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**Exploring the views of teleradiology end users regarding its utilisation and impact on rural health services in the Dr RSM district, Northwest Province**

**by**

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A dissertation submitted in fulfilment of the requirements for the

degree

Masters in Radiography

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**Date:** 31 August 2018

## DECLARATION

I, Hafsa Essop, declare that the research study:

**“Exploring the views of teleradiology end users regarding its utilisation and impact on rural healthcare in the Dr RSM district, Northwest Province”**

which is submitted in accordance with the requirements for the Master of Radiography (Diagnostics) degree at the University of Pretoria, is my own original work and has not previously been submitted to any other institution of higher learning. All sources cited or quoted in this research paper are indicated and acknowledged with a comprehensive list of references.



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H. Essop

3 August 2018

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## **ABSTRACT**

### **Introduction**

Teleradiology, a subcategory of eHealth, was aimed at providing specialised radiological services to such communities, by means of telephone lines and internet connectivity. The Dr Ruth Segomotsi Mompati (RSM) district of the North West province, was one of several sites across South Africa, where teleradiology was first implemented. There have been no reports of teleradiology progress that the researcher could find in the Dr RSM district to determine whether the community is benefiting from this already established infrastructure. What is known about teleradiology in this district, is through the observations of the researcher, who expressed concern that the teleradiology end users seem to be experiencing challenges with regards to CT examinations. This has appeared to the researcher as resulting in a compromised teleradiology service to the rural community. Some of the teleradiology challenges observed in this district were similar to those noted in literature, both globally and locally.

### **Aim of the study**

The aim of the study was to explore and describe the views of the teleradiology end users on the utilisation of teleradiology for CT examinations and the impact it has on health care service delivery.

### **Methodology**

A qualitative research approach, with an exploratory descriptive design were found to be appropriate to gain an in-depth understanding of the research problem and address the research question. Focus group interviews were conducted with three key teleradiology end users, namely the radiographer, referring clinician, and radiologists. Collected data were transcribed verbatim and analysed by means of rigorous content analysis processes to ensure trustworthiness of the research findings. From the analysed data, three major themes emerged, namely; a) factors that positively impacted teleradiology utilisation and service delivery, b) factors that negatively impacted on teleradiology utilisation and service delivery, as well as c) strategies for improving teleradiology utilisation and service delivery.

## **Conclusion**

The following findings were made: namely; a) teleradiology is being utilised for CT examinations in the Dr RSM district, b) the teleradiology end users have respect for each other's professional identity, c) onsite teleradiology end users want to be upskilled and d) there is a need to strengthen teleradiology infrastructure. The researcher therefore concludes that teleradiology is being utilised in the Dr RSM district, despite there being several aspects that need be addressed to improve its utilisation and service delivery to the community in the Dr RSM district.

## **Key words**

eHealth, Teleradiology, radiographer, referring clinician, radiologist, rural health care.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

ACR -	American College of Radiology
ALARA -	As Low As Reasonable Achievable
CT	Computed Tomography
DoH	Department of Health
ESR	European Society of Radiology
HPCSA	Health Professionals Counsel of South Africa
IAEA	International Atomic Energy Agency

IRME	Ionising Radiation Medical Exposure
ITC	Information Technology Communication
LAN	Local Area Network
MRI	Magnetic Resonance Imaging
MTMS	Multimedia – interactive Teleradiology Management System
NW	North West
PACS	Picture Archiving and Communications Systems
PoPi	Protection of Personal Information
RIS	Radiology Information System
RSM	Ruth Segomotsi Mompati
RSSA	Radiological Society of South Africa
SATMA	South African Telemedicine Association
SOP	Standard Operating Procedure Manual
WHO	World Health Organisation

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## CHAPTER 1: OVERVIEW OF THE STUDY

*“Sustainability does not imply staying the same, but rather embracing the winds of change of an ever-evolving technology”*

Cheryl de la Rey

### 1.1 INTRODUCTION

Health is defined by the World Health Organisation<sup>1</sup> as a fundamental human right that must be enjoyed by every human being without a distinction of race, religion, political belief, economic, or social standing.<sup>1</sup> According to the patients' rights charter in South Africa, all citizens have the right to timely and accessible health care.<sup>2</sup> This however is contrary to what is being observed in the rural areas of South Africa, where communities are faced with poverty, unemployment and lack of running water, all of which exacerbates the burden of disease.<sup>3</sup> South Africa is considered the most developed country in Africa, however poverty is reported to be increasing at a rapid pace, now worse than ever before.<sup>4</sup> This places an increasing demand for access to health care. Provision of quality health care services in rural areas of South Africa is impacted by accessibility and shortage of human resources, particularly with regards to specialists.<sup>5</sup> In an attempt to address issues regarding accessibility to health care, the South African government has formulated the National Development Plan (NDP) 2030.<sup>4</sup> In Chapter 10 of this document, the “Health care for all strategy” is outlined. One of its main objectives is to implement strategies to provide quality, sustainable, and accessible health care, using the national health information system, which comprises of eHealth technology.<sup>4</sup> The WHO supports the proposed strategy and has identified telemedicine as an essential tool that can be used to bridge the gap between impoverished communities and urban institutes to achieve health care goals as outlined by the national development plan.<sup>6</sup>

Based on the importance placed on telemedicine applications and its proposed benefits, the researcher was interested in exploring the views of health professionals operating these systems, specifically teleradiology, in a socially vulnerable district,

fully reliant on the services that are provided by eHealth. These services include radiological reports for Computed Tomography (CT) examinations only. A qualitative inquiry was used to explore the views of the health professionals utilising these systems as part of their daily work, and how it impacts rural health care services. These health professionals, namely the radiographer, referring clinician, and radiologist, were invited to participate in focus group interviews in an attempt to answer the research questions, which were as follows:

- a) What are the views of teleradiology end users regarding its utilisation for CT examinations in the Dr RSM district?
- b) How does this impact on the services provided to the rural community with specific reference to CT examinations?

The focus of this chapter is to present an overview of this study by briefly outlining the research background and researcher's profile, before presenting the study and describing how it was conducted.

## **1.2 BACKGROUND TO THE STUDY**

Health care institutes in rural communities face major challenges with regards to functioning effectively to address a range of problems. Their challenges range from a lack of human resources such as radiology specialists and equipment.<sup>4</sup> Teleradiology, a subcategory of telemedicine, shares the same aim as eHealth, which is the focus on providing specialised radiological services, such as radiological reports, to remote rural communities that do not have access to radiologists.<sup>7</sup> The vision of the North West Department of Health (NW DoH) for teleradiology is to provide access to specialised imaging procedures, reports on all Computed Tomography (CT) examinations, radiographs and mammograms, specialist consultations with doctors, and continuous professional development presentations.<sup>8</sup> To gain an understanding of the foundation of eHealth applications in the North West province, the researcher provides a brief overview of the first eHealth implementations in the North West province, where the study was conducted.

Teleradiology was piloted in the North West province for the first time in 1998, with the main objective of providing specialised radiological reporting to rural areas, that were non-existent before this implementation.<sup>9</sup> Three teleradiology sites were initially installed across the province. In the year 2000 the Medical Research Council in conjunction with the National Department of Health evaluated the progress of the first phase of telemedicine implementation. The report revealed both challenges and achievements of the teleradiology systems from the end users' perspective.<sup>9</sup>

Following the evaluation of the telemedicine programme in 2000, many developments were noted in this province. The developments included the addition of two more teleradiology sites, a new private radiology service provider, and the appointment of new health professionals, including radiographers, referring clinicians, and radiologists. Teleradiology is used at all five sites across the province, mainly to assist the onsite radiologist with reporting of CT scan examinations. In 2013, the NW DoH issued a new Standard Operating Procedure (SOP) manual to all teleradiology sites within the province, to ensure standardisation of all teleradiology practices, alluding to the fact that teleradiology services have resumed. In this study, the researcher will focus on one teleradiology site in the Dr RSM district and its district hospitals. This is because the hospitals chosen for this study are the only hospitals in the North West province that do not have onsite radiologists. This district only offers reports for Computed Tomography (CT) examinations and excludes mammography and general radiographs, which are offered at other sites within the province. The communities in these areas are fully dependant on teleradiology infrastructure and the health professionals operating the systems to provide a radiological service, which entails the actual CT examination and radiological report thereof.

From observations made by the researcher within the context of the teleradiology systems in the Dr RSM, that is, before embarking on this research project, it appeared that the services provided through teleradiology to these rural communities, were not addressing what was proposed by the National Department of Health's eHealth strategy. The following section details the researcher's observations, which lead to this study.

### 1.2.1 Researcher's profile and observations that led to the study

The researcher joined the North West Department of Health as a radiographer in 2014. While performing procedures in the CT Department where teleradiology is used, the researcher made the following observations:

- a) There were many technical challenges with regards to poor connectivity, which resulted in delays in CT report delivery from the radiologists. This observation is one of the key challenges affecting telemedicine implementation globally and across provinces in South Africa.<sup>9,10</sup>
- b) Radiographers were at times put in positions where they had to make decisions that were outside their scope of practice, such as booking CT examinations for the referring clinician, and deciding when to administer contrast media (Figure 1, blue arrow). This practice is generally done by the radiologist (Figure 1, green arrow) and globally, is seen to be limited to 'advanced radiographers'.<sup>11</sup>
- c) Radiographers and referring clinicians at the teleradiology sites often had heightened expectations from each other, in terms of the knowledge they exhibit in the teleradiology setting. Examples of this include radiographers expecting referring clinicians to know the appropriate referral channels for requesting CT examinations, as well as the referring clinicians expecting the radiographers to decide on administration of contrast media as stated above.
- d) Radiographers perform all the administrative work in the CT department to facilitate the transmission of images to the radiologist and the delivery of the report to the referring clinician. Due to the sensitive nature of the radiological reports, the radiographers themselves handle this aspect of the administrative work. These tasks were noted in a study conducted in Ireland as role flexibility and practising beyond the existing scope of practise of the radiographer.<sup>12</sup> This role flexibility in rural health care was also noted by Mung'omba, who indicated that radiographers practising in rural areas have to adopt role extension to meet the needs to the communities that they serve



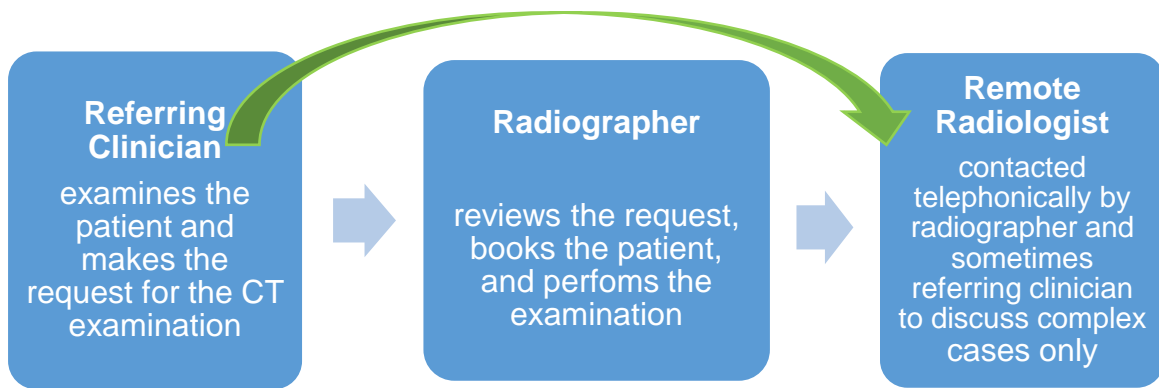


Figure 1.1 Observed CT booking procedure in the Dr RSM district

### 1.3 PROBLEM STATEMENT

Research problems identify an area of concern and provide reasons for why the issue should be explored.<sup>14</sup> In this study, the problem identified by the researcher was that the teleradiology system in the Dr RSM District of the North West province did not meet all the needs of the rural community as envisioned by the eHealth strategy of South Africa in terms of efficiency and timeliness. This is with regards to delays in radiological reports on CT examinations. On further observation, teleradiology end users were often put in positions where they were required to provide services that could be classified as being beyond their scope of practice. In this dissertation, the researcher was interested in exploring the views of the actual teleradiology end users who utilise these systems within the Dr RSM district, North West province of South Africa. This argument is supported by several studies, which explored barriers in teleradiology infrastructure. These studies reported challenges in the implementation and sustainability of these systems both globally and local.<sup>10,15 6,16-17</sup> However, a gap identified in the literature on eHealth is that it fails to involve the viewpoints of the end users. The assumption is that the system will work for everyone. This gap is further supported by Ossebaard and Van Gemert-Pijnen, who report that studies conducted in eHealth tend to focus on statistical findings and not on the experiences of the end users.<sup>18</sup>

## **1.4 RESEARCH QUESTION**

The research question details the exact characteristics of phenomenon that will be explored.<sup>14</sup> The questions that this study attempted to answer were:

- a) What are the views of the end users regarding teleradiology and its utilisation for CT examinations in the Dr RSM district North West province?
- b) How does teleradiology impact the services provided to this rural community with specific reference to CT examinations?

## **1.5 RESEARCH AIM**

Research aims outline the intended purpose of the study, to deliver a specific outcome. The aim of this study is to:

Explore and describe the views of the teleradiology end users on the utilisation of teleradiology for CT examinations and the impact it has on health care service delivery . Based on the outcome of this study, recommendations could be provided to the relevant authorities to enhance the utilisation of teleradiology systems for the CT department.

## **1.6 RESEARCH OBJECTIVES**

Research objectives are concrete and measurable ends towards which effort or ambition is directed.<sup>19</sup> The following objectives have been identified for this study:

- a) To explore teleradiology end users' views on the utilisation of teleradiology systems for CT examinations in the Dr RSM district.
- b) To describe the impact that this has on service delivery to the rural community of the Dr RSM district.

- c) To provide recommendations on how the utilisation of teleradiology systems for CT examinations in the Dr RSM district can be improved.

## **1.7 PHILOSOPHICAL ASSUMPTIONS**

Philosophical assumptions guide the researcher's approach to the research question, determines the nature of concepts and influences the logic of the study.<sup>19</sup> Polit and Beck, describe assumptions as principles that are assumed to be true without scientific proof or verification.<sup>20</sup> Three major philosophical assumptions of the paradigms are ontology, epistemology, and methodology.<sup>21</sup>

### **1.7.1 Ontological assumptions**

Ontology refers to the way in which something exists in reality.<sup>21</sup> Teleradiology by nature, depends on technical infrastructure and connectivity to be able to function. The reality of teleradiology, is that these systems often do not work, which is viewed as a common barrier in teleradiology implementations, both globally and locally.<sup>15,22</sup> The second reality is that there are not enough radiologists in South Africa. This is evident through statistical records as received from the HPCSA, which state that there was 930 radiologists registered in year 2017, in comparison to 8032 registered radiographers for the same year.<sup>23</sup> In the context of this study, this reality is further heightened by the fact that there is no onsite radiologist in the Dr RSM district.<sup>24</sup> The other reality is that this shortage of specialists seems to persist, despite there being teleradiology systems. This will be highlighted in the description of the study population which is presented in Section 1.8.3. Due to the shortage of radiologists, radiographers and referring clinicians are not able to provide competent and quality services to the community. These professionals are at times, put in positions that force them to practice beyond their scope. This, in most cases, attempts to close the gap that emanates from the lack of human resources. Hence, the study intends to explore and describe the views of teleradiology end users regarding its utilisation and impact on rural health care in the Dr RSM district, North West province.

### **1.7.2 Epistemological assumptions**

Epistemology is the theory of knowledge construction based on the researcher's view of the world around him or her.<sup>25</sup> In this study, the researcher described their observations within the teleradiology setting, which formed the problem statement of the research. These are further correlated by the views of the teleradiology end

users, namely the radiographers, radiologists, and referring clinicians, who share their real-life experiences, as well as their knowledge regarding teleradiology practice within their clinical settings.

### **1.7.3 Methodological assumptions**

Methodological assumptions are ways of obtaining knowledge about the described reality.<sup>19</sup> Scotland defines methodological assumptions as the strategy, plan of action, process, or design lying behind the choice and use of particular methods in a research project.<sup>26</sup> For this study, a qualitative, exploratory, and descriptive design will be used as described in the following section. Motivation for the use of this design will be elaborated upon in the following section.

## **1.8 OVERVIEW OF THE RESEARCH METHODOLOGY AND DESIGN**

Based on the research problem, research question, and aim of the study, a qualitative, exploratory, and descriptive design was found to be appropriate for this study. A brief overview of the methodology used in this study is presented first, with focus on a qualitative research approach.

### **1.8.1 Overview of qualitative research approach**

The qualitative approach enables the researcher to gain a wealth of information by exploring the participants' views. It was found to be appropriate for this study as it helps gather in-depth information regarding utilisation of teleradiology and its impact on health care in the Dr RSM district. Other studies investigating teleradiology applications made use of mostly quantitative research designs.<sup>9,16,27</sup> To give an example, a study by Gulube and Wynchank used monthly telemedicine interaction forms and questionnaires to assess the first phase of telemedicine implementations in provinces across South Africa.<sup>9</sup> Although these evaluation tools yielded sufficient information, they did not allow for in-depth exploration of the views of the teleradiology end users, but rather provided an overview of the statistical usage and challenges that occurred at each site. A more in-depth discussion of qualitative research approach will be presented in Chapter 3 of this dissertation. This will be compared with the quantitative research approach to demonstrate why the qualitative approach is appropriate for this study. An exploratory descriptive design

was identified as being well suited for this study and it is presented briefly in the following section.

### **1.8.2 Exploratory descriptive design**

Exploratory, descriptive designs have been commonly used in nursing research, with its main aim being to explore and describe the experiences of individuals regarding a particular area of interest.<sup>28</sup> The exploratory, descriptive design enabled the researcher to adequately explore the phenomenon presented in the teleradiology setting of the Dr RSM district. Focus group interviews were used for the collection of data. This allowed participants to describe their experiences in a free and unobtrusive manner.

Further methodological factors such as the research setting, research process, and detailed discussion on focus group interviews, will be elaborated on in Chapter 3. The following section focuses on the research participants, study population, and sampling strategy.

### **1.8.3 Research participants**

As previously mentioned, purposeful sampling was used to select the research participants. The researcher addresses the three key questions outlined by Richie and Lewis.<sup>29</sup> The primary role of these health professionals is outlined in the following section.

#### **1.8.3.1 Radiographers**

Radiographers are health care professionals who use radiation emitting equipment to produce images of the internal structures of the body for diagnostic purposes<sup>30</sup>. According to Long, Frank and Ehrlich, they have three competency standards, namely: to produce diagnostic images; to be knowledgeable about ionizing radiation; and to be competent in clinical judgment.<sup>31</sup> These standards relate to the fact that they use technical equipment to produce images that will assist medical practitioners in the diagnosis and management of clinical conditions. It is important that the images that they produce are of good quality, and that the radiographers must adhere to the rules of 'As Low As Reasonably Achievable' (ALARA), which

means that radiographers have the responsibility of keeping radiation towards patients, personnel, and the general public, as minimal as possible.<sup>32</sup> Firstly, their role in this aspect is underscored by the Image Gently campaign, which requires radiographers to pledge to optimise imaging examinations and use radiation in a knowledgeable manner, whereby minimal radiation is used in such a way that the diagnostic value of the image is not compromised.<sup>33</sup> Secondly, radiographers are required to create a platform of engagement with referring clinicians to be able to communicate these strategies, and therefore place the patients' health and safety first.<sup>33</sup> The Health Professionals Counsel of South Africa (HPCSA) further states that a radiographer "...shall perform professional acts only at the written request of a practitioner approved by the board for such purpose"<sup>34</sup>, and that the radiographer shall not interpret radiographical investigations, report thereon or furnish information in regard to any work performed by him or her in his or her profession to any person other than a practitioner approved by the board at whose request such work was undertaken".<sup>34</sup>

#### **1.8.3.2 The referring clinician**

A referring clinician is a medical doctor or dentist who has direct contact with the patient and is responsible for diagnosing, treating, and managing the patient.<sup>35</sup> The role of the referring clinician seeking radiological investigations, is to provide justification on the necessity of the imaging request.<sup>36</sup> In the context of a CT scan, where there is significantly increased amounts of radiation dosage, the referring clinician's primary responsibility is to ensure that the CT request is indeed necessary and that adequate and clear clinical history is always given.<sup>36</sup> This statement is further reiterated by the Image Gently Campaign, which requires clinicians to pledge that they will educate themselves on radiation exposures for imaging examinations that use ionising radiations, to request examinations after careful consideration that the medical benefits will outweigh radiation risks involved, and lastly to consult with radiographers and radiologists to choose the most appropriate imaging that yields the highest diagnostic value.<sup>33</sup>

#### **1.8.3.3 The radiologist**

A radiologist is a specialist medical practitioner whose primary responsibilities are to interpret radiological images, provide a radiological report, and perform

interventional studies. In the context of this study, the responsibility of the radiologist is to "...justify examinations depending on the components of each clinical case, protocol modification, contrast type, amount to be injected and provide a radiological report".<sup>37</sup> One special regulation outlined by the HPCSA for radiologists specifically, is that a "...radiologist is permitted to form a partnership with a radiographer registered in the relevant discipline in view of the fact that the said two medical professions are related to each other in terms of the nature of their field of professional practice".<sup>34</sup>

#### 1.8.4 Study population

The study population is the sample from which the research participants will be selected. In this study the population includes radiographers and referring clinicians practising at hospitals in the Dr RSM district and radiologists from a private radiology service provider in Gauteng. (Table 1.1).

**Table 1.1 Population of teleradiology end users in the Dr RSM district and private radiology practice (2017).**

	<b>Radiographers</b>	<b>Referring clinicians</b>	<b>Radiologist</b>
Teleradiology referral site 1	8	20	0
District hospital 1	6	10	0
District hospital 2	4	10	0
District hospital 3	1	3	0
District hospital 4	3	5	0
District hospital 5	2	5	0
Radiology practice	-	-	5
<b>Total study population</b>	<b>24</b>	<b>53</b>	<b>5</b>

As demonstrated in Table 1.1, the number of referring clinicians is higher than that of radiographers. This is somehow unusual as compared to other areas in South

Africa, and as per the HPCSA statistics mentioned in Section 1.7.1. This imbalance in the number of radiographers and referring clinicians may have an impact on the request for the medical X-ray examinations as well as teleradiology services. According to Coleman, Hersel and Coleman, the average number of doctors per rural hospital in South Africa is around three.<sup>38</sup> In this district we see that the figure of referring clinicians is concurrent with the average number of doctors in the rural setting. Table 1.1 further showcases the dire situation of specialist shortages in this district. It must however be noted, that during the time of data collection, the number of radiologists further declines to two radiologists.

### **1.8.5 Overview of data collection**

Data was collected by means of separate focus group interviews with each group of research participants described in section 1.8.3. This allowed for homogeneity in each group as well as the triangulation of data, ensuring trustworthiness, which will be discussed at length in section 1.8.8.

### **1.8.6 Sampling strategies and data saturation**

The sampling strategy chosen is a key feature in both quantitative and qualitative studies, and describes the criteria that the researcher used when choosing a particular strategy.<sup>29</sup> Sampling and data saturation are discussed together in this section.

#### **1.8.6.1 Purposive sampling**

The strategy used in this study was non-probability purposive sampling. Polit and Beck describe non probability sampling as a strategy that can be used in both quantitative and qualitative research.<sup>20</sup> However, Ritchie and Lewis explains that non-probability sampling is best suited for qualitative research designs.<sup>29</sup> In the context of qualitative research, widely used methods of non-probability sampling include convenient, snow balling, theoretical, and purposive.<sup>20</sup> Purposive sampling can be described as the selection of specific individuals who manifest certain characteristics and experiences pertaining to the research problem.<sup>28</sup> Grove and Gray highly recommend the use of purposive sampling in qualitative research, and



explain that its benefits lie in selecting information rich participants that can provide the researcher with a wealth of knowledge that is of central interest to the area of inquiry.<sup>28</sup> In the context of this dissertation, all radiographers, referring clinicians, and radiologists, who utilise teleradiology within in the Dr RSM district (Table 1.1), were invited to participate in the focus group interviews. Due to the qualitative, exploratory, and descriptive nature of the study, no definitive sample size was established, as the researcher was interested in information rich descriptions from the participants and not statistical numbers of individuals for the focus group interviews. Liamputtong suggest that qualitative studies should not have too many participants, as this may create a risk of increasing the complexity of the analysis process.<sup>39</sup> This author further recommends six to 12 participants in one focus group session. It is further mentioned that the number of participants in a qualitative study is adequate if data saturation can be achieved. Saturation is discussed in the next section and details on how focus groups were planned and facilitated will be outlined in section 3.4.2.

#### **1.8.6.2 Data saturation**

Data saturation is the term given to a point when no new information is obtained during the data collection in a qualitative study. This means that expanding the sample further would yield no new insights.<sup>29</sup> Polit and Beck further describe data saturation in qualitative research as the point where closure is attained, whereby the researcher is satisfied that they have explored that area of inquiry adequately.<sup>20</sup> In this study, the researcher aimed at starting with two focus group interviews for radiographers, and two for the referring clinicians. However, data saturation was reached after conducting three focus group interviews, one for each group of end user. The duration of the focus group interview with the radiographer was one hour and 22 minutes, whereby no new information was presented by the participants. The same occurred for the referring clinicians, whereby the same experiences were shared by all the participants and thus data saturation was reached after one hour. Due to the limited number of radiologists, only one focus group interview was going to be conducted. The duration of this interview was 20 minutes.

#### **1.8.7 Overview of data analysis method**

As mentioned in Section 1.8.2, focus group interviews were conducted to attain the qualitative data. Following this, data was transcribed and organised for the data analysis. The research process leading up to the data analysis will be described in Section 3.4. Data analysis is a method of deriving meaning from the data collected in structured way.<sup>20</sup> In this study, the researcher used content analysis to analyse the data. This method of analysis encompasses subjective interpretation of the transcribed data through a process of coding, categorising, and the establishment of themes.<sup>40</sup> Several authors discuss ways in which content analysis can be used to analyse data, however in this study, the researcher used the method described by Zhang and Wildemuth, which encompasses eight stringent steps, these are namely: 1) preparing the data, 2) defining the unit of analysis, 3) develop categories and a coding scheme, 4) test your coding scheme on a sample of text, 5) code all text, 6) assess your coding consistency, 7) draw conclusions from coded data, and 8) report your methods and findings.<sup>40</sup> These steps will be described in detail in Section 3.7.1.

### **1.8.8 Trustworthiness**

Trustworthiness has been a long-standing issue of contention in qualitative research, because the research depends on the expressions of the participants and the inductive reasoning drawn by the researcher. These two factors can contribute subjectivity to the interpretation of the research findings, an occurrence that cannot be completely avoided in qualitative research.<sup>41</sup> This view is shared by Polit and Beck, who raised concerns over the quality criteria needed to establish a trustworthy and rigorous study.<sup>42</sup> For this reason, the research must demonstrate sound strategies that were used to ensure trustworthiness namely; credibility, dependability, transferability, and confirmability.<sup>43</sup> However Noble and Smith are of a different opinion and stated that reliability and validity methods, commonly used in quantitative research, are somewhat related to credibility and dependability.<sup>44</sup> In the context of this study, the researcher used the following methods to ensure trustworthiness are described.

#### **1.8.8.1 Credibility**

Credibility refers to the level of confidence presented in the analysed data in relation to the research focus.<sup>42</sup> As alluded to by Noble and Smith, credibility as a measure

of trustworthiness in qualitative research is likened to validity in quantitative studies.<sup>44</sup> In this study credibility was ensured by taking the following steps:

a) Member checking

Creswell states that member checking is a key aspect in assuring credibility.<sup>45</sup> Member checking on the activities carried out by the researcher during that data collection process, was carried out by a research assistant during the data collection process. The research assistant's role was to take field notes (Annexure K and L) during the focus group interviews. Immediately after the focus group interviews were conducted, the research assistant and researcher reviewed the notes in relation to the voice recording to ensure that notes were captured correctly.

The researcher further maintained credibility through member checking by confirming the description of the study setting and socio-economic context with a senior educator practicing within the Dr RSM district. This was to verify if the study setting was described correctly. This was essential to ensuring that the research findings were a true reflection of the socio-economic situation in the Dr RSM district.

b) Co-coder during data analysis process

Saldana advises that the process of coding should be undertaken collaboratively, whereby the co-coder can provide a wider analytic interpretation and "reality check" of the data, particularly if the researcher is an insider.<sup>46</sup> Erlingsson and Brysiewicz also support the use of a co-coder and state that it adds to quality of the data analysis, and enhances the trustworthiness of the data.<sup>47</sup> In this study the co-coder was the supervisor, who was involved in the coding process during all stages of analysis. An insert from the co-coders memo during the analysis phase is included in Annexure P

c) Inclusion and exclusion of relevant and non-relevant data

Graneheim, Lundman and Creswell state that factors affecting credibility include adequately covering all aspects of the data that are relevant to the research focus and conversely excluding irrelevant data.<sup>43,45</sup> This was achieved by careful selection of the unit of analysis and explained in Section 3.7.2.2, whereby the researcher chose to analyse three categories of participants separately to ensure that no significant findings were omitted. This aspect of credibility was further maintained

by excluding teleradiology end users from other districts, who have radiologists that do not share the same research problem as described in Chapter 1.

#### d) Triangulation

Triangulation is defined as a method of collecting different sets of data on the same phenomenon to increase the validity of the study.<sup>48</sup> In this study, the researcher only made observations from the radiographers' perspective. For this reason, it was necessary to gain the viewpoint of all the end users who utilise teleradiology systems, namely the radiographer, referring clinician, and radiologist, to gain an authentic understanding of why the phenomenon is occurring and how it affects service delivery to the Dr RSM district. There are several classic distinctions in triangulation, namely: data source, data type, methods, investigator, and environment<sup>41,48</sup>. In this study triangulation was applied to data source, investigator, and environment specifically.

- **Data Triangulation:** In this category, the pertinent question asked is from whom did the researcher attain the data? As mentioned, the researcher was an insider in radiography and presented observations from the radiographer's perspective in Section 1.2. However, to only explore the views of the radiographers would bring about significant bias and would present a one dimensional view on teleradiology utilisation. For this reason, the views of all teleradiology end users were explored to ensure credibility of the study.
- **Investigator Triangulation:** Different evaluators reach a general consensus, the credibility of the findings is heightened. In this study the supervisor and researcher both evaluated the data as described above, to come to a conclusion about the final themes and findings that emerged.<sup>46</sup>
- **Environmental Triangulation:** The participants of the study were all from different district hospitals within the Dr RSM district. All these hospitals are largely dispersed from each other and have their own unique demographics, however what is common among all of them, is that they depend on teleradiology services from the main teleradiology site where they refer their patients for CT examinations.

#### 1.8.8.2 Dependability

Dependability refers to the stability of the data over a period of time and under different circumstances.<sup>43</sup> To achieve dependability the researcher must, at all costs, ensure that pragmatic scientific evidence is integrated within the complete research process.<sup>42</sup> Miles, Huberman and Saldana support this notion and place emphasis on the availability of the chain of evidence in the research process.<sup>41</sup> In this study dependability of the research results were ensured by explicitly describing each step taken during the phases of the data collection in terms of preparation before the focus group interviews, during the focus group interviews, and during the organisation of the collected data, which will be described in Section 3.5. The researcher also described the steps that were involved in analysing the data, including the preparation, organisation, and reporting stage in content analysis, which will be described at length in Section 3.8.

#### 1.8.8.3 Transferability

Transferability refers to the extent to which research findings can be transferred in another context.<sup>42</sup> However, Depoy and Gitlin explain that findings from qualitative designs are personal accounts, which cannot be generalised, and transferred to another context, as seen in quantitative studies.<sup>14</sup> However, where transferability can be applied, is when the method of the study is applied to a different context. In this study the researcher ensured transferability by providing a thick description of the data collection and data analysis process followed. This will enable research to be conducted in different areas following the same methodology to determine the similarities and differences experienced by other teleradiology end users in different geographical areas, however under the same social context, namely teleradiology sites without an onsite radiologist.

#### 1.8.8.4 Confirmability

Confirmability is expressed as methods of ensuring that the findings and conclusions are a true representation of the reality expressed by the participants who experienced the phenomenon.<sup>42</sup> This is achieved by explicitly presenting the attempts at bringing rigour to the study. Grove and Gray explain that lack of rigour in qualitative studies are often related to the researcher allowing personal feelings to encroach on the actual findings.<sup>28</sup> Issues of poorly described data collection and

analysis methods are also contributing factors to lack of rigour. In this study rigour was achieved by the following methods:

- Data collection process: As will be demonstrated in Chapter 3, there is a thick paper trail of the data collection and analysis process. These processes are outlined step by step in Section 3.7.2.
- Data presentation: Rigour was further established by the researcher presenting the codes of each focus group in the data analysis section. This enables the reader to have a visual understanding of how the researcher translated the codes into categories and then into themes. These themes were then interpreted, which lead to the final research findings. The researcher also provided inserts from the actual transcriptions of each focus group interview (Annexures M, N and O) to confirm that what was presented, was what was actually said by the participants.

## **1.9 ETHICAL CONSIDERATION**

Ethical consideration is an essential aspect in research as it provides guidelines in which the researcher must take into consideration to ensure that the research methodology to be undertaken is “...scientifically, ethically and legally sound”.<sup>42</sup> This is with the view of providing research that benefits the community at large and brings no harm or disrepute to the participants or institutes involved.<sup>34</sup> Before the study could commence, the research protocol was reviewed by various ethical bodies. Ethical clearance was then granted by the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (423/16) (Annexure A), as well as the North West Provincial Office for Policy, Planning, Research, Monitoring and Evaluation (Annexure B). After receiving ethical clearance, the researcher ensured that ethical consideration was maintained throughout the research process. The Bioethical principles of the National Patient’s Rights Charter provides a framework in which the researcher aligned with to ensure that the research participants were not vulnerably exposed during the research. These principles include autonomy, beneficence, non-maleficence, justice, and respect for human dignity, which will be discussed in the following section, beginning with autonomy.<sup>49</sup>

### **1.9.1 Autonomy**

In medical research involving living participants, the researcher must honour the participants' right to make their own informed choices.<sup>49</sup> In this study the researcher created multiple opportunities for the participants to view the information leaflet before the actual focus group interview was to take place as described in Section 1.9.1. This enabled the participants to take their time and go through the information leaflet, thus allowing them to make an informed decision if they wanted to take part in the study or not, before travelling to the venue of the focus group interview.

Privacy and confidentiality are the corner stone of health care ethics and fall under the category of autonomy. It is defined as keeping personal information within proper bounds.<sup>50</sup> Mason and Dhali go on to say that revealing personal information and experiences can cause feelings of shame, inadequacy, and embarrassment to the participant. The participant willing to partake in the study must be assured that the information he or she is about to share as an individual will not be disclosed to others outside of the research context.<sup>50</sup> In the context of this study, the researcher maintained privacy and confidentiality during the data collection process and in the data presentation. Firstly, this was achieved by the researcher advising the participants before the focus group interviews to not mention any names when addressing each other during the focus group interview, ensuring that the audio recordings will be free of identifications. Secondly, privacy and confidentiality were maintained throughout the data presentation by coding the participants' responses as Radiographer #1, Referring Clinician #1 and Radiologist #1, to maintain the participants' anonymity. The researcher was also very cognisant of the institution's right to privacy and ensured that the names of the hospitals involved, and the private radiology service provider remained anonymous.

### **1.9.2 Beneficence**

Beneficence refers to the participant's best interests being upheld during and after the study even if the participant's best interests conflict with the researcher's own self-interest.<sup>42</sup> The researcher indicated that the focus group interview was a platform to share experiences and opinions with each other to ultimately improve teleradiology systems and operations, which they are currently using. The researcher emphasised to all groups of participants that the study in no way

intended to bring disrepute to any institute, professional group or individual, but rather was seeking the views of each end user and ultimately identify ways of improving the current teleradiology systems being utilised.

### **1.9.3 Non-maleficence**

In research, non-maleficence entails that the study to be undertaken will not cause harm to any of the participants or institutes who choose to participate.<sup>50</sup> With regards to this study, the researcher ensured that non-maleficence was maintained by means of privacy and confidentiality of the participants and service providers as explained in Section 1.9.2. Non-maleficence was further maintained by means of triangulation, such that the views of all end users were taken into consideration and from multiple perspectives. By doing this, all participants were fairly represented to ensure that the participants' reputations were not harmed. Before the focus group interviews commenced, the researcher further reminded the participants about the research objectives of this study, one of which was to provide recommendations for improving teleradiology systems, and not to harm the professional identity of any of the participants.

### **1.9.4 Justice**

Justice refers to the participants' right to fair selection and equality, such that the selection of participants is based solely on the research requirements.<sup>42</sup> In this study, justice was ensured by inviting all teleradiology end users who utilise teleradiology services in the Dr RSM to partake in the study as well as the private teleradiology service provider in Gauteng. This decision was taken to capture an authentic view of teleradiology from all aspects, whereby each category was fairly represented, and all views were considered. Justice was further made by including all teleradiology end users regardless of their level of qualification or expertise. All categories of participants were treated equally in terms of how they were invited and catered for during the focus group interviews. There was no payment made to any of the research participants, however refreshments were prepared for all focus group interviews, with the exception of the radiologists who faced time-constraints. The major concepts used in this study are discussed in the following section.



## **1.10 CONCEPT CLARIFICATION**

Before delving into the multifaceted nature of eHealth applications, the reader must first be acclimatised with terminology that will be used throughout the chapters of this dissertation. The importance of this, is to provide an understanding of the concepts that will be explained and discussed, and the context in which they appear in literature. These terms are first defined broadly and then explained in the context of this specific study.

### **1.10.1 eHealth**

eHealth is the collective term used to describe clinical services, hospital information systems, and electronic medical records that are all dependant on information and communication technology.<sup>10</sup> In relation to this study, it refers to the systems that enable a specialised radiology service to be delivered, with regards to the transmission of CT images, and the retrieval of radiological reports.

### **1.10.2 eHealth strategy**

The eHealth strategy is policy document developed by the National Department of Health of South Africa to address issues of uneven distribution of health services across all provinces. The strategy was intended to create a road map that effectively directs the usage of eHealth technology to ensure proper integration and sustainability of its various applications across South Africa.<sup>15</sup> In the context of this study, the eHealth strategy will be the reference point for discussions to enable the researcher to ascertain alignment of the research findings.

### **1.10.3 Telemedicine**

Telemedicine is an application of eHealth technology. Telemedicine refers to the transfer of health care services from urban institutes to rural communities, using communication networks, such as telephone lines and internet connections<sup>51</sup>. Telemedicine applications include telecardiology, tele-pathology, tele-ophthalmology, ante-natal tele-ultrasound, tele-dermatology, tele-education, and teleradiology.<sup>10</sup>

### **1.10.4 Teleradiology**

Teleradiology is a subcategory of telemedicine. It refers to the remote transmission of radiological images (x-ray and CT images) over electric networks, and the interpretation of transmitted images for diagnostic purposes by means of a radiological report.<sup>52</sup> Teleradiology provides rural communities without a radiologist, access to specialised radiological services such as reporting services, and assists onsite radiologists with a high work volumes.<sup>52</sup> This form of teleradiology has been seen in other districts of the North West province. In relation to this study, teleradiology in the Dr RSM district is limited to the CT department, where it is used to transmit CT images to the remote radiologist, who in turn sends back a radiological report.

#### **1.10.5 Picture Archiving and Communication Systems (PACS)**

PACS is synonymous with teleradiology, with its main function being to store the digital images and reports as well as enable transmission of these records within the hospital.<sup>53</sup> PACS essentially require a local area network (LAN) and are limited to end users within a hospital, unlike teleradiology whereby there can remotely.<sup>53</sup>

#### **1.10.6 Teleradiology end users**

Teleradiology end users refer to people within an organisation who directly utilise equipment or services as opposed to the people who authorise, procure, or order the services.<sup>54</sup> Teleradiology end users include radiographers, nurses, referring clinicians, and radiologists.<sup>36</sup> However, in the context of this study teleradiology end users refer only to the radiographers, radiologists, and referring clinicians who utilise teleradiology systems in their daily duties within the CT Department. Nurses will not form part of the participants, as there is no dedicated radiology nurse in this context, as seen in other radiology departments.

#### **1.10.7 Turnaround time**

Turnaround is term given to concept of rotating, from one point to another.<sup>35</sup> Turnaround time in the teleradiology context refers to the time the radiological investigation was ordered by the clinician, to the time the report is delivered to the clinician. Turnaround times are the most common metric used to gauge the success of teleradiology services.<sup>55</sup> In the context of this study, turnaround time refers to the

time the CT images are sent to the radiologist to the time the report is received by the radiographer or referring clinician.

#### **1.10.8 Teleradiology referral site**

The teleradiology referral site is the main referral hospital of the district for specialised radiological examinations such as CT examinations.<sup>8</sup> It is specifically equipped with teleradiology infrastructure that connects directly with the remote radiologist to enable the transmission of images and the retrieval of radiological reports. In this study the main teleradiology site is located centrally to all the district hospitals. This will be illustrated in the study setting section of Chapter 3, Section 3.4.1.

#### **1.10.9 District hospitals**

District hospital is defined as a hospital that supports and receives referrals from smaller community health care centres.<sup>56</sup> These hospitals offer a wider range of health care services to the district upon referral from the Community Health Centre, such as diagnostic imaging, rehabilitative treatment, and consultations with senior medical officers. In the Dr RSM district, there are five district hospitals, which will also be illustrated in the study setting section of Chapter 3, Section 3.4.1. All these district hospitals have general radiographic services, however no CT scan and refer all their patients to the main teleradiology site.

#### **1.10.10 Specialised tertiary hospital**

Specialised tertiary hospitals are defined as hospitals that provide care to “specified” patients for certain conditions. These institutes also provide education to health care professionals and often have specialists within every field.<sup>56</sup> There is one specialised tertiary hospital in the North West province. It is situated in the Dr Kenneth Kaunda district. Following a complete diagnostic work up, inclusive of general x-rays, CT examinations, ultrasound and radiological reports, patients of the Dr RSM district are referred to this hospital for treatment.

## **1.11 OVERVIEW OF DISSERTATION CHAPTERS**

This dissertation comprises of five chapters which will be outlined in the following section:

### **Chapter 1 - Introduction and overview of the study**

This covers an introduction to the study, which includes a broad overview of eHealth and its applications within rural health care. The background outlines the foundations of teleradiology implementations in the Dr RSM district and how it has evolved from this first implementation to currently. The researcher's profile is shared, and observations are highlighted that lead to the rationale for the study. The problem statement and research questions are outlined. The aims and objectives are presented. Keeping in line with the qualitative nature of the study, the researcher introduces the philosophical assumptions, giving a brief overview of the research methodology. Under the methodology section, the research design, being exploratory and descriptive, was introduced. This extended to an overview of the sampling strategy used, study population, and research participants. Methods of ensuring trustworthiness were described, inclusive of credibility, dependability, transferability, and confirmability. The chapter also includes the definition of terminology, giving first the broad definition, and then an indication of how the terms are used in this study. The importance of ethical consideration is highlighted, and an overview of ethical clearance is provided. The principles of bioethics are introduced and how it is addressed in this study is elaborated.

### **Chapter 2 - Literature review**

An in-depth exploration of the literature surrounding rural health care globally, in South Africa as well as in the North West province, is provided. Governmental policies regarding the vision of eHealth and teleradiology are discussed. The evolution of information technology in radiology is described, focussing on teleradiology, PACS, and the current trend of mHealth applications in eHealth. The chapter then goes onto describing the roles of human resource responsible for operating these applications, in predominantly rural areas. These human resources include the radiographers and referring clinicians, as well as the remote radiologists.

### **Chapter 3 – Research methodology**

In this chapter the rationale for qualitative inquiry is provided, followed by an introduction to the exploratory and descriptive research design used. The research process is described, including details about the study setting, roles of the researcher and assistant, and the research instrument. The preparation for conducting the focus group interviews is presented, detailing the planning, logistics, and execution of each focus group interview. In the final section of this chapter the data organisation methods are presented, followed by a detailed account of the data analysis method used, namely content analysis.

### **Chapter 4 - Data analysis, discussion and interpretation**

In this chapter the data from each focus group interview are coded and categorised. These categories are presented and discussed in accordance with literature. This is followed by an illustration of emerging themes derived from all categories of participants. These themes are interpreted in relation to the research objectives, which leads the reader to the overall research findings.

### **Chapter 5 – Findings, recommendations and conclusions**

In this chapter the overall research findings from the interpreted themes are presented in relation to the research questions, aims, and objectives. The researcher's recommendations are discussed with regards to future studies that can be conducted, and suggestions for improving the current study that was undertaken. The limitations that occurred during the research process are described, and suggestions to overcome these limitations in future studies are provided. The chapter ends by drawing conclusions from the research findings.

## **1.12 CONCLUSION**

In this chapter the reader was first introduced to what is regarded as a right to accessing health service delivery and its associated challenges in the rural areas of South Africa, like the North West province. The concept of eHealth and teleradiology were presented in this chapter as a means of addressing the challenges to

accessing health services. The observations made by the researcher while working in the rural settings of the North West province, where attempts were made by government to improve health care service delivery, led to this study. The study is attempting to answer what are the views of the teleradiology end users regarding its utilisation for CT examinations, and the impact this has on their service delivery in the Dr RSM district, North West province. The aim of the study is to explore and describe the views of these teleradiology end users, regarding the utilisation of teleradiology and the impact that it has on health care service delivery in this district.

Several factors mentioned in background of study, as observed by the researcher while practising in the teleradiology setting, culminated into the problem statement and rationale behind the study. Keeping in line with the qualitative nature of the study, the researcher highlights the philosophical rationale of the research, taking into consideration the epistemological and odonatological aspects of the study. The chapter concludes by taking the reader through the ethical factors carefully considered by the researcher due to the sensitive nature of the study.

An overview of all the chapters has been provided. The following chapter will provide an in-depth literature review of the key aspects mentioned in Chapter 1.

## CHAPTER 2: LITERATURE REVIEW

*“Technology is best, when it brings people together.”*

Matt Mellenweg

### 2.1 INTRODUCTION

In Chapter 1, an overview of the study was presented by introducing the concept of eHealth and how it is meant to address the challenges experienced by communities in the rural district of Dr RSM, with respect to accessing health services. In this chapter, the reader will be taken through the literature that was reviewed for this study. The purpose of the literature review is to explore and correlate research findings from other studies and policies related to the study being undertaken by the researcher <sup>45</sup>. Literature review is also conducted to identify gaps in knowledge. As indicated in the preceding chapters, most of the studies conducted on teleradiology, tend to be quantitative. This may imply that such studies provide limited information that focuses on statistics only and a lack of in-depth exploration of a phenomenon as experienced by the users of a particular system. Since this is a qualitative study, it is very important that the reader is aware that the literature review did not follow a linear approach, rather it is integrated throughout the dissertation. The key words and electronic search engines that were used to access literature are presented in Table 2.1

Table 2.1. Electronic search engines and key words used to search literature

Electronic search engines	Pubmed, Science Direct, Google Scholar, Clinical key
Key words	eHealth, teleradiology, telemedicine, rural health care, radiologists, radiographers, referring clinicians, radiation protection, role extension

Focus on the reviewed literature will first be on the concept of eHealth and how different communities experience it, followed by a discussion and correlation of global, African, and South African eHealth strategies.

## 2.2 THE CONCEPT OF EHEALTH

In Section 1.10.1, the concept of eHealth was introduced as the use of information technology to aid clinical services, strengthen hospital information systems, and enable electronic medical record keeping.<sup>15</sup> With regards to clinical services, the uses of eHealth extend far beyond this and is said to be a “road map” for achieving a well-functioning health care system by supporting the health care management of the patient.<sup>15</sup> This can be achieved through various eHealth applications such as telemedicine, teleradiology, and tele-dermatology, amongst others.<sup>10</sup> These applications make use of technology such as broad band networks and telephone lines to transfer clinical information to specialists, in a way that patient management can be fast tracked, with improved quality of care and health services, particularly for rural communities who don’t have access to specialists.<sup>10</sup> Provision of quality health care is the reference point for gauging the success of eHealth applications. The US Institute of Medicine, Committee of Quality Healthcare in America established the six components of quality health care in the 21<sup>st</sup> century, namely: timeliness, efficiency, effectiveness, safety, equity, and patient centeredness.<sup>57</sup> The South African Department of Health have also endorsed these components and has listed them in the eHealth strategy document as the six domains of quality health care.<sup>15</sup> These domains are illustrated in Figure 2.1 and will be elaborated upon further in the next section.



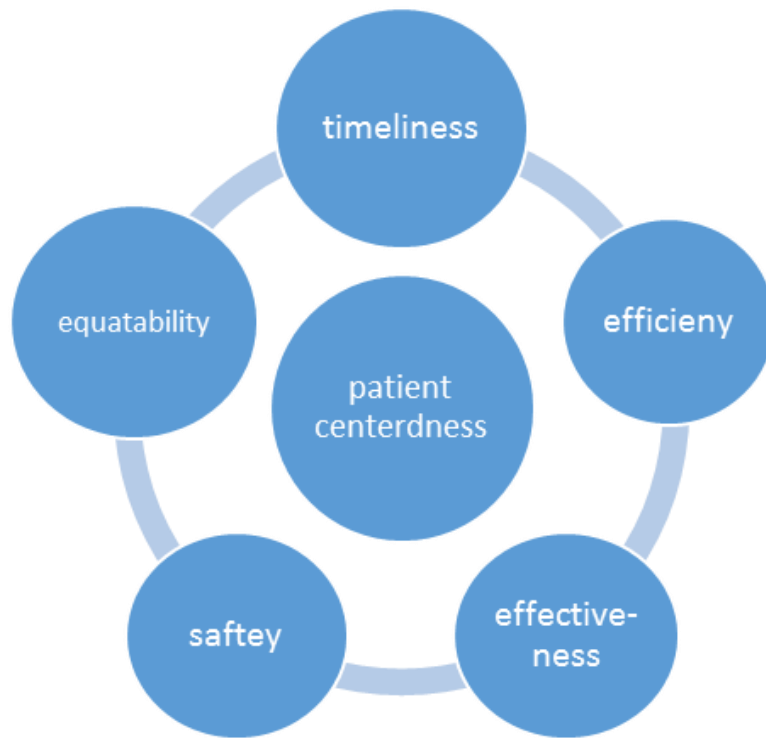


Figure 2.1 Six domains of quality health care in the eHealth strategy<sup>15</sup>

### 2.2.1 Timeliness

Timeliness refers to reduced waiting times and delays in health care management that can potentially harm the patient.<sup>15</sup> In the context of this study, the researcher observed such delays with regards to turnaround time as described in Section 1.2.1.

### 2.2.2 Efficiency

Efficiency, as described in the eHealth strategy, is the avoidance of wasting valuable resources, such as equipment and supplies. However in the context of specific eHealth applications such as teleradiology, efficiency refers to the “...speed and accuracy in producing and delivering” a radiological report.<sup>55</sup>

### 2.2.3 Effectiveness

Effectiveness refers to providing a service that will benefit the patient, and avoiding under and over usage of the service.<sup>15</sup> In the context of teleradiology, effectiveness can also be regarded as providing a service that will positively influence the medical care received by the patient.<sup>58</sup> This directly relates to the domains of timeliness and efficiency described in Section 2.2.1 and 2.2.2.

#### 2.2.4 Safety

Safety is described as avoiding harm to patients, from services that were intended to benefit them.<sup>15</sup> This domain also directly relates to the context of teleradiology, which is a discipline in health care that uses ionising radiation that can be potentially hazardous to the patient if used negligently.<sup>32</sup>

#### 2.2.5 Equitability

Equitability, as stated in the eHealth strategy, is providing care that is not influenced by the patient's personal characteristics, such as geographic location and socio-economic status<sup>15</sup>. This component is particularly important in the eHealth context, given that these services are being rendered to the poorest communities in outlying rural areas, as seen in the Dr RSM district.

#### 2.2.6 Patient centeredness

As suggested in Figure 2.1, all five domains must put the patient at the centre of all eHealth activities. The eHealth strategy describes patient centeredness as providing care that is "...respectful and responsive to the individual patient needs".<sup>15</sup> In the context of this study, it was observed that the health professionals operating the teleradiology systems are attempting to do this, as described in Section 2.1.1.

The six domains of quality health care in eHealth in terms of clinical services were elaborated upon. However, the concept of eHealth also has other benefits, such as being able to build the capacity of health care workers who must deliver this quality of care by means of distance education. Distance education is enabled through eHealth infrastructure that supports video conferences with specialists in urban areas and around the world.<sup>59</sup> eHealth therefore appears to be a promising tool that can be used to enhance health care. Governments and health care bodies around the globe have identified eHealth as more than a useful adjunct in health care, but rather a necessity due to the increasing rate of limited access to health care, particularly in rural communities around the world.<sup>6</sup> The next section will look at need for eHealth health care and how it has been experienced by different communities around the globe.

## **2.3 HOW DIFFERENT COMMUNITIES EXPERIENCE eHEALTH**

The World Health Organisation (WHO) reports that half of the global community live in rural outlying areas.<sup>60</sup> Often these communities are faced with poverty and have adverse socio-economic challenges such as low income, high environmental risks such as exposure to hazardous wastes, poor water quality, and overcrowded living conditions, all of which results in health consequences.<sup>61</sup> Not only are rural communities faced with socio economic challenges, but they also face limited access to proper healthcare due to their geographic dispersion and a shortage of health professionals who practice in these areas.<sup>61</sup> WHO explains that this challenge of imbalance is observed in almost all countries and poses a nationwide strain in providing quality health care to these communities.<sup>60</sup> Governments across the globe have therefore endorsed eHealth strategies as an effective way to address the challenges described.<sup>6</sup> eHealth will be further discussed according to way it is experienced globally, in Africa, South Africa, and the North West province.

### **2.3.1 Global eHealth strategies**

The main aim of eHealth applications is to provide specialised healthcare services to areas that have limited access to specialists, therefore bridging the gap between over saturated urban areas and outlying impoverished rural communities that are often forgotten about.<sup>52</sup> There is much optimism surrounding the breakthrough benefits that can be derived from eHealth, however much evidence rather points to eHealth implementations that have not been widely successful at delivering quality health care.<sup>18</sup> To attain an overview of eHealth amongst the global community, a meta-analysis of eHealth practices in eight countries was conducted by Altharhi.<sup>62</sup> These countries included New Zealand, Australia, United States of America (USA), Canada, Malaysia, United Kingdom (UK), China, and India. It was evident that despite being geographically dispersed around world, all eight countries share common experiences associated with eHealth strategies. Some of these experiences include legislation challenges, business modelling, and a lack of trained telehealth human resource. Further to these, financial constraints were reported to be the major challenges experienced by all countries due to the global economic recession.<sup>62</sup> However, in contrast to these findings, another study took on an optimist approach to eHealth strategies. An example of this is seen in the USA with

a success rate of 69% for eHealth implementation.<sup>63</sup> This rate can be attributed to the fact that the USA is reported to have 27,570 registered radiologists in the year 2013, with a further 1,526 radiologist jobs projected for 2016.<sup>64-65</sup> Elbert, van Os-Medendorp, van Renselaar, Ekeland, Hakkaart-van Roijen, Raat, Nijsten and Pasmans conducted a systematic review and meta-analysis of the effectiveness and cost-effectiveness of eHealth interventions in somatic diseases.<sup>66</sup> Their findings revealed that 23% of the 31 studies reviewed found eHealth to have positive effects on healthcare, 42% to be promising, and 35% to be limited or inconsistent.<sup>66</sup> These findings highlight that there is great potential for eHealth, as envisioned by WHO. It is also evident that first world countries, such as the USA, have the financial and human resources to support eHealth strategies as well as sound ITC infrastructure. In addition to providing rural areas with healthcare, these countries largely draw on eHealth strategies to enhance the quality of their existing healthcare systems.<sup>67</sup> This view however contrasts with the description of South Africa's eHealth strategy as described in Section 1.1, which alludes to eHealth being an integral part of health care systems to provide access to health care in rural areas.

### **2.3.2 eHealth strategies in Africa**

In parts of Africa, most countries are considered developing countries that are grappling to meet the populations' basic human needs such as healthcare, education, sanitation, and nutrition.<sup>68</sup> There is a stark contrast of eHealth adoption in comparison to some first world countries mentioned in Section 2.2.1. Here rural communities account for 60% of the continent's population.<sup>10</sup> These figures reflect a large percentage of the population who are directly affected by lack of proper health care services and access to specialised diagnostic procedures.<sup>5</sup> The major difference that Africa faces in comparison to the rest of the world, is the reality of not having enough specialists, particularly in the field of radiology.<sup>69</sup> For this reason most eHealth applications in Africa largely depend on specialists from other countries, such as Europe, to support systems that have been implemented.<sup>7</sup> At this point the reader is reminded about the problem that led to this study as described in Section 1.2, with regards to specialist shortages, whereby a population of approximately 460 000 people in the Dr RSM district, have no onsite radiologist. Similarly to the global context, eHealth strategies were subsequently put in place to bridge the gap between impoverished communities.

Although these measures exist, eHealth implementation and sustainability has proven to be low in parts of Africa due to the major challenge of “digital divide” which implies that most areas in Africa still don’t have access to technology as seen in first world countries.<sup>70</sup> eHealth in Africa is targeted at the poorest populations who live in rural areas, however these communities lack basic needs that eHealth demands, such as computers, internet access, telephone lines, and health professionals with computer literacy.<sup>10</sup> These challenges evoked the need to relook at healthcare in Africa, which led to the Dream Project being initiated in countries such as Mozambique, Malawi, Tanzania, Kenya, Republic of Guinea, Swaziland, Cameroon, Congo RDC, Central African Republic, Angola, and Nigeria.<sup>71</sup> The aim of the Dream Project was to create a new model of public health, whereby patients in rural areas can still access health care, despite their economic and transportation difficulties. This project utilises telemedicine, by transmitting questions and clinical data to specialists in Europe. Some teleconsultations included cardiology, dermatology, neurology, and infectious diseases.<sup>71</sup> This indicates that despite various technical challenges, communities in these rural areas can access specialised health care to a certain degree.

WHO therefore remain optimistic that eHealth is the solution to strengthening developing countries’ health care systems.<sup>6</sup> WHO has developed the *Global Observatory for eHealth*, whereby the main objective is to determine a series of benchmarks at various levels of eHealth adoption, such that governments can monitor their own development in eHealth, and draw on the successes and failures encountered by eHealth developers and users.<sup>72</sup> The Dream Project described above, is one such example of successes of eHealth in Africa. This strategy is essential for the sustainability of eHealth technology as many countries lack support.

### **2.3.3 eHealth strategies in South Africa**

South Africa falls under the category of upper middle income according to the World Bank Group.<sup>73</sup> It is therefore presumed that eHealth applications would also be used to enhance existing health care systems as noted in the USA, described in Section 2.2.1. However, based on the statistics of registered radiologists in South Africa, which is 930 in the year 2017, in comparison to the USA, which is 27 570 for the year 2013, it becomes evident that South Africa is facing similar challenges to parts

of Africa as mentioned in the preceding section.<sup>74</sup> This is with regards to poverty and the increased burden of disease. In South Africa, the rural population makes up 35.20% of the country's population.<sup>15</sup> Mirowsky explains that there is complex relationship that exists between poor social economic status and health, whereby lack of essential resources such as access to health care can significantly reduce life expectancy.<sup>61</sup> A survey conducted by Le Roux, Mans, Van Huyssteen and van Niekerk identified areas in South Africa where communities were most socially vulnerable.<sup>3</sup> These areas, as depicted in Figure 2.2 (shaded in dark red), show the highest percentages of unemployment, rural population, informal settlements, and lack of public water. These factors are said to contribute to, and acerbate the burden of disease in these areas, placing a demand on health care services.<sup>3</sup> In the context of this study, the Dr RSM district of the North West province is noted to fall under this category.

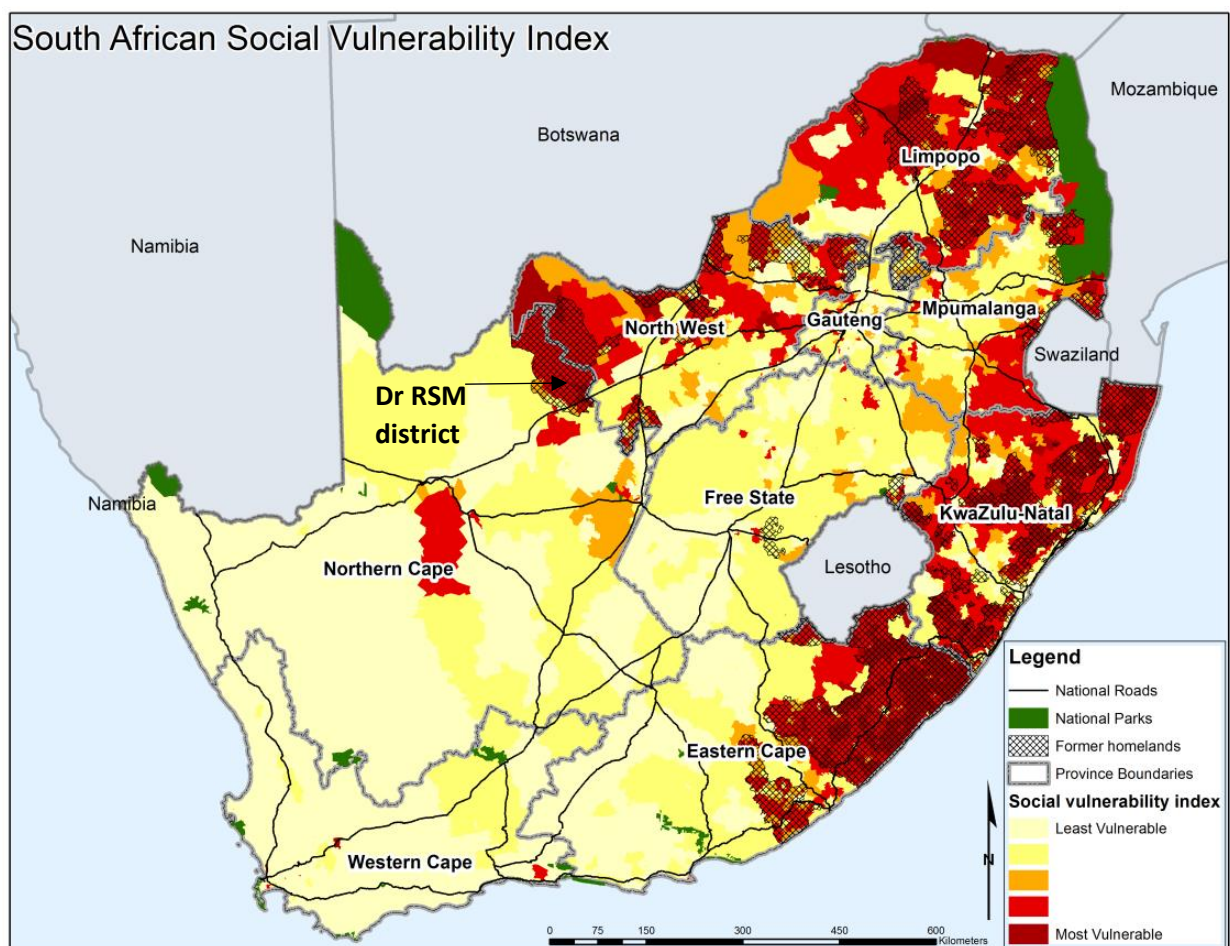


Figure 2.2 Social vulnerability index of communities in South Africa<sup>3</sup>

Given South Africa's growing poverty figures as indicated by the social vulnerability index illustrated in Figure 2.2, the National Department of Health (NDoH) of South Africa has adopted eHealth strategies to address issues of health care accessibility, particularly in outlying rural areas where access to specialists is limited.<sup>15</sup> Some strategies related to health care outlined in the South Africa eHealth strategy document, include governance and regulation, affordability, sustainability, capacity building, work force, and the monitoring and evaluation of these strategies. The next section will look at specific eHealth applications that have been implemented in South Africa, namely telemedicine and teleradiology.

## **2.4 TELEMEDICINE AND TELERADIOLOGY IN SOUTH AFRICA**

The concept of telemedicine and teleradiology is not new to South Africa, however most of these applications are predominately found in the private sector.<sup>75</sup> As explained in Section 1.2, the first telemedicine applications were implemented in the public sector in 1999. Following these implementations, an article by Strachan questioned whether telemedicine was really working.<sup>76</sup> Several studies conducted in South Africa have since shown that telemedicine in the government setting has had positive impacts on rural communities and has great potential, however technical challenges remain the main hurdle in telemedicine across all provinces.<sup>10,77-78</sup> Other studies however, have revealed barriers of a different nature in telemedicine, other than technical challenges. Cilliers and Flowerday sought to explore the user acceptance of telemedicine in the Eastern Cape province.<sup>27</sup> Their findings revealed that rural health care facilities benefit considerably from telemedicine because the patients can be referred to specialists without the inconvenience of travelling. However, 40,3% had considerable apprehension in using the technology. Most of these health professionals who participated in the study were from rural backgrounds and had limited exposure in using information technology (IT) in their everyday working environments, and reported to have lack of IT support when they struggled to access the systems in comparison to the health care workers in urban areas.<sup>27</sup> Mulla concurs with these findings, and reported that the majority of radiographers in urban areas are sufficiently trained in IT with regards to PACS and find it relatively easy to use in comparison to their rural counterparts, who need additional training and support.<sup>79</sup>

Hauman explored teleradiology utilisation in the Eastern Cape province of South Africa. In addition to technical factors, Hauman identified organisational and behavioural factors as key influences causing implementation barriers in teleradiology.<sup>17</sup> This is due to work flow and urgent reports not being “flagged”, as well as lack of incentive and lack of commitment by the referring clinician and radiologist. A study by Andronikou found language between the teleradiology end users to be a limitation in teleradiology, whereby the radiologist could not understand the clinical history given by the referring clinician, who in turn struggled to understand the radiologists telephonic advice.<sup>80</sup> From these studies, it is evident that challenges in telemedicine and teleradiology are far more complex than just technical challenges, but encompass limitations regarding the human factor. Ossebaard and Van Gemert-Pijnen therefore emphasise that when exploring challenges in any eHealth application, the views of the end users themselves are very valuable in deriving information on the dynamics of the actual operation and its associated flaws.<sup>18</sup>

#### **2.4.1 Teleradiology in the North West province**

In Section 1.2, the reader was made aware of the first eHealth applications that were implemented in South Africa. In the North West province, teleradiology was the only eHealth application implemented in 1998 during its pilot stage.<sup>9</sup> The evaluation report of the pilot stage revealed that teleradiology was only utilised in 2000, following technical malfunctions.<sup>9</sup> When the systems were functional, only 264 studies out of 2663 radiographic examinations were reported on using teleradiology. Despite these low figures, clinicians indicated that teleradiology was a useful aid in diagnosing and managing patients with the limited experience that they had regarding teleradiology utilisation.<sup>9</sup> However in 2009, Wootton, Patil and Scott reported that teleradiology was no longer being utilised in the North West province.<sup>81</sup> This statement is further supported by the National Health Counsel, who took a decision to halt all software solutions that were not operable, including teleradiology, until the eHealth strategy was finalised.<sup>15</sup> To date, teleradiology in the North West province, particularly in the Dr RSM district has not been adequately explored. This poses serious limitations to the sustainability of teleradiology systems, as its challenges remain unknown in a district servicing the largest and



poorest area the North West province, as indicated by the social vulnerability map illustrated in Section 2.2.3.

In 2012, other districts in North West province were explored by Coleman, Herselman and Coleman, who shed light on the effectiveness of computer-mediated synchronous communications of rural doctors and remote specialists. Their findings revealed that although these systems are in place, the ITC infrastructure is not strong enough to support the system, thus making real time consultation through these systems non-existent.<sup>38</sup> They further added that communicating through cell phone and text messages were found to be the best means of communication between the doctors in the rural settings and specialists at the tertiary institutes.<sup>38</sup> To gain a comprehensive understanding of the eHealth applications discussed, namely telemedicine and teleradiology, it would be appropriate to delve into the technical aspects of these systems and how they have evolved through the decades.

## **2.5 EVOLUTION OF INFORMATION TECHNOLOGY COMMUNICATION (ITC) IN RADIOLOGY**

ITC over the decades have made vast strides in terms of speed and capacity. Radiology, particularly teleradiology, has seen to maximise on these developments due to the technical nature of the equipment and software used to create diagnostic images.<sup>75</sup> The reader will now be taken through the technical aspects of these systems, and how they have evolved through time.

### **2.5.1. Teleradiology as a concept in eHealth**

The concept of teleradiology, as described in Section 1.10.4, is the transmission of radiological images to the remote radiologist for a radiological report. These images can include a wide range of imaging such general radiographs, CT, MRI, mammograms, and ultrasounds amongst others. In this study, teleradiology is used for the transmission of CT images. The earliest citation of teleradiology occurred in 1929 with the first two dental radiographs transmitted in the USA by means of a telegraph to a remote location.<sup>7</sup> Teleradiology through network transmission then started taking off with the development of film digitizers, which scanned radiographs

into a computer system and images. The images were then transmitted to the radiologist's computer through an internet connection.<sup>82</sup> These approaches were however cumbersome as the images had to be scanned through one at a time.<sup>7</sup> However, with the advent of digital imaging, images are captured immediately and safely stored within the PACS and Radiology Information Systems (RIS) managing the radiological workflow within the hospital.<sup>7</sup> Transmission of CT images to remote locations starting taking place in the early 1900s, when a CT scan was installed in a mobile military hospital in the Saudi Arabian desert and images were transferred to the radiologist in the USA.<sup>83</sup> In the 21<sup>st</sup> century, CT examinations are seen being installed in mobile trucks for stroke screening in the USA and fully rely on teleradiology to transmit the images to the neurologist and radiologist at the receiving site. The radiologist then instructs the radiographer on board the mobile truck to perform additional examinations if necessary.<sup>84</sup> When reflecting on these first and current implementations of teleradiology, it is evident that any form of transmission of images to a remote location for a report falls under the umbrella of teleradiology. This is supported by the executive director of the Radiological Society of South Africa, who says "...all radiology is now effectively teleradiology, the only variable being the distance between the server and the reporting station".<sup>85</sup>

As mentioned previously, teleradiology in South Africa was predominantly utilised in private institutes, however the NDoH has identified the large benefits that could be derived from using these systems in rural areas. Hauman explains that when teleradiology applications are used in the government environment, whereby multiple hospitals are connected to the remote radiologist, there needs to be an efficient connection network that enables smooth work flow and the transmission of images.<sup>17</sup> Huang graphically depicts a generic teleradiology system and its network connections in Figure 2.3.<sup>86</sup> A similar teleradiology network system is used in the context of this study.

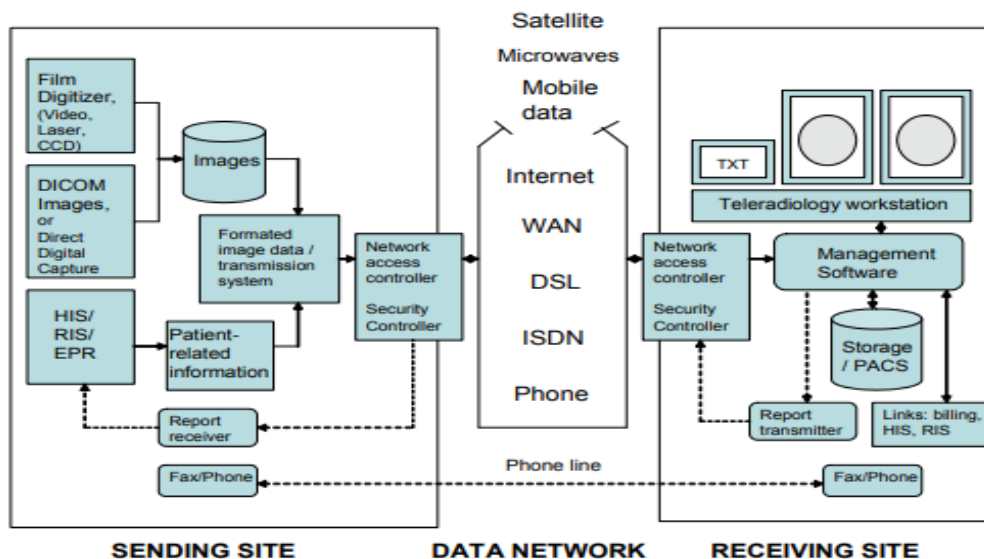


Figure 2.3 Teleradiology systems network<sup>86</sup>

Figure 2.3 illustrates how the teleradiology system operates, starting off with images being captured at the sending site by the radiographer, either digitally or conventional films scanned through a film digitizer, formatted, saved, and then transmitted through the network access controller through several connection options. The images are then accessed by the remote radiologist at the receiving site and the report is stored and transmitted back to the sending site.<sup>86</sup> For this system to effectively work, there must be a sound internet connection and sufficient bandwidth to transfer the large file volumes. With reference to the observations noted in this study, described in Section 1.2, as well as internet challenges reported in other countries, it becomes clear why implementation and sustainability issues arise due to poor connectivity.

The above description portrays teleradiology as a very technical and robust system, simply encompassing transmission of images and receiving of reports. However the European Society of Radiology (ESR) are of a different opinion and state that “teleradiology does not only equate to remote reporting of radiological images, but is a medical act on its own.”<sup>87</sup> This implies that teleradiology heavily depends on the clinical dynamics between the end users who are at the sending site, namely the radiographer and referring clinicians, as well as receiving site, who are the radiologists. Failure in effective communication between the sending and receiving site can lead to significant failures in the system, despite all the technical aspects and internet connection being mechanically sound.<sup>88</sup> There is, however, limited exploration on the clinical dynamics between the end users and how it affects

teleradiology services. For this reason, the research focuses on the viewpoints of the end users who operate these complex teleradiology systems, and how this may impact on service delivery.

### **2.5.2 Picture Archiving and Communication Systems (PACS)**

In Section 1.10.5, PACS was defined in relation to teleradiology systems. The main advantage of PACS is to improve patient management and increase access to patient information in such a way that doctors are able to access their patients' imaging records immediately within the same hospital, therefore improving service delivery.<sup>53,55</sup> However PACS alone has limitations in comparison to teleradiology, some of these limitations include the need for digital imaging equipment and only local hospital network access, such that only health professionals within the hospital can access a patient's images.<sup>55</sup> Teleradiology however is more well suited for the rural environment due to the fact that there can be wide spread access across provinces.

### **2.5.3 Mobile Health supplementary support to teleradiology**

In recent years there has been a rapid development in mobile phone technology, in terms of quality and features, which have become attractive to health care providers<sup>89</sup>. This becomes especially beneficial when clinical information needs to be relayed to a specialist instantaneously, particularly in emergency cases.<sup>89</sup> mHealth is the term given to this new trend of sharing clinical information and can be defined as the use of mobile devices for healthcare services.<sup>90</sup> The NDoH has acknowledged the benefits that can be derived using mHealth and has endorsed it as a supplement to current eHealth strategies.

mHealth in the context of teleradiology or telemedicine involves images or clinical presentations being sent via the mobile phone to the remote radiologist or specialist physician. Consultations can also be made through verbal communication or text messages with these specialists.<sup>90</sup> In developing countries, such as Africa, it is reported that for every 5300 people, 43% have mobile phones compared to only 5% who have computers.<sup>91</sup> South Africa is seen to have one of the highest populations of mobile users with an estimated 93 out of 100 people subscribed to a mobile

service provider.<sup>91</sup> For this reason, government has included mHealth as part of the eHealth strategy and is confident that it will be able to reach rural communities more effectively.<sup>90</sup> However, the challenges identified with mHealth include consent, confidentiality, and quality of care due to the fact there are no regulatory guidelines as to how these ethical concerns will be handled.<sup>92</sup>

## **2.6 HUMAN RESOURCE AND ITS IMPACT ON eHEALTH SERVICES**

Successful adoption of telemedicine applications are largely influenced by the health care professionals involved in the everyday running of the system.<sup>17</sup> Mburu and George, investigated what influenced health care professionals to migrate internally and externally. Their findings revealed that healthcare professionals most often move from health care institutes in rural areas to urban areas.<sup>93</sup> The health professionals who participated in their study indicated that this decision was based on age, levels of stress experienced, and job satisfaction in their work place and not on financial incentive. This was also noted by the NW DoH, who state that one of the reasons for health professionals seeking improved working conditions is due to increased work load and a high pressure environment.<sup>94</sup> Gqweta explains that the majority of healthcare professionals want to remain in metropolitan cities or in private healthcare institutions with sufficient staffing, advanced modalities such as CT and MRI, and interventional studies.<sup>5</sup>

In terms of the actual figures of human resource, South Africa has about 8032 radiographers and only 930 radiologists according to the statistical records as received from the HPCSA in February 2017 as described in Section 1.7.1.<sup>23</sup> This can further be related to other African countries such as Liberia with as little as 10 radiologists for a population of 3.5 million.<sup>95</sup> Kekana, Swindon, and Mathobisa highlight the disproportionate distribution of radiographers and radiologists across South Africa. Rural provinces such Mpumalanga, Eastern Cape, Limpopo, Northern Cape and the North West are reported to have less than 5% of radiologists in comparison to urban provinces such as Gauteng, Kwa-Zulu Natal, Western Cape and Free state.<sup>96</sup> These provinces have 40.9%, 18.2%, 18.2% and 9.1% of radiologists respectively. These findings concur with the study population in the Dr RSM district of the North West province, which was noted in Section 1.8.3. This uneven distribution of specialists rationalises the need to utilise technology,

specifically eHealth, to bridge the gap between underserved populations and oversaturated urban areas, to provide health care services to all as outlined in the NDP 2030.<sup>4</sup> In the context of this study, there are more referring clinicians than radiographers at each hospital as described in Section 1.8.3. Despite this there is still a significant decrease in the number of referring clinicians practising in rural hospitals, with an average of three doctors per hospital, each serving an average of 18000 patients per month.<sup>38</sup>

Health care professionals are defined as “any human and/or organisation that accept, provide, supports or controls healthcare services”.<sup>97</sup> Due to the complexity of relationships between teleradiology end users, there is a need to identify individual roles and navigate clinical principles that can address a variety of situations, ensuring quality of the radiographic examinations and safety of the patient in a teleradiology setting.<sup>88</sup> End users of teleradiology include radiographers, radiologists, and referring clinicians who will be described further in the following section.

### **2.6.1 The radiographer practicing in a rural setting**

In Section 1.8.3.1, the reader was provided with a general description of the radiographer, whose main responsibility is to perform radiological investigations using specialised equipment. In this section, the researcher will highlight the extended roles that rural radiographers take on, in comparison to their urban counterparts. As mentioned in Section 2.2.3, South Africa is faced with severe specialist shortages, particularly in rural areas, which drives the need for radiographers to take on additional roles to fill this gap.<sup>13</sup> Etheredge explains that the general description of the radiographer, as noted above, does not afford the radiographer with much professional autonomy in the clinical setting, especially when there is no radiologist.<sup>98</sup> The professional role of the radiographer as it relates to this study is that the radiographer may perform professional acts at the written request of a practitioner.<sup>34</sup> The NDoH policy on the request for medical x-rays further states that radiographers may consult with and interpret work performed by himself or herself only to the clinician that requested the radiological investigation.<sup>36</sup> This description of the radiographer was found to be more appropriate, especially for the

rural radiographer working in settings without a radiologist. It is widely known that radiographers working in rural settings have to adopt role extension in order to meet the demands of optimal service delivery.<sup>5</sup> In further support of radiographer autonomy, the Radiation Control Directorate of the Department of Health, reviewed their policy on requests for medical x-ray examinations in 2014. This policy was further endorsed by the HPCSA and states that a "...radiographer may refuse or accede to the request of the referring clinician provided that good and sufficient grounds exist for their decision".<sup>36</sup> It further states that "should the radiographer question the possibility of an unsubstantiated request, for example, the clinical history indicated does not justify the performance of the x-ray examination, the radiographer may refuse to perform the examination".<sup>36</sup>

The above mentioned policy clarifies the role of the radiographer in relation to the concerns raised over the radiographer being considered only as a supportive function in the chain of healthcare, as stated in Etheredge's opinion article<sup>98</sup>. Further critical analysis of this policy shows that some flexibility is allowed for radiographers to practise in extended roles and engage in decision making. This can be useful in rural areas, such as the Dr RSM district, where there are no specialists. Such districts, as outlined in Section 1.2, do not have a radiologist and are dependent on the radiographer to handle all components of teleradiology practise in the clinical setting.

As observed by the researcher, one such example of the role that radiographers play besides operating teleradiology systems, is that they handle all the administrative work and decision making around requests for medical imaging services as described in Section 1.2. Similar situations were noted in a study conducted in Ireland, where it was identified that radiographers take on additional administrative duties to facilitate the transmission of images and clinical information between the radiologist and the teleradiology site.<sup>12</sup> This is regarded as role flexibility and practising beyond the existing scope of practise of the radiographer, who has not been teleradiology trained.<sup>12</sup> In contrast to this view, radiographers operating teleradiology systems in Australia are required to produce the appropriate qualifications and teleradiology training before handling teleradiology software and equipment.<sup>99</sup> In the South African context, there are no teleradiology courses that the researcher could find, with specific reference to CT training for the teleradiology

setting. Courses that are offered in the telemedicine domain, include post graduate academic programmes in medical informatics.<sup>59</sup> However, this does not address the teleradiology needs, which are directed to specialised imaging. There are also no studies to determine if teleradiology or telemedicine is included in the undergraduate radiography programme, except assuming that this might be included in the subject Radiographic Imaging. What can be stated is that some background knowledge needed by radiographers in a teleradiology setting include knowledge of image interpretation, anatomy, physiology, and pathology. These subjects are covered more in detail and implemented in the clinical undergraduate programme across all years of study in the radiography course. With regards to CT examinations, radiographers are also provided some basic background knowledge and clinical training within the final year of study of Universities offering the Radiography course, such as University of Pretoria and the University of Johannesburg.<sup>100-101</sup>

It is evident that South African radiographers have the basic knowledge to perform general radiographic and CT scan examinations, and to operate teleradiology systems. However, there is no evidence to support the radiographer's effectiveness in a rural setting without a radiologist, particularly with regards to working independently in a CT scan department. Due to this, it is necessary to identify the radiographer's perspective of teleradiology in the Dr RSM district.

### **2.6.2 The referring clinician practising in a rural setting**

The American College of Radiology (ACR) states that clinicians, especially those practising in emergency departments, are to be considered teleradiology end users due to the fact that the clinical management of urgent cases are based upon teleradiology reports and radiologist consultation.<sup>88</sup> The role of the referring clinician in a teleradiology environment, as described in the NW SOP 2013 is: to provide an accurate clinical history for every radiological request, to ensure the request is justifiable, and to ensure that adequate consultation must be made with the radiologist for CT examinations.<sup>8</sup> In Section 2.2.3 the researcher described the poor socio-economic situation of rural communities and the lack of access to specialists. This places an increasing demand on the referring clinician in this setting to consult with specialists in outlying areas for professional advice.



In a report by Gulube, referring clinicians in rural areas of the North West province have reported to reap many benefits from teleradiology systems in terms of it being a means of clinical support and a platform for consultation with specialists.<sup>9</sup> However, the same study reported that radiologists and radiographers expressed concern over the request forms completed by referring clinicians and stated that limited clinical history and unclear requests make remote reporting challenging.<sup>9</sup> The radiation policy on requesting medical x-ray examinations, states that radiographers may accept or reject a radiological request from a practitioner that is not justified and based on good and sufficient judgment on the part of the radiographer.<sup>34</sup> To date there is still much emphasis being placed on the need to complete radiological request forms correctly, as stipulated by the NW SOP which states that forms must be clear with a comprehensive medical and radiographic history to ensure a meaningful report.<sup>8</sup>

Van Dyk, Groenewalt and Abrahams state that telemedicine embodies a multidisciplinary team that may find challenges in working synergistically together due to the differences in the nature of their own fields.<sup>102</sup> For this reason, there is a greater need to strengthen the lines of communication between teleradiology end users, and develop guidelines and protocols for teleradiology practise that addresses the needs of all users.<sup>88</sup>

### **2.6.3 The radiologist located in a remote location**

The remote radiologist holds a paramount role in the workflow process of teleradiology systems in terms of providing a diagnosis on the transmitted image.<sup>17</sup> This role has been long established by the Ionizing Radiation Medical Exposure regulations (IRME) of Great Britain, which state that the role of the radiologist is to justify examinations according to their clinical relevance and provide a radiological report.<sup>103</sup> The ESR reiterate the IRME regulations in their response to *Communication on Telemedicine* issued by the European Commission, by stating that teleradiology does not only involve remote reporting of radiological images, but that it is a medical act on its own.<sup>104</sup> Previously, communication between the radiologist and the referring clinician was limited to a written report, however due to the increase in advances in imaging and display software, there is a growing need

for direct communication between the radiologist and the referring clinician in real time <sup>105</sup>. Examples of this are described by the ESR, who state the following requirements for the fulfilment of radiological reporting on CT examinations:

- a. Evaluating examination requests to ensure appropriateness such that exposure to unnecessary radiation is avoided, particularly for radiological examinations that yield a high radiation dosage such as fluoroscopy and CT examinations
- b. Selecting the most appropriate imaging strategy according to clinical history
- c. Optimising examination performance
- d. Customisation of imaging protocols to individual patients
- e. Integration of clinical and imaging information into the radiological report<sup>87</sup>

The notion of radiologist involvement in teleradiology is highlighted by Safadi, who conducted a study in Saudi Arabia to evaluate the effectiveness of a Multimedia-interactive Teleradiology Management System (MTMS).<sup>105</sup> This system is aimed at providing real time interaction between the radiologist, referring clinician, and radiographer. The participants of the study indicated that this form of constant communication in the teleradiology setting would significantly improve patient care and safety, as well as decision making from a distance.<sup>105</sup> Such systems appear promising in achieving constant communication and engagement with the radiographer and referring clinician, to achieve the ESR's reporting requirements. However, the reality of the matter is that teleradiology infrastructure requires a well-functioning IT system to support an aspect that is severely compromised in the teleradiology context.<sup>80</sup> Coleman, Herselman and Coleman further highlight the fact that the current internet connections in the North West province cannot support real time interactions.<sup>38</sup>

In the context of this study, the researcher will explore and describe the views of the radiologist during their interview, with regards to the above mentioned expectations of the ESR and the limitations of internet connections described by Coleman, Herselman and Coleman in the North West province.

In the South African context, there are no specific teleradiology guidelines as seen in Europe. Radiologists are therefore guided by the general CT examination policy

from the RSSA, which state that a "...radiologist must be present, either in person or by remote digital connection to view and approve the images at the completion of the examination".<sup>37</sup> In the Dr RSM district, the radiologists are present by remote digital connection, however they report for six different sites across the North West province and Gauteng. It is presumed that the radiologists cannot be available telephonically to discuss request forms, imaging customisation, and image approval for every examination performed at various sites. For this reason, the researcher will explore the views of the radiologists servicing this district, regarding teleradiology utilisation.

## **2.7 CONCLUSION**

This chapter provided an overview of the literature on eHealth starting from the global perspective, scaling down to rural health care in Africa and South Africa. The chapter further highlighted the plight of the poor in terms of limited access to health care and specialists such as radiologists. This perspective introduced the concept of eHealth and how it impacts on rural health care. eHealth applications such as telemedicine and teleradiology, particularly in South Africa and the North West province, were described. The literature then presented the way ITC in radiology has evolved from the first teleradiology and PACS systems, to wide usage of mHealth in rural areas. Lastly the literature delved deeper into the roles of teleradiology end users, as described by various medical bodies, and how these need to be flexible in a teleradiology setting. The reviewed literature made it apparent that radiographer role extension in rural settings are being supported. In the context of this study in relation to the reviewed literature, it is unknown how the teleradiology end users view the flexibility that is referred to, especially in teleradiology setting, where CT examinations are involved. The expectations of the radiologists were highlighted, however it is also unknown if these are achievable in this district, and thus the views of radiologists also need to be explored. The next chapter focuses on the actual research methodology followed in this study.

## CHAPTER 3

### RESEARCH METHODOLOGY

*“Understanding is much deeper than knowledge. There are many people who know us, but very few who understand us”*

Author unknown

#### 3.1 INTRODUCTION

In Chapter 2, a critical analysis of literature that was reviewed for this study was presented. This included an in-depth description of eHealth strategies, with particular focus on teleradiology in South Africa and the North West province. In this chapter, the research methodology and research process are presented. This is the detailed presentation of what was briefly presented in Chapter 1. This will entail a broad overview of qualitative research, and the justification for adopting it as the overarching research approach of the study. The justification is clearly presented by comparing the qualitative and quantitative research approaches. The reader will then be presented with an elaborate discussion of the exploratory descriptive research design. Thereafter, the research process will be presented, delving into the research instrument, its design, advantages and disadvantages, as well as the full data collection and analysis processes. Justification for adopting a qualitative research approach is presented first.

#### 3.2 QUALITATIVE RESEARCH APPROACH

The nature of the discipline of teleradiology encompasses various key aspects such as infrastructure, connectivity, and turnaround time.<sup>10</sup> Exploring these aspects of teleradiology would no doubt generate information about the success and failures regarding teleradiology implementation. Instead of approaching the study quantitatively, which would incorporate stringent measurement methods of the variables described above and subsequent statistical findings, it was decided that the qualitative approach would be more appropriate. In quantitative research, the researcher formulates a hypothesis whereby he or she predicts the outcome of the study based on variables or prior literature.<sup>45</sup> However in qualitative research there

is one or two central questions that allows the area under investigation to be explored without limitation.<sup>45</sup> These research questions incorporate exploratory verbs that leave room for the researcher to further explore a general concept and all its complexities with the intent of describing and interpreting the experiences and views of the research participants in their natural setting.<sup>106</sup> There were two questions for this study:

- a) What are the views of the end users regarding teleradiology for CT examinations in the Dr RSM district, North West province?
- b) How does teleradiology impact the services provided to this rural community with specific reference to CT examinations?

By following a qualitative research approach, the researcher is given space to explore different aspects of a phenomenon, rather than limiting the research to proving or disproving the hypothesis. A flaw identified in approaching eHealth research in a quantifiable manner, is that the study tends to focus on the technical aspects of the discipline and often fails to include the human perspective, that is the actual people who use the technology as part of their everyday work.<sup>18</sup>

Reverting to the research aim as outlined in Section 1.5, which is to explore the views of the teleradiology end users regarding its utilisation for CT examinations and the impact it has on rural health care, it was very important that this information be attained through the views of the end users who utilise the systems in the study context, therefore keeping in line with the opinions of Ossebaard and Van Gemert-Pijnen.<sup>18</sup> As mentioned, qualitative studies do not adopt a narrow and stringent measurement approach, but rather leaves ample room for the researcher to present multiple aspects of the reality through the narrated views of the participants, thus describing what the participants actually do, instead of assuming what they do.<sup>21</sup> In the context of this study, the researcher wanted to explore the teleradiology end users' views on using teleradiology systems and how it impacts on rural health care, based on their experiences of teleradiology.

To provide further justification for adopting the qualitative approach, a comparative analysis between quantitative and qualitative research is presented in Table 3.1. The information in this table was formulated based on the literature from Creswell and Polit and Beck.<sup>20,45</sup> It also outlines the activities undertaken in this study.

Table 3.1: Difference between quantitative and qualitative research approaches

	Quantitative	Qualitative
Research designs	Survey experimental	Exploratory Descriptive
Sampling strategies	Probability sampling: <ul style="list-style-type: none"> <li>• random sampling</li> <li>• convenient sampling</li> <li>• stratification</li> <li>• quota sampling</li> <li>• systemic</li> </ul>	Non-probability sampling <ul style="list-style-type: none"> <li>• purposive sampling</li> <li>• convenient sampling</li> <li>• snow balling</li> <li>• theoretical</li> </ul>
Research tools and their design	Questionnaire/ data collection sheet. close-ended questions	Focus group interviews to gather in-depth data face to face interviews. Open-ended questions
Role of researcher in data collection and analysis	An outsider and not a key instrument: <ul style="list-style-type: none"> <li>• can adopt questionnaire by other researchers</li> <li>• can employ others to collect data</li> </ul>	An insider and key instrument: <ul style="list-style-type: none"> <li>• construct interview guide</li> <li>• prepare for focus group interview</li> <li>• facilitate and conduct interview</li> <li>• organise data</li> <li>• interpret data</li> </ul>
Data analysis	<ul style="list-style-type: none"> <li>• Deduction</li> <li>• inferential statistical analysis</li> </ul>	Mainly Induction, but can take both the deduction and induction processes
Quality assurance	Validity and reliability	Trustworthiness
Bias control	Strict experimental setting and researcher as outsider	Triangulation, bracketing, member checking and co-coder
Presentation of results or findings	Graphical presentation: graphs or tables	Transcribed narratives: codes and categories

From Table 3.1, it can be clearly seen that quantitative and qualitative approaches encompass very different methods within the research process, to purposefully yield a targeted outcome. In this study the outcome that the researcher wanted to achieve was an in-depth exploration and description of teleradiology utilisation by the end users themselves and the impact this has on rural health care. Based on the characteristics described above, it was evident that a qualitative approach was best suited for this study.

Lichtman describes critical elements of qualitative research as being focused on the description, understanding, and interpretation of human behaviour.<sup>107</sup> The qualitative research is further said to be dynamic, inductive, and deductive in nature. These aspects will be discussed in the next section, starting with the focus on describing, understanding, and interpreting human behaviour.

### **3.2.1. Describing, understanding and interpreting human behaviour**

Grove and Gray state that the primary purpose of qualitative research is to describe the experiences of participants, and understand how they interact and communicate with each other when experiencing the same phenomenon.<sup>28</sup> In this study, the researcher aimed at describing and understanding teleradiology end users' experiences with regards to the use of teleradiology technology, and the impact it has on rural health care in their view. This data is based on descriptions of personal experiences and views cannot be quantified, which reinforces the need for a qualitative approach, and provides for in-depth data to effectively meet the objectives of the study. In the words of Denzin, qualitative researchers are not called to just interpret data, but rather to change the world, which is inclusive of participatory democracy.<sup>108</sup> It is based on statements like this, that the researcher invited the teleradiology end users to share their views of teleradiology utilisation, to ultimately be able to improve the system.

### **3.2.2 Dynamic approach to qualitative research**

In qualitative research the researcher is expected to adopt a fluid approach to the research methodology and abandon strict measures.<sup>107</sup> With reference to fluidity in qualitative research, Creswell also states that not all qualitative studies employ an

explicit philosophical theory, but instead provides a rich, detailed description of the area of interest.<sup>45</sup> In this study the researcher does not adopt a specific theory, however the researcher provided a detailed description of the background into the area under inquiry, as stated in Section 1.2. The characteristic of fluidity in qualitative research allows the researcher to explore and discover new aspects of the phenomenon that the researcher may not have initially considered. For this reason, an exploratory approach was found suitable for this study, which will be explained further into this chapter. Creswell adds, when conducting qualitative interviews, there needs to be a certain degree of logic, rational, and approach. This can be achieved by using a semi-structured interview guide.<sup>45</sup> In the context of this study, the researcher formulated a semi-structured open-ended interview guide for all groups of participants (Annexure H, I and J) and utilised many probing questions to gain clarity of the participants' responses and to reach a deeper understanding of the participants' descriptions.

### **3.2.3 Inductive and deductive nature of qualitative research**

Literature says that in qualitative research the researcher can adopt both inductive and deductive reasoning when choosing an analysis method, both of which are dependant of the aim of the research.<sup>47</sup> In deductive reasoning there is already established theory surrounding the area of interest which the researcher wishes to test their findings against.<sup>28</sup> However, in inductive reasoning there is limited knowledge on the area of interest, or the knowledge available is fragmented. This then requires the researcher to review the data back and forth, developing an explanation from the data that does not have a preconceived hypothesis.<sup>28</sup> In this study, inductive reasoning was used because there was no established theory surrounding the views of teleradiology end users regarding its utilisation and impact on service delivery in the Dr RSM district, following the changes that have occurred since its first implementation in 2000.

Inductive reasoning was utilised as the researcher described her observation in the teleradiology setting as well as when conducting a review of literature. Depoy and Gitlin support this type of analysis and state that there is no "...truth or general principle" established before the study commences, but rather it unfolds as the study progresses.<sup>14</sup> In the context of this study the researcher used an inductive



reasoning to work back and forth, critically analysing the data collected from each group of teleradiology end users, to identify emerging patterns and frequently used words from information as narrated by the participants. This process will be demonstrated in the data analysis and interpretation in Section 3.6.

### **3.3 DETAILED PRESENTATION OF THE RESEARCH DESIGN**

In Section 1.8, the reader was provided with a brief overview of the research design that was followed in this study. In this section, further discussions surrounding the rationale for the selected research design will be presented. A research design is described as the “road map” for navigating the researcher on the data collection process in attempts to answer the research question being studied.<sup>20</sup> The research design adopted for this study was exploratory and descriptive in nature. As indicated in Section 3.2.2, the research did not follow an explicit underlying theory. Grove and Gray state that, sometimes in nursing research there is no specific qualitative methodology followed. Instead exploratory-descriptive designs are used, particularly when there is no specific category adopted, such as phenomenology, ethnography, or grounded theory.<sup>28</sup>

As stated in Section 3.2.2, qualitative research is dynamic and fluid, and allows the researcher to permeate through the different boundaries of these categories. This Exploratory-descriptive qualitative method therefore encompasses several research processes which must speak directly to the specific research questions and objectives.<sup>20</sup> The main aim of such a design is to identify gaps in the knowledge of a phenomenon, and address it by gaining the viewpoints of the people affected by it. This approach in qualitative research is termed the naturalistic inquiry, whereby people and events are studied in their natural states.<sup>28</sup> The exploratory-descriptive design was therefore appropriate for this study, as its main aim is to explore and describe the views of teleradiology end users regarding its utilisation and impact on rural health care.

In the next section the researcher will expand further on the value of exploratory and descriptive designs for this study.

### **3.3.1 Exploratory design**

Exploratory designs begin with an area of interest that is not well understood, whereby the researcher wants to investigate the full extent of the phenomenon.<sup>20</sup> Creswell further supports this view and states that exploratory designs can be used when the researcher wants to further probe an area of concern that has limited theory available.<sup>45</sup> This is in line with the inductive reasoning chosen for the study, as described in Section 3.2.3. An exploratory design was therefore found to be appropriate in this study as its focus was on gaining an in-depth understanding of the participants' experiences, such that the researcher does not just provide an overview of the area of interest, but explores the complexities within it.<sup>28</sup> This is particularly necessary for the context of this study, where there is little known about current teleradiology utilisation for CT examinations in the Dr RSM district, which was last documented to no longer be functioning.<sup>81</sup> Using an exploratory design will enable the researcher to explore effectively the teleradiology end users perspectives regarding their experiences and views when utilising teleradiology in their daily work.

### **3.3.2 Descriptive design**

The study adopted a descriptive design to describe participants responses to questions posed about a phenomenon with which they are familiar. Grove and Gray state that descriptive designs essentially portray an overall picture of an area of interest as it naturally happens.<sup>28</sup> The authors further state that descriptive designs are useful in identifying current challenges with current practises. In the context of this study a descriptive design was found to be appropriate in describing the teleradiology end users' views regarding teleradiology and the impact that it has on rural health care from their own personal experiences.

## **3.4 THE RESEARCH PROCESS**

The research process is a method of obtaining new insights in an area being studied through a series of carefully described steps.<sup>45</sup> This consists of contextualising the study setting and describing the steps taken when collecting and analysing the data.<sup>19</sup> This aspect of the research is particularly important to ensure rigour is maintained as described in Section 1.8.6. The data collection methods will first be

described followed by an in-depth explanation of the data analysis methods followed.

### 3.4.1 Study setting

The details of the research participants were outlined in Chapter 1. Creswell states that one of the characteristics of qualitative research is to explore the participants' view in their natural setting.<sup>45</sup> This section of the dissertation focuses on that natural setting, which is the Dr RSM district in the North West province. The entire province has a population of approximately 3.1 million people, divided into four districts, namely; Dr Kenneth Kaunda, Ngaka Modiri Molema, Bojanala, and Dr RSM. Figure 3.1 depicts the location of the Dr RSM district (red) in relation to other three districts (white) in the North West province and Gauteng (green), where the remote radiologists are based.<sup>109</sup>



Figure 3.1: Map of South Africa, illustrating Dr RSM district of the North West province (red) in relation to Gauteng province (green)<sup>109</sup>

Dr RSM district is the largest district in the North West province, in terms of radius, however it holds the smallest population of approximately 460 000 people in comparison to the other districts.<sup>109</sup> This indicates that the population is widely scattered and are required to travel long distances to access health care. At this point the reader is hereby reminded of the social vulnerability map of South Africa that was presented in Section 2.2.3, where the Dr RSM was seen to fall under the

category of most socially vulnerable. In terms of access to healthcare, there are 44 clinics, 13 community health care centres (CHC), 23 mobile services and five district hospitals. There is no regional or specialised tertiary hospital in this district <sup>109</sup>. There is only one hospital that has a CT scanner and is therefore the primary teleradiology site (Figure 3.2). The five other district hospitals (Figure 3.2, district hospital 1-5) all refer patients to this site and utilise teleradiology services.

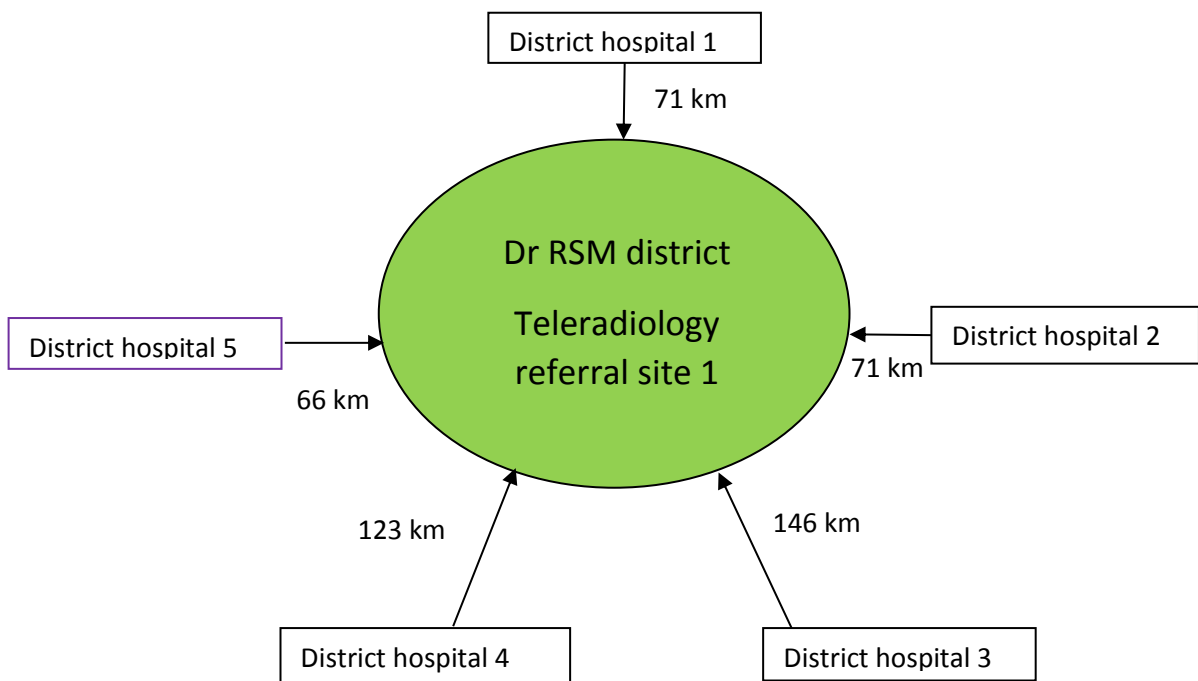


Figure 3.2 Teleradiology referral system in the Dr RSM district

Patients who need CT examinations from this district are referred to the central teleradiology site. The referring clinicians from the district hospitals provide the radiographer at their hospital with the request form for the CT examination. The radiographer here then contacts the radiographer at the teleradiology site and makes a booking on behalf of their referring clinician. For urgent cases, the referring clinicians from these district hospitals contact the radiographer and make the booking directly. After the examination has been performed, the patient is sent back to the district hospital. The CT images are then transmitted to the radiologists to provide a report. The radiology report must be delivered within 24 hours for routine cases, two hours for semi-urgent cases, and 30 - 60 minutes for urgent cases, as indicated in the North West province Teleradiology SOP.

Data for this study, was collected at the teleradiology referral site, as depicted in Figure 3.2. This decision to use this setting was taken because the site was centrally located in terms of distance to the surrounding district hospitals, thereby the participants would travel equal distances (Figure 3.2) to be able to attend the focus group interview. When reflecting back to Table 1.1, in Section 18.4, the reader is reminded that there were limited radiographers and referring clinicians at these district hospitals, therefore holding focus group interviews at each district hospital would not provide sufficient information to suit the exploratory nature of the study. It was therefore more appropriate to invite all the surrounding district hospitals to the main teleradiology site, who already had a larger number of participants. The participants were invited by means of negotiation access, which will be described next.

### **3.4.2 Negotiating access**

Negotiating access implies taking the necessary steps to gain access to the particular setting, where the area of inquiry occurs.<sup>45</sup> It also involves gaining permission to study the participants or the situation in this setting.<sup>45</sup> All research conducted in any hospital within the North West province must first be approved by the North West Provincial Office, Policy, Planning, Monitoring and Research department. The research proposal together with the University of Pretoria ethics clearance certificate (Annexure A) were sent to the provincial office. Following approval from the North West provincial office (Annexure B), the researcher contacted all participating hospitals and the private radiology practice, telephonically and by email, to schedule an appointment with the CEO and Head of Department (Annexure C and D). The proposal and information leaflet (Annexure E, H, and I) was made available for review prior to the meeting. Only two CEOs responded and indicated that the provincial office is responsible for approval and consultation with them was not necessary. For this reason, there are no CEO approval letters included as annexures in this study. The researcher then commenced with data collection.

According to the National Health Act, informed consent is a mandatory requirement when researching a living person. This includes informing the research participants of the nature of the study and the possible negative and positive consequences of

the study on their daily activities. Following this, a written consent must be obtained by the participants once he or she fully understands the purpose of the research<sup>110</sup>. In the context of this study the researcher first emailed the information leaflet and invitation to the focus group interview to the radiography head of departments and clinical managers in each hospital and requested the information leaflet to be distributed to their staff members. On the day of the focus group interview, the researcher provided a verbal explanation of the study to be conducted and again provided the participants with the information leaflet of the study. After the invited participants read the information leaflet, they agreed to partake in the study and signed the consent forms.

### **3.5 DATA COLLECTION METHOD**

The manner in which data is collected in a qualitative study plays a critical role in the research methodology as it must be able to achieve the overall objectives of the study.<sup>20</sup> The objective of conducting this study was to explore and describe the participants' views regarding teleradiology utilisation and the impact it has on rural health care. The researcher therefore chose to use focus group interviews to effectively explore and describe the participants' views, which also aligns with the exploratory descriptive research design of the study. The use of focus groups interviews also enabled the researcher to delve deeper into broad aspects of the issues raised by the participants.<sup>20</sup>

A study by Gulube and Wynchank used monthly telemedicine interaction forms and questionnaires to assess the first phase of telemedicine implementations. Although these evaluation tools yielded sufficient information, it merely provided an overview of the opinions of teleradiology end users and did not allow for further exploration of the participants' viewpoints.<sup>9</sup> Another study attempting to explore user acceptance of telemedicine in Eastern Cape used questionnaires with closed ended questions to collect data.<sup>27</sup> Recommendations from this study suggested that interviews should also be conducted with health care professionals to avoid the risk of self-reported usage reflecting as actual usage.<sup>27</sup> This statement concurs with Merriam, who explains that narrated descriptions from participants found in qualitative studies yield accurate information regarding the social context in which they practice, rather than an assumption of what is taking place as indicated in Section 3.1.<sup>21</sup>

Based on the limitations of gaining in-depth data from these two studies, a focus group interview appeared to be the more appropriate qualitative research tool as it would encompass all the views of the participants within the different categories through interactive discussions. By doing this, different viewpoints are put together to gain a holistic account of teleradiology practices.<sup>20</sup>

### **3.5.1 Focus group interviews**

Focus group interviews are described as a carefully planned verbal engagement between people, surrounding a particular topic that shares a common interest with the individuals involved.<sup>39</sup> In health care research, this type of research instrument is favourable to gain in depth information regarding service delivery and evaluation of health care systems.<sup>111</sup> Van Manen further provides reasons why focus group interviews are successful research tools. Firstly, because they can effectively explore and gather rich data of participants views to enable the researcher to develop a greater sense of understanding of the issue at hand. Secondly, it can create a platform for discussion with the interviewee and other participants about the meaning of the events that they have experienced.<sup>112</sup> In this study, these purposes well align with the exploratory and descriptive nature of the research design, such that rich data can be attained, with room for probing to further explore the research problem. This will allow for new findings to surface that were not initially considered.<sup>20</sup>

Creswell explains that focus group interviews ideally occur with groups of between six to eight people. The disadvantage of having participants more than this figure is that the data collected becomes complex to analyse and data saturation may be reached quickly.<sup>45</sup> Stewart and Shamdasani state that the purpose of gathering data should direct the degree of homogeneity or heterogeneity that the participants of the focus group interview should exhibit.<sup>113</sup> These authors further recommend that exploratory studies should have a heterogeneous group as they may generate rich data adding depth and dimension to the findings.<sup>113</sup> In this study, focus groups conducted with the radiographers and referring clinicians both comprised of a homogenous and heterogeneous group. Homogeneous by virtue of their basic educational background and heterogeneous because of their varying levels of clinical experience as well as ranks. For the radiographer focus group interview this

included community service radiographers, junior, senior and chief radiographers. For the referring clinicians focus group this included interns, community service clinicians, medical officers, dentists, and a clinical manager.

As stated in section the researcher intended to have a focus group interview with the radiologist, however at the time of data collection, only two radiologists were practicing on site. Although a discussion between various participants did not take place, the researcher was still able to extract rich information from the radiologist.

As indicated above, focus group interviews were conducted with the two groups of end users, and one face to face interview was conducted with the radiologist. The researcher constructed a semi-structured open-ended interview guide for all groups of participants (Annexures H, I and J). The questions used to guide the interview in this study were derived from literature as well as the researcher's observations. Liamputtong states that for interviews to be successful, both focus groups and individually, the researcher must ask well thought out questions to attain rich data from the research participants.<sup>39</sup> The researcher therefore plays a key role in the planning of the focus group interview, which leads the reader to how the preparations for the focus group interviews were conducted.

### **3.5.2 Preparing for the focus group interview**

To execute a successful focus group interviews which adequately explores the area of interest and yields information rich data, the researcher needs to carefully plan the logistics of the focus group interview.<sup>113</sup> In the following section, the reader is taken through all the steps that were undertaken during the preparatory phase of the focus group interview.

#### **3.5.2.1 Developing the interview guide**

As mentioned in Section 3.4.3.1, one of the key roles of the researcher is to ask well thought-out questions that will adequately explore the area of interest. To achieve this the researcher must ask predetermined questions addressing certain aspects of the topic to be explored.<sup>20</sup> Focus group interviews make use of semi-structured interview guides, with open-ended questions that allow the interviewer to ask further



probing questions, to ensure that all the information required surrounding that topic is sufficiently obtained.<sup>20</sup> This guide must be carefully constructed before the focus group interview as the questions within the semi-structured interview guide must encompass questions that address the purpose of the research.<sup>113</sup> In this study the researcher formulated questions based on the background of the study as described in Section 1.2 where certain aspects of teleradiology were observed, namely technical, booking processes, interaction with teleradiology end users, and general experiences using teleradiology systems as part of the participants' everyday work. The original focus group interview guide was used for the radiologist during the individual interview.

Formulation of these questions were guided by the five types of questions that should be asked in an interview as described by Kreuger and Casey, namely: opening, introductory, transitional, key, and ending.<sup>114</sup> In this study, opening questions asked by the researcher, were used to describe how teleradiology systems were used in each of the end users' contexts. Introductory questions included more specific details on the booking processes, followed by transitional questions addressing teleradiology interactions with other end users and technical aspects of teleradiology. Key questions then included the participants' experiences on teleradiology utilisation and the impact that teleradiology has on service delivery in their opinion. Lastly, the ending questions asked the participants to provide recommendations to improve the current teleradiology systems.

There were six questions that guided the focus group interviews for the radiographers (Annexure H): Five questions for the referring clinicians (Annexure I) and six questions for the radiologists (Annexure J). All these followed the same structure as noted above.

#### 3.5.2.2 Identification of the appropriate day and time for the interviews

The researcher identified two different dates for the radiographers and referring clinician interviews. These were 22<sup>nd</sup> March 2017 and 23<sup>rd</sup> March 2017 respectively. The radiologist interview was conducted on the 11<sup>th</sup> April 2017. These days were chosen after ensuring that no other meetings were clashing with the focus group interviews and that clinical departments were covered by other staff members, such that services to patients were not compromised. The time allocated for the focus

group interview was at 09h00, to accommodate the participants travelling from surrounding hospitals. The same time was scheduled for the radiologist.

### 3.5.2.3 Identification and preparations of the appropriate venue

Krueger and Casey suggest that the setting of the focus group should be carefully considered, taking into account comfort, accessibility to the participants, easy to locate, and acoustically sound for voice recording devices.<sup>114</sup> The researcher identified the hospital board room at the main teleradiology site as the appropriate venue to hold the focus group interview. This decision was taken due to the central location of the teleradiology site in relation to the surrounding district hospitals, which was illustrated earlier in Section 3.4.1, who were also invited to participate in the focus group interviews. In addition to this, the board room was a comfortable size, accommodating up to 30 people, with appropriate chairs and tables to conduct a focus group interview. On the day of the interview the researcher placed in the boardroom, a folder containing an information leaflet and consent form, as well as a pen for each participant. Signage for directions to the board room was placed in the parking area for participants coming from surrounding district hospitals. There was also a sign at the door indicating that interviews were in progress and that recording was underway.

For the radiologist's interview, the researcher arranged with the radiology practice manager to come to the practice in Gauteng for the focus group interview. This decision was taken because the radiologists indicated time constraints and noted that they would not be able to leave the practice. However as indicated, at the time of data collection, only one radiologist was available. This interview was conducted by the researcher in an office at the radiology practice. The researcher followed the same informed consent method as with the previous groups of participants, by providing the radiologist with the information leaflet before the interview by email. On the day of the interview, the researcher further explained the nature of the study to be conducted, and asked the radiologist to sign the consent form stating that they were willing to participate in the interview.

#### 3.5.2.4 Compensation to the participants

During the recruitment process of participants, the researcher can compensate the participants in the form of an incentive. This can include providing transport to the focus group interview, food, or gifts.<sup>114</sup> As depicted in Figure 3.2, the participants from the surrounding district hospitals had to travel approximately 60 to 150 km to get to the venue. As a show of gratitude for incurring this time and the related travel costs, the researcher provided the participants with light refreshments before the focus group interview proceeded and welcomed them to have more when the focus group interview ended. This was made available to both the radiographers and referring clinicians. The radiologist face to face interview did not have refreshments as the interview was conducted at the radiology practice to which the researcher had to travel.

#### 3.5.2.5 Research assistant role

The researcher organised a research assistant to help with the setting up and facilitation of the focus group interviews for the radiographers and referring clinician. The assistant was recruited based on availability and appropriate level of education to be able to capture field notes. Their tasks involved setting up the refreshment station and ensuring that all the participants had a folder containing the documents described in Section 3.4.2.2. The assistant was received prior training from the researcher on what was expected of her, in terms of taking field notes, and was taken through the medico-legal prerequisites and the need to maintain confidentiality of all that was discussed during the focus group interviews. The assistant further helped with placing the voice recorders near the participants and taking field notes during the focus group interviews. Following each focus group interview the researcher and the assistant had a debriefing session by going through the written notes and cross checking them against the voice recordings, to ensure that information was correctly captured. The research assistant was not needed for the radiologist focus group interview as it was a manageable number of participants for the researcher to facilitate independently.

### 3.5.3 Conducting the focus group interview

As previously mentioned, qualitative focus group interviews involve meaningful discussions between the researcher and participants, guided by an interview guide.<sup>45</sup> The manner in which the interview is conducted and the rapport the researcher creates from the onset of the interview, largely influences the quality of the data produced.<sup>20</sup> As indicated, the researcher conducted the focus group interview personally. The actual role played by the researcher is briefly presented in the next section.

#### 3.5.3.1 Researcher's role

As explained in Section 3.4.4.1, the role of the researcher is twofold. This is with regards to preparing the interview questions, as well as becoming the interviewer, and conducting the actual interview to generate quality data during the focus group interview. Krueger and Casey state that the quality and quantity of the data collected is largely influenced by the interaction between the researcher and participants during the focus group interview.<sup>114</sup> The researcher's role as the interviewer is to ensure that participants don't dwell on irrelevant experiences, but rather lead the participants to the research question, which the researcher can delve deeper into, by means of probing questions.<sup>112</sup> Examples of these probing questions are provided in the inserts from the focus group interviews (Annexure M, N and O). Lastly, the researcher can attempt to clarify questions that participants struggle to answer, by providing examples of situations with which they may be familiar <sup>112</sup>. The researcher conducted separate focus group interviews with two categories of end users, namely the radiographer, referring clinicians, and a face to face interview with the radiologists on three different dates.

#### 3.5.3.2 Advantages and disadvantages of having the researcher as an insider

It is permitted in a qualitative research whereby the researcher is seen as an insider. The advantage is that the researcher understands the vocabulary used by the participants and is able to follow the discussion, enabling the researcher to add appropriate probing questions.<sup>113</sup> There are however, some disadvantages of the researcher being an insider and the interviewer, such as bias in the data collection. For this reason, the researcher formulated questions that were similar for all three groups of participants. These questions were reviewed by the supervisor before

commencement of the interviews to ensure that there were no leading questions to favour a particular response from a certain group. Other measures to overcome bias during the entire research process was described in Section 1.8.8 under trustworthiness.

#### 3.5.3.3 Organising the order of the focus group interviews

The researcher had to determine the order in which the groups were to be interviewed. The radiographer focus group interview was done first due to the researcher being an insider in the radiography profession. This allowed the researcher to reflect on the radiographer's experiences before interviewing the referring clinicians. Gaining this insight, equipped the researcher to reflect on further questions to ask the referring clinicians and radiologists, such that plausible explanations could be identified for the experiences shared by each of the end users. Details of the focus group interviews will be described in the following section.

#### **3.5.4 Radiographer focus group interview**

This was conducted in the morning in the hospital boardroom with a total of six participants. The interview started as soon as the radiographers signed the consent form. As indicated in literature, Polit and Beck reiterate the need to create a good rapport with participants and maintain their trust before the interview, particularly when a sensitive topic is being discussed.<sup>42</sup> The questions from the interview guide for radiographers are included in (Annexure H). The focal point for this focus group interview, as expressed in Section 1.3, was to explore the views of the radiographers regarding teleradiology utilisation and its impact on service delivery. The transcribed raw data collected during this interview can be found as Annexure M. Only one focus group interview was conducted with the radiographer, due to data saturation being reached. A description of this was provided in Section 1.8.4.

#### **3.5.5 Referring clinician focus group interview**

This was conducted the following day, at the same time and venue as the radiographer's focus group interview with a total of 11 participants. As indicated,

care was taken to ensure that there were minimal disruptions due to noise. The same process was followed as the radiographer focus group interview. The purpose of this focus group interview was to explore the referring clinicians' views on teleradiology and how it impacts on the service they deliver. Upon completion of the focus group interview the researcher thanked the participants for their time and contributions. The questions that guided the focus group interviews are included in Annexure I. Transcribed raw data collected in this time can be found as Annexure N. The referring clinicians had one focus group interview, due to data saturation being reached. Details of this were explained in Section 1.8.4.

### **3.5.6 Radiologist interview**

Collecting data from the radiologists posed some challenge with regards to the number of the participants that were part of the practice at the time of data collection. This then meant that instead of having a focus group interview, it became a one-on-one interview. As indicated in Section 3.5.1, the advantage of having a focus group interview was to gain information on the topic from various view points and to create a platform for discussion. However, face to face interviews can yield rich data provided when the interview guide incorporates well thought out questions as well as probing questions to elicit more information from the participant.<sup>20</sup> Lichtman states that in qualitative research, the researcher must adopt a fluid approach in the research methodology and abandon strict measures.<sup>107</sup> For this reason, the researcher welcomed this form of qualitative data collection. The researcher followed the same approach as for the radiographer and referring clinician focus group interviews and used a semi-structured interview guide as with the other categories of participants. Notification was given to support administrative staff that an interview was underway, and that queries will be handled shortly after the interview. The focus of this interview was to explore the views of the radiologists regarding teleradiology utilisation and how it impacts on the service delivery rendered by the radiologists. Due to factors mentioned the participant could only give a short period of time to accommodate the interview. The interview questions are included in Annexure J. The transcribed raw data collected during this session can be found in Annexure O. The next section focuses on how data from the different interviews was organised.

### **3.6 DATA ORGANISATION**

Data organisation in the context of research, entails grouping the collected data into structured co-ordinated parts thereby making analysis simpler for the researcher.<sup>35</sup> The researcher immediately saved all the voice recordings after each focus group interview and sent the same to two computers as backup storage. The researcher personally transcribed all recorded data verbatim from each focus group interview and saved the transcription in separate folders for each category of participants. Each folder contained the semi-structured interview guide, audio voice recordings, and transcribed data.

Polit and Beck describe two main methods of organising the transcribed qualitative data, namely through computer-based software or manual organisation. In computer analysis, the transcribed data undergoes various indexing functions, producing a frequency of words and can assist in examining relationships between codes, however cannot do the coding itself.<sup>20</sup> In manual organisation, Polit and Beck suggest using different applications of colours to do the preliminary coding of the content. In this study, the researcher organised the data by colour coding words that were similar through the transcription and then later revisiting these colour coded words to formulate the actual coding.<sup>20</sup> (Annexure M, N and O). The same process was followed for all three categories of participants.

### **3.7 DATA ANALYSIS**

Data analysis is a method of deriving meaning from the data collected in a structured way.<sup>20</sup> Some qualitative authors have conflicting opinions on how data from focus group interviews should be analysed.<sup>39</sup> Stewart and Shamdasani indicate that attention must be paid to the dynamics of the interaction within the group and the insights that are generated from this interaction.<sup>113</sup> However Barbour is of a different opinion, stating that analysing data on an individual level can help the researcher explore differences within the group.<sup>115</sup> At this point the reader is reminded of the fluid and unrestricted nature of qualitative research which enables the researcher to explore the area of interest in relation to the main aim and objective of the research. For this reason, the researcher will incorporate the opinions of Stewart and Shamdasani, as well as Barbour to analyse the data on an individual level and the collective perceptions of each category of participants. Liampattong states a

common method of data analysis used to analysis focus group interviews is content analysis.<sup>39</sup> This method of analysis will be described in the next section.

### **3.7.1 Content analysis**

Content analysis is a method that was primarily used in quantitative research until recent decades.<sup>40</sup> Although not widely used in qualitative research due to the misnomer of it being a statistical analytical tool, qualitative researchers have now identified its value in analysing qualitative data, particularly in the field of nursing research.<sup>116</sup> Qualitative content analysis has been defined by Hseih and Shannon as a method of interpreting data through a systematic classification process of coding and identifying themes.<sup>116</sup>

This description suggests that content analysis is far more complex than merely counting words, but rather enables the researcher to understand the field of interest as it occurs in reality, in a subjective manner, guided by scientific methods.<sup>40</sup> The main objective in qualitative content analysis is to extract significant information from the data with the intention of surfacing new information and understanding a phenomenon.<sup>20</sup> Although content analysis of qualitative data appears straightforward, the researcher must establish an approach in which specific characteristics will be studied.<sup>47</sup> As explained in Section 3.2.3, qualitative research, unlike quantitative research, does not have a preconceived hypothesis that the researcher is trying to prove or disprove, but rather attempts to surface new insights and understanding of the topic being explored. For this reason, the researcher will analyse the data inductively, working back and forth from the raw data. Zhang and Wildemuth share the same view as Hseih and Shannon, stating that in inductive qualitative content analysis, categories and themes emerge through the researcher's constant comparison and examination of the data.<sup>40,116</sup>

### **3.7.2 The process of qualitative content analysis**

Content analysis is supported in qualitative research due to its systematic and transparent procedure that is outlined by Zhang and Wildemuth, thus adding to the trustworthiness of the study. Although the steps that guide the content analysis process appear stringent, flexibility is allowed depending on the study's objectives.<sup>40</sup>



Elo and Kyngäs outline three phases in content analysis, namely; the preparation phase, in which the unit of analysis is selected; the organising phase which includes open coding, grouping and categorising; and the last phase of abstraction, which entails reporting the analysing process and results and presenting the model or conceptual system.<sup>117</sup> Erlingsson and Brysiewicz follow a similar method of data analysis, however they state that the researcher may choose categories as the highest level of abstraction or may go a step further and create themes.<sup>47</sup> This method of analysis is similar to that of the views of Hseih and Shannon as well as Zhang and Wildemuth.<sup>40,116</sup> As mentioned in Section 1.8.5, the researcher has adopted the eight steps by Zhang and Wildemuth and attempted to integrate the processes as described by the authors cited here. These steps are namely; a) preparing the data, b) defining the unit of analysis, c) develop categories and a coding scheme, 4) test the coding scheme on a sample of text, d) code all text, e) assess coding consistency, f) draw conclusions from coded data, and g) report methods and findings.

#### 3.7.2.1 Step 1: Preparing the data

In this first step of the preparation phase the raw data must be converted into written text before any analysis can occur.<sup>46</sup> The researcher transcribed the audio recording from the three focus group interviews verbatim. Through the transcription process, the researcher had the opportunity to immerse self in the data. This is supported by Liamputtong, and Polit and Beck, who encourage the qualitative researcher to undertake this process, as a means of becoming familiar to the data analysis.<sup>20,39</sup> The transcriptions were inclusive of: a) the questions asked by the researcher as well as probing questions when the researcher wanted more clarity on participant's response; b) literal verbalisations of the participants' responses; and c) observations such as pauses and other sounds such as laughing, as recommended by Schilling<sup>118</sup> (Annexure M,N and O). The researcher opted to do the transcription to become completely immersed in the data, with the intention of discerning patterns in preparation for the more in-depth analysis to follow.<sup>39</sup>

#### 3.7.2.2 Step 2: Define the unit of analysis

A unit of analysis refers to the sample that the researcher aims to analyse and must be established in the preparation phase of content analysis.<sup>47</sup> Erlingsson and Brysiewicz state that the unit of analysis is chosen by the researcher and can be a

whole or divided into smaller sections.<sup>47</sup> In keeping with the research objectives, the three groups of research participants are taken separately as the unit of analysis for this study. The decision to have these three groups as separate units of analysis was taken because each discipline has its own unique experiences in the teleradiology setting. To generalise the unit of analysis as a whole would overlook the significant challenges experienced by each group of end users.

### 3.7.2.3 Step 3: Develop coding and categorisation scheme

Codes are defined as a label or a descriptive word that is closest to the words used of the participants<sup>47</sup>. In content analysis there are three approaches that can be taken when choosing a coding method. Grove and Gray describe three types of coding, namely interpretive, explanatory, and descriptive;<sup>28</sup>

- Interpretive codes emerge later in the data collection process. These codes are interpreted by the researcher and are given an abstract term representing merged codes<sup>28</sup>
- Explanatory codes develop in the final stages of data analysis and are constructed after identifying recurrent patterns which can be related to an emergent theory<sup>41</sup>
- Descriptive codes are formed by using terms that are close to the participants' actual words to best describe their views.<sup>39</sup> These words form a "basic vocabulary" of data will be used to create categories. Descriptive coding is often referred to as first cycle coding and occurs in this step of the content analysis<sup>46</sup>

In this study the researcher chose to adopt a descriptive coding method for two fundamental reasons. The first reason is to achieve the aim of the study, which is to explore and describe the views of teleradiology end users regarding its utilisation and the impact it has on service delivery. Secondly it is to ensure the alignment with the descriptive and exploratory nature of the research design.

After the researcher conducted the preliminary coding using different colours, as described in Section 3.6, the researcher commenced with the actual coding,

followed by the development categorisation scheme. Categories are defined as groups of codes that are clustered together based on the similarity they share in relation to the context being explored.<sup>47</sup> In inductive research, there are no preconceived categories, but rather the researcher must work inductively to generate categories from the data. In this study, the codes and generated categories for all the groups of participants are presented in Chapter 4.

#### 3.7.2.4 Step 4: Test the coding scheme on a sample of text

According to Zhang and Wildemuth, once a coding scheme has been formulated, the researcher must ensure its validity before progressing into further analysis.<sup>40</sup> As mentioned in Section 1.8.8.1, credibility of the study is maintained through member checking and the use of a co-coder. This step was achieved by the researcher coding a small sample of data first, which was verified by the supervisor to check its accuracy before commencing with the full coding. This was done for every focus group interview. Erlingsson and Brysiewicz support this method of testing the coding scheme, and explain that it can be used to overcome bias by preventing the researcher from applying preconceived ideas into the coding process.<sup>47</sup>

#### 3.7.2.5 Step 5: Code all text

When the supervisor was satisfied with the sample coding employed, the researcher commenced with coding all the text from each group. The supervisor was actively involved in all stages of the coding process to ensure that the research did not drift into the researcher's own preconceived ideas and personal experiences within the field of teleradiology.<sup>118</sup> Erlingsson and Brysiewicz emphasise that this an essential aspect in ensuring consistency of the coding process as well as maintaining trustworthiness of the study which was discussed in Section 1.8.8.<sup>47</sup>

#### 3.7.2.6 Step 6: Assess coding consistency

As indicated in Section 3.1.2, there is paramount of importance placed on the type of analysis method used in the research, namely inductive and deductive. Due to the inductive nature of qualitative studies, the researcher must constantly revisit the codes and reflect on the initial analysis.<sup>41</sup> Creswell supports this view and explains that in inductive reasoning the researcher will draw categories and themes from the data.<sup>45</sup> This is an important aspect in the data analysis process as this analysis may change after reflecting on other data presented by the participants. For this reason

the analysis method does not follow a linear rigid process, rather it is subject to change throughout the analysis process.<sup>47</sup> Miles, Huberman and Saldana further state that failure to follow this inductive process can lead to inconsistencies in the understanding and presentation of the findings.<sup>41</sup> Another way of ensuring coding consistency is to involve the supervisor in assessing the coding throughout the data analysis process to avoid researcher bias.<sup>47</sup> (Annexure P). As mentioned in Section 3.1, the researcher used an inductive reasoning.

#### 3.7.2.7 Step 7: Draw conclusions from the coded data

In this step the researcher critically analysed the different dimensions presented in the categories to uncover the emerging themes. Themes are described as presenting the data on an interpretive level.<sup>47</sup> This step requires inductive reasoning as described in Section 3.2.3. The emergent themes in this study will be presented and interpreted in Section 4.6, followed by the overall findings of the research which will be presented in Section 5.2. The supervisor was also involved during this step to ensure credibility of the researcher's interpretation of the emergent themes (Annexure P).

#### 3.7.2.8 Step 8: Reporting methods and findings

This is the last step in the content analysis process and its aim is to truthfully and explicitly describe the reporting methods used to present the research findings. As will be demonstrated in the following chapter, the reader is carefully guided throughout the data analysis on how codes, categories, and themes emerged and how they ultimately lead to the research findings. One is reminded of the subjective nature of qualitative research. For this reason, there needs to be several methods employed to ensure the trustworthiness of these findings. These methods, which were applied in this study, were described in Chapter 1, Section 1.8.6.

### **3.8 CONCLUSION**

In this chapter, a detailed account was given into the rationale behind the qualitative research approach adopted for the study and how it differs from a quantitative approach. The inductive reasoning method for the study was elaborated upon, followed by an explanation of the exploratory and descriptive research design that will be used, leading the reader into the research process of the study. The study

setting was introduced and the process of selecting researching participants, namely radiographers, referring clinicians, and radiologists, was explained. The data collection process, including focus group interviews and a face to face interview, was described. This was followed by an in-depth description of the different stages in the qualitative content analysis process, described in Section 3.7.1. In the next chapter the researcher will be presented with the data analysis and interpretation, which will be discussed in conjunction with a literature control.

## CHAPTER FOUR

### DATA ANALYSIS, DISCUSSION AND INTERPRETATION

*“Coming together is a beginning, keeping together is progress, and working together is success”*

Henry Ford

#### 4.1 INTRODUCTION

The methodology followed in this study was outlined in Chapter 3. In this chapter the analysed data is presented in terms of codes and categories, and will eventually lead to emerging themes. Induction research strategies are used to guide the interpretation of this data, which will be used to pave the way to the revelation of the major findings from this study. It will be demonstrated in this chapter how the triangulation of data from the three groups of participants was used in this study, which was described in Section 1.8.6. The first analysis that was conducted was that of the radiographers' focus group, followed by the referring clinicians and radiologists.

#### 4.2. Analysis of data from radiographer focus group interview

As explained in the preceding chapter, qualitative content analysis yields codes and categories. As it is seen in Table 4.1, three major categories were identified from this focus group interview. These are: a) request for CT examinations as experienced by the radiographers, b) inter-professional relationships between the radiographer and other teleradiology end users, and c) how teleradiology impacts on service delivery as viewed by the radiographer.

**Table 4.1: Codes and categories from radiographer focus group interview**

CATEGORIES	CODES
Request for CT examinations	<ul style="list-style-type: none"> <li>• Validity of CT request</li> <li>• Urgency of CT request</li> <li>• Lack of radiologist support</li> <li>• Booking protocols</li> <li>• Standard Operating Procedure (SOP) manual</li> <li>• Clinical history</li> </ul>
Interprofessional relationships between teleradiology end users	<ul style="list-style-type: none"> <li>• Disregard for decisions</li> <li>• Lack of radiographer confidence</li> <li>• Lack of trust</li> <li>• Neglect</li> </ul>
Teleradiology has impacts on service delivery	<ul style="list-style-type: none"> <li>• Accessibility</li> <li>• Long report turnaround time</li> <li>• Delays</li> <li>• Death</li> <li>• Exposure to Ionising radiation</li> <li>• Financial burden</li> </ul>

These categories are presented and discussed, starting with the request for CT examinations.

#### **4.2.1 Request for CT examinations as experienced by the radiographers**

As mentioned in Section 1.8.5, the radiographer can only perform medical examinations that have been requested in writing by the referring clinician. As stated by radiographer #4 who indicated “*We book the scan (radiographer, without radiologist) and then sometimes we have to decide if this scan is necessary, sometimes based on what we know, we need contrast for certain things and then we advise the referring doctor*”.

This radiographer further expressed her discomfort with this situation by saying “*I don’t think I can make these decisions because I have not had CT training, I only learnt CT when I came here. So, me personally I feel really I can’t make a decision*”

The second issue that was raised in relation to the request for CT examinations, was that radiologists are not always readily available when the radiographer wants to consult with them. Radiographer #1 said *“When you call them they don’t respond, they are busy, call later, those are the experiences. In that space there is no one advocating for you or assuring the referring doctor that this (CT examination) should have not been done”*.

With regards to the guidelines for making requests as outlined in the teleradiology SOP, both the referring clinician and radiologist, seem to have challenges adhering to these. As radiographer #4 explained: *“We need clear protocols, clear what we should do, even though we have the SOP, clearly, it’s not being followed or taken into consideration regarding radiologists being called for babies, that’s not happening.”*

This was echoed by radiographer #3, who stated: *“The doctor dictates I want this then you must do it that time, the impact of this patient, the patient obviously that time becomes a Guinee pig. We get a lot of interns, for them it’s a matter of experiencing and so forth.”*

Radiographer #1 added: *“Clinical history is still very much bad, if I am booking I can still enquire, but if other people are booking they don’t know as much as you, so by the time you come and see that this is not supposed to be and you try to explain to the patient it’s like you don’t want to give the service.”*

Having assessed the views and experiences shared by the radiographers regarding the requests for the CT examinations in this teleradiology setting, it is important that reference be made to what the literature say, which will be discussed in the next section.

#### 4.2.1.1 Literature on request for CT examinations.

With regards to the request for CT examinations, the cornerstones for ensuring that the key competencies of the radiographer are met, are through justification and optimisation. Justification in the context of radiography implies that the benefit of the radiological examination requested will outweigh the associated radiation risks.<sup>119</sup>



Optimisation in radiology/radiography entails making effective use of radiation and thus keeping in line with the ALARA principle.<sup>119</sup>

The Ionizing Radiation (Medical Exposure) Regulations of Great Britain as well as the Radiation Control Directorate of South Africa, both are of the view that it is primarily the role of the radiologist to justify examinations depending on the components of each clinical case, protocol modification, contrast type, and amount to be injected.<sup>103,120</sup> However, due to the severe lack of radiologists as described Section 2.2.3, justification and authorization have become part of the radiographers' scope of practice as indicated in the policy for requesting medical x-ray examinations by the Radiation Control Directorate, which states "A radiographer in his/her professional capacity may refuse or accede to the request, provided that good and sufficient grounds exist for his/her decision".<sup>120</sup> The policy further indicates, "Should the radiographer question the possibility of an unsubstantiated request, for example, clinical history indicated does not justify or necessitate the performance of the x-ray examination, the radiographer may refuse to perform the examinations".<sup>120</sup>

The IAEA has realised that although policies are in place, health professionals are still met with challenges when attempting to seek justification for unwarranted radiological requests.<sup>119</sup> This view can be related to the above narratives, where radiographers indicated that they are met with similar challenges.

A study conducted by Borgen, Stranden and Espeland sought to explore referring clinicians' knowledge regarding the consideration of radiation when requesting a radiological investigation.<sup>121</sup> Their study revealed that referring clinicians have limited knowledge of the dangers of radiation and indicated that clinicians who don't take cognisance of radiation doses often order imaging that is unlikely to affect the patient's treatment plan.<sup>122</sup> These authors further indicated 52-57% of referring clinicians underestimated the high radiation dose associated with chest and abdominal CT examinations, and only 19.7% of referring clinicians made use requesting guidelines.<sup>122</sup> This can be related to the radiographers' viewpoints, where it was indicated that patients often become 'guinee pigs' as the referring clinicians don't fully know the dangers of radiation as stated by radiographer #1.

In Section 2.2, the reader was introduced to the domains that are used to guide quality health care. One of the domains pertaining to this category includes safety which was described as, "...avoiding harm to patients from the care that is intended to help them".<sup>122</sup> Malone, Guleria, Craven, Horton, Järvinen, Mayo, O'reilly, Picano, Remedios, and Le Heron reports that there has been a spike in the number of radiological requests for CT scan, this practice has raised concerns particularly with regards to the appropriateness of the requested examination.<sup>119</sup> These authors further mention that in clinical settings, referring clinicians have limited knowledge regarding the individual doses and risks associated with ionising radiation. This evokes the need to implement stricter justification measures, which is often perceived by referring clinicians as unwillingness to assist the patient.<sup>119</sup>

Another issue that emerged is the impact that the lack of clinical history has on the booking, in terms of patient preparation. Reiner explains that the depth of clinical or imaging history can directly affect the outcomes of the radiological report.<sup>58</sup> In the teleradiology context, a study conducted in Israel revealed that radiologists experience challenges in accessing and reviewing patient history.<sup>55</sup> In the North West province this experience was shared by radiologists during the first pilot phase of teleradiology. It was noted that CT requests without proper history were meaningless.<sup>9</sup> Having assessed from literature what the issues are in relation to making a request for CT examination, the next section looks at the second category, which is inter-professional relationships between the radiographer and other teleradiology end users.

#### **4.2.2 Inter-professional relationships between radiographers and other teleradiology end users**

Inter-professional relationships in healthcare are described as a collaboration between a group of health professionals who work closely together and share a common responsibility to the patient.<sup>123</sup> In analysing the data, what appears to be eminent is that, the teleradiology end users work closely together, despite their relationship not appearing optimal, which became notable in the first category discussed.

Radiographer #3 describes this by stating: *“When you say to a doctor, this cannot happen based on one, two and three, the doctor doesn’t take your word for it, to say another professional maybe advising me not to do this”*. This radiographer further stated: *“At the end the doctor must make the decision, you can say what you think but the doctor must make the final decision”*.

Radiographer #4 shared a recent experience with the referring clinician and stated: *A patient seen yesterday, came this morning as an urgent headache (with a clinical history of headaches and was regarded by referring clinician as being urgent) \*pause\* so it was just done, like I said we don’t have the confidence to call the radiologist to ask if its urgent, so we just do it at the end because the doctor says.”*

According to Radiographer #1: *“It sours the relationship between doctors on site and the radiographers because it’s like the radiographers don’t want to assist, they will do anything in their power to not assist the patient”*.

This expression seemed to relate to the issues around the request for the CT examinations.

#### 4.2.2.1 Literature on inter-professional relationships between radiographers and other health care professionals.

Challenges in inter-professional relationships between health care workers has been a long standing issue in health care.<sup>124</sup> This experience was found not be unique to radiographers and referring clinicians, but also shared by other professions such nursing. Salhani and Coulter describe how nurses have had challenges in maintaining their professional autonomy in a setting where medical professionals dominate.<sup>124</sup> The authors go on to mention that these experiences commonly exist in settings that call for inter-professional collaboration and flexible professional boundaries, similar to the teleradiology setting in a rural environment.<sup>124</sup> Findings from a study conducted by Mung’omba found similar views whereby radiographers practicing in rural areas felt disrespected by referring clinicians, which translated into feelings of low self-esteem.<sup>13</sup> This view was echoed by the some of the radiographers in this study, who indicated that they did not have

the confidence to engage with the referring clinicians, mostly because they feel dominated by them.

Malone *et al.* explains that certain professionals, such as medical doctors, have a deep rooted understanding of their hierarchical role within the medical team.<sup>119</sup> An individual within the team who is seen to act outside his or her scope of practice, risks being rejected by the other team players who wish to continue with the norm.<sup>119</sup> In the context of this study, the referring clinicians may perceive the radiographers' apprehension towards performing the radiological request, as being an act of insubordination and not keeping within their professional boundary. Radiographers on the other hand, might be refusing to perform the examinations in relation to the ethical rules and guidelines for their profession, which entails keeping the radiation dose as low as possible as described in Section 2.5.1. As stated in the guidelines from the radiation control directorate, the referring clinician is responsible for justifying the necessity of the imaging request and that the radiographer is primarily responsible for optimising the technical aspects of the examination to ensure the principle of ALARA is met.<sup>120</sup> The directorate highlights the importance of these two role players in health care and emphasise the need for them to work synergistically together to ensure the patient receives the appropriate examination and optimal radiation dose.<sup>120</sup> The call for effective inter-professional collaboration between the radiographer and other health professionals is further emphasised by the Imaging Gently Campaign pledge for radiographers. In this pledge it is stated that the radiographer shall, "...convey the principles of the Image Wisely program" to the rest of the imaging team, namely the radiologist and other radiation workers as well as to, "...communicate optimal patient imaging strategies to the referring physicians".<sup>33</sup> However, in the context of this study, radiographer attempts of effectively communicating with both the referring clinician and radiologist appear to be failing.

#### **4.2.3 Teleradiology and its impact on service delivery as experienced by the radiographers**

Delivery of health care services to rural communities remain high on South Africa's list of priorities.<sup>4</sup> For this reason ITC interventions, such as eHealth, have been incorporated in health care projects to enable rural communities to access

specialised services as explained in Section 1.1.<sup>15</sup> With regards to service delivery through teleradiology systems radiographers expressed concerns over the delays that patients incur because of teleradiology systems.

Radiographer # 6 explains the implications of delayed reports by stating: *“If there is no report, it delays or changes their appointments date and creates a big mess, delays take a month, they [the patient] might not get appointment for the following month [at the specialised tertiary hospital for treatment]”*.

Another area of concern expressed by Radiographer #1 was with regards to the availability of radiologist through the statement: *“The patient is being delayed in the sense that it is an urgent case, but now being delayed because we cannot get a radiologist who is supposed to be available to us 24 hours so it goes back to a delay in service delivery.”*

Radiographer #3 portrayed an even dire situation regarding delayed reports and stated: *“You end up doing that patient, that patient can pass away waiting for the report.”*

From the above narratives, participants mentioned certain aspects of service delivery that appeared to be compromised, which will be discussed alongside literature in the next section.

#### 4.2.3.1 Literature on the impact that teleradiology has on service delivery as experienced by radiographers.

Relating all these views as presented by the radiographers, the concerns raised seem to touch on most of the domains of the eHealth strategy described in Section 2.2, namely patient centeredness, effectiveness, timeliness, efficiency, equitability, and safety.<sup>15</sup> With regards to timeliness and efficiency, the ACR indicates that there is no standard turnaround time for reporting, but rather each department should set their own times according to their individual requirements.<sup>88</sup> In the NW SOP, the average turnaround time for a non-urgent report is 48 hours of referral, semi-urgent is three hours after referral, provided that the referring clinician has discussed the case with the radiologist, and one hour after consultation with the radiologist for

emergency cases.<sup>8</sup> However, according the narrated descriptions of the radiographers, these times are not adhered to.

In terms of effectiveness, Reiner states that regardless how diagnostically accurate a radiological report is, if it is not received by the referring clinician within an appropriate time, its value and positive effect on the patient is significantly diminished.<sup>58</sup> The next section will now look at the referring clinicians' perspectives from the analysed data.

### 4.3 Analysis of data from the referring clinician's focus group interview

The referring clinicians was the second focus group interview that was conducted, as indicated in Section 3.5.1. In Table 4.2, the codes and categorisation from the data analysis process are presented.

Table 4.2: Codes and categories from referring clinician focus group interview

Category	Codes
Impact of teleradiology on service delivery	<ul style="list-style-type: none"> <li>• Long turnaround time</li> <li>• Internet down time</li> <li>• Delays in treatment</li> <li>• Sharing of pictures</li> </ul>
Skills development for referring clinicians and radiographers	<ul style="list-style-type: none"> <li>• Limited CT services</li> <li>• Incomplete CT examinations</li> <li>• Lack of CT training for referring clinicians</li> <li>• Uncertainty in CT environment</li> <li>• Lack of confidence</li> </ul>
Inter-professional relationship between referring clinicians and other teleradiology end users	<ul style="list-style-type: none"> <li>• Hostility</li> <li>• Anger</li> <li>• Accommodating</li> <li>• Small community</li> <li>• Good relations</li> </ul>

Three categories were identified from the analysis of data, namely: teleradiology impact on service delivery; skills development for teleradiology end users; and inter-professional relationships between referring clinicians and other teleradiology end users.

#### **4.3.1 Impact of teleradiology on service delivery as experienced by referring clinicians**

From the data analysis conducted it appears that referring clinicians view teleradiology as sometimes having a negative impact on service delivery whereby reports are not delivered in time due to technical failures. However, they have some measures in place to ensure that the services to the patients are being delivered.

Starting with what appeared to be negative impact, referring clinician #5 stated: *“Due to internet problems and I don’t know what else they (radiographers) were not able to send the images to the radiologist, so the CT was done, but the radiologist didn’t have the scan so they can’t report, it depends on how the infrastructure is”*.

The researcher then asked what happens to the patient when such cases arise, to which the same referring clinician responded: *“They [patient] just stay [in hospital] or, we send them home because they are stable and we take their phone numbers and call them once we have the report and then only can we refer them to the tertiary hospital”*. Referring clinician #2 stated: *“It delays the onset of chemo [chemotherapy]”*.

What was further noted was that the referring clinicians attempt to put some measures in place to ensure services to patients. Referring clinician #4 stated: *“What I do is, we know people [other radiologists who are not the designated service provider] we have a community of doctors, so I send pictures to them to help us”*. Referring clinician #1 indicated that the teleradiology radiologists also support this measure when there are delays in the internet connectivity and stated: *“Twice or thrice I sent [pictures] to the radiologists [designated radiology service provider] and they helped me”*.

#### 4.3.1.1 Literature on the impact that teleradiology has on service delivery as experienced by the referring clinicians.

In this category, the referring clinicians, like the radiographers, also experience challenges in receiving a timeous report. This has a direct impact on their service delivery as they now must make the patient wait for treatment as alluded to by referring clinicians #5 and #2. The referring clinicians attribute this delay to internet connectivity. The dependence of eHealth strategies on internet connectivity and functioning infrastructure was highlighted throughout the preceding chapters. This infrastructure includes well-functioning devices that uphold the connectivity between the referral site and the remote radiologist to ensure the timeous transmission of radiological images and reports.<sup>17</sup> Despite advancements in ITC, to date connectivity issues still remain a major barriers in teleradiology implementation both locally and globally.<sup>125</sup> The eHealth strategy of South Africa 2012 - 2016, have acknowledged that large amounts of money have already been spent on eHealth infrastructure, however poor connectivity remains a significant limitation in providing timeous services and it is included as a priority area in the National eHealth strategy 2012 - 2017 document.<sup>15</sup>

Participants indicated the direct impact that delays in reports have on the patient by stating that it delays the onset of treatment, particularly for oncology patients as narrated by referring clinician #2. Similarly to the radiographers, the impact of this is that the report becomes diagnostically less effective as the patient's condition may have exacerbated during the waiting period.<sup>58</sup> In the context of teleradiology the radiologist is expected to deliver a timeous report to the referring clinician, who must intern relay the information to the patient and act on the management and treatment accordingly.<sup>58</sup>

However, despite all these challenges experienced by the referring clinicians, it is evident that they attempt other means of sending images to the radiologists or other specialists. This practice is termed mobile Health (mHealth) and is described as the use of mobile devices to aid service delivery in health care.<sup>90</sup> As discussed in Section 2.4.3, this practice is commonly seen in settings that utilise eHealth



systems, and is also supported by the national eHealth strategy which states that the use of mobile technology envisages to revolutionise health care.<sup>15</sup>

Mars and Scott discuss the benefits of using social medial platforms such as 'Whatsapp' to improve service delivery.<sup>126</sup> They describe communications between clinical teams regarding second opinions, educational resources, sharing of x-ray images, and clinical presentations.<sup>126</sup> These descriptions align with the narratives of the referring clinicians who refer to communications with their community of doctors. One of the barriers found in telemedicine is the reluctance of referring clinicians in rural areas to expose their doubts to other colleagues such as radiologists in high technology urban settings.<sup>127</sup> This may be a plausible explanation as to why the referring clinicians prefer to use this channel of communication as opposed to seeking the help of the radiologist first.

Although this means of communication appears to be more efficient, mainly because the speed at which information can be shared, it comes with dire medico-legal consequences. Kunde, McMeniman and Parker raise concerns over the misuse of clinical images in the field of dermatology in Australia.<sup>128</sup> These authors state that images taken by clinicians should only be shared with parties that are directly involved with the decisions regarding the patient's diagnosis and management.<sup>128</sup> Similarly, in the teleradiology context, as narrated by referring clinician #4, the sharing of radiographic images commonly occurs. In South Africa, the need to regulate sharing of information was highlighted in the Protection of Personal Information (PoPI) Act.<sup>129</sup> This act was formulated to protect personal and prevents any person from sharing electronic communications or making automated decisions without the consent of the person to whom the information belongs.<sup>129</sup>

Kekana, Noe and Mkhize, further explain that in the telemedicine context, there are concerns over patient consent and liability that must be addressed.<sup>92</sup> These authors specifically make reference to the teleradiology setting, whereby the patient does not know who will provide the radiological report and question should there be a misdiagnosis who would be held liable to the patient. In this context of mHealth, ethical regulation remains a major concern as information may be shared with another party not affiliated with the hospital and may not have the suitable

qualifications to undertake decisions regarding the patient's condition.<sup>92</sup> As narrated by referring clinician #4, pictures are sometimes sent to a community of doctors for further advice on the radiological images. As indicated by the authors above, the problem that arises with such situations is that the safety of the patient and their personal details, cannot be maintained.

#### **4.3.2 Skills development of referring clinicians and radiographers**

Skills development entails the training and upskilling of individuals in fields that have limited human resource.<sup>15</sup> In the context of this study, this refers to eHealth education as well as CT training. The referring clinicians' concerns in this category are twofold, the first being skills development of radiographers as well as their own skills development, particularly that of internship doctors who are new to the rural environment. With regards to concerns over the radiographers, referring clinician #3 shared his personal experiences regarding inadequate images by stating: "*I experience problems getting CT Angio [Angiogram], when it comes to CT Angio not all radiographers can do that, certain times we have to wait for the radiographer to come. Angiograms seem incomplete, we don't see distal arteries, we just see the end of the knees, we can't comment on the distal arteries and the report only comes after a week, so now I'm stuck, I can't tell.*" Referring clinician #6 raised another point of concern regarding the report outcomes and stated: "*What was reported and what the patient had was completely different. Another instance is the report stating that everything was normal, but using another modality such as ultrasound revealed it was far more serious, so that could possibly be that the scanning that was done, perhaps there was no delay in the scan [delayed protocol].*"

From these narratives it is clear that the referring clinicians have challenges with the radiographers' level of experience when it comes to performing the CT scan, and sometimes the accuracy of the radiological report.

Secondly referring clinicians also reflected on their own limited knowledge and expertise in CT scan. In responding to the question on regarding their *experiences in the CT department* referring clinician #8, an intern, stated: "*Well to be honest I have never been prepared for CT scan.*" Referring clinician #9, also an intern, stated: "*I have been called to inject, but I wouldn't know how to react if the patient reacts*".

The researcher then probed further and questioned the referring clinicians' views on their education and training for contrast media administration as this is part of most of the CT examinations. Referring clinician #1 stated: *"It is good, I don't want to assume that it is common information, I think per semester is enough for those [referring clinicians] who don't have the information and also reminding ourselves that when we have new staff we have to make sure they know these things, for example when you send an intern you have to be a backup also"*. This clinician went on to say that there was a more serious need in terms of contact and training from the radiologist by stating: *"If they [radiologist] can see us once in two or three months, so they can bring us those images to discuss, there is something like an x-ray meeting. It's the type of thing that we would love to happen, that we having the file, the blood and imaging of the patient but now with the radiologist we are focusing on the images"*.

As it was done in the preceding (radiographers') section, the responses from the referring clinicians are related to literature in the next section.

#### 4.3.2.1 Literature regarding skills development and capacity building in rural health care.

CT is a specialised area in radiography, demanding that the health professionals utilising it must be skilled and experienced in its use and applications.<sup>130</sup> According to du Plessis, Freindrich - Nel and van Tonder, referring clinicians are expected to be knowledgeable regarding the appropriate examinations to requests and radiographers must be able operate highly advance equipment, as well as be able to discern complex radiographic anatomy and basic pathology.<sup>130</sup> These decisions are often guided by the radiologist, however in the teleradiology context, the radiographers and referring clinicians are left alone to make these decisions. These challenges are not unique to this district but are also seen globally in countries such as Brazil, whereby poor quality images presented as a challenge in the teleradiology setting.<sup>127</sup> When reflecting back to the radiographer focus group interview, radiographer #4 made mention that they did not receive any CT training and therefore did not feel equipped to make decisions regarding CT examinations. It is

therefore clear, that both the radiographers and referring clinicians both share this challenge in the teleradiology setting.

Current education and training in radiography provides limited opportunity for the post graduate radiographers to develop their skills, particularly in CT scan. It was further mentioned that training in these areas is usually done by an application specialist or senior radiographer.<sup>130</sup> However, unlike the radiographers, referring clinicians do not receive direct CT training. This was mentioned by referring clinicians # 8 and #9, who pointed out that they have not received training in in CT scan and do not have sufficient expertise and knowledge in making CT requests as well as dealing with contrast induced reactions. From these narratives we see that referring clinicians need further training in CT, however there is no specific reference point where they can attain it from.

Benjamin, Aradi and Shreiber identified education as a stake-holder expectation for radiology service providers. This entails radiologists attending clinical meetings and the teaching of non-radiology medical professionals.<sup>55</sup> With specific reference to telemedicine training, skills development and capacity building is considered as a critical aspect in the sustainability of eHealth projects and often forms part of the service level agreement for the outsourced private radiologists. In the situation analysis report of the eHealth document 2012 - 2016, it states that capacity building in eHealth has to date, been limited, however government is driving several attempts at providing telemedicine training to health professionals entering the eHealth environment, which include onsite visits for support and post graduate programmes in telemedicine to develop competent and skilled practitioners.<sup>15</sup>

#### **4.3.3 Inter-professional relationship between referring clinicians and other teleradiology end users**

The referring clinicians described the different relationships that they share with the radiographers and radiologists. Referring clinician 1 described their relationship with the radiographers by stating: “*The communication we have works well, when we speak to them and we want a patient to be done, it’s less likely that it’s not going to happen.*”

With regards to the referring clinicians' relationship with the radiologist, referring clinician 4 acknowledged having communication with the radiologist by stating: *"The radiologists do contact us to tell us if there is something urgent."* This is with regards to telephonic reports on after hour examinations. Referring clinician #7 had a somewhat different view, stating: *"With paediatric patients, there was a circular that was sent out that all cases must be discussed with radiologists, when I spoke to the [radiologist] at some point they get really angry, they say you are sitting with the patient there, what is your clinical judgment, why can't you do the scan, you don't have to call for all of them there is those you can call especially for contrast, especially for small patients and it was a neurologist who requested the CT, not us, so when I explain they get upset"*. Referring clinician #4 had a similar experience and stated: *"Couple of times I called and it was like I was just calling to hear their voice, they [radiologist] just said 'ya ok', so I ended up booking the patient"*.

Statements presented by these participants, seem to indicate lack of support or poor relations with radiologists. The section to follow is the presentation of a brief literature review to ascertain if such relations were noted in studies conducted before this research study.

#### 4.3.3.1 Literature regarding Interprofessional relationships between referring clinicians and other health care professionals.

In this category the referring clinicians perceive themselves to have a good relationship with the radiographers, as indicated by referring clinician 1#. However, this contrasts with the views of the radiographers indicated in Section 4.2.2. It appears that this relationship is an asymmetrical one, whereby individuals with less power have a higher feeling of failure in comparison to the higher powered individual, who has exhibits common acts of defence.<sup>131</sup> As indicated in Section 1.8.3.1, the Imaging Gently Campaign encourages communication between the radiographer and the other health professionals. Similarly the same expectation applies to the referring clinician as indicated by their pledge which states, "I will consult, as needed, with professionals specialising in medical imaging (radiology, nuclear medicine, ultrasound, and magnetic resonance imaging) in order to choose the most appropriate imaging examinations for my patients".<sup>33</sup> This indicates that

communicating and seeking professional opinions of other teleradiology users is a necessary requirement in the radiology setting, and more so in the teleradiology environment.

The referring clinicians however, had contrasting experiences with regards to their telephonic interactions with the radiologists. This is a common phenomenon experienced amongst referring clinicians and specialists in telemedicine.<sup>127</sup> Findings from a study conducted by de Souza, Morbeck, Steinman, Hors, Bracco, Kozasa, and Leão indicated that referring clinicians are reluctant to call the specialist as they feel unprepared regarding the questions that the specialist might ask them. In addition, they may harbour feelings of inadequacy if their shortcomings are exposed.<sup>127</sup> Another participant from the same study indicated that not all specialists have the patience to understand the difficulties that they experience in the rural setting.<sup>127</sup> From the views expressed by the referring clinicians of this study, their relationship with the radiologists is different to what was described by the radiographers, as referring clinician #7 indicated. Referring clinician 7 noted that when they do seek to communicate with the radiologist, they are met with reluctance for engagement. Having analysed the focus group interviews of radiographers and referring clinicians, the next section focuses on the analysis of data collected from the interview with the radiologist.

#### **4.4 Analysis of data from interview with the radiologist**

As mentioned in Section 3.5.4, there were challenges with the radiologists' focus group interview. The analysis of data presented here is the data that was collected from the one radiologist who was available. The same coding process used for radiographers and referring clinicians was used, and the outcome is presented in Table 4.3. As can be seen in the table, there were four codes and only one category was identified. The discussion of this category with relation to literature is presented hereafter.

Table 4.3: Codes and categories from radiologist interview

Category	Codes
<ul style="list-style-type: none"> <li>Factors that impact teleradiology services.</li> </ul>	<ul style="list-style-type: none"> <li>Poor image quality</li> <li>Insufficient clinical history</li> <li>Internet down time</li> <li>Channels of communication</li> <li>Volume of examinations</li> </ul>

#### 4.4.1 Factors that impact teleradiology services

In Sections 4.2.3 and 4.3.1, the radiographers and referring clinicians shared their views regarding the impact that teleradiology has on service delivery to the patients of the Dr RSM district. However, in this interview, the radiologists shared views on factors that affect the actual teleradiology service, which is delivered to the end users, namely radiographers and referring clinicians, and ultimately impacts upon service delivery to the patient. Both challenges and recommendations were presented by the radiologist.

In responding to the experiences in this teleradiology setting, the radiologist started with the challenges, by stating: *“Technotes [typed note from the radiographer to the radiologist attached to the CT examination, describing the clinical history of the patient] from the technician which is not adequate, so we have a scan of the chest, abdomen and pelvis but the history is colic, so this doesn’t help us. So the problem is twofold, it’s from the technotes and from the clinicians.”*

The radiologist further commented that in cases, particularly for paediatrics and angiograms, there should be further exchange of clinical history between the referring clinicians and themselves by stating: *“In both cases of paediatrics and angiograms, consultations should definitely happen, because what happens is the referring physicians may not understand the implications of those CT examinations for those particular examinations and I think it’s for us to advice being the specialist”.*

The radiologist went on by explaining why there is need for skills development of the radiographers, by stating: *“Generally planning of the cases are not done*

*correctly. Images that are sent are not adequate, it's only sent in only axial, its either missing the sagittal or coronal views, lung windows and that, so when it's done in the peripheral site, it's very difficult for me to manipulate on this side, so that my biggest challenge I have."*

The other challenges that the radiologist raised was with regards to the technical aspects of the systems, by stating: *"The second biggest challenge I have is line delay, when we have internet connectivity problems, so the patients get scanned but I can't access it. The connectivity problem is from both sides, from the scanner to the server and to the server from us, from us back to the site"*.

Having acknowledged connectivity as a major problem in teleradiology, the radiologist alerted the researcher to the fact that in those cases he accommodated the referring clinicians with mHealth by stating: *"I've got many phone calls where doctors are unsure and they send me a picture and ask for an opinion, so there is definitely a need for that (mHealth)"*.

Many of the challenges listed by the radiologist appeared to be directed to infrastructure and skills development of the radiographer. The researcher then asked if there were any factors coming from the radiologist's part that could also contribute to delays in report turnaround time. The radiologist responded by stating: *"Volume of work, a lot of the cases are long, just from one peripheral hospital you can get fifteen cases that are very long, to get to them takes a long while"*.

In response to the challenges indicated, the radiologist then provided recommendations by stating: *"We can have written protocols, for example with the liver this what we do, for example trauma this is what we need to do, alternately we can suggest to them to call if post contrast is needed, but then that delays the scan, but I think written protocols is the way to go"*.

Having noted the views from the radiologists, the following section explores the literature relating to radiologists practicing a teleradiology setting.



#### 4.4.1.1 Literature on factors that impact services rendered by the radiologist

In Section 2.5.3, the role of the radiologist was described. In this section, literature is related to the views of the radiologist based on their experiences when reporting for this particular district. The ACR advise that radiographers and radiologists must maintain an open, reliable, and timely communication between each other to ensure improved quality of examinations and the transfer of pertinent clinical information, which can assist in diagnosis.<sup>88</sup> With regards to the inter-professional relationship between the radiologist and referring clinician, as described in Section 4.5.2, the reader is reminded of Reiner describing the bidirectional and collaborative relationship that the two professional groups must exhibit to ensure effective service delivery.<sup>58</sup> It seems even more important when it is related to the teleradiology setting, that this relationship and communication must be of a high quality. The radiologist indicated examples of when communication should be occurring between themselves and the referring clinicians, such as when a paediatric patient is to be scanned or an angiography should be performed. The radiologist also made mention that communication should be occurring between the radiographer and themselves, but thought that written protocols would suffice, as direct telephonic communication may not happen on an ongoing basis for every patient.

At this point, the reader is reminded that the radiologists are part of an outsourced private radiology service provider and still have responsibilities towards their own patients, as described in Section 2.5.3. Benjamin, Aradi and Shreiber explain that, from a radiology perspective in the teleradiology setting, there are two ultimate goals.<sup>55</sup> The first being to maximise reports without compromising accuracy. The second being to balance work load across all sites, regardless of the geographical location, without compromising local services.<sup>55</sup> As indicated by the radiologist, the volume of cases coming through from the teleradiology site is large, and attributes to delay times.

From the above narratives and literature support, it is evident that there are similarities as well as differences between the ways the three groups of teleradiology end users experience teleradiology in the Dr RSM district. As mentioned in Section 1.8.7, inclusion of the viewpoints of all the teleradiology end users was a necessary step to consider triangulation thus maintaining the credibility of the study. The next

section demonstrates how the categories, as identified from all the groups of participants, contributed to the emerging themes.

#### **4.5 EMERGING THEMES**

Categories are often transformed into themes to enable the researcher to provide an overall meaning to a pattern of experiences identified through the coding process.<sup>46</sup> This is done to eventually extract the overall findings from the study. Themes are described as an analytic reflection of the codes that were presented in the data analysis, and represent the 7<sup>th</sup> step in content analysis, namely to draw conclusions from the coded data, as described in Section 3.7.1.<sup>40</sup>

In this study, the conversion of categories into themes is illustrated in Figure 4.1. as demonstrated in this figure, all groups of participants seem to have had similar experiences with teleradiology. From the preceding sections where data collected from the three groups was analysed, it became evident that they all experienced a) factors that positively impacted teleradiology utilisation and service delivery, b) factors that negatively impacted on teleradiology utilisation and service delivery, as well as c) strategies for improving teleradiology utilisation and service delivery. These three themes will be interpreted and related to the research objectives to identify the major findings from this study.

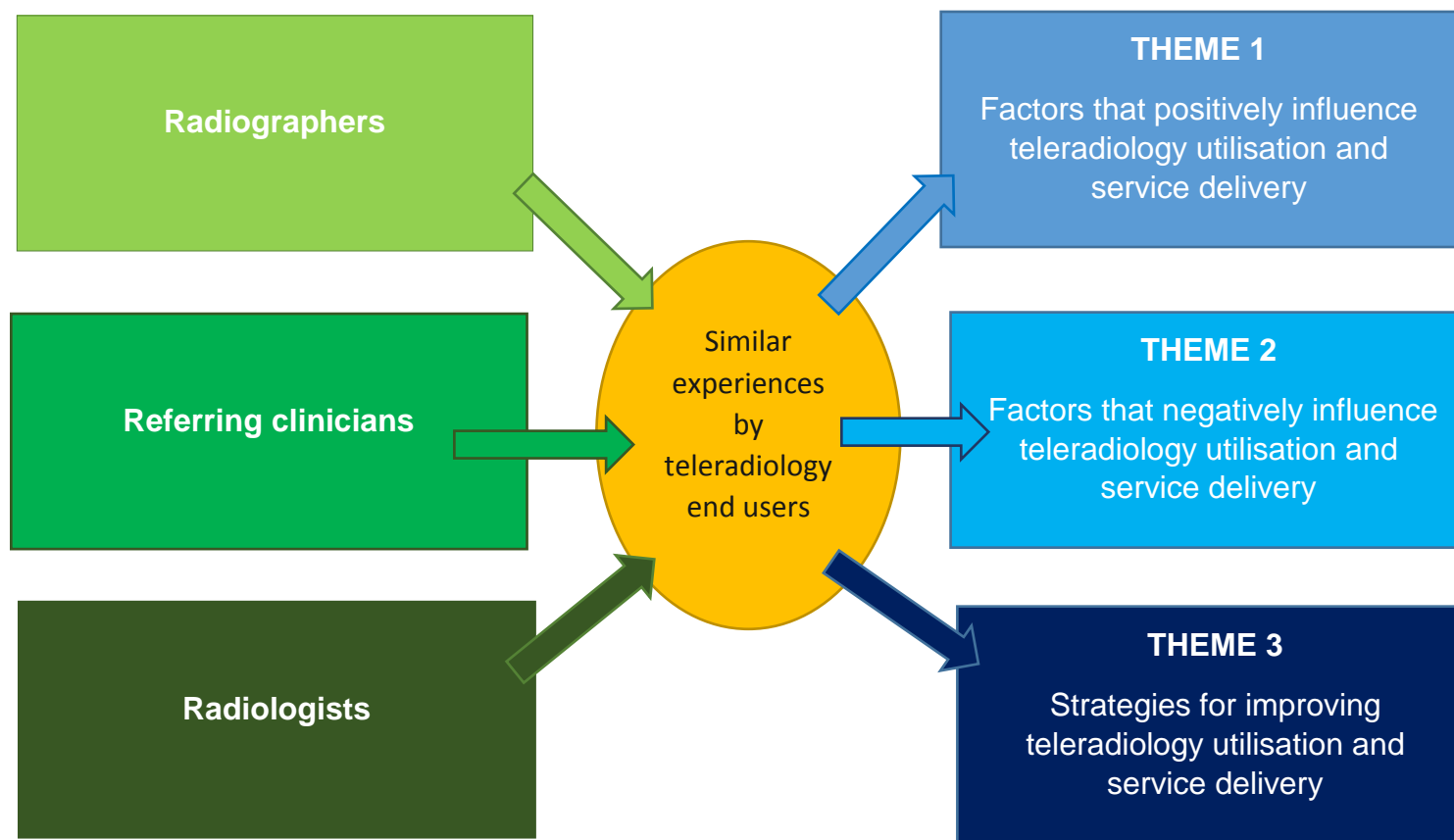


Figure 4.4 Translation of categories from all three groups teleradiology end users into themes.

## 4.6 INTERPRETATION OF EMERGING THEMES

The goal of qualitative research is to identify problems that affect a social context and to shed light on ways to bring about a positive change.<sup>108</sup> This can only be achieved by the researcher taking on an interpretive approach to the data to be able to fully understand the needs of a particular group.<sup>108</sup> This view is further supported by Denzin, Licolin and Guba, who explain that at the interpretation point, the researcher must piece together the information gained from the participants to portray a story of their lived experience.<sup>132</sup> In this section the emergent themes are discussed in relation to the research objectives. This is necessary to demonstrate that the study has adequately addressed the objectives and the aim of the study. The first theme is discussed next.

### 4.6.1 Theme one: Factors that positively impact teleradiology utilisation and service delivery

As shown in Figure 4.4, theme one emerged from the analysis of data from all three groups of participants. When related back to the data analysis, there are no groups that have openly declared that there are positive factors that impact on the telemedicine services in the Dr RSM district. However, the researcher was able to extract these factors from the experiences described by the participants. To that point, the researcher hereby presents how theme one relates to both objective one and objective two. Objective one and its relation to theme one is explored first.

#### **Research objective one:**

To explore teleradiology end users' views on the utilisation of teleradiology systems for CT examination in the DR RSM district.

In relation to this objective, the researcher was able to extract from the different categories of participants, that there were factors with regards to utilisation, which were having a positive impact on teleradiology service delivery in this district.

From all the focus group interviews, the researcher could ascertain that patients are receiving specialised radiological services, specifically contrast enhanced CT examinations as well as specialised imaging such CT angiograms, and the radiological reports thereof. The experiences presented by the research participants reflected certain acts that appeared to be enablers for the continued provision of specialised radiological services in the Dr RSM district. These were imbedded in their responses to the questions where they were asked to describe the current practice of teleradiology in their respective fields. When trying to extract the positive factors that impacted on service delivery from the experiences of the research participants, it became evident that there is existence of some inter-professional relations among the all the teleradiology end users, that end users have adopted a patient-centred approach and that there are Teleradiology guidelines in existence.

#### 4.6.1.1 Interprofessional relations and collaboration among teleradiology end users

In any radiology setting, there must inter-professional collaboration between the referring clinician, radiographer, and radiologist in order to meet the requirements for requesting, performing, and reporting of CT scan examinations.<sup>36,120</sup> In this district, there are three categories of end users involved in the teleradiology system. They might not all be in the same location and inter-professional relations are expected to be negatively affected, however the positive point is that they are all involved and are utilising teleradiology systems in the Dr RSM district.

Interprofessional relations between the radiographers and referring clinicians exist by virtue of the fact that referring clinicians are making requests, which is expected according to legislation stated by the Radiation Control Directorate, which indicates that, "...all requests must be in writing".<sup>36</sup> However, what differs here from a traditional radiology setting, is that the requests are being made directly with the radiographer and not telephonically with radiologists. This is evident through referring clinician #1's description of the booking process, where he states: "*We speak to the radiographer, we agree on the emergency of the request and then they proceed*".

Although the above acts are generally done by the radiologists as explained in Section 2.5.3, the teleradiology end users on site are taking on these roles to deliver a continued service to the patient.

There is at times, a certain degree of inter-professional between the referring clinician and the radiologist, who both indicated that there is sharing of pictures between each other when the internet connectivity was down. There appears to be increased interaction between these two end users with regards to urgent cases, whereby the referring clinician calls the radiologist to get an urgent verbal report as narrated by referring clinician #1.

There are attempts made by the radiographers to enhance the communication of important clinical information to the radiologist by means of technician notes, which accompany all CT examinations transferred to the radiologist for reporting. As reported by the radiologist, the technician notes just need to be improved in order to fulfil the purpose it is intended to serve. The Image Gently Campaign places great emphasis on inter-professional collaboration between the radiographer, referring clinician, and radiologist, and states that it goes hand in hand to ensure effective radiation protection to the patient.<sup>33</sup> When health professionals within an organisation can successfully collaborate and break down their professional silos, they can achieve a patient - centred approach.<sup>123</sup>

#### 4.6.1.2 Adoption of patient centred approach

In order to provide quality health care to communities, there must be a work place culture centred on the patients' best interests, well-being, and safety as outlined in the eHealth strategy in Section 2.2, whereby patient centeredness was described as "...providing care that is respectful of and responsive to individual preferences and needs".<sup>15</sup> From all focus group interviews, some evidence of this practice was found whereby end users adopted strategies to accommodate the patients on an individual basis. This was firstly seen from the radiographers who attempt to keep in line with the ALARA principle to protect the patient, by actively seeking justification for all CT examinations before performing the scan. This can be viewed in a positive light and in line with the HPCSA and Radiation Control Directorate as discussed in Section 2.5.1.

Patient - centeredness is also evident with referring clinicians, who try to accommodate patients by taking their telephone numbers and telling them when their radiological reports are ready, thus catering to the patient's individual needs.

It is further noted that both the referring clinician and radiologist have adopted mHealth strategies to supplement the teleradiology system, particularly when technical challenges arise. This is demonstrated by the sharing of CT images between the two groups of participants to fast track diagnosis and management of the patient as described in Section 4.3.1 by referring clinician #1 and Section 4.4.1 by the radiologist.

MacFarlane, Clerkin, and Murphy explain that in telemedicine settings, it is common to see the end users taking up the responsibility of organising and delivering services.<sup>12</sup> Findings from their study revealed that referring clinicians and other health professionals practicing in telemedicine settings often "...go beyond the call of duty" by performing additional tasks, similar to those expressed by the participants in this study, such as facilitating transmission of radiological images. Here it is demonstrated that both the referring clinicians and radiographers are practicing responsibly in accordance with radiation safety legislature when utilising teleradiology systems. The next point that became evident is the existence of teleradiology guidelines as another factor that contributes positively to service delivery, which is discussed next.

#### 4.6.1.3 Existence of teleradiology guidelines

In the undertaking of any health care project, there needs to be clear rules and guidelines.<sup>22</sup> Teleradiology is one of these projects that require sound guidelines, which are to be reviewed regularly, taking into consideration the specific context in which the teleradiology setting exists.<sup>88</sup> It was found in the Dr RSM that there are two teleradiology guidelines available for the end users to use, namely the North West Teleradiology SOP manual as well as the North West CT Scan Request Guidelines.<sup>8,36</sup> These documents are available in the radiography department and comprise of a comprehensive compilation on how to appropriately request for CT examinations, as well contrast administration and response to anaphylactic reactions. The participants also alluded to the SOP not being utilised optimally. However, it is evident through the participants' experiences of the teleradiology practices that there are still requests being made for the radiological examination. This is a positive factor as it means that the participants take into consideration the use of x-radiation and the need to protect the patients, as well as other users from unnecessary exposure to the minimum.

It was also apparent that these positive factors contributed to the provision of services to the community in this district. This confirms that theme one relates to research objective two as well:

### **Research objective two**

To describe the impact that teleradiology has on service delivery to the rural community of the Dr RSM district.

The inter-professional relations and collaboration between teleradiology end users, as expressed by the research participants, can be described as having adopted strategies to enhance patient centeredness. Through this interprofessional relations and the availability of teleradiology guidelines, can be regarded as positive contributors to the delivery of services to this rural community in the Dr RSM district. The next section focuses on theme two.

#### **4.6.2 Theme two: Factors that negatively influence teleradiology utilisation and service delivery**

Similar to theme one, certain aspects from all categories of end users culminated into theme two. As discussed in the previous section, utilisation of the teleradiology systems appear to have a direct impact on service delivery. For this reason, theme two will be discussed in relation objective one and two. It was further demonstrated in theme one that the teleradiology end users take on active roles to ensure ongoing utilisation of the teleradiology systems. There are however, other factors that seem to stand in the way of achieving a fully operational and high-quality service that can be achieved through the use of teleradiology. These barriers seem to dominate the experiences and views which were shared by the different groups of participants. These include suboptimal teleradiology infrastructure, strains in inter-professional relations, unavailability of the radiologists, and limited skills and competency of the radiographer and referring clinician with regards to CT examinations.



#### 4.6.2.1 Suboptimal teleradiology infrastructure

Through extensive literature review and from the narratives of the participants, technical challenges were highlighted as an ongoing challenge in teleradiology applications. Daniels, an independent PACS administrator reiterates that infrastructure is the most important aspect in teleradiology.<sup>75</sup> He further states that strong networks to uphold these systems are lacking in government health care departments of South Africa.<sup>75</sup> This is particularly important to note in this study, given the fact that the teleradiology end users are not only practising in government health care institutes, but also in rural settings, thus decreasing the availability of technical support in comparison to their urban counterparts as indicated by Mulla in Section 2.3.<sup>79</sup> The reader is hereby reminded of the complex network system that exists in teleradiology as described in Section 2.4. From there it is evident that the entire technical aspect of teleradiology systems heavily depend on internet connectivity to operate, which is out of the control of the end users themselves.

From all the focus group interviews, mention was made about poor internet connectivity, which seems to compromise teleradiology utilisation. This appears to affect the radiologist and referring clinicians the most, who depend on the transfer of images and reports respectively, to ultimately deliver a service, as indicated by the referring clinicians in Section 4.3.1 and radiologists in Section in 4.4.1.

These challenges in teleradiology are not unique to this district, but have also occurred in the Eastern Cape province.<sup>17</sup> Hauman reported that certain components of the teleradiology system could be functioning perfectly, however if there is no internet connection, service delivery is impossible.<sup>17</sup> These sentiments were also echoed by some of the participants of this study who attributed delays in service delivery to connectivity. It is stated in the eHealth strategy (2012-2016) that there is a need to strengthen the effectiveness of healthcare systems. With reference to this statement, internet connection and bandwidth needs to be improved, such that internet connection is consistent and reliable.<sup>15</sup>

#### 4.6.2.2 Strains in inter-professional relations

In Section 4.6.1.1 it was highlighted that a certain degree of inter-professional collaboration does indeed exist between the end users. However, in this section we explore another perspective expressed by the participants that could potentially negatively impact on service delivery. There are feelings of professional dominance expressed by the radiographers between themselves and the referring clinician, as reported by radiographer #1, who stated: *“The doctor dictates, we must just do the scan”*.

This phenomenon is not unique to these end users specifically but is a long standing issue of contention amongst health professionals in general. Salahni and Coulter elaborate on this and explain that nurses and occupational therapists also have feelings of decreased autonomy and heightened professional dominance by doctors.<sup>124</sup> Their findings revealed that the doctors were not aware that the nurses and occupational therapists harboured those feelings and explained that they did not intend to create that kind of environment in their setting.<sup>124</sup> Similar views were identified in this study, whereby the referring clinicians seem not to be aware of the radiographer’s feelings and the radiologists, not aware of the other teleradiology end users’ feelings. This is evidenced by the following view expressed by referring clinician #1 who stated: *“The relationship we have is good [between radiographer and themselves], when we request a scan it’s less likely that it won’t be done”*. From the views expressed by the radiologist, regarding consultations, it was evident that the notion of discussing paediatric and angiogram cases with the referring clinicians was welcomed. This is in contrast to the views of the referring clinicians who stated *“When we call [the radiologist], it’s like we calling to hear their voice, they [radiologist] say you have the patient there, use your clinical judgement.”* Referring clinician #2

The phenomenon can be interpreted as a break in communication amongst radiologists and referring clinicians, whereby one is not aware of the policies regarding consultations. This can further be interpreted as a possible cause for tension among the teleradiology end users. Sustainability of health care projects, particularly in rural settings, has a lot to do with a staff complement of skilled professionals.<sup>133</sup> Campbell, McAllister and Eley describe intrinsic factors that influence health professionals to stay or leave rural settings, namely challenge, autonomy with specific reference to case

management, and significance of work.<sup>133</sup> In this study the researcher extracted from the radiographer's views, that there was a sense of decreased autonomy with regards to CT requests.<sup>133</sup> Although it was mentioned that referring clinicians discuss the CT requests with the radiographers, it appears that the radiographer's opinion is still not taken into consideration thus leaving the radiographers with feelings of self-doubt and decreased motivation. This negatively impacts on service delivery as the radiographers are less likely to do more than what is expected of them.<sup>12</sup>

One radiographer seems to feel this way at times and describes the impact this has on service delivery by stating: "*Patient is being delayed in the sense that it is an, urgent case, but now being delayed because we cannot get a radiologist who is supposed to be available to us 24 hours so it goes back to a delay in service delivery*".

Reiner underscores the importance of communication between the radiologist and other teleradiology end users and explains that matters regarding protocol selection, clinical, and imaging history all can directly or indirectly influence the overall quality of the report, and the standard of radiological service a patient receives.<sup>58</sup> The researcher further identified that this strain between the radiologists and teleradiology end users is further exacerbated by their unavailability, which will be explored in the next section.

#### 4.6.2.3 Unavailability of radiology services

As highlighted in Section 1.1, eHealth applications, such as teleradiology is aimed at bridging the gap, particularly between specialists in urban areas and health professionals in rural areas, by means of consultations through the telephone. However, what was found in this setting, is that consultations with the radiologist don't happen on regular basis. The radiographers expressed concerns regarding this area, and further expressed vulnerability when they were not able to make contact with the radiologist, with radiographer #1 stating: "*In that space of time, no one is advocating for you*".

Although the referring clinicians at times contact the radiologists, it appeared as though there was a reluctance from the radiologist to further engage as noted in Section 4. 3.3. Legido-Quigly, Doering and Mckee shared similar findings, and stated

that the most frequently reported negative aspect in teleradiology was the radiologists' inability to keep a continuous communication with the referring clinician.<sup>22</sup> Participants in their study attributed this to high volume of work and an almost production line setting. These sentiments concur with Benjamin, Aradi and Shreiber, who state that teleradiology services become inefficient in terms of high level throughput, when multi-sites are being handled, as in the case with most teleradiology models.<sup>55</sup> In this study the radiologists, also servicing multiple sites, stated that their volume of work contributed to delays in report, and indicated that the cases received by the Dr RSM site often comprised of long examinations. The experiences regarding radiologist unavailability is again not unique to this district, but was also noted in the USA, whereby it was reported that increasing work load demands have made remote consultations less effective.<sup>58</sup>

#### 4.6.2.4 Limited skills and competency of the radiographer and referring clinicians for CT examinations.

In all the focus group interviews, it was highlighted that radiographers are lacking specialised skills in the CT department. The radiographers themselves expressed lack of confidence with regards to decision making on the appropriateness of the CT examination, as stated by radiographer #4. When junior or new radiographers enter the CT environment, they are dependent on their limited undergraduate training in CT as described in Section 2.6.1, as well as senior staff within the CT department to adequately train them to ensure a consistent standard of imaging quality.<sup>130</sup> However, in the context of this study, it appears that adequate training is not taking place at the teleradiology site, resulting in the improper and underutilisation of CT applications. This is especially so, when considering the need for specialised imaging such as angiograms and additional imaging sequences. This notion was echoed by the referring clinician #3 who stated: *"I experience problems getting CT Angio [Angiogram], when it comes to CT Angio not all radiographers can do that."*

The quality of the examinations coming through from the radiographers was a particular issue of concern for the radiologist who stated: *"Generally planning of the cases are not done correctly. Images that are sent are not adequate, it's only sent in only axial, it's either missing the sagittal or coronal views, lung windows."*

A study conducted by Andronikou, confirmed poor quality images as a limitation in teleradiology and attributed this to the radiologist being at a distant location and having little influence over the radiographer performing the radiological examination.<sup>80</sup> Swensen and Johnson formulated a radiology quality map in which they describe several aspects that must be covered in radiology practices to ensure the adequate quality of radiological images.<sup>134</sup> One of these aspects include protocol selection and the standardisation of best practices. These authors elaborate that the radiologist determines how the examination will be carried out and carefully guides the radiographer in doing this.<sup>134</sup> When reflecting on the context of this study, it can be seen that radiographers have to take on this role independently, therefore less than optimal images are expected.

The referring clinician's competency in the CT department also came under scrutiny by themselves and the radiographers. The radiographers expressed concerns over the referring clinicians wanting to experience what CT examinations are about as narrated by radiographer #1 in Section 4.2.1, without a proper justification for the scan. The ACR have developed the appropriateness criteria with which referring clinicians must guide their request for medical imaging.<sup>88</sup> However, Swenson and Johnson argue that often complex and urgent cases require customised care. These sentiments are shared by the American Society of Physicians, who state that while radiation safety remains a priority, the diagnostic benefit of the examination in comparison to the radiation risks should be taken into consideration, particularly when urgent cases are involved.<sup>134</sup> However, in the context of this study, the radiographers state that referring clinicians often request urgent examinations that do not appear to be urgent as indicated by radiographer 4 in Section, 4.2.1.

The referring clinicians themselves expressed discomfort in having to inject contrast media and shared their fear of not knowing how to react if a contrast induced anaphylactic reaction were to occur, as described by referring clinician 9 in Section 4.3.2. However, the American Academy of Family Physicians indicates that it is within the scope of practice for a medical practitioner to recognise and quickly respond to anaphylactic reactions.<sup>135</sup> These barriers are seen to result in poor utilisation of teleradiology systems and service teleradiology. The end users provided noteworthy recommendations to these challenges, which culminated into theme three.

#### **4.6.3 Theme three: Strategies for improving teleradiology utilisation and service delivery**

In theme one and two, positive and negative factors were discussed. In this theme recommendations emerged from all focus group interviews, thus directly addressing research objective three:

##### **Research objective three:**

To provide recommendations on how the utilisation of teleradiology systems for CT examinations in the Dr RSM district can be improved.

When an organisation wants to improve on the quality of a programme or a system, one should incorporate a continuous quality improvement plan<sup>136</sup>. Pap further mentions, the focus of this lies in the process in which employees run an operation, rather than on the employees as individuals.<sup>136</sup> This statement directly applies to this study, where it was evident that the participants' experiences were not unique to this Dr RSM setting, but also shared amongst other teleradiology and health care settings.

According to Pap, in developing a continuous improvement plan, one must harness the positive contributing factors that exist within the system and identify ways to enhance these successes.<sup>136</sup> Problems must be identified and strategies for improving these, particularly from the end user, must be suggested.<sup>136</sup> In this study, both positive and negative factors in teleradiology were identified. Through the interrogation of data and the application of inductive strategies, the researcher was able to identify the following recommendations for the teleradiology services in the Dr RSM district.

##### **4.6.3.1 Recommendation to improve channels of communication among the end users.**

In the previous two themes, communication was highlighted, which is evidenced by the fact that patients are being referred, and CT examinations are being performed.

The communication however, is not optimal and hence the recommendation by the participants is to have it improved. It should further be noted that communication is at the centre of all other activities including interpersonal relations, requests for the CT examinations, as well as the interpretation and putting into practice the guidelines as provided in the SOP.<sup>8</sup> In addressing issues of break in communication, radiographer #4 suggested that there be a review of the current SOP.<sup>8</sup> By doing this, everyone will have the same understanding of what is expected of them to alleviate this challenge. The radiologist suggested that the ideal setting would be one where there is constant communication through platforms such as Skype or simple messaging. The referring clinicians, however, felt that they needed face to face contact with the radiologists from time to time, as explained by Referring clinician #1, that it would be beneficial to see the radiologists at least once in two or three to discuss cases. This view was also shared by Radiographer #1 who emphasised the need for quarterly meetings between themselves and the radiologists to discuss challenges and find solutions. These recommendations were noted to already be in place in the NW Teleradiology SOP,<sup>8</sup> which states under section eight - Lines of communication:

- The Service Provider [radiologist] shall provide reasonable assistance to radiographers and other relevant personnel in drafting clinical protocols and guidelines on special examinations.<sup>8</sup>
- The Service Provider [radiologist] shall facilitate and participate in Continuous Professional Meetings (CME) for health professionals in the province.<sup>8</sup>
- The Service Provider [radiologist] shall attend quarterly performance evaluation meetings with relevant stake holders to evaluate the project.<sup>8</sup>

From the views expressed by all participants in relation to the NW teleradiology SOP, it is evident that these measures have already been put into place. However, it appears that these measures are not being adequately followed, leading to the break in communication experienced by all groups of participants.

#### 4.6.3.2 Recommendation to improve the skills of the teleradiology end users in the Dr RSM district

In theme two it was indicated by both the radiologist and referring clinicians that the radiographers needed some upskilling in their CT training. The radiologist recommended that one way of supporting the radiographer in this aspect was to have written protocols. He further elaborated on this by saying that there could be provision of guidelines specific to a region of interest or condition. It was however stated in the interpretation of theme two, that such planning of the CT examination is determined and guided by the radiologist, a luxury that is not available to the radiographers. Therefore, it is interpreted as a call for the need to extend the scope of the radiographer to address this gap.

In theme two it was further highlighted by the referring clinicians themselves that they need to be upskilled with regards to administering contrast media. Suggestions were made by Referring clinician #1, that there could be training on contrast media administration per semester for staff who don't have the necessary information. This recommendation further addresses the need for orientation of new staff to the teleradiology setting.

#### 4.6.3.3 Recommendation to improve the overall teleradiology service in the district

Concern was raised by the radiographers and referring clinician on how the poor turnaround time was impacting the services provided to the patients in the district. Some radiographers seem to raise concerns with the mode in which they are receiving the reports. Radiographer #2 suggested reports be faxed to each hospital, and not emailed. This recommendation is worth noting, given the inconstant internet connection experienced in this district, which may inhibit the retrieval of reports from the radiologist. The referring clinicians suggested a more technical based solution by recommending an easier access to their reports and images, whereby they can click on a system within their own departments to retrieve information without having to go to the radiology department. This recommendation is in line with current PACS systems which encompasses this retrieval function for hospitals, whereby the patient's



imaging history and reports are available for the end users, particularly referring clinicians to access at any time at the teleradiology sites and district hospitals, as described in Section 2.5.2.<sup>55</sup>

From the exploration of the three themes the following findings were drawn, namely: Teleradiology is being utilised for CT scan examinations in the Dr RSM district, teleradiology end users have respect for each other's professional identify, teleradiology end users want to be upskilled, and the need to strengthen teleradiology infrastructure.

#### **4.7 CONCLUSION**

In this chapter the codes and categories from each focus group interview were presented. This was followed by an analytical reflection of data, discussed in relation to literature and how previous studies viewed the identified category. In comparing the outcome from the three groups of end users, the research identified some similarities and some differences. From the identified similarities, the researcher was able to extract the three major themes which were related to objectives one, two and three. Three themes emerged, namely: a) factors that positively impact on teleradiology utilisation and service delivery, b) factors that negatively impact on teleradiology utilisation service delivery and, c) strategies for improving teleradiology utilisation and service delivery. The interpretation of these themes led to the identification of major findings, namely: a) teleradiology is being utilised for CT examinations in the Dr RSM district, b) the teleradiology end users respect for each other's professional identity, c) onsite teleradiology end users want to be upskilled and, d) there is a need to strengthen teleradiology infrastructure. The findings will be elaborated on in the next chapter.

## CHAPTER FIVE

### RESEARCH FINDINGS, RECOMMENDATIONS AND CONCLUSION

*“The secret to longevity: If something was broken, you fixed it, not throw it away”*

Unknown Author

#### 5.1 INTRODUCTION

In chapter four the reader was provided with a detailed description of the analysed data from all three groups of teleradiology end users. These included codes, categories, as well as the interpretation of the emerging themes. Through the induction strategy, the interpretation of the three themes resulted in the identification of the major findings, namely: a) teleradiology is being utilised for CT examinations in the Dr RSM district, b) the teleradiology end users respect for each other’s professional identity, c) onsite teleradiology end users want to be upskilled and, d) there is a need to strengthen teleradiology infrastructure. These findings will be elaborated, and the overall conclusion will be drawn from the study. The chapter will also include limitations and recommendations for further study.

#### 5.2 RESEARCH FINDINGS

According to Grove and Gray, when interpreting the data of an exploratory descriptive design, the researcher must also address all the research questions that the researcher aimed to answer prior to the commencement of the study.<sup>28</sup> The first finding is discussed next.

##### 5.2.1 Teleradiology is being utilised for CT examinations in the Dr RSM district

The reader is reminded that the teleradiology systems were introduced with the aim of improving access to specialised healthcare services. The service that was identified as lacking in the district as far as medical imaging is concerned, was specialised reporting for CT examinations. Contrary to what was reported by Wootten *et al.*<sup>81</sup>, that

teleradiology services had stopped in the North West province in 2009, this study has demonstrated that teleradiology systems are functioning and are being utilised by teleradiology end users in Dr RSM district. Following the exploration of the views of the teleradiology end users, and relating these to literature, the researcher was able to ascertain that in 2013, all teleradiology sites in the North West province were issued with standard operating procedures. This was to assist in standardising teleradiology practice across the province. It can be assumed that the teleradiology services were resumed then. What was found in the interpretation of theme one to three, is that the teleradiology SOP needs to be reviewed in such that it addresses the specific needs of the teleradiology end users of this district. It must be noted that this SOP is for teleradiology sites of the whole North West province that have at least one radiologist, however in the Dr RSM district, there is no onsite radiologist. Through the narratives of the participants highlighted in Chapter 4, various other factors were identified as being instrumental in providing a continued service of specialised CT imaging and radiological reports through teleradiology systems.

eHealth strategies around the globe and in Africa have been known to face several sustainability challenges as described in Sections 2.2.1 and 2.2.3. What is positive to draw from this study, is that together with government initiatives, such as the National Development Plan 2030 and eHealth strategy 2016 - 2017, as well as the dedication seen from the end users, teleradiology systems were able to be revived and largely benefit this community, which is in desperate need of health care. The reader is hereby reminded that the Dr RSM district falls under one of South Africa's most socially vulnerable communities as illustrated in Chapter 2, Section 2.2.3. It must however be highlighted that the entire teleradiology operation still faces challenges in utilisation, which takes the system from functioning optimally to sub-optimally, and influences the degree of service delivery received by the rural community. As mentioned, the Dr RSM community are receiving a specialised imaging service encompassing a CT examination and the report thereof however, this service is noted to be sub-optimal due to the fact that patients often have to wait for extended periods before receiving the radiological report, delaying their treatment.

### **5.2.2 Teleradiology end users have respect for each other's professional identity**

As identified in Chapter 4, Section 4.6.1, it was evident that communication was a thread woven into all themes, which is meant to hold the teleradiology operation together. Communication amongst the teleradiology end users plays a key role in ensuring that the teleradiology services are delivered in a way that will contribute to the quality of life of the patients in the district.

Despite the strains in inter-professional relations as expressed by some of the teleradiology end users, the three professional groups have been able to communicate to provide a service to the Dr RSM district. This indicates that they still respect each other's professional identity, and referring clinicians are still following the correct process of requesting for CT scan examinations. This entails booking the patient and discussing the case to a certain degree. Conflicting situations were seen to arise when there is a difference in opinion on the validity of the examination, to which the radiographer becomes submissive to the doctor's decision, thus respecting his or her hierarchal role within the health team. It is also evident that the radiologist as a specialist is respected in the sense that for certain cases both the referring clinicians and the radiographers seek the guidance and expertise of the radiologist, who often becomes the mediator when issues of conflicting opinions arise. Lastly, what is interpreted from the radiologist's aspect is that they provide the onsite end users with professional autonomy to make decisions regarding cases on their own, aided with the CT scan request guidelines.

This type of collaboration is endorsed by the ISSRT, who support radiographer autonomy when it comes to issues of justification and authorisation (ISSRT policy document). At the same time, the American Association of Physicists in Medicine (AAPM)<sup>137</sup> supports referring clinician's autonomy when it comes to negotiating for a scan to be done in cases where the benefit of the CT scan outweighs the associated radiation risks, particularly for urgent cases. When reflecting on the participants' views in relation to the legislature stipulated by these two bodies, it can be seen that the end users are respectful towards the roles that each of them have to carry out to maintain a patient-centred approach in the teleradiology setting, however at times they may not

fully agree with the final decision taken, this in turn was found to harbour negative feelings within some of the end users towards their own professional identity and the other end users. Examples of this were highlighted by radiographer #4 who said, “the doctor dictates and we just have to do the scan”. To improve this relation and enhance the effectiveness of the teleradiology operation, it is recommended that inter-professional and multidisciplinary workshops be held with the teleradiology end users, whereby they learn about each other, from each other.<sup>123</sup>

Wahab *et al.* explain that inter-professional education is important in maintaining collaborative and non-hierarchical relationships in healthcare.<sup>123</sup> Inter-professional education is not only used to enhance skills, but suggests that it can be used as an effective tool to cultivate a sense of appreciation for other health professionals’ roles within the team.<sup>138</sup> It is assumed, that once a culture of togetherness is achieved between the end users, they can channel their concerns towards addressing issues that are common to them, namely connectivity challenges and training needs.

The impact that this has on service delivery, is that the teleradiology end users of this district, are at times able to put aside their differences to continue to provide a radiological service to the patient.

### **5.2.3 Onsite teleradiology end users want to be upskilled**

In Section 5.2.2 the reader was made aware of the fact the onsite teleradiology end users have some professional autonomy with regards to requesting and authorising examinations, in a setting without an onsite radiologist. The challenge that arises is when this autonomy is not applied correctly, which leads to conflict and strains in inter-professional relations, and compromises radiation safety to the patient.

What is needed is for the end users to be upskilled in the knowledge they do have regarding the CT scan context. From the radiographer focus group interview, radiographer #4 emphasised that they found it difficult to exercise decision making in the CT context by saying “me I personally feel like I can’t make that decision”. However, the act of booking, which the radiographers do in this setting, requires them

to make decisions, indicating that this forms an integral of the teleradiology operation for the radiographer. In Chapter 4, Section, 4.3.2, the junior referring clinicians expressed similar views as the radiographers.

From the interpretation of the data, it is apparent that the radiographer is taking on roles in the CT context that are essentially the responsibility of the radiologist. These roles were described in Section 2.5.3. However, from the narratives one gets a sense that the onsite end users need further support, particularly those who have the responsibility to carry out added duties but feel ill-equipped to do so. The eHealth strategy identifies this as an important aspect for the sustainability of eHealth projects.

In this document some universities in Kwa-Zulu Natal and Western Cape are listed to offer introductory telemedicine training programmes, aimed to develop competent and skilled telemedicine practitioners.<sup>15</sup> However, due to the large geographic dispersion between the North West in relation to these provinces, as well as the economic constraints faced by the North West Department of Health, this would not be an affordable and practical solution to the training needs of the Dr RSM teleradiology end users. Based on the needs analysis of the end users it would be more effective to have in house training within the district itself. This training should be structured and consistent, focusing on the requirements for each category of end users' needs. Examples of this include responses to contrast induced anaphylactic reactions, which some referring clinicians indicated they are still not confident in handling. The IAEA also support the notion of further training in radiology departments and advised that "government shall ensure that arrangements are in place for the provision of education and training services required for building and maintaining the competence of persons and organizations with responsibilities relating to protection and safety".

It is presumed that by upskilling the onsite end users, the quality of examinations and safety of the patients will improve considerably. By achieving this, service delivery to this rural community will be enhanced with regards to the quality of radiological service they are receiving.

#### **5.2.4 The need to strengthen teleradiology infrastructure**

In this study, it was found that there is a large demand for teleradiology services, given the geographical location and social vulnerability index of this district. This is evidenced by the radiologist's experiences with an increased volume of cases coming from the teleradiology site and the fact that these cases are long. This indicates that CT is also commonly used in the district for oncology work up cases as alluded to by the referring clinicians. When issues of increased work load arise, it is presumed that increasing human resource can meet the growing demand for services. However as described in Section 2.3, South Africa is already faced with dire shortages of radiologists and the notion of having more radiologists appears to be an impractical solution for an already human resource constrained environment. Benjamin, Aradi and Shreiber suggest that when issues of increased work load arise, radiology service providers should consider upgrading their current infrastructure, whereby referring clinicians can readily access their patients' images and reports, thus cutting out the additional delay of faxing or emailing the report, as seen in the context of this study.<sup>55</sup> These authors further suggest that teleradiology service providers should also consider outsourcing other radiology service providers to assist with the work load.<sup>55</sup> The eHealth strategy further endorses improvement of infrastructure and partnering with the private sector to improve access to health care.<sup>15</sup>

### **5.3 LIMITATIONS**

It is standard practice that for every research project, limitations be highlighted, as well as how they were addressed in the study.<sup>15</sup> The following limitations were found in this study:

- At the time of data collection, there was a significant decline in the number of radiologists employed at the radiology practice. This resulted in only one radiologist being able to partake in the interview. As noted to in Chapter 3, Section 3.2, the nature of qualitative research is not to gather large quantities of data, but rather attain authentically described experiences regarding a specific phenomenon.<sup>141</sup> This was achieved by the radiologist describing the challenges that they face when reporting for this particular district, as well possible solutions to overcoming them. The challenges described were similar to that of the other teleradiology end users, indicating that

despite the geographic location, teleradiology end users share similar challenges to each other.

- The second limitation to the study was that the research assistant was not from within a medical background. This resulted in some errors in medical terminology in the notes that were captured by the research assistant (Annexure K and L). The researcher ensured that this did not have any impact on the research findings, by going through all the notes with the research assistant and correlating them with the audio recording and final scripts.
- The third limitation of the study was that the researcher was an insider to the research, as the researcher practiced within the setting before. To ensure that the researcher's previous experience did influence the way data was collected, interpreted and presented, the researcher employed various methods to ensure credibility and reliability that were explained in Section 1.8.4. Some of these methods included member checking, use of a co-coder, and triangulation. Tufford explains that the researcher must declare their prior knowledge and experience of the social context that is about to be explored.<sup>142</sup> This was provided in Section 1.2, where the researcher listed all personal observations while practising in the clinical setting. The researcher further highlighted the fact that they were wholly interested in the participants' experiences, and not trying to compare the researcher's personal views to that of the participants.

## **5.4 RECOMMENDATIONS**

Undertaking this research project has been a great eye-opener for the researcher. Being an insider in a qualitative research project, the researcher is at the point of making recommendations which can guide further studies in the field of eHealth and the radiography profession.

- This being a qualitative research that was also limited to one district in the North West, means that the findings cannot be generalised to other parts of the province or SA as a whole. It must be highlighted however, that the aim of this research was not generalise, but rather to explore the views of end users in this



district who function as a true teleradiology unit, whereby the radiologist is in a remote location unlike other sites who have at least one onsite radiologist. It is therefore recommended that future studies be conducted at these sites, which compare how they differ to the Dr RSM district, extracting strengths and weaknesses for further improvements.

- It was reported by Wootton *et al.*, that teleradiology and tele-ultrasonography in the Free State and Northern Cape provinces have also stopped along with the North West province.<sup>81</sup> As discovered through this study, teleradiology services have resumed in the North West province, however it is unknown if this has also occurred in these two mentioned provinces. For this reason, it is recommended that future studies be conducted in these two provinces to ascertain whether these rural communities are receiving radiological services. The studies can even be extended to include all provinces in SA.
- Teleradiology in the Eastern Cape, Kwa-Zulu Natal, and Western Cape have been reported to be functioning efficiently.<sup>10</sup> It will therefore be valuable to conduct a comparative study to identify the strengths of these sites and how these can be applied to teleradiology operations in the North West province or any other province in South Africa.
- Despite the poverty and lack of access to health care being wide spread across South Africa, teleradiology has not been well documented across all provinces. This was attributed to lack of feedback from certain provinces, such as Limpopo, Northern Cape, Mpumalanga.<sup>10</sup> For this reason, it will be worthwhile investigating the needs of these rural communities in terms of radiological services, and how eHealth strategies can be used to address this.
- The study was further limited to CT examinations only and the need for the radiologists to offer advice or interpret the CT images. It is not known how the other radiology services are being offered to the communities in the North West province. By other radiology services, reference is made to general radiography, fluoroscopy, and other procedures, like ultrasound or theatre

radiography. Further studies should be conducted in other areas of specialised imaging such as mammography, fluoroscopy, and ultrasonography, to determine if eHealth strategies are actually being utilised to improve the quality of life of the communities in rural areas of the North West province or South Africa as a whole.

## **5.5 CONCLUSION**

The study addressed the research questions, namely: What are the teleradiology end users' views on teleradiology utilisation for CT examinations in the Dr RSM district? How does teleradiology impact the services provided to this rural community with specific reference to CT examinations? The study addressed all the research objectives whereby the researcher managed to explore the teleradiology end users' views on teleradiology utilisation for CT examinations in the Dr RSM district, describe the impact that teleradiology has on service delivery in the Dr RSM district, and finally provide recommendations on how the utilisation of teleradiology systems for CT examinations in the Dr RSM district can be improved.

The study also managed to achieve the aim of the study, which was to explore and describe the views of teleradiology users regarding the utilisation of teleradiology for CT examinations and the impact it has on service delivery in the Dr RSM district. The research findings were drawn from the experiences of all groups of teleradiology end users. These experiences were further interrogated alongside literature to bring an overall meaning to the experiences that end users shared. This is the inductive reasoning that is core to qualitative research approaches. It can therefore be concluded that teleradiology has had positive effects on service delivery by virtue of the fact the Dr RSM community is receiving a specialised service, that was not existent before. Although success of these teleradiology systems are largely influenced by technical factors, it is the end users who are the driving force behind promoting the delivery of quality health care service.

It is therefore concluded that although a service is being delivered, it is not optimal. This is with regards to service delivery often being delayed, when there is break in communication between the end users and during times of technical failures. The

teleradiology service was also seen to be at times compromised due to end users not having adequate skills, in terms of the actual scanning and appropriate imaging referral knowledge. Service delivery using the teleradiology system can however be improved by taking into consideration the recommendations that were made by the end users themselves and described in Section 5.3. It must be noted that most of these recommendations already exist in the NW Teleradiology SOP, however there is a need to ensure stricter measures for implementation and the monitoring.

When reflecting on the ultimate goal of qualitative research, which is to bring about positive change by understanding the context in which people practice and the challenges they face,<sup>108</sup> it can be concluded that this research has met this goal in terms of exploring, describing, and understanding the experiences of teleradiology end users of this district.

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## ANNEXURE A

- University of Pretoria, Faculty of Health Sciences Research Ethics Committee approval certificate

The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal Wide Assurance.

- FWA 00002567, Approved dd 22 May 2012 and Expires 28 August 2018.
- IRB 0000 2235 IORG0001762 Approved dd 22/04/2014 and Expires 22/04/2017.



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee

24/11/2016

### Approval Certificate New Application

Ethics Reference No.: 423/2016

**Title:** Exploring the views of telerradiology end users regarding its' utilisation and impact on rural health services in Dr RSM district, Northwest

Dear Hafsa Rahman

The **New Application** as supported by documents specified in your cover letter dated 14/11/2016 for your research received on the 14/11/2016, was approved by the Faculty of Health Sciences Research Ethics Committee on its quorate meeting of 23/11/2016.

Please note the following about your ethics approval:

- Ethics Approval is valid for 1 year
- Please remember to use your protocol number (**423/2016**) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, or monitor the conduct of your research.

Ethics approval is subject to the following:

- The ethics approval is conditional on the receipt of **6 monthly written Progress Reports**, and
- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

#### Additional Conditions:

- The Recommended conditional approval, on condition that no research may begin without a permission letter from the sites first being submitted to the Research Ethics Committee.

We wish you the best with your research.

Yours sincerely—

Dr R Sommers, MBChB, MMed (Int), MPharm, PhD  
Deputy Chairperson of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

*The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 51 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).*

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## ANNEXURE B

- North West department of Health, Policy, Planning, Research, Monitoring and Evaluation approval letter



### POLICY, PLANNING, RESEARCH, MONITORING AND EVALUATION

**Name of researcher :** Mrs. H. Rahman  
University of Pretoria

**Physical Address** \_\_\_\_\_  
**(Work/ Institution)** \_\_\_\_\_  
\_\_\_\_\_

**Subject :** **Research Approval Letter – Exploring the views of teleradiology end users regarding its utilization and impact on rural health services in Dr. RSM District.**

This letter serves to inform the Researcher that permission to undertake the above mentioned study has been granted by the North West Department of Health. The Researcher is expected to arrange in advance with the chosen facilities, and issue this letter as proof that permission has been granted by the Provincial office.

This letter of permission should be signed and a copy returned to the department. By signing, the Researcher agrees, binds him/herself and undertakes to furnish the Department with an electronic copy of the final research report. Alternatively, the Researcher can also provide the Department with electronic summary highlighting recommendations that will assist the department in its planning to improve some of its services where possible. Through this the Researcher will not only contribute to the academic body of knowledge but also contributes towards the bettering of health care services and thus the overall health of citizens in the North West Province.

Kindest regards

**Mr. L.P. Moaisi**  
Acting Direc



23/02/2017

Date

\_\_\_\_\_  
Researcher

\_\_\_\_\_  
Date



Healthy Living for All

## ANNEXURE C

Invitation to attend focus group interview:

Radiographer and referring clinicians

To: Head of Clinical services

**RE: Teleradiology focus group interview**

I, Ms Hafsa Essop, researcher at the University of Pretoria, wish to extend a formal invitation to you and your clinical department to attend a teleradiology focus group interview.

The meeting will involve clinicians and radiographers who utilise teleradiology services in the Dr RSM district. This meeting will create a platform for teleradiology end users to share their experiences regarding teleradiology services and its impact on clinical services as well as to provide recommendations for improving the service. The outcomes of the study will be given to all participating departments and the North West Policy, Planning, Research, Monitoring and Evaluation department to assist in guidelines being reviewed or reinforced.

I am kindly requesting that the number of clinicians attending be finalised by the 13<sup>th</sup> of March for catering purposes.

**Date: 22 March 2017 - Radiographers**

**23 March 2017 – Clinicians**

**Time: 09h00**

**Venue: Joe Morolong Memorial Hospital Boardroom - Refreshments will be served.**

Thank you for your valuable time.



Ms H. Essop

Principle Researcher/Clinical lecturer

Cell +27 715897939

Email: hafsa.essop@up.ac.za



## ANNEXURE D

Invitation to participate in focus group interview

Radiologist

To: The Practice Manager

**RE: Teleradiology focus group meeting**

I, Ms Hafsa Essop, researcher at the University of Pretoria, wish to extend a formal invitation to you and your radiologists to attend a teleradiology focus group interview

This meeting will create a platform for the radiologists who report on examinations to the Dr RSM district, to share their experiences regarding teleradiology systems and its impact it has on service delivery. The outcomes of the study will be given to all participating departments and the North West Policy, Planning, Research, Monitoring and Evaluation department to assist in guidelines being reviewed or reinforced.

I look forward to hearing from you.

**Date: 11 April 2017**

**Time: 09h00**

**Venue: Rand Clinic Radiology Department**

Thank you for your valuable time.



Ms H. Essop - Rahman

Principle Researcher/Clinical lecturer

Cell +27 715897939

Email: hafsa.essop@up.ac.za

## **ANNEXURE E**

Information leaflet and consent form

Radiographers

### **INFORMATION LEAFLET FOR PARTICIPATION**

**STUDY TITLE:** Exploring the views of teleradiology end users regarding its utilisation and its impact on rural healthcare in the Dr RSM District, North West province.

#### **1. INTRODUCTION**

You are invited to participate in a research study to investigate the value of the current eHealth systems, namely teleradiology, in providing a healthcare service delivery in radiology departments of the North West province. If you require any further information regarding the study, please do not hesitate to ask the researcher.

#### **2. THE NATURE AND PURPOSE OF THIS STUDY**

The purpose of this study is to explore the views of teleradiology end users operating at a grass roots level, in order to explore the current state of teleradiology in the North West province. This data will help establish if healthcare service delivery using eHealth, has improved or regressed from the first teleradiology implementation.

#### **3. EXPLANATION OF PROCEDURE**

You will be invited to attend a focus group interview at the Memorial Hospital, Executive Boardroom on the 22nd March 2017, together with other radiographers from various hospitals within the district, who use teleradiology systems. The researcher will then ask you a series of questions pertaining to your views and experiences regarding teleradiology in your setting. All the responses from the participants will be written and voice recorded to ensure no information is missed while writing.

#### **4. RISK AND DISCOMFORT INVOLVED**

There will be no physical discomfort or risk when participating in the interviews. If you however feel uncomfortable with the questions being posed or expressing your opinions, you are free to discontinue the interview at any point.

#### 5. POSSIBLE BENEFITS OF THIS STUDY

The study envisages shedding light on new issues and challenges that have arisen from the last telemedicine evaluation in 2000. The data collected from this study envisions to provide recommendations to improve the current teleradiology utilisation and thus service delivery to the community of the Dr RSM district.

#### 6. ETHICAL APPROVAL REGARDING THE RESEARCH STUDY

The study will only commence once ethical clearance has been granted from the Ethics Committee of the University of Pretoria and the North West Department of Health Research Counsel.

#### 7. I MAY AT ANY TIME WITHDRAW FROM THIS STUDY.

8. I UNDERSTAND THAT IF I DO NOT WANT TO PARTICIPATE IN THIS STUDY, it will have no influence in my interactions with the radiology department.

#### 9. INFORMATION

The researcher's name is Mrs H. Essop and her supervisor is Ms M Kekana. Should you have any questions or concerns about the study, you are free to contact the researcher or supervisor at 0715897939 and 0825444165. You are also welcome to communicate with them by means of email at hafeesa@gmail.com and mable.kekana@up.ac.za. You may also contact the University of Pretoria Ethics department at 0123563085, should you any queries regarding your rights as a research participant.

#### 10. CONFIDENTIALITY

All information obtained during this study will be regarded as confidential. Results will be published or presented in a manner such that all participants are anonymous. After the researcher has analysed the data obtained, a report will be written, and findings will also be given to management of the respective institutions and the North West

Department of Health. The research reports will not include any detail by which participants can be identified.


If you are satisfied with the nature and purpose of the interview to be conducted, kindly sign the attached consent form.

CONSENT TO PARTICIPATE IN THIS STUDY

I confirm that the person asking my consent to take part in this study has told me about nature, process, risks, discomforts and benefits of the study. I have also received, read and understood the above written information (Information Leaflet) regarding the study. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I am participating willingly. I have had time to ask questions and have no objections to participate in the study. I understand that there is no penalty should I wish to discontinue with the study and my withdrawal will not affect me in any way. I have received a signed copy of this informed consent agreement.

Participant's signature: ..... Date.....

Investigator's name: Hafsa Essop.....

Investigator's signature .....  ..... Date.....

## **ANNEXURE F**

Information leaflet and consent form

Referring Clinicians

### **INFORMATION LEAFLET FOR PARTICIPATION**

**STUDY TITLE:** Exploring the views of teleradiology end users regarding its utilisation and its impact on rural healthcare in the Dr RSM District, North West province.

#### **1. INTRODUCTION**

You are invited to participate in a research study to investigate the value of the current eHealth systems, namely teleradiology, in providing an improved healthcare service delivery in radiology departments of the North West province. If you require any further information regarding the study, please do not hesitate to ask the researcher.

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#### **3. EXPLANATION OF PROCEDURE**

You will be invited to attend a focus group interview at the Memorial Hospital, Executive Boardroom on the 23rd March 2017, together with other referring clinicians from various hospitals within the district, who use teleradiology systems. The researcher will then ask you a series of questions pertaining to your views and experiences regarding teleradiology in your setting. All the responses from the participants will be written and voice recorded to ensure no information is missed while writing.

#### 4. RISK AND DISCOMFORT INVOLVED

There will be no physical discomfort or risk when participating in the interviews. If you however feel uncomfortable with the questions being posed or expressing your opinions, you are free to discontinue the interview at any point.

#### 5. POSSIBLE BENEFITS OF THIS STUDY

The study envisages shedding light on new issues and challenges that have arisen from the last telemedicine evaluation in 2000. The data collected from this study envisions to provide recommendations to improve the current teleradiology utilisation and thus service delivery to the community of the Dr RSM district.

#### 6. ETHICAL APPROVAL REGARDING THE RESEARCH STUDY

The study will only commence once ethical clearance has been granted from the Ethics Committee of the University of Pretoria and the North West department of Health Research Counsel.

#### 7. I MAY AT ANY TIME WITHDRAW FROM THIS STUDY.

8. I UNDERSTAND THAT IF I DO NOT WANT TO PARTICIPATE IN THIS STUDY, it will have no influence in my interactions with the radiology department.

#### 9. INFORMATION

The researcher's name is Mrs H Essop and her supervisor is Ms M Kekana. Should you have any questions or concerns about the study, you are free to contact the researcher or supervisor at 0715897939 and 0825444165. You are also welcome to communicate with them by means of email at hafeesa@gmail.com and mable.kekana@up.ac.za. You may also contact the University of Pretoria Ethics department at 0123563085, should you any queries regarding your rights as a research participant.

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If you are satisfied with the nature and purpose of the interview to be conducted, kindly sign the attached consent form.

### CONSENT TO PARTICIPATE IN THIS STUDY

I confirm that the person asking my consent to take part in this study has told me about nature, process, risks, discomforts and benefits of the study. I have also received, read and understood the above written information (Information Leaflet) regarding the study. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I am participating willingly. I have had time to ask questions and have no objections to participate in the study. I understand that there is no penalty should I wish to discontinue with the study and my withdrawal will not affect me in any way. I have received a signed copy of this informed consent agreement.

Participant's signature: ..... Date.....

Investigator's name: Hafsa Essop.....

Investigator's signature .....  ..... Date.....

## **ANNEXURE G**

Information leaflet and consent form

Radiologists

### **INFORMATION LEAFLET FOR PARTICIPATION**

**STUDY TITLE:** Exploring the views of teleradiology end users regarding its utilisation and its impact on rural healthcare in the Dr RSM District, North West province.

#### **1. INTRODUCTION**

You are invited to participate in a research study to investigate the value of the current eHealth systems, namely teleradiology, in providing an improved healthcare service delivery in radiology departments of the North West province. If you require any further information regarding the study, please do not hesitate to ask the researcher.

#### **2. THE NATURE AND PURPOSE OF THIS STUDY**

The purpose of this study is to explore the views of teleradiology end users operating at a grass roots level, in order to explore the current state of teleradiology in the North West province. This data will help establish if healthcare service delivery using eHealth, has improved or regressed from the first teleradiology implementation.

#### **3. EXPLANATION OF PROCEDURE**

You will be invited to attend a focus group interview at the Radiology department at the Rand Clinic in Johannesburg, on the 11<sup>th</sup> April 2017. The researcher will then ask you a series of questions pertaining to your views and experiences regarding teleradiology systems. All the responses from the participants will be written and voice recorded to ensure no information is missed while writing.

#### **4. RISK AND DISCOMFORT INVOLVED**



There will be no physical discomfort or risk when participating in the interviews. If you however feel uncomfortable with the questions being posed or expressing your opinions, you are free to discontinue the interview at any point.

#### 5. POSSIBLE BENEFITS OF THIS STUDY

The study envisages shedding light on new issues and challenges that have arisen from the last telemedicine evaluation in 2000. The data collected from this study envisions to provide recommendations to improve the current teleradiology utilisation and thus service delivery to the community of the Dr RSM district.

#### 6. ETHICAL APPROVAL REGARDING THE RESEARCH STUDY

The study will only commence once ethical clearance has been granted from the Ethics Committee of the University of Pretoria and the North West Department of Health Research Counsel.

#### 7. I MAY AT ANY TIME WITHDRAW FROM THIS STUDY.

8. I UNDERSTAND THAT IF I DO NOT WANT TO PARTICIPATE IN THIS STUDY, it will have no influence in my interactions with the radiology department.

#### 9. INFORMATION

The researcher's name is Mrs Essop and her supervisor is Ms M Kekana. Should you have any questions or concerns about the study, you are free to contact the researcher or supervisor at 0715897939 and 0825444165. You are also welcome to communicate with them by means of email at hafeesa@gmail.com and mable.kekana@up.ac.za. You may also contact the University of Pretoria Ethics Department at 0123563085, should you any queries regarding your rights as a research participant.

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Department of Health. The research reports will not include any detail by which participants can be identified.

If you are satisfied with the nature and purpose of the interview to be conducted, kindly sign the attached consent form.

CONSENT TO PARTICIPATE IN THIS STUDY

I confirm that the person asking my consent to take part in this study has told me about nature, process, risks, discomforts and benefits of the study. I have also received, read and understood the above written information (Information Leaflet) regarding the study. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I am participating willingly. I have had time to ask questions and have no objections to participate in the study. I understand that there is no penalty should I wish to discontinue with the study and my withdrawal will not affect me in any way. I have received a signed copy of this informed consent agreement.

Participant's signature: ..... Date.....

Investigator's name: Hafsa Essop.....

Investigator's signature .....  ..... Date.....

## **ANNEXURE H**

### Radiographer focus group interview guide

1. Describe how teleradiology services are being carried out in each of your departments.
2. What are your experiences when booking patients for teleradiology examinations?
3. What are your views regarding the teleradiology standard operating procedure manual?
4. What is your average turnaround time and how does it impact on rural health care?
5. Can you kindly share any other challenges you experience regarding teleradiology?
6. What are your recommendations to improve current system teleradiology systems?

## **ANNEXURE I**

### Referring clinician focus group interview guide

1. What are your experiences when booking patients for teleradiology examinations?
2. What is your average turnaround time and how does it impact on rural health care?
3. Share your experiences on the utilisation current teleradiology systems.
4. Can you share any other challenges you may have with regards to teleradiology?
5. What recommendations can you suggest to improve current teleradiology systems or operations?

## **ANNEXURE J**

### **Radiologist focus group interview guide**

1. Can you describe the process of reporting CT examinations coming from the Dr RSM district using teleradiology?
2. What are your experiences when having to report CT examinations from this district?
3. What are your experiences with the quality of request forms/ clinical history?
4. What in your opinion, is the main reason for to delays in reporting or sending the final report?
5. In a traditional radiology setting, the referring clinicians will always consult with the radiologist before booking any CT examinations, however in a teleradiology setting without a radiologist the radiographer takes on this role? What are your thoughts on this practise?
6. What recommendations can you suggest to improve to current teleradiology system or operation?

## ANNEXURE K

### Inserts from research assistant field notes – Radiographer focus group interview

Only back patients if necessary

P3 = Some patients brought only in by the scan.  
The back will be on vitality or contrast  
if the blood is fine, doctors will discuss  
with you. The looking will be affected, ~~the~~  
brasserie

P4 = Radiologist not involved, example, ~~and~~ patients  
came in morning urgent headaches have to  
take the scan at the end because there is  
no proper radiologist.

P1 = Only challenges 5 patients a week.  
\* will try to see to all patients at a time  
\* a big decision which patient is first and second,

P2 = Radiographer goes to the urgent patients,  
\* will discuss case together what's the next step  
step at the Citi scan, give own opinion

P4 = does not happen.

P3 = Meeting with Doctors, nurses discuss issues

P4 = only have meeting with patient doctors

P2 = Each 2 weeks, go to 2 or 3 patients  
doctor currently working in ward.

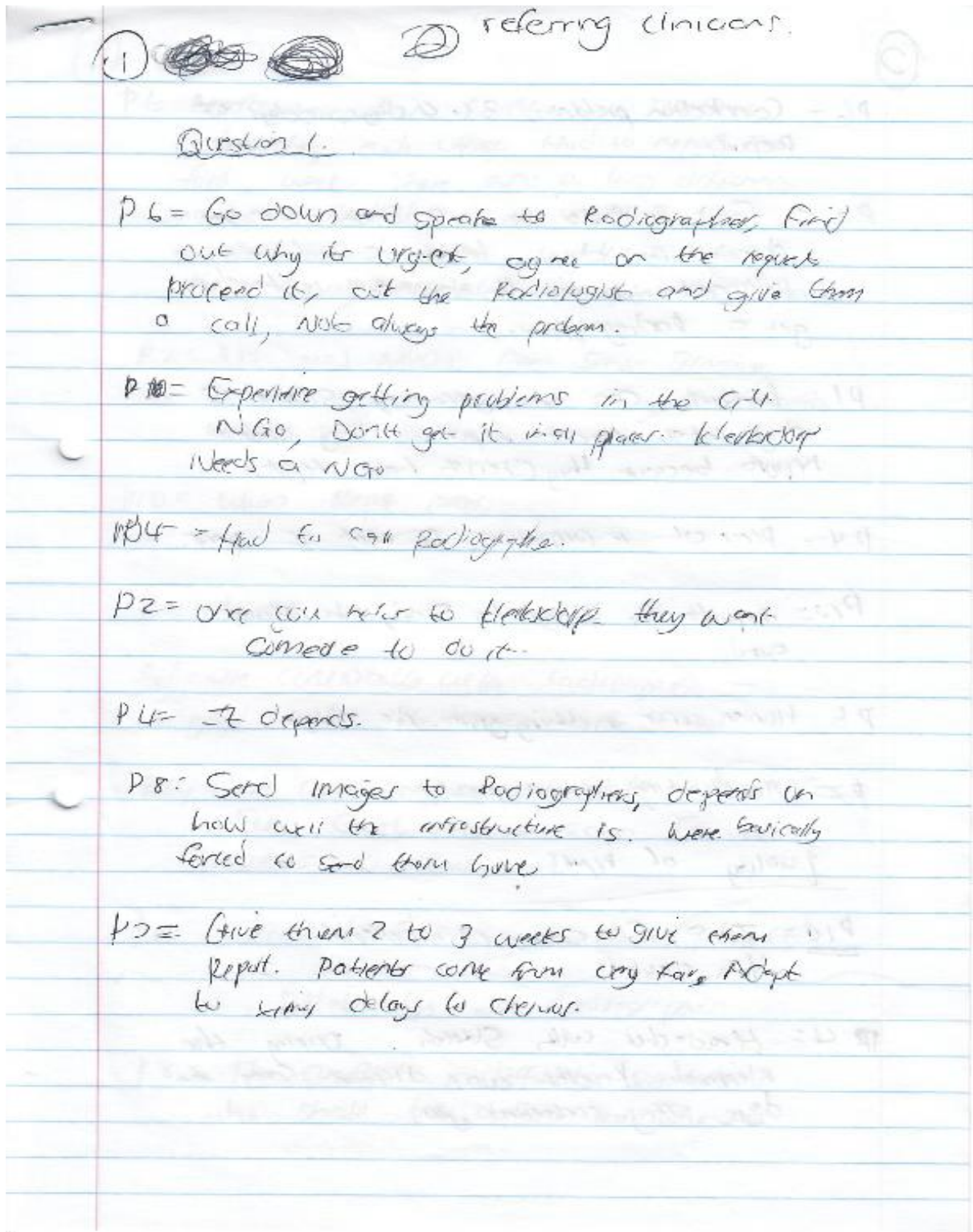
↓ Discuss meetings

P3 = Some procedures should be left out

It's a learning practice doctors make the  
decision. A doctor wanted excessive information  
radiographer should give more contrast

## ANNEXURE L

### Inserts from research assistant field notes – Referring clinician



## ANNEXURE M

Raw data from radiographer focus group transcription

Preliminary codes:

- Booking
- Decision making
- Lack of radiologist support
- Delays

**Researcher: Describe how teleradiology procedures are being carried out in each of your departments?**

Radiographer #3—servicing in and out of hospital patients. In patients, doctor makes a *booking, sometimes they don't*, depending on the urgency of the scan. The patient comes to the x-ray department – file, form information about scan. Having followed processes such as blood, if contrast is given. The patient then goes for the CT scan. Radiographer will check allergies, consent and so forth. After CT scan is done, and all procedures are done, images are printed. For the report, images are sent to the teleradiology system.

**Researcher: If you have to get a request, do you think you are well equipped to make these decisions? Have you been trained to make these decisions?**

Radiographer #4: me personally I *don't think I can make these decisions*, because I have not have CT training, I only learnt CT when I came here. So, me personally I feel I really *can't make a decision*. The *radiologists they are not always* there when you call them.

**Researcher: Do you feel like you have adequate support from the radiologist?**

Radiographer #4: *definitely not*



Researcher: ***If you had to have support, what would be the ideal support for you?***

Radiographer #4 – *there is radiologist rosters, but we really don't know who to contact for advice. I just feel if they could give us support and say call this doctor during the day, sometimes when we call doctor is not available, or call back we are busy, if we can call in confidence and not think who we can call.*

Researcher: ***In terms of bookings, what criteria do you base your bookings on at the site?***

Radiographer 4 – *usually the doctor calls or come to the department, radiographer would ask what examination and indication, contrast or not. Sometimes based on what we know we need contrast for certain things, we would advise doctor that they would need contrast, but we don't always ask questions we just book that patient.*

Radiographer 3 – *Other doctors will just bring patients without discussing with you and this affects the booking. Some issues can't be resolved, doctor's decision is final.*

Researcher: ***How do all these decisions you have to make impact/influence rural health care for the patient?***

Radiographer #1: - *if he (patient) misses that booking his treatment will be delayed and you end up compromising health services while trying to help one patient.*






Radiographer #3 –, *when you say to doctor, this cannot happen based on 1,2,3 the doctor doesn't take your word for it, to say another professional maybe advising me not to do this, what you have to do is call the radiologist, as we alluded to earlier, when you call them they don't respond sometimes they are busy, call later, those are the experiences. Now coming back to the impact it would have you need to make a decision, now you cannot get a radiologist and the doctor is here, and you must decide if you are going to this patient. In that space there is no one advocating you or how do I say, or assuring the doctor that this should have not been happening.*

Because now the doctor dictates I want this then you must do it that time, *The impact of this patient, the patient obviously that time becomes a guinee pig*, we get a lot of interns, for them it's a matter of experiencing and so forth, for example when I received a form today, the first thing I did I said let me go see the clinical manager and then on the way I said let me first relate this to the radiologist , so they *can assist with our decision making*, because they will be able to say go or not, even if we go to the clinical manager we must speak to radiologist for advice. So we called, the first one we called, the *radiologist said we are busy call after 5min*. then I called another, and it went to voice mail, then I called the radiologist again and he managed to assist me in terms of decision making, so he said just do without contrast and so forth and so forth. Now coming back to how does it impact on the patients, say for example this *patient was not booked* and brought to us as an urgent patient the patient had to be delayed for that moment when I had to get the radiologist to decide whether to go on not the *patient had to be delayed* and there was a time when I was thinking that they should go back to the ward while we are *still waiting for the radiologist* to take a decision.so you can see that impact on the patient already, the patient is being delayed in terms of getting what he is supposed to get. Patient is being delayed in the sense that it is an "*urgent case*" but *now being delayed* because we cannot get a radiologist who is supposed to be available to us 24 hours so it goes *back to a delay in service delivery* and there are a lot of things that come into play. *The delay in getting report itself after examination* is a problem. you can see that even though teleradiology is there, that system it's still not coming to what it was meant to be with regards to that.

## ANNEXURE N

Raw data from referring clinicians' transcription

Preliminary codes:

-  Lack of CT training for referring clinician
-  Incomplete CT examination
-  Anger
-  Delays in treatment
-  Sharing of pictures

**Researcher: *What are your experiences when booking? #silence – reluctance to answer***

Referring clinician #1 – *urgent patients basically what we used to do we go down and speak to the radiographers and then when it's urgent they don't have a problem with that, sometimes they would like to find out why do we think it's urgent, and then we agree on the emergency of the request, then they proceed.*

Referring clinician #3- *I just want to add, I experience **problems getting CT Angio (Angiogram)**, when it comes to CT Angio **not all radiographers can do that**, certain timings we have to wait for the radiographer to come, so there seems to be a condition attached to that*

P5 –*What happened last week we had three patients with obstructive jaundice but due to internet problems and I don't know what else they were not able to send the images to the radiologist, so the CT was done, but the radiologist didn't have the scan so they can't report, it depends on how the infrastructure it*

**Researcher: *What do you do with your patient in that time while waiting for the report?***

*\*laughing from participants \**

Referring clinician #5 – ***they just stay, we send them home** because they are stable, and we take their phone numbers and call them once we have the report and then only we can refer them to the tertiary hospital*

Referring clinician #2 – *with regards to metastatic work up – we give them two to **three weeks to come back** for the report, because they come from far and you find that the **report is not ready**, so we adopted that system. **Delays onset of chemo***

**Researcher: *What kind of relationship do you have with the radiologist? How often do you engage with them?***

Referring clinician #7 – with paediatric patients, there was a circular sent out that all cases must be discussed with radiologists, when I spoke to them at some point they *get really angry*, they say you are sitting with the patient there, what is your clinical judgement why can't you do a scan you don't have to call for all of them, there is those you can call especially for contrast, especially very small patients, and it was the neurologist who requested the CT scan not use, so when I explain that they get *upset*.

**Researcher: Do you still have to phone them now?**

Referring clinician #7 - *Certain radiologists will say don't call me*, make a judgement and we can discuss afterwards. Neonates with contrast can be discussed

Referring clinician #4 – couple of times I called, and it was like I was just calling to hear their voice, they just said ya ok so I end up booking the patient

**Researcher: What is your relationship with the radiographers?**

Referring clinician #1 – the communication we have works quite well, when we speak to them and we want a patient to be done, it's less likely that it's not going to happen

**Researcher – asking to the newer doctors: How are your bookings guided? Are there any protocols?**

Referring clinician #1 – I saw it somewhere but *we don't know exactly*,

**Researcher: How do you go about requesting a scan?** \*mumbling and laughing -  
\*Reluctance to answer

Referring clinician #8 – well to be honest I have *never been prepared for CT scan*

Referring clinician #9 – I have been called, but I *wouldn't know how to react* if the patient reacts

**Researcher (asks probing question) – If you are not sure of your diagnosis and don't want to send for a CT chest, what do you do? what support do you have?**

Referring clinician #4 - what I do is, we know people, we have community of doctors, so I *send pictures* to them to help us





**Researcher further probes - What about radiologist?**

Referring clinician #1 - twice or thrice I *sent to them* and they helped me

## ANNEXURE O

### Raw data from radiologists focus group interview

Preliminary codes:

-  Poor image quality
-  Insufficient clinical history
-  Internet down time
-  Channels of communication

#### **Researcher? How does the process of reporting work in the teleradiology setting?**

Radiologist #1 – so what happens is the patient gets scanned at the hospital, those images are sent to us as a batch, via the internet to our server, we download the images to our viewing station, so we can view and reconstruct and manipulate, and then I report on the case, which then gets attached to patients file

#### **Researcher: What is the greatest challenge you have regarding this site?**

Radiologist #1 – ok well several, (\*quick response) one is the images that are sent, are *not adequate*, its only sent in *only an axial, its either missing the sagittal or coronal views, lung windows and that*, so when it's done in the peripheral site, it's very difficult for me to manipulate on this side, so that's the biggest challenge I have. The second biggest challenge I *have line delay*, when we have *internet connectivity problems*, so the patients are being scanned but I can't access it

#### **Researcher: Is the internet problem from your side or that of the hospital's side?**

Radiologist #1 – both, its connectivity from the scanner to the server, and to the server from us, from us back to the hospital.

#### **Researcher: What are your experiences with the examinations received? \*pause\* Does the radiographer perform the correct protocols?**

Radiologist #1 – I find that often. But it is difficult, sometimes the patient is there and they have to scan and to get hold of us is a problem, but generally *planning of the cases are not done correctly*

**Researcher: How do you think you can support the radiographer in this aspect?**

Radiologist #1 – unless we *have written protocols*, for example with the liver this is what we do, for example trauma this is what we need to do, alternately we can suggest to them ok a post contrast is needed, but then that delays the scan, but I think *written protocols is the way to go*

**Researcher: What are your experiences regarding the clinical history of the examinations?**

Radiologist #1 – yes and no, thing is that sometimes all we get is a *technote* from the technician which *is not adequate*, so we have a scan chest, abdomen and pelvis but the history is colic, so this doesn't help us, so the problem is twofold, it's from the *technotes and from the clinicians*

**Researcher: From your view, what are the major factors that cause delays in reporting turnaround time?**

P1 – volume, volume of work, a lot of the cases are long, just from one peripheral hospital you can get 15 cases that are very long, to get to them takes a long while. Second thing is connectivity, if we have a down time it again delays the time

**Researcher: I would like to get your opinion on mHealth (mobile health) where the referring clinicians send pictures.**

Radiologist #1 – I think it's definitely a possibility, I've got many *phone calls* where doctors are unsure, and they send *me a picture and ask for an opinion*, so there is definitely a need for that. Coming back to general x-rays, the doctors should have had some basic training on reading an x-ray so that's why x-rays are not reported, with the CT I understand they can't

**Researcher: What recommendations can you suggest to improve the current teleradiology systems?**

Radiologist #1 – I think a virtual teleradiology, you know *direct communication with the radiographer* when the scan is being done, either by skype or by simple messaging, so the patient is on the table and I have a look at the imaging, so constant communication, but in a rural setting that may not always work for various reasons, cost, staffing and availability

**Researcher: What procedures should doctors/ radiographers consult with the radiologist?**

Radiologist #1 – *in both cases of paediatrics and angiograms consultations should definitely happen, because what happens is the referring physicians may not understand the implications of those CT examinations for those particular examinations and I think it's for us to advice being the specialist, but I think for general CT scan there isn't a need to consult.*



ANNEXURE P

Copy of Co-coders Memo

Hajjari's Chapter 4

Findings from Radiography

4 Major findings - There are literature control for each  
It would be in a structured fashion & not repeating  
what was mentioned in previous chapters

① Report to CT scanning

- Institutional & unlicensed
- Availability of Radiologists forced radiologists to work outside their scope
- Professional dominance - evidence of strained relationship

② Working relationships

- IP relationship being a recommendation for improvement. (The pt is at the centre)
- Communication is key (\*)

③ Guidelines used

- Northwest has SOP
- RSSA guidelines
- Intern

All three were discussed in Ch 2?

What came out from FG2 is grouped into 2 - looking protocols  
Transition of air history

④ Impact on Service delivery.

- Delay in treatment
- Radiation exposure
- Financial burden on the pt.

All three factors (findings) have an impact on Service delivery -> The objective of starting Tele Med / Telerad was good - There is however need to address the first 3 findings



## ANNEXURE Q

### Declaration of storage of data

I, the Principal Investigator(s),\_Hafsa Essop of the following study titled: **Exploring the views of teleradiology end users regarding its' utilisation and impact on rural healthcare in the Dr RSM District, North West province**, will be storing all the research data and/or documents referring to the above mentioned trial/study at the following address:

Department of Radiography  
HW Snyman Building  
Level 4 – Radiography Storeroom  
Gezina  
Pretoria  
0186

**I understand that the storage for the abovementioned data and/or documents must be maintained for a minimum of 15 years from the commencement of this trial/study.**

START DATE OF TRIAL/STUDY: \_\_\_October 2016\_\_\_\_\_

END DATE OF TRIAL/STUDY: \_\_\_\_\_September 2018\_\_\_\_\_

UNTIL WHICH YEAR WILL DATA WILL BE STORED: \_January 2032\_\_\_\_\_

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**Name: Hafsa Essop**\_\_\_\_\_

**Signature** \_\_\_\_\_

**Date** \_\_22/03/18\_\_\_\_\_

## ANNEXURE R

### Supervisor's declaration of storage

I, the Supervisor, Ms Mable Kekana, for the following student, Hafsa Essop for the study titled “**Exploring the views of teleradiology end users regarding its utilisation and impact on rural health care in the Dr RSM district, Northwest Province**” will be storing all the research data and/or documents referring to the above mentioned study at the following address:


Department of Radiography  
HW Snyman Building  
Level 4 – Radiography storeroom  
Gezina  
Pretoria  
0186

**I understand that the storage for the abovementioned data and/or documents must be maintained for a minimum of 15 years from the commencement of this study.**

START DATE OF STUDY: \_\_October 2016\_\_\_\_\_

END DATE OF STUDY: \_\_\_\_September 2018\_\_\_\_\_

UNTIL WHICH YEAR WILL DATA WILL BE STORED: 2032\_\_\_\_\_

Name of Supervisor	Signature	Date
Ms Mable Kekana		22/03/2018

## Annexure S

### Editorial certificate

#### The Write Words South Africa

Corner House Offices  
504 Lilian Ngoyi Road  
Morningside  
South Africa



### EDITORIAL CERTIFICATE

27 August 2018

To whom it may concern

This document certifies that the dissertation listed below was proofread and edited for proper English language, grammar, punctuation, spelling, and overall style by The Write Words, a division of Mardi Gras Marketing (Pty) Limited. Neither the research content nor the author's intentions were altered in any way during the editing process.

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#### DISSERTATION TITLE

Exploring the views of teleradiology end users regarding its utilisation and impact on rural health services in the Dr RSM district, North West province

#### AUTHOR

Hafsa Essop

A handwritten signature in black ink, appearing to read 'S. Worthington'.

**Samantha L. Worthington**  
Director, Editor – The Write Words

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