radiography is the bread and butter of everyone. Most patients either have TB or HIV and even the trauma patients you know -they would need to have a chest X. rays for pneumothoracies or whatever so I think if the radiographers were trained with regards to musculoskeletal system and chest I think what would be that would be helpful to patients and to clinicians."***

3.1 Dr M what education which you say is needed by radiographers for the interpretation of images like here I mean well we do a 4-year degree. Do you think we need to go and do a PG course? Does it need to be for a specific system? What would you say.

"Umm maybe a postgraduate course for each system where you could get like a certificate of competence maybe a post graduate diploma -some sort of board certification."

3.2 Who should assess the radiographers if they are actually deciding to do specific courses in the image interpretation?

"I think you would definitely need at least a radiologist besides just the radiographers that normally assess you and I think you would definitely need to have a radiologist on board as well so that you know you can be taught basic image interpretation and also so that you could assess. It would be similar to the way we teach registrars."

So it would basically be a joint establishment because you would be going to campus for lectures and you would have radiographers guiding you and then you would have radiologists. Like you could have someone like attached to a hospital for 6 months to a year sitting with the radiologists doing plain films you know yeah something like that"

3.3 What type of accreditation should be awarded to people who do courses on image interpretation

'I think you would end up probably it wouldn't be a degree per say …Obviously they have to be adequately trained and I think you have to have some form of accreditation- so some form of accreditation and continuous monitoring and education in terms of that because radiology is a completely different field even for clinicians I think. I don't know if you can equate it to a radiology fellowship but maybe something more a like a certificate of competence maybe a post graduate diploma something"

3.4 What about accreditation?

"Obviously accreditation should be awarded because if you are going to be reporting on patients' conditions, there could be medico legal issues.

Definitely there's medical legal implications, there's ethical implications because I mean the general public and even certain clinicians- they don't draw any distinction between radiologists and radiographers…It should be noted that the role between a radiologist and radiographer cannot be misconstrued, chiefly because the medical school training of 5 years is completely different from what a radiographer is taught in 4 years".

4.1 Okay. And what that's meant by clinical competencies required? I know you said that some kind of accreditation would be a certificate of competence so what is meant by clinical competencies. Is it taking the patients history down? Taking their clinical presentation and then deciding what the future plan for the patient is?

"I think, when we report the x-rays it makes a huge difference when you know what the clinical history and the patient's background. I don't think a radiographer would necessarily need to unless I mean obviously a doctor would be ordering the radiographs so you should definitely have a good history and an understanding of the clinical picture and what potential pathologies they looking for in order for you to give a good differential diagnosis. I don't think that a radiographer needs to interact with the patient any more than they need to. The clinical background should definitely come from the clinician and then based on that, for example, if it's gunshot abdomen- need to know okay fine are they looking for free air under the diaphragm in terms of clinical competency to know what the basic things are, that they're looking for you know and work from there."

4.2 What about communication skills requirements if the radiographers would be interacting with physicians and sometimes staff?

"Definitely and also because the radiographers interact with patients. Very often we find that that the doctor would write the wrong X -ray. on the left shoulder and you speak to the patient and they say no but I got hurt on my right shoulder. Yeah well obviously you have to have communication skills because you deal with the patient, you deal with the radiologist and you deal with the clinicians so good communication skills are essential so that you know at least the correct investigation is done. Obviously if you're going to be reporting then to make sure that you communicate the urgency of certain things to the clinicians so that they can act on it timeously. If you are doing post CVP insertion chest radiograph to say, there's a huge pneumothorax so they would need to put in a chest drain. So definitely you need good communication."

4.3 Okay you said for the accreditation, there should be a joint establishment where there should be a radiologist apart from the radiographers assessing the radiographers for these competencies. How should they be assessed?

"I think that the way/ how they do the mammo accreditation. Obviously they come and assess them doing patients. I think it would be a similar sort of thing so after you have done your 6 month or one year then you have maybe independent radiologists that come and examine you so we'll give you- you have a series of basic pathology that you should know, for example, pneumothoraxes, fractures, free air under the diaphragm, things like that. Yeah so you just like how we have our exact audiology exams basically but obviously

tailored to basic common pathologies that one would expect to find if you're going to be working in some rural hospital or some sort of a hospital that doesn't have a radiologist."

4.4 Doctor M, do you have any comments thus far?

*"**No**"*

5.1 Okay. Tell me doctor. What medico legal responsibilities should be included as part of their training.

"I think the radiographer needs to be covered if there are any adverse outcomes obviously from reporting because you're not a radiologist, so I think, they should be like obviously some kind of protection for them. They just need to be covered you know for whatever scope of practice they are doing so if they are reporting, they need to be covered and also the clinicians and patients need to be aware that it's not reported by a radiologist, its reported by a radiographer who has been trained to assist you."

5.2 Doctor M., what patients' rights and ethics, do you think, should be included in this training for image interpretation?

*"**…With normal radiography, radiographers are cognizant of patients' rights and making sure that patients are not harmed. That you don't scan patients against their will so I don't think it's any different to what you would normally be trained to do. Make sure that you don't violate patient's rights and it's just the basic Hippocratic oath. Obviously you're going to do no harm, you don't disclose a patient's findings to other people including family members or the staff members"***

5.3 What rights and responsibilities of healthcare professionals should be included in the training?

*"**Again I don't think it's any different to what a diagnostic radiographer is taught you know in terms of- You know acting ethically yeah your basic things like I mean if you're male and there is unconscious male you know make sure you have someone there. It's just basic things that you know just to make sure that patients' rights are maintained and your rights as a healthcare provider are protected as well…I think the radiographer needs to be covered if there are any adverse outcomes obviously from reporting***

because you're not a radiologist, so I think, they should be like obviously some kind of protection for them.

Appendix 9: Letter from the professional editor

EDITING LETTER

696 Clare Road

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20 January 2022

To: Whom it may concern

Editing of Masters: R Budhu

KNOWLEDGE, CLINICAL COMPETENCIES AND MEDICO-LEGAL RESPONSIBILITIES REQUIRED BY DIAGNOSTIC RADIOGRAPHERS FOR THE INTERPRETATION OF RADIOGRAPHS

This letter serves as confirmation that the aforementioned thesis has been language edited.

Any queries may be directed to the author of this letter.

Regards

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